

6 Soils and Land Management

6.1 Introduction

This Chapter provides a discussion on:

- the topography, geology, soils, and erosion hazard of the B2N Project Area
- how those factors have influenced the B2N Project
- the potential impacts of the B2N Project on those factors
- potential mitigation measures.

Discussion of soils includes acid sulfate soils and contaminated lands.

6.2 Assessment Methods

Details on soil types and characteristics, geological and topographical data, contaminated lands, saline/acid sulfate soils, and other general problematic soils conditions were compiled from existing investigations and publicly available mapping for the area including:

- Caboolture to Landsborough Rail Upgrade Study: Beerburum to Landsborough Corridor (Arup, for Queensland Transport, 2007)
- Geological Survey of Queensland (1977) 1:100,000 series Nambour geological map sheet
- Beerburum to Landsborough Final Geotechnical Report (Trackstar Alliance, 2008)
- Atlas of Australian Soils (1991) Broad-scale soils mapping
- CSIRO Australian Soil Resource Information System (ASRIS)
- mapping of Acid Sulfate Soils (ASS) undertaken by the Queensland Government
- Sunshine Coast Council Steep Land overlay mapping
- Glass House Mountains and Surrounds map (DNPRSR, 2015)
- Glass House Mountains National Landscape map (Australian Government, 2006).

A search of the DES EMR and the Contaminated Land Register (CLR) was undertaken in October 2019 for properties within the Project Area.

Assessments were then undertaken using the compiled data with the climate data in Chapter 3 and the existing water environment in Section 5.3 to identify soils susceptible to erosion and areas potentially impacted. While construction methodology is yet to be determined, sensitive receptors with a potential risk of impact from ground disturbing works including vegetation clearing, bulk earthworks (cut and fill placement), piling etc. have been highlighted for field investigations in a future phase of the B2N Project.

A detailed geotechnical investigation was undertaken by the Trackstar Alliance in 2008 and documented in the 'Beerburum to Landsborough Final Geotechnical Report'. This included drilling and sampling of 232 boreholes along the existing and proposed railway between Beerburum and Landsborough. Soil, geology and topography information were also documented in the Landsborough to Nambour (L2N) Rail Project EIS, relevant only to areas between Landsborough and Nambour. Additional geotechnical assessment was undertaken by SMEC in 2016 in support of business case preparation. These reports were reviewed for environmentally relevant aspects during the preparation of this REF.

6.3 Existing Environment

6.3.1 Topography

The Project Area is located within the coastal lowlands of SEQ and is classified as having a subtropical climate. The east coast of southern Queensland has the general feature of coastal plains leading into the Dividing Range. The rail corridor generally follows the boundary between the coastal plains and the range; from Beerburum to Landsborough it remains on the coastal plains with a ground level between 20m and 40m AHD, and from Landsborough to Nambour crossing into the foothills of the Dividing Range with an undulating ground level of 10m to 100m AHD. The existing rail corridor passes in close proximity to a number of the Glass House Mountains, which form part of the National Heritage place - Glass House Mountains National Landscape. Glass House Mountains in close proximity include Mount Beerburum, Mount Tibberoowuccum, Mount Tibrogargan, Mount Ngungun, and Mount Coochin. Mount Beerwah,

Mount Tunbubudla and Mount Coonowrin are located further west, with Mount Elimbah and Mount Miketeebumulgrai to the south west.

6.3.2 Geology

According to the 1:100,000 scale Nambour geological map sheet, the two predominant geological formations underlying the Project Area are the Landsborough Sandstone (from Beerburrum to Eudlo) and the Woogaroo Subgroup sandstone (from Eudlo to Nambour). In addition, the Project Area crosses over Qa-QLD and TQr-QLD which are generally associated with floodplains, and avoids Ti-SEQ and Tv-SEQ which are generally associated with high relief terrain. Geological units of the Project Area are described in Table 33.

The Landsborough Sandstone and Woogaroo Subgroup are quartzose sandstone, but with distinctions based on varying amounts of secondary components such as feldspar (Arup 2009). The Trackstar Alliance 2008 report notes in addition to the Landsborough Sandstone, volcanic lithologies are located in the vicinity of Back Creek and Coonowrin Creek.

The Qa-QLD is alluvial material associated with flood plains. Considerable variability in terms of grain size, distribution and grading is expected given the deposition processes that generated the material (Arup 2009). The thickness is likely to vary significantly, from less than one metre to greater than 10 metres.

The TQr-QLD is colluvial material associated with alluvial material and lower lying areas at the base of slopes. It is described as residual deposits and pediment slope wash, clay scree and soil.

Ti-SEQ and Tv-SEQ are volcanic in nature (basalt and rhyolite respectively) and are associated with high relief terrain. The Project Area avoids these local outcrops, however the presence of these in context of the high relief topography to the west of the Project Area is indicative of the processes that formed the topography of the region and as such, localised occurrence of these geological formations may occur irrespective of the mapping.

These rock types are illustrated in Figure 7.

Table 33: Geology Units

ROCK UNIT NAME	SYMBOL	AGE	LITHOLOGICAL SUMMARY	ROCK TYPE	NOTES
Landsborough Sandstone	RJI	Triassic - Jurassic	Lithofeldspathic labile and quartzose sandstone, siltstone, shale, minor coal, ferruginous oolite marker	Stratified Unit (including volcanic and metamorphic)	Predominant geology type south of Eudlo
Woogaroo Subgroup	RJbw	Triassic - Jurassic	Quartzose sandstone, siltstone, shale conglomerate, coal	Stratified unit (including volcanic and metamorphic)	Predominant geology type north of Eudlo
Qa-QLD	Qa	Quaternary	Clay, silt, sand and gravel; flood-plain alluvium	Stratified unit (including volcanic and metamorphic)	Project Area passes over this unit; associated with waters such as from flooding
TQr-QLD	TQr	Late Tertiary - Quaternary	Clay, silt, sand, gravel and soil; colluvial and residual deposits (generally on older land surfaces)	Stratified unit (including volcanic and metamorphic)	Project Area passes over this unit; associated with waters such as from flooding
Ti-SEQ	Ti	Tertiary	Rhyolite	Intrusive Unit	Project Area generally avoids this, associated with high relief terrain
Tv-SEQ	Tv	Tertiary	Mainly basalt flows	Stratified unit (including volcanic and metamorphic)	Project Area generally avoids this, associated with high relief terrain

Source: 1:100,000 scale Nambour geological map sheet

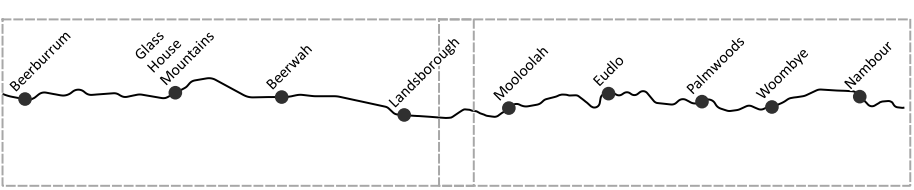
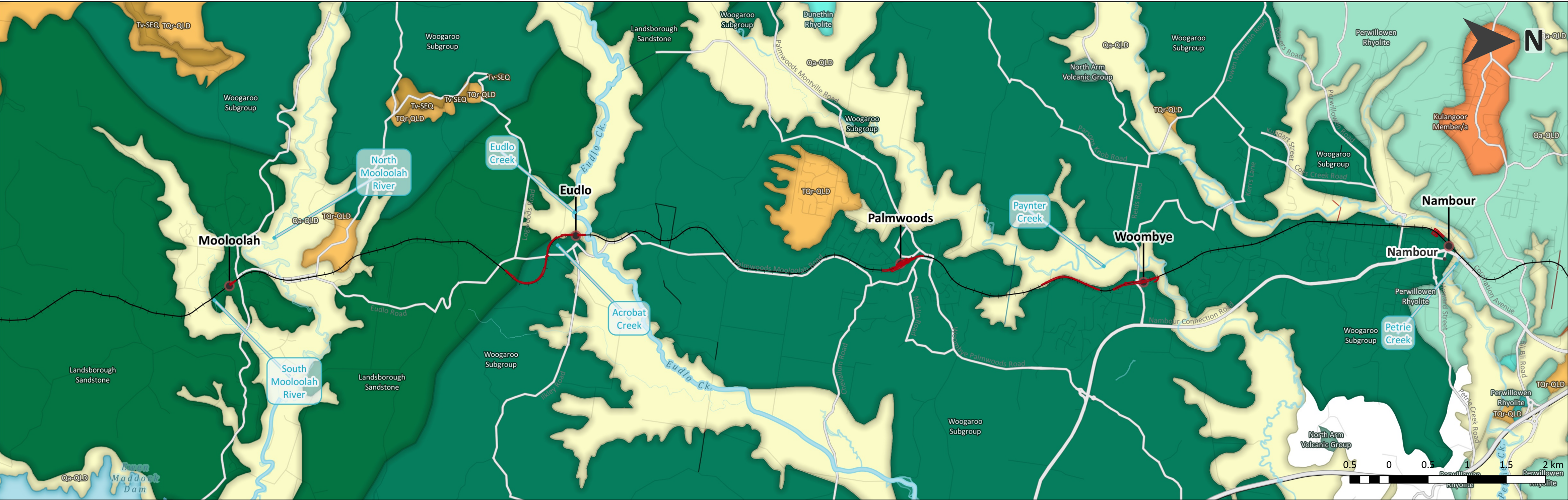
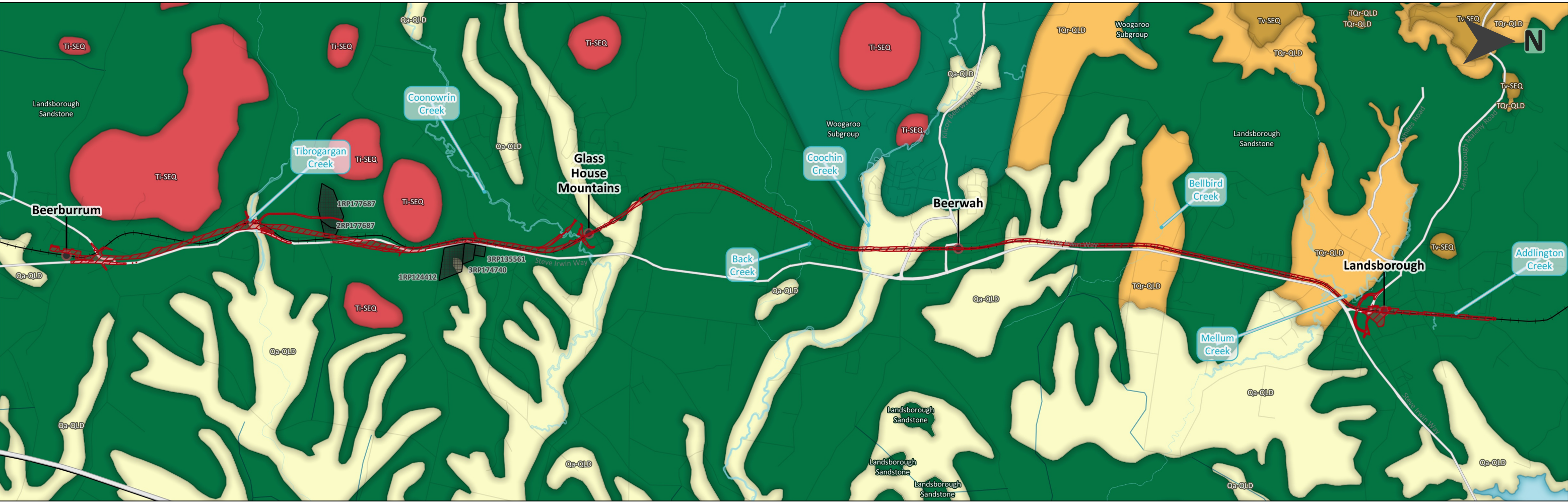


Figure 7: Geology

6.3.3 Soils

A review of broad-scale soils mapping (Atlas of Australian Soils) has been undertaken across the Project Area and summarised in Table 34. The soils from Beerburum to Landsborough are classed as Mf12 (Atlas-7578). A small section of the railway between Landsborough and Mooloolah crosses onto class Wf1 (Atlas-9112) with the rest of the section between Landsborough and Eudlo classed as Wf2 (Atlas-8983). The section between Eudlo and Nambour is located on Mw24 (Atlas-8618), with Nambour station being located on Mm9 (Atlas-9000).

Table 34: Soil Classes

MAP CODE	DESCRIPTION	GENERAL SOIL TYPE	DOMINANT PRINCIPAL PROFILE FORM
Mf12	Low hilly landscape	Yellow smooth-ped earths	Gradational yellow, A2 horizon non-bleached, acid smooth-ped whole col or mottled B horizon
Wf1	Erosion scarps cut in sandstone-slopes are very steep and ridge tops narrow	-	Duplex yellow-grey, non-hard setting A horizon, A2 horizon non-bleached, acid pedal mottled B horizon
Wf2	Low hilly to hilly terrain	-	Duplex yellow-grey, non-hard setting A horizon, A2 horizon non-bleached, acid pedal mottled B horizon
Mw24	Hilly to low hilly landscape on sandstone; narrow sharply convex hill crests with moderate to steep slopes to narrow alluvial flats	Red massive earths	Gradational red, A2 horizon non-bleached, acid massive earth whole col B horizon
Mm9	Steep hilly eastern scarp of basaltic plateau including steep hills	Black smooth-ped earths	Gradational black, no A2 horizon, neut smooth-ped whole col B horizon
Source: Atlas of Australian Soils			

6.3.4 Acid Sulfate Soils and Acid Rock

While acid sulfate soils (ASS) can be associated with alluvial soils (Qa-QLD geology unit), they are generally associated with low lying areas below 5m AHD, on alluvial plains where groundwater is generally close to the surface and where materials have generally been in reducing conditions. A review of the topography indicated the Project Area does not pass below 10m AHD.

A review of the 1:100,000 Acid Sulfate Soils of Tweed Heads to Teewah - South East Queensland probability mapping published by DES and publicly available through Queensland Globe notes that no probability zones are mapped along the Project Area. CSIRO Australian Soil Resource Mapping (ASRIS) Acid Sulfate Soils probability mapping shows the Project Area between Beerburum and Landsborough, and the Nambour area as 'low probability of occurrence', with the Project Area between Landsborough and just south of Nambour mapped as 'extremely low probability of occurrence'.

SCC Acid Sulfate Soils Overlay mapping viewed via Council's online portal shows the Project Area traverses land classified as 'Area 2: land above 5m AHD and below 20m AHD' at:

- Tibrogargan Creek, south of Glass House Mountains
- Coochin Creek, south of Beerwah
- Woombye, west and north of existing station
- Nambour, including the car park extension area.

The SCC Acid Sulfate Soils Overlay mapping indicates areas where there is a risk of encountering ASS based on topography only and does not confirm the actual presence of this material.

The Landsborough to Nambour EIS (Arup 2009), indicates that the potential for acid sulfate rock (ASR) to occur in the vicinity of Petrie and Paynter creeks. This is due to the potential for the Landsborough Sandstone to contain sulfide bearing materials. However, the risk of encountering ASR along the Project alignment is considered low. Works in the vicinity of these creeks are likely to occur in built up/ previously disturbed areas.

6.3.5 Contaminated Land

Searches of the EMR and CLR were undertaken on 12 July 2016 and updated during October 2019 for properties within the Project Area. Searches were undertaken as a combination of bulk searches, reporting results in tabulated format, and individual lot searches, with the results documented as listing reports. Individual lot reports returned are attached in Appendix I.

The EMR lists properties where notifiable activities have been, or are being, carried out on the land. The listing is an indication that the land is likely to be contaminated, but does not mean it needs to be remediated or is not suitable for its current land use. The CLR lists properties where contamination has been confirmed and where it may be necessary to remediate the land to prevent serious environmental harm and protect human health or other aspects of the environment. The search of the registers identified no properties listed on the CLR.

Lots reported as listed on the EMR are shown in Table 35 and Figure 8. A significant proportion of these properties are in the existing rail corridor due to the notifiable activity of 'railway yards' or the presence of hazardous contaminants including arsenic. Several lots reported as listed on the EMR were unable to be located using either Queensland Globe mapping or SARA's Development Assessment Mapping System. It is likely that these lots have been subject to redevelopment and now have new real property descriptions. It is recommended that full EMR listing reports be obtained for all lots listed on the EMR within the proposed alignment in order to clarify parent lots, existing lot descriptions, reasons for listings and any Site Management Plans that may be in place.

Contamination may exist over land where potential contaminants are currently used or have been used historically. For example, contamination may be associated with rail corridors, agricultural enterprises, military training areas, sewerage treatment areas, fuel storage, landfills, building demolition or various industrial uses. There may be previous contaminating land uses that are unrecorded in databases such as the EMR. It is important to note that potentially contaminated land in the Project Area is not limited to lots listed in the EMR database.

An assessment of contamination potential using multiple databases and historical records, where soil disturbance is proposed along the length of the proposed alignment, will be required. Soil identified as potentially contaminated will need to be characterised to determine the level of impact (if any) and management actions that may be required.

Table 35: Properties listed on the EMR as at October 2019

LOT PLAN	LOCATION	PROPERTY TYPE/ USE	NOTIFIABLE ACTIVITY	COMMENTS
589FTY1827	Beerburum	State Forest	Waste storage, treatment or disposal	This lot and plan applies to two lots, associated with the old state forest nursery, Beerburum Road
589FTY1876	Beerburum	State Forest	Waste storage, treatment or disposal	Beside railway line
62CP827058	Beerburum	Existing railway	Hazardous contaminant	In existing rail corridor
611FTY1614	Beerburum	State Forest	Petroleum product or oil storage, waste storage, treatment or disposal	Lot unable to be located
611FTY1611	Beerburum	State Forest	Petroleum product or oil storage, waste storage, treatment or disposal	Beside railway line
71CP827059	Beerburum – Glass House Mountains	Existing railway	Hazardous contaminant	In existing rail corridor
72CP827059	Beerburum	Existing railway	Hazardous contaminant (to be confirmed)	In existing rail corridor
529CG6252	Beerburum	Existing railway	Hazardous contaminant (to be confirmed)	In existing rail corridor
91CP909422	Glass House Mountains	Existing railway	Railway yards (to be confirmed)	In existing rail corridor
92CP827060	Glass House Mountains	Existing railway	Railway yards	In existing rail corridor
93CP827060	Glass House Mountains	Existing railway	Railway yards	Railway carpark
91CG2699	Glass House Mountains	Existing railway	Railway yards (to be confirmed)	In existing rail corridor
93CP827061	Beerwah	Existing railway	Hazardous contaminant	In existing rail corridor
101CP827062	Beerwah	Existing railway	Hazardous contaminant	In existing rail corridor
1SP264856 (listed under 111CG2699)	Beerwah	Existing railway	Petroleum product or oil storage (to be confirmed)	In existing rail corridor; Beerwah railway station
115SP264856	Beerwah - Landsborough	Existing railway	Petroleum product or oil storage	In existing rail corridor
131CP827067	Landsborough	Existing railway	Hazardous contaminant	In existing rail corridor
132CP827066	Landsborough	Existing railway	Hazardous contaminant	In existing rail corridor
133CP827065	Landsborough	Existing railway	Hazardous contaminant	In existing rail corridor
121CP827064	Landsborough	Existing railway	Railway yards	Existing rail corridor
122CP827064	Landsborough	Existing railway	Railway yards	Open space beside railway station carpark
301M332061	Landsborough	Sports field	Livestock dip or spray race	Beside existing rail corridor

LOT PLAN	LOCATION	PROPERTY TYPE/ USE	NOTIFIABLE ACTIVITY	COMMENTS
2RP8438	Landsborough	Existing railway	Railway yards	In existing rail corridor
1RP76609	Landsborough	Historical museum	Petroleum product or oil storage	6 Maleny Street – former Council depot
2RP76609	Landsborough	Industrial	Petroleum product or oil storage	6 Maleny Street; shed – former Council depot
2RP111079	Landsborough	Industrial	Petroleum product or oil storage	6 Maleny Street – former Council depot
3RP76609	Landsborough	Industrial	Petroleum product or oil storage	6 Maleny Street – former Council depot
1RP55228	Landsborough	Service station	Service stations (requires clarification)	Caloundra Street
2RP55228	Landsborough	Service station	Service stations (requires clarification)	Caloundra Street
12L2588	Landsborough		Service Stations (requires clarification)	Old Landsborough Road
3CP827039	Mooloolah	Existing railway	Hazardous contaminant (requires clarification)	In existing rail corridor
152SP109441	Eudlo	Existing railway	Hazardous contaminant	In existing rail corridor
163SP102275	Eudlo	Existing railway	Hazardous contaminant	In existing rail corridor
171SP102276	Palmwoods	Existing railway	Hazardous contaminant	In existing rail corridor
182SP102277	Woombye	Existing railway	Hazardous contaminant	In existing rail corridor
190SP105000	Woombye	Existing railway	Hazardous contaminant	In existing rail corridor
191SP105000	Woombye	Existing railway	Hazardous contaminant	In existing rail corridor
1SP263819	Nambour	Commercial	Petroleum product or oil storage, chemical storage, hazardous contaminant	Former Nambour sugar mill
14RP26509	Nambour	Unknown – lot unable to be located	Chemical storage	9 Mill Street
17SP207112	Nambour	Unknown – lot unable to be located	Chemical storage	9 Mill Street
19RP26509	Nambour	Unknown – lot unable to be located	Chemical storage	Mill Street
21RP26509	Nambour	Unknown – lot unable to be located	Petroleum product or oil storage	9 Mill Street
22RP26509	Nambour	Unknown – lot unable to be located	Petroleum product or oil storage	9 Mill Street
38RP26509	Nambour	Unknown – lot unable to be located	Chemical storage	9 Mill Street
39RP26509	Nambour	Unknown – lot unable to be located	Hazardous contaminant	9 Mill Street
41RP26509	Nambour	Unknown – lot unable to be located	Petroleum product or oil storage	9 Mill Street

LOT PLAN	LOCATION	PROPERTY TYPE/ USE	NOTIFIABLE ACTIVITY	COMMENTS
43SP207112	Nambour	Unknown – lot unable to be located	Hazardous contaminant	9 Mill Street
44RP26509	Nambour	Unknown – lot unable to be located	Chemical storage, petroleum product or oil storage	9-15 Mill Street
45RP26509	Nambour	Unknown – lot unable to be located	Hazardous contaminant	9 Mill Street
389SP207112	Nambour	Unknown – lot unable to be located	Hazardous contaminant	9 Mill Street
390CG321	Nambour	Unknown – lot unable to be located	Hazardous contaminant	9 Mill Street
9SP110903	Nambour	Existing Railway	Hazardous Contaminant	Lot beside rail line
10SP110903	Nambour	Existing Railway	Hazardous Contaminant	Lot beside rail line
216SP102280	Nambour	Existing Railway	Hazardous Contaminant	In existing rail corridor
8RP883859	Nambour	Unknown – lot unable to be located	Hazardous Contaminant	Currie Street

6.3.6 Erosion Hazard

A review of the Coastal Protection mapping layer within the Development Assessment Mapping System (DAMS) shows that the Project Area is not located within a coastal management district or coastal hazard area (erosion prone area or storm tide inundation area).

An erodibility assessment was carried out as part of the geotechnical assessment along the proposed alignment (Trackstar Alliance 2008). This assessment was carried out through the collection of samples for Emerson Class Dispersion Tests and their assessment for erodibility. Samples for Emerson Class were tested as per AS1289. The recorded Emerson Class numbers ranged from 4 to 6, meaning the on-site material ranges from medium to very low potential for dispersivity. No visible evidence of dispersive erosion behaviour was observed in either the cuttings or low lying areas during the field inspection.

6.3.7 Unexploded Ordnance

A search of the Department of Defence unexploded ordnance (UXO) mapping showed no areas of mapped UXO in the Project Area. The area immediately to the east between Beerwah and Landsborough, associated with the Beerwah State Forest is mapped as 'UXO Area: Other'. This classification indicates that the area was used for military training during and after World War II and could have potential for UXO finds. The Project will not impact on this area.

6.4 Potential Impacts

Planning and design activities considered in this assessment include the optimisation of the Project footprint, including establishing the heights of embankments and depths of cuts and requirements for bridges and culverts. Other activities considered include early works and investigations undertaken to inform the design such as geotechnical testing and searches of the EMR and CLR.

Potential impacts associated with construction may include:

- erosion or destabilisation of cuttings and embankments, with release of sediments into waterways, affecting water quality and ecosystem health
- erosion and destabilisation of created creek banks and bed, inability for riparian vegetation to re-establish and reduction in ecological function for aquatic fauna and flora and as a fauna movement corridor
- erosive and dispersive soils that are not recognised or treated appropriately, leading to erosion and sedimentation and subsequent effects on water quality and ecosystem health
- management measures (including surface treatments, landscaping and rehabilitation) that do not adequately protect areas subject to erosion, resulting in water quality and ecosystem health impacts
- importation of fill that introduces contaminants (biological or chemical) to the works area
- previously unconfirmed contamination exposed during site works, with impacts to human and / or ecosystem health
- re-use of material from the existing rail corridor, particularly track formation in sections of the new corridor that introduces contamination into previously clean areas
- re-use of material from the existing rail corridor, outside the immediate track area (i.e. embankment to fence line) in sections of the new corridor, which introduces contamination into previously clean areas
- previously unconfirmed potential or actual acid sulfate soils exposed, which affects ecological function and habitats, or resultant leachate moves through the shallow groundwater system
- localised changes to the hydrological regime as a result of drainage and flow path modification that alters soil salinity conditions.

6.5 Proposed Mitigation Measures

An erosion and sediment control plan (ESCP) should be developed for the construction phase in accordance with the with the International Erosion Control Association's *Best Practice Sediment and Erosion Control* (2008) and certified by a Certified Professional in Erosion and Sediment Control (CPESC). The ESCP should take into account local flow paths and constraints to the use of 'traditional' erosion and sediment controls such as retention basins.

The ESCP is to include:

- definition of locations requiring protection, including waterways, and bunding of higher risk areas
- definition of the location and protection requirements for stockpiles and access tracks
- measures to divert 'clean' water around construction disturbance areas
- requirements for regular inspection and maintenance erosion control devices
- requirements for rehabilitation and stabilisation works.

Landscaping and rehabilitation treatments should be installed as quickly as possible after completion of earthworks. If this is not possible, consider installation of temporary protection measures with a recommended emphasis on stabilising the rail embankment.

Other mitigation measures proposed to manage impacts include:

- maintenance and monitoring of drainage infrastructure across the Project
- maintenance, monitoring and remediation of stabilisation works including landscaping and rehabilitation works
- all imported fill materials (for structural or landscaping purposes) to be certified contaminant free
- implementation of an Acid Sulfate Soils Management Plan in order to identify and provide procedures in the unlikely event of encountering acid soils or acid rock
- works within the existing rail corridor to comply with the QR contaminated land procedures current at the time of construction works

- identification of all potentially contaminated land within the Project footprint and characterisation of soil proposed to be disturbed within these areas
- waste tracking of excavated soil – while the majority of material within the existing rail corridor may be re-used within the rail corridor (subject to QR and DES approval), this material should not be reused on any new section of the alignment; if it is to be re-used, a soil disposal permit may be required (subject to soil characterisation).

6.6 Residual Impact Assessment

Potential impacts experienced may include minor decreases in water quality along adjacent waterways as a consequence of disturbed soils and would be predominantly experienced as construction works were in proximity to the waterways. With the implementation of the mitigation measures outlined in Table 36, it is anticipated that the Project's potential soil and land management impacts will be short term, moderate and manageable.

Table 36: Residual Impact Assessment, Soils and Land Management

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Topography – cuttings and embankments	Construction	Erosion or destabilisation of cuttings and embankments due to inadequate temporary drainage. Release of sediments into waterways, affecting water quality and ecosystem health.	<p>Erosion and sediment control plan (ESCP) developed in accordance with the International Erosion Control Association's Best Practice Sediment and Erosion Control (2008) and certified by a CPESC for the construction phase taking into account local flow paths and constraints to the use of 'traditional' erosion and sediment controls such as retention basins.</p> <p>ESCP to be developed as per the requirements of TMR Specification MRTS52 Erosion and Sediment Control for a High risk site.</p> <p>The ESCP will include:</p> <ul style="list-style-type: none"> Definition of locations requiring protection, including waterways, and bunding of higher risk areas Definition of the location and protection requirements for stockpiles and access tracks Measures to divert 'clean' water around construction disturbance areas 	Erosion potential minimised and managed in accordance with construction erosion and sediment control plan.	Short term	Possible	Moderate

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			<p>Requirements for regular inspection and maintenance erosion control devices</p> <p>Requirements for rehabilitation and stabilisation works.</p> <p>Landscaping and rehabilitation treatments installed as quickly as possible after completion of earthworks. If this is not possible, consider installation of temporary protection measures.</p> <p>Emphasis is recommended to stabilising the rail embankment and areas of disturbance.</p>				
Topography – cuttings and embankments	Operation	<p>Erosion or destabilisation of cuttings and embankments due to inadequate permanent drainage works or failure of stabilisation works.</p> <p>Release of sediments into waterways, affecting water quality and ecosystem health.</p> <p>Reduced success of landscaping and rehabilitation treatments.</p>	<p>Maintenance and monitoring of drainage infrastructure across the Project.</p> <p>Maintenance, monitoring and remediation of stabilisation works including landscaping and rehabilitation works.</p>	Erosion potential minimised and managed in accordance with operational EMP.	Long term	Unlikely	Minor

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Topography- in the event a creek realignment is required – not identified to date.	Construction	Erosion and destabilisation of created creek banks and bed, inability for riparian vegetation to re-establish and reduction in ecological function for aquatic fauna and flora and as a fauna movement corridor.	Careful staging of works and development of rehabilitation plan would need to be developed, addressing flow paths, extreme weather events and landscaping and rehabilitation works. Redirecting flows around the disturbed construction zone.	Some local water quality and ecosystem impacts likely to be unavoidable in the short term.	Short term	Likely	Moderate
Soils and geology-imported fill	Construction	Importation of fill introduces contaminants (biological or chemical) to the Project Area	All imported fill materials (for structural or landscaping purposes) to be certified contaminant free.	No introduction of new contaminants to the Project Area.	Long term	Possible	Minor
Erosive soils	Construction	Erosive soils are not recognised or treated appropriately, leading to erosion and sedimentation. Water quality and ecosystem health impacts result.	Implementation of ESCP, including minimising extents of exposed earthworks, staged works and rapid rehabilitation where practical and as defined in the ESCP.	Adverse water quality or ecosystem impacts are minimised, but some effects still occur.	Short term	Possible	Insignificant
Saline or sodic soils	Construction	Localised changes to the hydrological regime as a result of drainage and flow path modification alters soil salinity/ sodic conditions.	Implementation of ESCP. Minimise extents of runoff rehabilitation areas.	Some modification to the extent of riparian vegetation and habitat, to be addressed through rehabilitation and/ or offsets.	Short term	Unlikely	Insignificant

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Contaminated land- exposure of previously unconfirmed contamination, UXO or other material requiring management.	Construction	Previously unconfirmed contamination is exposed during site works. Likely impacts to human and / or ecosystem health.	Disturbance to new or previously unconfirmed contaminated areas is minimised and treated where encountered.	Minimisation of risk of unconfirmed contamination being exposed.	Short term	Unlikely	Medium
Contaminated land- re-use of material from the rail corridor (track formation area and ballast)	Construction	Re-use of material from the existing rail corridor, particularly track formation in sections of the new corridor introduces contamination into previously clean areas.	Works within the existing rail corridor to comply with the QR contaminated land procedure current at the time of construction.	No new contamination as a result of construction activities within the corridor, corridor not entered on the EMR.	Long term	Unlikely	Insignificant
Contaminated land- re-use of material from the rail corridor (embankment to fence line)	Construction	Re-use of material from the existing rail corridor, outside the immediate track area (i.e. embankment to fence line) in sections of the new corridor introduces contamination into previously clean areas.	Works within the existing rail corridor to comply with the QR contaminated land procedures, current at the time of construction. Establish/certify that the areas proposed for re-use as fill are contaminant free, particularly in the vicinity of sensitive receiving environments. If material is borrowed from the existing rail corridor, a soil disposal permit is likely to be required.	No new contamination as a result of construction activities within the corridor, corridor not entered on the EMR.	Long term	Unlikely	Insignificant

7 Flora and Fauna

7.1 Introduction

This Chapter documents the flora and fauna values within the Project Area and provides an assessment of the potential impacts of the B2N Project. Recommendations for further work to support permits and approvals are also provided in this Chapter.

7.2 Assessment Methods

The flora and fauna assessment involved the following:

- a review of background information including previous studies, relevant databases, mapping and literature
- identifying gaps in background information
- completing field surveys to identify the terrestrial flora within the Project Area and verify Regional Ecosystems (REs) present
- completing field surveys to identify habitat available for conservation significant terrestrial fauna species and faunal movement corridors
- completing field surveys to assess the presence of koala (*Phascolarctos cinereus*)
- describing the flora and fauna values within and surrounding the Project Area
- describing the aquatic habitat available and fish communities that may be present within waterways that intersect the Project Area
- assessing the potential impacts of the B2N Project on flora and fauna values in the context of relevant state and commonwealth legislation
- proposing recommendations for the mitigation of potential B2N Project impacts at the design, construction and operational phases
- identifying requirements for further studies.

The terrestrial flora and fauna assessment comprised two components:

- a desktop assessment of previous studies, relevant databases, mapping and literature
- two field surveys of the vegetation communities and flora and fauna present within the survey area and significance status under the EPBC Act, the *Nature Conservation Act 1992* (NC Act) and the *Vegetation Management Act 1999* (VM Act).

The aim of the desktop assessment was to identify the terrestrial ecology values that may occur within the Project Area, and gain an appreciation of the previous investigations conducted in the Project Area. This information was then used to identify priorities for further field investigation and provide the foundation for assessing the likelihood of occurrence of significant species.

A desktop assessment and field survey were completed in 2016 to inform the REF. The desktop assessment was updated in 2019 to capture changes in the available mapping, databases and literature. An additional field survey was also undertaken in August 2019 to assess the environmental values of additional properties (1RP124412, 3RP174740, 3RP135561, 1RP177687, and 2RP177687) affected by the updated B2N Project design. The sites surveyed in 2016 were not re-assessed as part of the 2019 survey.

7.2.1 Desktop Assessment

A number of sources were used to obtain information on the flora and fauna occurring or expected to occur within the Project Area. These included:

- Protected Matters Search Tool (PMST) to identify Matters of National Environmental Significance (MNES) under the EPBC Act (Department of the Environment and Energy (DoEE)). A 5km buffer was adopted for this search.
- Protected Plants Flora Survey Trigger Mapping (DES)
- Regulated Vegetation Management Mapping (also described as Regional Ecosystems or RE Mapping) under the VM Act as at September 2019
- Wildlife Online database to determine the records of endangered, vulnerable or near threatened (EVNT) and Special Least Concern species under the NC Act (DES). A 5km buffer was adopted for this search.
- aerial imagery

- Trackstar Environmental Planning Study (2007)
- Caboolture to Landsborough Rail Upgrade Study: Beerburrum to Landsborough Corridor (Arup, 2007)
- Caboolture to Landsborough Rail Upgrade – Beerburrum to Landsborough Ecological Assessment (WBM and BAMM, 2006)
- Beerburrum to Landsborough Track Duplication Environmental and Planning Study (Trackstar Alliance, 2007).

7.2.2 Previous Field Studies

Several flora and fauna studies have previously been conducted within the Project Area, relevant results have been discussed in Table 37.

Table 37: Previous Flora and Fauna Studies

REPORT OR STUDY	DESCRIPTION
Caboolture to Landsborough Rail Upgrade Study: Beerburrum to Landsborough Corridor (Arup for Queensland Transport, 2007)	<p>In 2007 Arup engaged WBM and BAAM to conduct an ecological assessment within the proposed Beerburrum to Landsborough rail corridor as part of the Caboolture to Landsborough Rail Upgrade Project. The assessment included desktop and field surveys of terrestrial flora and terrestrial and aquatic vertebrate fauna and their habitats.</p> <p>The flora survey focused on describing vegetation communities present and conducting targeted searches for threatened flora species and their habitats. The survey was conducted in November and December 2005 and January and February 2006.</p> <p>The terrestrial fauna survey included targeted surveys and habitat assessments at locations selected from aerial imagery and remnant vegetation mapping as most likely to contain threatened fauna species. The terrestrial field survey program took place over five days/four nights in February/March 2006.</p> <p>The fish and aquatic habitat assessment included fish sampling, water quality monitoring and a habitat condition assessment using the methodology developed by DRNM (2001). The assessment was conducted over 3 days in March 2006.</p>
Beerburrum to Landsborough Track Duplication Environmental and Planning Study (Trackstar Alliance, 2007)	<p>In August / September 2007 further ecological investigations were conducted by TrackStar Alliance in order to supplement the previous study by Arup (2007). The focus of the additional work was to verify RE mapping and undertake targeted searches for significant flora species at some additional areas that were not surveyed in the original study.</p>
Landsborough to Nambour Environmental Impact Statement (Arup, 2009)	<p>Arup conducted a field program to gather information on the presence of conservation significant flora and fauna species, terrestrial vertebrate assemblages present, areas of high fauna use and areas of high environmental value.</p> <p>Two systematic baseline vertebrate surveys were conducted. The first survey was conducted during the cooler months between 3 September 2007 and 7 September 2007. The second was undertaken during the summer period between 29 January 2008 and 2 February 2008. The systematic surveys involved the establishment of seven transects in representative habitats, particularly those that were likely to be inhabited by endangered, vulnerable or rare (EVR) species.</p> <p>A targeted survey for the frog species Giant Barred Frog <i>Mixophyes iteratus</i> and Wallum Sedge Frog <i>Litoria longburensis</i> was conducted between 29 January 2008 and 2 February 2008 in response to the confirmation of the presence of the Giant Barred Frog and habitat for Wallum Sedge Frog in September 2007. Techniques used during the targeted survey included spotlighting using head torches, call playback and call detection as well as tadpole collection.</p>

7.2.3 Additional Field Studies

An ecological field study was undertaken by SMEC to build upon and update previous studies undertaken by Arup (2007), Trackstar (2007) and Arup (2009). The field survey was conducted over five days from 20 to 24 June 2016 and on 13 August 2019. Field survey locations were identified based on the desktop assessment and primarily focused on areas of remnant vegetation, riparian vegetation and other locations identified as most likely to contain threatened flora species.

The flora survey consisted of 35 quaternary survey sites in 2016 and four quaternary survey sites in 2019. Data collected was used to verify mapped regional ecosystems and assess the likelihood of the Project Area supporting threatened flora species. Not all areas containing mapped remnant vegetation were sampled. Data collected included:

- structural composition
- list of dominant species in the various strata
- visual estimate of percentage canopy cover and canopy height
- presence and cover of restricted invasive plants (listed under the *Biosecurity Act 2014*).

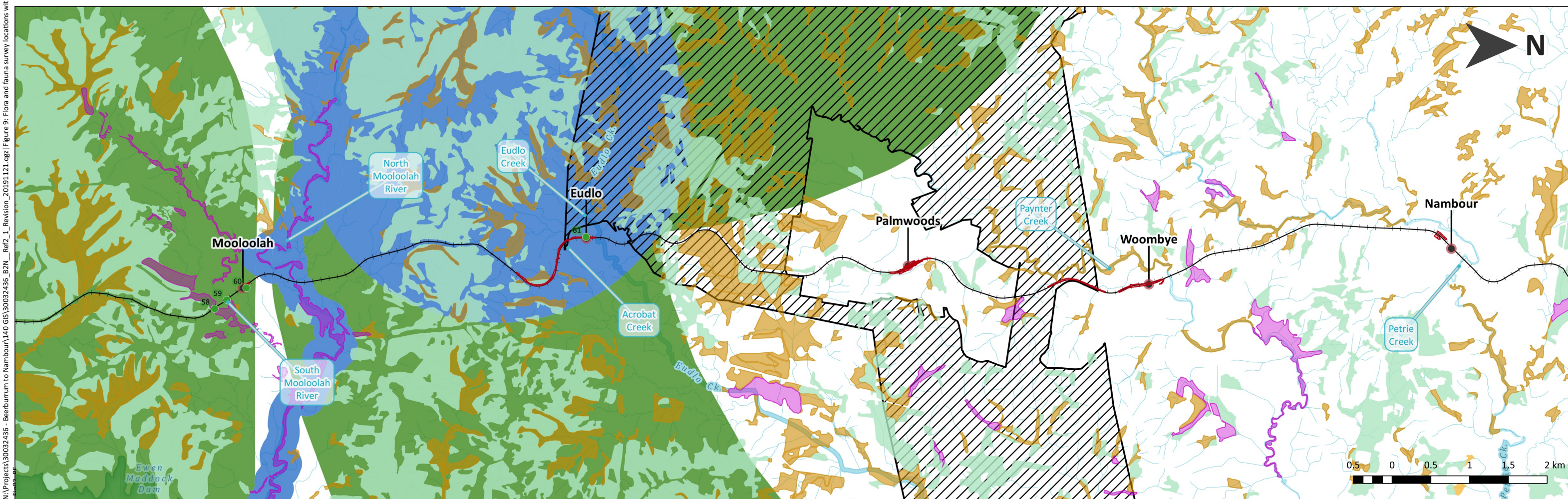
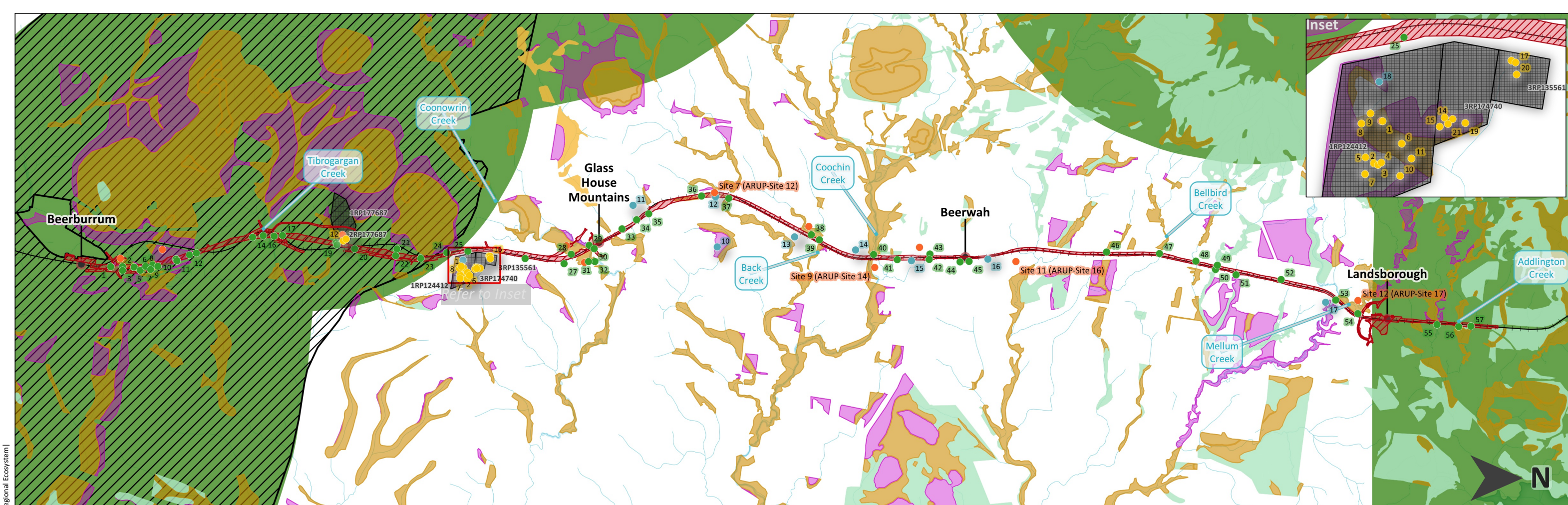
A habitat assessment was also conducted at each quaternary survey site to determine the suitability of habitat present to support threatened fauna species. Data collected included:

- slope and aspect
- level of disturbance
- age structure
- abundance of fauna features (i.e. hollow-bearing trees, fallen logs, fleshy fruit, flowering trees etc.), leaf litter depth and cover
- proximity to permanent surface water
- importance of site as a fauna corridor.

A survey of koala presence and activity, utilising the Spot Assessment Technique (SAT) (Phillips and Callaghan 2011), was conducted at nine locations within the Project Area. The SAT is a point-based tree sampling method that uses the presence/absence of koala faecal pellets around the base of trees to derive a measure of koala activity.

A summary of the findings of the field survey by SMEC is included in this Chapter, with the full Ecological Findings Report provided in Appendix B. Sites surveyed during the field survey by SMEC (2016 and 2019) are shown in Figure 9, along with RE mapping. Previous survey locations (where known) are also identified in Figure 9.

The field survey was conducted to provide the basis for the impact assessments in this REF, and to inform the scoping of additional survey effort where required to address potential future EPBC Act referral requirements or State permits.



7.3 Existing Environment

7.3.1 Vegetation Communities

Threatened Ecological Communities (EPBC Act)

The EPBC Act Protected Matters Search Report, for a 5km buffer around the Project Area identified the following two threatened ecological communities (TECs) as having the potential to occur within 5km of the Project Area:

- The Lowland Rainforest of Subtropical Australia, which is listed as critically endangered under the EPBC Act
- The Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland which is listed as endangered under the EPBC Act.

The Lowland Rainforest TEC is equivalent to RE 12.3.1 is mapped as present within the Project Area.

The Coastal Swamp Oak (*Casuarina glauca*) Forest of New South Wales and South East Queensland TEC is synonymous with RE 12.1.1 and RE 12.2.20; neither of which are mapped as present within the Project Area.

Field surveys by SMEC (2016) found that vegetation consistent with the Lowland Rainforest community was best developed at Site 40, which is mapped as RE 12.3.2 Flooded Gum on alluvium. It should be noted that the community may be dominated by Blackbutt on sedimentary soils. A tall, open canopy (40 m high, 10% crown cover) of Forest Red Gum and Blackbutt was present over a main canopy 20m high with 60% cover. The combined cover of the two strata is, therefore, 70%. A smaller area of potential Lowland Rainforest was present at Site 55, but this was not mapped as RE vegetation. Canopy height at Site 55 is 20m with a crown cover of 90%. Both sites meet the cover and high requirements of the TEC (>20 canopy height with >70% cover).

Consistent with the TEC description, the abundance of Eucalyptus, Melaleuca and Casuarina was very low, but Eucalyptus and similar genera (e.g. Corymbia) was common adjacent to the rainforest communities. To be part of the TEC, there must be a minimum of 30 species from Appendix A of the TEC Listing Advice present. Due to time constraints, only a minimum of flora survey effort was achieved, so it is not currently possible to test this criterion for either site.

To be part of the TEC, the rainforest vegetation must also cover a minimum area, which depends on the quality of the community present (e.g. larger areas provide the patch area trigger as quality goes down (e.g. remnant versus regrowth, number of native rainforest species present, percent cover of native species). Minimum trigger thresholds of 0.1ha, 1ha or 2ha are required depending on the quality of a patch. The extent of the rainforest communities (excluding any contiguous areas of Eucalypt or other vegetation) is yet to be determined.

Detailed mapping of spatial extent and quantitative measures of community attributes in line with that recommended by the Conservation Listing Advice will be required to determine whether the TEC Lowland Rainforest is present at either Site 40 or Site 55.

Wetlands of International Importance (EPBC Act)

The PMST identifies Moreton Bay as a Wetland of International Importance (Ramsar) that is relevant to the search area. At its nearest point, the B2N Project is located approximately 6km in a linear distance from Pumicestone Passage. Whilst activities in the upper reaches of these catchments can have an influence downstream, the distance and number of different land use activities and pressures between the Project Area and the Ramsar site reduces the likelihood of an impact being generated at this distance.

Nationally Important Wetlands

There are several Nationally Important Wetlands located adjacent to or close to the Project Area, these are shown on Figure 4. These include:

- three sections of the Pumicestone Upper Coastal Plain, two associated with Beerwah State Forest and Forest Reserve east of the Project Area, one associated with a section of the Glass House Mountains National Park immediately west of the Project Area
- the Lower Mooloolah River, approximately 5km east of Mooloolah
- the Pumicestone Passage, also listed as a Wetland of International Importance.

Regional Ecosystems (Queensland VM Act)

The Project Area has been extensively cleared of native vegetation for State Forest plantations, agriculture and more recently for urban development. Remnant vegetation is now largely confined to narrow strips along waterways and

drainage lines and areas unsuitable for development such as the Glass House Mountains and their foot slopes. Most areas of remnant vegetation have been affected by weed invasion, particularly along waterways and drainage lines.

Eight REs are mapped across the Project Area (Table 38). Of these, two are listed as endangered (RE 12.3.1 and 12.5.3), four are listed of concern (RE 12.3.2, 12.3.4, 12.3.11, 12.3.14) and two are listed as least concern (RE 12.3.5, 12.9-10.14). RE mapping is shown in Figure 9.

Table 38: Regional Ecosystems

RE	SHORT DESCRIPTION (REDD)	VM ACT STATUS/ BIODIVERSITY STATUS
12.3.1	Gallery rainforest (notophyll vine forest) on alluvial plains	Endangered
12.3.2	<i>Eucalyptus grandis</i> tall open forest on alluvial plains	Of Concern
12.3.4	<i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> woodland on coastal alluvium	Of Concern
12.3.5	<i>Melaleuca quinquenervia</i> open forest on coastal alluvium	Least concern
12.3.11	<i>Eucalyptus tereticornis</i> +/- <i>Eucalyptus siderophloia</i> , <i>Corymbia intermedia</i> open forest on alluvial plains usually near coast	Of Concern
12.3.14	<i>Banksia aemula</i> low woodland on alluvial plains usually near coast	Of Concern
12.5.3	<i>Eucalyptus racemosa subsp. racemosa</i> woodland on remnant Tertiary surfaces	Endangered
12.9-10.14	<i>Eucalyptus pilularis</i> tall open forest on sedimentary rocks	Least Concern

SMEC undertook an assessment at 19 representative locations across the Project Area, mapped as remnant vegetation, to describe the floristic, structural and habitat attributes at each site. This field survey found some areas of remnant vegetation support different REs to that shown on Certified RE Mapping. Field verified REs at each site are shown in Table 39 and justification for the proposed changes are outlined in the Ecological Findings Report provided in Appendix B. Further assessment will be required to map the extent of field verified REs.

Table 39: Field Verified Regional Ecosystems

SITE ID	RE MAPPING	FIELD VERIFIED RE
4	12.3.4	12.3.4
9	12.3.4	12.3.5
11	12.5.3	12.9-10.4
13	12.5.3	12.5.3
19	12.5.3	12.5.3
19A	12.3.4	12.3.5
31	12.3.4	12.3.6
37	12.3.2	12.3.2
40	12.3.2	12.3.1

SITE ID	RE MAPPING	FIELD VERIFIED RE
54	12.3.1	12.3.11a
55	12.3.2	12.3.1
56	12.3.2	12.3.2
57	12.3.2	12.3.2
1RP177687	12.3.4	12.3.4
2RP177687	12.3.4	12.3.4
1RP124412	12.3.4	12.3.4
	12.5.3	12.5.3
3RP174740	12.3.4	12.3.4
	12.5.3	12.5.3

A summary of the key ecological features of REs surveyed is provided in Table 40 in addition to the location where they were observed.

SMEC identified eight REs represented across the sites surveyed. Three of these, RE 12.3.5, 12.3.6 and 12.9.10.4 (all of which have a VM Act status of Least Concern), are not shown on RE Mapping of the Project Area. Areas mapped as supporting RE 12.9-10.17d and 12.9-10.14 were not observed at the locations surveyed, however this does not indicate their absence from within the Project Area.

Table 40: Key Ecological Features of Regional Ecosystems Observed within the Project Area

RE	KEY ECOLOGICAL FEATURES
12.3.1 Gallery rainforest (notophyll vine forest) on alluvial plains	<u>VM Act/Biodiversity Status:</u> Endangered <u>Commonwealth Listed Equivalent and Status:</u> Lowland Rainforest, Critically Endangered, however further assessment is needed to confirm if the survey area meets the criteria for the TEC <u>Overstorey:</u> <i>Eucalyptus tereticornis</i> , <i>Eucalyptus pilularis</i> , <i>Flindersia australis</i> <u>Midstorey:</u> <i>Syzygium francisii</i> <u>Understorey:</u> <i>Syzygium smithii</i> , <i>Castanospermum australe</i> , <i>Ficus coronata</i> <u>Groundcover:</u> <i>Lomandra hystrix</i> <u>Declared Weeds:</u> <i>Ligustrum sinense</i> , <i>Cinnamomum camphora</i> <u>Observed habitat suitability:</u> Tusked Frog, Short-beaked Echidna, Platypus, Grey-headed Flying-fox <u>Sites observed:</u> Site 40 and 55
12.5.3 <i>Eucalyptus racemosa</i> subsp. <i>racemosa</i> woodland on remnant Tertiary surfaces	<u>VM Act/Biodiversity Status:</u> Endangered <u>Commonwealth Status:</u> - <u>Overstorey:</u> <i>Eucalyptus racemosa</i> , <i>Corymbia intermedia</i> , <i>Eucalyptus tindaliae</i> , <i>Melaleuca quinquenervia</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus racemosa</i> , <i>Eucalyptus robusta</i> , <i>Angophora woodsiana</i> , <i>Corymbia gummifera</i> , <i>Corymbia intermedia</i> <u>Midstorey:</u> <i>Acacia disparrima</i> , <i>Alphitonia excelsa</i> , <i>Banksia integrifolia</i> , <i>Allocasuarina littoralis</i> , <i>Petalostigma pubescens</i> <u>Understorey:</u> <i>Acacia disparrima</i> , <i>Acacia concurrens</i> , <i>Allocasuarina littoralis</i> <u>Groundlayer:</u> <i>Themeda triandra</i> , <i>Lomandra</i> sp., <i>Xanthorrhoea</i> sp., <i>Oplismenus imbecillis</i> , Native grasses, Native herbs, <i>Pratia purpurascens</i> <u>Declared Weeds:</u> <i>Lantana camara</i> , <i>Cinnamomum camphora</i>

RE	KEY ECOLOGICAL FEATURES
	<p><u>Observed habitat suitability:</u> Koala, Tusked Frog, Short-beaked Echidna</p> <p><u>Sites observed:</u> 13, 19 and 22</p>
<p>12.3.2</p> <p><i>Eucalyptus grandis</i> tall open forest on alluvial plains</p>	<p><u>VM Act/Biodiversity Status:</u> Of Concern</p> <p><u>Commonwealth Status:</u> -</p> <p><u>Overstorey:</u> <i>Eucalyptus grandis</i>, <i>Eucalyptus microcorys</i>, <i>Eucalyptus resinifera</i>, <i>syncarpia glomulifera</i>, <i>Corymbia intermedia</i>, <i>Lophostemon confertus</i>, <i>Melaleuca quinquenervia</i>, <i>Eucalyptus pilularis</i>, <i>Corymbia intermedia</i>, <i>Eucalyptus racemose</i>, <i>Glochidion ferdinandi</i>, <i>Lophostemon suaveolens</i></p> <p><u>Midstorey:</u> <i>Melicope elleryana</i>, <i>Syzygium smithii</i>, <i>Melicope elleryana</i>, <i>Glochidion ferdinandi</i>, <i>Ficus coronate</i>, <i>Cryptocarya sp.</i></p> <p><u>Understorey:</u> <i>Ficus coronate</i>, <i>Cryptocarya sp.</i>, <i>Lomandra longifolia</i>, <i>Lantana camara</i>, <i>Calochlaena dubia</i>, <i>Cordyline sp.</i>, <i>Archontophoenix cunninghamiana</i>, <i>Blechnum indicum</i>, <i>Acacia maidenii</i></p> <p><u>Ground layer:</u> <i>Oplismenus imbecillis</i>, <i>Dianella caerulea</i>, <i>Lomandra hystrix</i>, <i>Calochlaena dubia</i>,</p> <p><u>Declared Weeds:</u> <i>Lantana camara</i>, <i>Sphagneticola trilobata</i></p> <p><u>Observed habitat suitability:</u> Tusked frog, Short-beaked Echidna, Platypus, Grey-headed Flying-fox</p> <p><u>Sites observed:</u> 37, 56 and 57</p>
<p>12.3.4</p> <p><i>Melaleuca quinquenervia</i>, <i>Eucalyptus robusta</i> woodland on coastal alluvium</p>	<p><u>VM Act/Biodiversity Status:</u> Of concern</p> <p><u>Commonwealth Status:</u> -</p> <p><u>Overstorey:</u> <i>Melaleuca quinquenervia</i>, <i>Eucalyptus robusta</i></p> <p><u>Midstorey:</u> <i>Alphitonia excelsa</i>, <i>Glochidion ferdinandi</i></p> <p><u>Understorey:</u> <i>Glochidion ferdinandi</i>, <i>Gahnia sieberiana</i></p> <p><u>Groundlayer:</u> <i>Blechnum indicum</i>, <i>Lygodium microphyllum</i>, <i>Baumea rubiginosa</i></p> <p><u>Declared Weeds:</u> <i>Cinnamomum camphora</i>, <i>Baccharis halimifolia</i>,</p> <p><u>Observed habitat suitability:</u> Wallum Froglet, Wallum Rocketfrog, Koala, Tusked Frog, Wallum Froglet, Wallum Rocketfrog, Koala, Tusked Frog, Short-beaked Echidna, Platypus, Grey-headed Flying-fox</p> <p><u>Sites observed:</u> 4</p>
<p>12.3.11</p> <p><i>Eucalyptus tereticornis</i> +/- <i>Eucalyptus siderophloia</i>, <i>Corymbia intermedia</i> open forest on alluvial plains usually near coast</p>	<p><u>VM Act/Biodiversity Status:</u> Of concern</p> <p><u>Commonwealth Status:</u> -</p> <p><u>Overstorey:</u> <i>Eucalyptus grandis</i>, <i>Eucalyptus sideropholia</i>, <i>Eucalyptus tereticornis</i>, <i>Corymbia intermedia</i>, <i>Lophostemon suaveolens</i></p> <p><u>Midstorey:</u> <i>Archontophoenix Cunninghamianam</i>, <i>Ficus coronate</i>, <i>Alphitonia excelsa</i>, <i>Callistemon salicina</i>, <i>Neolitsea dealbata</i>, <i>Jagera pseudorhus</i>, <i>Mallotus philippensis</i></p> <p><u>Understorey:</u> <i>Neolitsea dealbata</i>, <i>Ficus coronate</i>, <i>Parsonsia straminea</i>,</p> <p><u>Groundlayer:</u> <i>Oplismenus imbecillis</i></p> <p><i>Calochlaena dubia</i></p> <p><u>Declared Weeds:</u> <i>Lantana camara</i>, <i>Ligustrum sinense</i>, <i>Ligustrum lucidum</i>,</p> <p><u>Observed habitat suitability:</u> Koala, Tusked Frog, Echidna, Platypus, Grey-headed Flying-fox</p> <p><u>Sites observed:</u> 54</p>
<p>12.3.5</p> <p><i>Melaleuca quinquenervia</i> open forest on coastal alluvium</p>	<p><u>VM Act/Biodiversity Status:</u> Least Concern/Of Concern</p> <p><u>Commonwealth Status:</u> -</p> <p><u>Overstorey:</u> <i>Melaleuca quinquenervia</i>, <i>Eucalyptus tereticornis</i>, <i>Eucalyptus robusta</i></p> <p><u>Midstorey:</u> -</p> <p><u>Understorey:</u> -</p> <p><u>Groundcover:</u> <i>Gahnia sieberiana</i>, <i>Blechnum indicum</i>, <i>Lygodium microphyllum</i>, <i>Baumea rubiginosa</i>, <i>Parsonsia straminea</i></p>

RE	KEY ECOLOGICAL FEATURES
	<u>Declared Weeds:</u> <i>Ligustrum sinense</i> , <i>Cinnamomum camphora</i> <u>Observed habitat suitability:</u> Wallum Froglet, Grey-headed Flying-fox <u>Sites observed:</u> 9, 19A
12.3.6 <i>Melaleuca quinquenervia</i> +/- <i>Eucalyptus tereticornis</i> , <i>Lophostemon suaveolens</i> open forest on coastal alluvial plains	<u>VM Act/Biodiversity Status:</u> Least Concern/No Concern at Present <u>Commonwealth Status:</u> - <u>Overstorey:</u> <i>Eucalyptus tereticornis</i> , <i>Corymbia intermedia</i> <u>Midstorey:</u> <i>Lophostemon suaveolens</i> , <i>Melaleuca quinquenervia</i> , <i>Spathodea campanulata</i> <u>Understorey:</u> <i>Parsonsia straminea</i> <u>Groundlayer:</u> <i>Lomandra longifolia</i> <u>Declared Weeds:</u> <i>Ligustrum sinense</i> , <i>Lantana camara</i> <u>Observed habitat suitability:</u> <u>Sites observed:</u> 31
12.9-10.4 <i>Eucalyptus racemosa</i> subsp. <i>racemosa</i> woodland on sedimentary rocks	<u>VM Act/Biodiversity Status:</u> Least Concern/No Concern at Present <u>Commonwealth Status:</u> - <u>Overstorey:</u> <i>Corymbia intermedia</i> , <i>Eucalyptus tereticornis</i> , <i>Eucalyptus resinifera</i> <u>Midstorey:</u> <i>Lophostemon confertus</i> , <i>Syncarpia glomulifera</i> , <i>Allocasuarina torulosa</i> <u>Understorey:</u> <i>Glochidion ferdinandi</i> <i>Polyscias elegans</i> , <i>Guioa semiglauc</i> <u>Groundlayer:</u> <i>Lomandra longifolia</i> , <i>Smilax australis</i> , <i>Macrozamia lucida</i> , <i>Oplismenus imbecillis</i> <u>Declared Weeds:</u> <i>Lantana camara</i> <u>Observed habitat suitability:</u> Tusked Frog, Short-beaked Echidna <u>Sites observed:</u> 11

High Value Regrowth

There is no mapped High Value Regrowth vegetation (Category C) within the Project Area.

Essential Habitat (VM Act)

Certified RE mapping indicates that the Project Area contains Essential Habitat for Tusked Frog, Wallum Froglet, Wallum Rocketfrog and Koala. REs and Essential Habitat associations are outlined in Table 41.

Table 41: Mapped Essential Habitat within the Project Area

RE	SHORT DESCRIPTION (REDD)	ESSENTIAL HABITAT
12.3.1	Gallery rainforest (notophyll vine forest) on alluvial plains	Tusked Frog
12.3.2	<i>Eucalyptus grandis</i> tall open forest on alluvial plains	Tusked Frog
12.3.4	<i>Melaleuca quinquenervia</i> , <i>Eucalyptus robusta</i> woodland on coastal alluvium	Wallum Froglet, Wallum Rocketfrog, Koala, Tusked Frog
12.3.6	<i>Melaleuca quinquenervia</i> +/- <i>Eucalyptus tereticornis</i> , <i>Lophostemon suaveolens</i> open forest on coastal alluvial plains	Wallum Froglet
12.3.11	<i>Eucalyptus tereticornis</i> +/- <i>Eucalyptus siderophloia</i> , <i>Corymbia intermedia</i> open forest on alluvial plains usually near coast	Koala, Tusked Frog
12.5.3	<i>Eucalyptus racemosa</i> subsp. <i>racemosa</i> woodland on remnant Tertiary surfaces	Koala, Tusked Frog
12.9-10.14	<i>Eucalyptus pilularis</i> tall open forest on sedimentary rocks	Tusked Frog

7.3.2 Threatened Flora Species

The PMST shows 13 flora species protected under the EPBC Act may occur within 5km of the Project Area.

The Wildlife Online database results show 59 fauna species and 36 flora species listed under the NC Act may occur within 5km of the Project Area. The Flora Survey Trigger Mapping shows that a large portion of the Project Area is within a High Risk Area.

Searches for threatened species were undertaken by SMEC (2016 and 2019), WBM (2006), Trackstar (2007) and Arup (2009) and no threatened flora species were observed during field surveys. During the SMEC (2019) surveys, approximately six mature Plunkett mallee (*Eucalyptus curtisii*), which is listed as 'near threatened' under the NC Act, were identified within property 1RP124412. The *Eucalyptus curtisii* individuals were identified growing in a linear alignment along the outer edge of an area of advanced revegetation (adjacent to remnant vegetation) and are therefore likely to have been planted as part of a revegetation program. Under the former Department of Environment and Heritage Protection's Operational Policy 'When a protected plant in Queensland is considered to be 'in the wild'', planted species are typically considered not to be 'in the wild' and therefore not afforded protection under the NC Act. However, the policy also states that 'an exception to this circumstance could be where vegetation had been propagated and established through human intervention as part of a revegetation program [which appears to be the case]. In this circumstance, artificially established vegetation may be considered to be 'in the wild' and thereby protected under the Act, particularly if the revegetated area had reached a relatively self-sustaining state and no longer received active management or maintenance through human intervention [which is the case]'. In this regard, discussions should be entered into with DES to confirm the extent to which the Plunkett Mallee are considered to be 'in the wild' and therefore afforded protection under the NC Act.

The Plunkett Mallee also has potential to be present within additional sites where suitable habitat is present. A more comprehensive survey effort is required to confirm the presence of this species in additional allotments.

A likelihood of occurrence assessment was conducted for all threatened species known or likely to occur with the Project Area based on database search results. This covers both EPBC Act listed and NC Act listed threatened flora species. The full likelihood of occurrence assessment is provided in the Ecological Findings Report (Appendix B). There were no species identified with a High likelihood of occurrence. Species with a moderate likelihood of occurrence with the Project Area are listed in Table 42.

Table 42: Flora Species with a High or Moderate Likelihood of Occurrence

SCIENTIFIC NAME	COMMON NAME	EPBC ACT STATUS	NC ACT STATUS	LIKELIHOOD OF OCCURRENCE
<i>Arthraxon hispidus</i>	Hairy-joint Grass	V		Moderate, potential to occur in seepages in agricultural and forested areas.
<i>Cryptostylis hunteriana</i>	Leafless Tongue Orchid	V		Moderate. Suitable floristic associations present within the Project Area.
<i>Thesium australe</i>	Austral Toadflax	V	V	Moderate, potential to occur in grassy areas of the Project Area, particularly where Themeda present.
<i>Ricinocarpos speciosus</i>		-	V	Moderate. Particularly along creeks.

EPBC Act Status: V=Vulnerable, E=Endangered, CE=Critically Endangered, EW=Extinct in the Wild

NC Act Status: LC=Least Concern, NT=Near Threatened, V=Vulnerable, Endangered, EW=Extinct in the Wild

Hairy-Joint Grass (*Arthraxon hispidus*) (EPBC Act)

There are no records for the Hairy-joint Grass in the Project Area. Hairy-joint Grass occurs in seepages in a variety of habitats, including pasture, and there is the potential for it to occur in parts of the Project Area that have not yet been investigated (e.g. exotic grassland). Further targeted survey effort is required to determine whether Hairy-joint Grass occurs within the Project Area.

Leafless Tongue-Orchid (*Cryptostylis hunteriana*) (EPBC Act)

The Leafless Tongue-Orchid occurs within a range of vegetation communities, including woodlands dominated by Scribbly Gum, Red Bloodwood and Black She-oaks. This type of community would include RE 12.5.3, which is common in the Project Area, particularly in the southern half. It prefers open areas within the understorey. Surveys will be required to determine whether the species occurs within the Project Area.

Toadflax (*Thesium australe*) (EPBC Act and NC Act)

Austral Toadflax has not been recorded in the locality. It is a root parasite on grasses, particularly Kangaroo Grass (*Themeda triandra*). The groundcover along much of the Project Area is either not grassy (e.g. Sites 4 and 19a had groundcovers of sedges and ferns) or were dominated by exotic grasses due to existing disturbance. Only small areas of Kangaroo Grass (particularly Site 11) or other native grasses are present within the Project Area. Targeted surveys are required to determine whether Austral Toadflax is present within the Project Area, but it is unlikely to occur given the lack of locality records.

Ricinocarpos speciosus (NC Act)

Ricinocarpos speciosus has fairly broad habitat preferences, including creek banks and floodplains. Numerous creeks bisect the Project Area and in the absence of more specific habitat preferences, it must be assumed the species could be present. Targeted survey of creek lines will need to be conducted for this species.

7.3.3 Threatened and Migratory Fauna Species

The EPBC Act PMST shows 48 fauna species protected under the EPBC Act may occur within 5km of the Project Area. The results comprised the following:

- two insects
- three amphibians
- three fish
- three reptiles
- eight mammals
- 13 migratory birds
- 14 non-migratory bird species.

The Wildlife Online database results show 12 EVNT or special least concern fauna species listed under the NC Act may occur within the Project Area. Search results for fauna included four amphibians, six birds, one mammal and one fish .

Threatened and migratory fauna listed under State and Commonwealth legislation were assessed for their likelihood of occurrence within the Project Area based on the community type (e.g. REs), habitat structure and the fauna features (e.g. hollow-bearing trees, nectar-producing trees) associated with the sites. Fauna with a moderate to high likelihood of occurring in the Project Area are listed in Table 43 and further discussed in this Chapter. Site survey numbers discussed in the following sections are shown on Figure 9. A discussion of fish species with a moderate to high likelihood of occurrence is provided in Section 7.3.7. Fauna species identified in the database search but considered to have a low likelihood of occurrence in the Project Area are discussed in the Ecological Findings Report provided in Appendix B.

Table 43: Fauna Species with a High or Moderate Likelihood of Occurrence

SCIENTIFIC NAME	COMMON NAME	EPBC ACT STATUS	NC ACT STATUS	LIKELIHOOD OF OCCURRENCE
<i>Litoria olongburensis</i>	Wallum Sedge Frog (acid frogs)	V	C	Moderate, potential habitat at Site 19A
<i>Adelotus brevis</i>	Tusked Frog	-	V	High, suitable habitat along slow-moving creeks
<i>Crinia tinnula</i>	Wallum Froglet (acid frogs)	-	V	Known, recorded at Site 19A, however habitat elsewhere very limited.
<i>Litoria freycineti</i>	Wallum Rocketfrog (acid frogs)	-	V	Moderate, potential habitat at Site 19A
<i>Mixophyes iteratus</i>	Giant Barred Frog	E	E	High. Potential habitat present along major drainage lines (particularly Sites 15, 37, 40, 54, 55, 56/57). Recorded within 300m of alignment at Site 56 (Arup, 2007).
<i>Tenuibranchiurus glypticus</i>	Swamp crayfish	-	E	Moderate. Suitable habitat associated with wallum wetlands (e.g. Site 19A).
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE	-	Seasonal
<i>Apus pacificus</i>	Fork tailed Swift	MM	-	High. Likely to forage over Project Area occasionally.
<i>Ardea ibis</i>	Cattle Egret	MM	SL	Moderate, within agricultural areas; possibly roosting habitat in vegetation near water.
<i>Cuculus optatus</i>	Oriental Cuckoo	M	SL	Moderate. Occasional visitor.
<i>Hirundapus caudacutus</i>	White-throated Needletail	M	SL	High. Likely to forage over the Project Area occasionally.
<i>Lathamus discolor</i>	Swift Parrot	CE	-	Moderate. Winter flowering trees in Project Area (e.g. <i>E. tereticornis</i> , <i>E. robusta</i> , <i>E. siderophloia</i>).
<i>Merops ornatus</i>	Rainbow Bee-eater	M	SL	High/ known. Recorded by SMEC and WBM.
<i>Monarcha melanopsis</i>	Black-faced Monarch	M	SL	High. Likely to occur in moister forests, particularly near creeks. Observed by WBM (2006) at WBM Site 12 and 17.
<i>Monarcha melanopsis</i>	Spectacled Monarch	M	-	High. Likely to occur in moister forests, particularly near creeks. Observed by WBM (2006) at WBM Site 17.
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	-	-	Moderate. Likely to occur in moister forests, particularly near creeks.
<i>Rhipidura rufifrons</i>	Rufous Fantail	M	SL	Moderate, in habitat along some creek lines.
<i>Chalinolobus dwyeri</i>	Large-eared Pied Bat	V	-	Moderate. Roosting habitat available in locality and may occasionally forage in part of the alignment, particularly in the southern half.

SCIENTIFIC NAME	COMMON NAME	EPBC ACT STATUS	NC ACT STATUS	LIKELIHOOD OF OCCURRENCE
<i>Pteropus poliocephalus</i>	Grey-headed Flying-fox	V	LC	High. Would forage on flowering Eucalypts and Banksias when available. Not known the roost in Project Area.
<i>Acanthophis antarcticus</i>	Common Death Adder	-	V	Moderate. May occur in forested areas with deep leaf litter.
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	-	SL	Moderate, particularly in larger areas of forest and agricultural land. Unlikely in narrow roadside strips.

EPBC Act Status: V=Vulnerable, E=Endangered, CE=Critically Endangered, EW=Extinct in the Wild

NC Act Status: LC=Least Concern, NT=Near Threatened, V=Vulnerable, Endangered, EW=Extinct in the Wild

Koala

Koala is not included in Table 43 as it was assessed as having a low likelihood of occurrence.

There are historic records identifying koala within the Project Area and surrounds, and four primary food species (Scribbly Gum, Tallowwood, Forest Red Gum, Swamp Mahogany) are present within the Project Area. A total of 14 SAT surveys (Sites 2, 7, 11, 19, 27, 32, 40, 55, 56 and all five 2019 sites) were undertaken across the Project Area, focusing on larger and/or better connected areas of habitat to reduce the influence of habitat fragmentation and mortality (e.g. vehicle strike) on species presence. All sites contained at least one of the primary food species listed above. Despite this effort, no evidence of the koala was found.

Numerous threats to the koala exist within the Project Area, some of which are likely to be intensifying. For example, much of the alignment is very close the Steve Irwin Way, which supports a high traffic volume and no koala mitigation strategies are in place (e.g. exclusion fencing and underpasses). Thus, there can be little doubt that mortality due to vehicle strike has increased over the years. Increased urbanisation has exacerbated the effects of habitat loss and fragmentation, resulting from prior agricultural activity. Increased urbanisation also indicates the potential for a greater presence of domestic dogs and increased risk of vehicle. Wild dogs are also known within the area. All of these factors have negative impacts on the koala, resulting in reduced habitat area and habitat quality, reduced rates of dispersal and increased extraneous mortality. Collectively, these factors can predispose koala populations to local extinction (e.g. Lunney *et al.*, 2002, 2007). As a result, the koala does not appear to be present within habitat impacted by the Project.

Although survey indicates koala is not present in the Project Area (or impacted B2N Project area) historic records exist, suitable habitat is present, and threats are present. It is recommended that the previous survey effort is replicated as part of future works, in accordance with the EPBC Act Referral Guidelines for the Vulnerable koala.

Giant Barred Frog

The Giant Barred Frog occurs along shallow rocky streams in rainforest, wet sclerophyll forest and farmland between 100 and 1000m AHD or deep, slow moving streams with steep banks in lowland areas. It is generally found within 20m of streams. A well-developed leaf litter layer is required for shelter and foraging (Lemckert and Brassil 2000, Koch and Hero 2007).

Potential habitat for the Giant Barred Frog occurs along many of the major drainage lines that cross the Project alignment, including Tibrogargan Creek (Site 15), Coonowrin Creek (Site 37), Coochin Creek (Site 40), Mellum Creek (54) and Addlington Creek and its tributaries (Sites 55, 56, 57). Of these, Site 40 and Sites 55-57 appears to provide the best quality habitat as rainforest or wet sclerophyll forest is present.

Site 54 also supports rainforest along the creek line, but its proximity to the town centre of Landsborough decreases the chance that the Giant Barred Frog is present. Sites 15 and 37 are quite disturbed, with a largely exotic groundcover. The canopy at both sites is dominated by Blackbutt with insufficient representation of rainforest species to be considered a wet sclerophyll community. There is a low probability that the Giant Barred Frog is present at these sites.

The Giant Barred Frog was not observed during the SMEC 2016 survey. Surveys by Arup (2009) covering the area between Landsborough and Nambour reported observations of the Giant Barred Frog north of Landsborough at the following locations that are within the area of interest, but outside the Project Area:

- near the South Mooloolah River, within close proximity to the existing rail corridor
- approximately 300m upstream of Site 56, across the existing railway
- on the Mooloolah River upstream of the existing rail corridor
- Eudlo Creek National Park.

Additional surveys are recommended to document the presence and extent of Giant Barred Frog habitat affected by the B2N Project. Threats to the Giant Barred Frog arising from the B2N Project include habitat loss (only limited habitat area is present), habitat fragmentation and sedimentation during construction. The B2N Project has the potential to interfere with a breeding place for the Giant Barred Frog. The management of water quantity and quality during the construction and operational stages of the Project will be required. Downstream impacts during construction can be addressed via a CEMP.

Acid Frogs

Acid frogs are a group of species that specialise in coastal habitats and wetlands with acidic groundwater and include the Wallum Froglet (*Crinia tinnula*), Wallum Sedge-frog (*Litoria olongburensis*) and Wallum Rocket Frog (*Litoria freycineti*). Potential habitat for these species consists of a canopy dominated by Broad-leaved Paperbark with a characteristic “wallum” understorey that includes Saw-sedge, Swamp Water Fern and Climbing Snake Fern. Suitable habitat for these species was recorded at Sites 4, north of Beerburum and site 19a (road reserve adjacent to Beerburum West State Forest), Lot 3 on RP174740, Lot 1 on RP124412 and Lot 2 on RP177687. The understorey at other sites where Broad-leaved Paperbark was present (e.g. Site 9, north of Beerburum) was not consistent with Wallum vegetation. The habitat at these sites is most likely to be suitable for the Wallum Froglet and possibly the Wallum Rocket Frog. The Wallum Sedge-frog is not discounted at this stage, but it is noted that sedge species typically preferred by this species as perch sites while foraging (see Shuker and Hero 2013) were in low abundance at these sites. Consequently, the Wallum Sedge-frog is considered less likely to be present in the Project Area.

The Wallum Froglet was heard calling at Site 19a. WBM (2006) found Wallum Froglet at Site 9 (which correlates to SMEC sites 15-19) and WBM Site 16 (located to the west of Glass House Mountains Road near Glass House Mountains National Park). Studies by Arup (2009) found Wallum Froglet west of the existing rail alignment in habitat off Beech Road, Landsborough, and several locations adjacent to the existing rail corridor north of Landsborough, however none of which are in close proximity to the Project Area. The Wallum Sedge-frog and Wallum Rocket Frog were not recorded during the field survey and were also not recorded during surveys by Arup (2009), WBM (2006) or Trackstar (2006).

Threats to acid frogs arising from the B2N Project would include habitat loss (however only limited habitat area is present in the Project Area), habitat fragmentation, sedimentation during construction and increased pH, reducing the competitive advantage of these species under low pH conditions. The Project has the potential to interfere with a breeding place for acid frogs. Additional surveys are recommended to document the presence and extent of acid frog habitat affected by the Project. Sites 4, 11, 19a Lot 3 on RP174740, Lot 1 on RP124412 and Lot 2 on RP177687 are potential habitat. Site 9 should also be subject to survey. The management of water quantity and quality during the construction and operational stages of the B2N Project will be required. Downstream impacts during construction can be addressed via a CEMP.

Tusked Frog

The Tusked Frog occurs in a fairly broad range of habitats (rainforest, sclerophyll forest), with the primary habitat requirement appearing to be the presence of still or slow-moving water. It will use disturbed areas, including grasslands, but prefers treed sites (Lemckert 1999).

Most creeks within the Project Area have potential habitat for the Tusked Frog, except for the highly disturbed waterways between Beerwah and Landsborough (Sites 46 to 53, though they may be up or downstream of the alignment at these locations) and at sites suitable for the Acid Frogs (Sites 4 and 19a). This is consistent with the findings of Arup (2009) which found Tusked Frog at most areas where pooling water occurred, including creeks, dams and swampy areas.

Threats to the Tusked Frog arising from the B2N Project would include habitat loss, habitat fragmentation and sedimentation during construction. The B2N Project has the potential to interfere with breeding places for the Tusked

Frog. Additional surveys are recommended to document the presence and extent of Tusked Frog habitat affected by the B2N Project. All major creek lines within the Project Area, including Tibrogargan Creek (Site 15), Coonowrin Creek (Site 37), Coochin Creek (Site 40), Mellum Creek (Site 54) and Addlington Creek and its tributaries (Sites 55- 57), should be investigated as well as the dams present within property 1RP124412. Other minor drainage lines may also require survey. The management of water quantity and quality during the construction and operational stages of the B2N Project will be required. Downstream impacts during construction can be addressed via a CEMP.

Swamp Crayfish

Swamp crayfish habitat comprises wallum wetlands. Suitable habitat for this species was recorded at site 4, north of Beerburum and site 19a (road reserve adjacent to Beerburum West State Forest), Lot 3 on RP174740, Lot 1 on RP124412 and Lot 2 on RP177687. No individuals were identified during the field surveys undertaken for the B2N Project and no individuals have been previously recorded on .

Threats to swamp crayfish arising from the B2N Project include habitat loss (however only limited habitat area is present in the Project Area), habitat fragmentation, sedimentation during construction and increased pH, reducing the competitive advantage of these species under low pH conditions. The B2N Project has the potential to interfere with a breeding place for swamp crayfish. Additional surveys are recommended to document the presence and extent of swamp crayfish habitat affected by the B2N Project. Sites 4, 11, 19a Lot 3 on RP174740, Lot 1 on RP124412 and Lot 2 on RP177687 are potential habitat. Site 9 should also be subject to survey. The management of water quantity and quality during the construction and operational stages of the B2N Project will be required. Downstream impacts during construction can be addressed via a (CEMP).

Death Adder

The Death Adder occupies a range of habitat types, including vegetation communities present in the B2N Project alignment, such as rainforests, sclerophyll forests, woodland, and grasslands. It is an ambush predator that hides in leaf litter, using its tail as a lure to attract prey. It mostly feeds on lizards and small mammals, but also takes birds and frogs. Rocks and coarse woody debris are used as shelter sites. Threats to the Death Adder include poisoning by cane toads (*Rhinella marina*), road kill and loss of coarse woody debris (e.g. through inappropriate fire regimes).

It is likely that the Death Adder would be restricted to larger habitat areas that include areas with deep leaf litter in the southern half and northern extreme of the Project Area. Such areas are more likely to offer a greater range of microhabitat features for foraging and shelter, and experience lower rates of mortality (e.g. roadkill).

Regent Honeyeater and Swift Parrot

The Regent Honeyeater and Swift Parrot both feed heavily on nectar. A variety of flowering Eucalypts (including winter flowering species such as Forest Red Gum and Grey Ironbark), Broad-leaved Paperbark and Banksia (notably Coast Banksia) were identified within the Project Area.

The Swift Parrot breeds in Tasmania, but overwinter visits the mainland, reaching as far north as South Eastern Queensland. It may be an occasional winter visitor to the Project Area, but there are no Wildnet records for the Project Area. The Regent Honeyeater is generally regarded as a blossom nomad. The Project Area may provide occasional floral resources for this species, particularly during periods of inland drought.

The major B2N Project threat to the Regent Honeyeater and Swift Parrot is the loss of seasonal foraging resources. The flowering times of many tree and shrub species within the Project Area is known, enabling the seasonal loss of foraging resources to be quantified by survey.

Glossy Black-cockatoo

The Glossy Black-cockatoo feeds exclusively on the seeds of *Allocasuarina* species (Clout 1989) and requires large tree hollows for nesting (Cameron 2006). Two species of *Allocasuarina* were recorded within the Project Area. Black She-oak was widespread and occurred at many Sites within the alignment, particularly within RE 12.5.3. Forest Oak was confined to Sites 56 and 57 in the far north of the Project Area. Although no formal surveys were conducted, feeding signs (chewed fruiting cones) were sought beneath *Allocasuarina* spp. wherever they were present. No feeding signs were located at any site, although two Glossy Black-cockatoos were heard calling opportunistically within Glasshouse Mountains National Park about 3km from the existing alignment. Despite its presence in the locality, there was no evidence of foraging or nesting by the Glossy Black-cockatoo at survey sites. WBM (2006) also found no feedings signs, but reported anecdotal evidence of their presence within the general locality.

Migratory Birds

A number of migratory birds listed under the EPBC Act are likely to occur within the Project Area. One group, which includes the Satin Flycatcher, Black-faced Monarch, Spectacled Monarch, Rufous Fantail and Oriental Cuckoo, primarily occur in moist forests. Many of the major drainage lines within the Project Area would provide foraging and/or movement habitat for these species, particularly Sites 40 and 54-57. Their presence in the Project Area was confirmed during field surveys by both WBM 2006 and Arup 2009. They are unlikely to breed within the Project Area due to existing levels of disturbance (e.g. noise, lights, etc.) and, in particular, the Oriental Cuckoo does not breed in Australia. As these species are capable of crossing more open habitat during migration, it is unlikely that habitat fragmentation would be a major B2N Project impact.

The Rainbow Bee-eater also occupies forested habitats, but also incorporates areas with scattered trees within its foraging habitat. The Cattle Egret would mostly associate with areas of pasture and other grasslands within the alignment.

The Fork-tailed Swift and White-throated Needletail are both aerial insectivores that breed in the northern hemisphere. Neither species is likely to be negatively impacted by the Project.

Habitat loss would affect migratory bird species, with the exception of the Fork-tailed Swift and White-throated Needletail. However, the extent of clearing required suggests that the B2N Project would not affect an ecological significant proportion of any migratory bird species.

Short-beaked Echidna

The broad habitat preferences of the Short-beaked Echidna and its diet of ants suggests they could occur across much of the Project Area. The B2N Project would cause minor loss of foraging habitat and increase gap widths across the existing north coast railway and Steve Irwin Way. A more open environment may result in a greater exposure to predators (e.g. Red Fox), causing mortality to increase above levels found in less disturbed environments.

Platypus

The Platypus is likely to occur in some of the creeks that cross the Project Area. However, large pools were not observed, suggesting that the absence of key breeding habitat for the Platypus at survey sites. Many of the drainage lines within the Project Area do not have pools suitable for foraging, but these may occur upstream and/or downstream of the alignment. All major creek lines within the Project Area, including Tibrogargan Creek, Coonowrin Creek, Coochin Creek, Mellum Creek and Addlington Creek and its tributaries should at least be considered for downstream impacts on the Platypus.

Potential B2N Project impacts on the Platypus include habitat loss, habitat fragmentation, loss of breeding opportunities and sedimentation. Surveys are required to determine whether breeding habitat for the Platypus occurs within the Project Area (e.g. presence of burrows). The management of water quantity and quality during the construction and operational stages of the B2N Project will be required. Downstream impacts during construction can be addressed via a CEMP.

Grey-headed Flying-fox

The Grey-headed Flying-fox feeds on nectar and fleshy fruit. A variety of flowering Eucalypts (including winter flowering species such as Swamp Mahogany, Forest Red Gum and Grey Ironbark), Broad-leaved Paperbark and Banksia (notably Coast Banksia) were identified within the Project alignment. Fleshy fruit provided by various rainforest trees is also seasonally available at Sites 40 and 55. Thus, foraging habitat for the Grey-headed Flying-fox is present in many parts of the alignment.

The Sunshine Coast Council has mapped Flying-fox camps within their local government boundaries. The following three Flying-fox camps are mapped as present in close proximity to the Project area:

- Jubilee Drive, Palmwoods
- West Palmwoods (location unspecified)
- Vilder Court, Landsborough

The Grey-headed Flying-fox roosts in permanent or temporary camps that can number thousands of individuals. Camps are usually located in moist forest types close to water (e.g. riparian rainforest, mangroves) and change locations periodically. Potentially suitable roosting habitat is present at some Sites (i.e. 40 and 55). Whilst there are no known Grey-headed Flying-fox camps within the proposed alignment, roost sites are known to be present immediately adjacent to the existing railway and proposed upgrade works at Palmwoods. At the time of writing

(October 2019), the roost sites at Palmwoods were located in Kolara Park (Lot 368 on CP893394), in the vegetation within the Chevallum Road reserve south of Kolara Park, and in the vegetation along the south-eastern border of Lot 2 on RP190651.

Although the proposed works are unlikely to directly impact roost sites, the works at Palmwoods have the potential to impact trees adjacent to roost sites. The primary impacts to the Grey-headed Flying-fox is anticipated to be the limited loss of seasonal foraging resources and potential impacts to trees adjacent to roost sites at Palmwoods.

The flowering times of many tree and shrub species within the Project area is known, enabling the seasonal loss of foraging resources to be quantified by survey.

Upon confirmation of the design and disturbance footprint at Palmwoods, further surveys of the roost sites are required to confirm the utilisation of the impacted vegetation by Grey-headed Flying-foxes.

Large-eared Pied Bat

The Large-eared Pied Bat is closely associated with clifflines and rocky terrain to provide favoured roosts and breeding sites in caves and rock crevices. Disused mines are also used for roosting occasionally. Most foraging occurs over adjacent fertile valleys and plains. The Large-eared Pied Bat generally forages in areas with a tree canopy, including riparian strips in otherwise cleared areas. However, it appears the species is sensitive to habitat clearing.

The outcrops of the nearby Glasshouse Mountains provide potential roosting/breeding habitat for the Large-eared Pied Bat. Individuals may forage in the Project Area opportunistically, but most of this habitat is fragmented or on the edges of large forest blocks. As much of the proposed alignment is adjacent to the existing north coast railway and Steve Irwin Way, increased habitat gaps are likely to be created. This may reduce mobility across the landscape. Thus, B2N Project impacts would include minor habitat loss and possibly habitat fragmentation. It is unlikely that any roosting or breeding sites are located in the Project Area and therefore would not be affected by the B2N Project.

7.3.4 Ecological Corridors

A review of the Queensland Government Statewide ecological corridor mapping shows there are two regional corridors and one state corridor within the Project Area. These corridors are shown in Figure 9. At a local scale, waterways (see Section 7.3.7) and remnant vegetation across the Project Area provide habitat connectivity. WBM (2006) reported that the most ecologically important corridors are associated with Beerburum East State Forest, Tibrogargan, Coonowrin, Coochin, Mellum and Bluegum Creeks. Others areas, while still ecologically important, have a higher level of disturbance or considerably less connectivity.

All corridors are likely to be used by vagile species such as birds and bats. However, the value of these corridors for other faunal groups such as terrestrial mammals, macropods, reptiles and frogs varies greatly.

7.3.5 State Forests and National Parks

The B2N Project intersects areas of State Forest in the south of the Project Area. It also runs adjacent to a portion of the Glass House Mountains National Park, and proposed works extend to just within the rail corridor surrounded by the Dularcha National Park. The Glass House Mountains National Park are a listed under the EPBC Act as National Heritage Properties- Glass House Mountains National Landscape, which is further discussed in Chapter 8 Cultural Heritage. These estates provide large areas of habitat and provide important east-west habitat linkages.

Beerburum East State Forest mostly occurs to the east of the alignment, on the opposite side of Steve Irwin Way. However, a small area of the State Forest is located between Steve Irwin Way and the existing north coast railway in the south of the alignment (Sites 4, 7, 9 and 11). These sites provide a linkage between Beerburum East State Forest and the Glass House Mountains National Park to the west of the existing railway. These areas are otherwise largely isolated from one another by private land used for agriculture. Another small area of Beerburum East State Forest occurs near Mt. Tibrogargan at Site 19. Site 19 is separated from the rest of the State Forest by agricultural land on the eastern side of Steve Irwin Way. It is also partially disconnected from the Glasshouse Mountains National Park to the west by agricultural land. Much of Beerburum State Forest is pine plantation (the exotic species Slash Pine, *Pinus elliotii*). However, areas of native habitat remain, particularly along drainage lines. These areas support vegetation types characteristic of impeded drainage (e.g. Swamp Forest, sedgeland). Fauna surveys by WBM (2006) recorded the greatest species diversity at Beerburum East State Forest, including: 11 mammals, 25 birds, four amphibians and one reptile. This suggests that this area is an important refuge for fauna and ecological corridors are of high importance to enable landscape connectivity.

The Glass House Mountains National Park is predominately located to the west of the Project Area, west of the existing railway. As noted above, there is some connectivity between the Glass House Mountains National Park and Beerburum East State Forest.

Dularcha National Park occurs just beyond the very northern limit of the Project Area, north of Site 57. The existing North Coast Rail line traverses this area. Whilst no works are proposed to occur within Dularcha National Park, works within the rail corridor will be directly adjacent to the National Park. Dularcha National Park provides important east-west connectivity in the locality.

7.3.6 Groundwater Dependent Ecosystems

As discussed in Chapter 5, mapping of GDEs have been reviewed. These are generally associated with creeks and drainage features. Available information is based on modelling, and the presence or absence of GDEs will require further investigation in later stages of the B2N Project to confirm appropriate mitigation and management measures.

7.3.7 Aquatic Habitats

The Project Area passes through the headwaters of three catchments; Maroochy River Catchment, Mooloolah River Catchment and the catchment for Pumicestone Passage. Within these catchments, works will be required at the following waterways:

- Pumicestone Passage Catchment
 - Tibrogargan Creek and upstream tributary
 - Coonowrin Creek and upstream tributary
 - Back Creek and upstream tributary
 - Coochin Creek and upstream tributary
 - Bluegum Creek and upstream tributary
 - Bellbird Creek
 - Mellum Creek and upstream tributary
- Mooloolah River Catchment
 - Addlington Creek and upstream tributary
- Maroochy River Catchment
 - Acrobat Creek/ tributary.

A description of the DAF waterway classifications of the Project Area is included in Chapter 5.

Two fish species of conservation significance are known to occur in South East Queensland and have a high likelihood of occurring in the Project Area: Oxleyan pygmy perch (*Nannoperca oxleyana*) and Honey Blue-eye (*Pseudomugil mellis*). Both species are listed as Vulnerable under the NC Act. Under the EPBC Act, Oxleyan Pygmy Perch is listed as Endangered, whereas Honey Blue-eye is listed as Vulnerable. Neither of these species were recorded by WBM (2006), however four creeks that occur in the Project Area have been previously found to contain these species, namely; Coochin Creek (Oxleyan Pygmy Perch), Bluegum Creek (Oxleyan Pygmy Perch), Tibrogargan Creek (Honey Blue-eye) and Mellum Creek (Oxleyan Pygmy Perch; Honey Blue-eye).

Both species typically occur in the coastal lowland “wallum” ecosystems and are thought to be restricted to acidic (pH 4.4-6.8) freshwater lakes, pools and streams with dense aquatic vegetation along the margins (Allen and Ivantsoff, 1982; Arthington and Marshall, 1993; Arthington, 1996 as cited in WBM, 2006).

WBM (2006) undertook an aquatic habitat assessment and fish survey at waterways within the Pumicestone Passage catchment, as summarised in Table 44. Waterways within the Mooloolah catchment and Maroochy River catchment were not surveyed. Several sites surveyed within the Project Area contained suitable structural habitat conditions for these wallum species, in particular (in descending order of habitat suitability) sites D and E in Bluegum Creek, site G at Back Creek, site J1 in the Tibrogargan Creek system and site A in Little Rocky Creek (WBM (2006)). Further discussion of habitat suitability and species pressures are outlined below. Survey references are shown in Figure 9.

Table 44: Aquatic Habitat Assessment Summary, WBM 2006

LOCATION	SURVEY REFERENCE	OBSERVATIONS
Mellum Creek	Site Z	Semi-urban setting near Landsborough town centre. Riparian vegetation was dense (but narrow) upstream of Old Landsborough Road, but consisted mainly of grass downstream. Between Old Landsborough Road and the existing rail easement, the channel was heavily disturbed and habitats were simplified as a result of hard engineering works (i.e. large box culverts, bridges) and heavy sedimentation. Downstream of this area, while still disturbed, the channel was more natural with pool and run habitats. The site was considered at the time to represent marginal habitat for target “wallum” fish species due to the high level of degradation, limited structural diversity and high abundance of <i>Gambusia</i> (<i>Gambusia holbrooki</i>).
Bellbird Creek	Site C	<p>Situated in a disturbed environment within the existing rail easement. The site is situated within 3km of the creek headwaters (situated on the eastern slopes of Mount Mellum), where it flows in an easterly direction through the existing rail easement, and then into Beerwah State Forest where it has a confluence with Bluegum Creek. Site C is located within 500m of the north-western boundary of the State Forest.</p> <p>Riparian vegetation in the rail corridor was predominately grasses (>50%) with no canopy cover existing in the maintained rail reserve. Vegetation upstream of Old Landsborough Rd was mostly Eucalypt woodland. The stream is characterised as having slow flow, with some pools and riffles. Moderate to extreme bed aggradation or degradation was observed.</p>
Bluegum Creek	Site D	<p>Site D of Bluegum Creek is situated immediately downstream of Bluegum Creek National Park, within and downstream of the existing cleared rail easement. There was an extensive <i>Melaleuca</i> wetland upstream of the easement within the National Park, and creek waters discharging from the wetland were darkly tannin-stained. Vegetation in the rail reserve was primarily grasses and sedges, with little woody vegetation in this area. The creeks flowed into a mixed pine and natural forest downstream of the rail easement, which is contiguous with Beerwah State Forest downstream of the site.</p> <p>The waterbody in the maintained rail reserve consisted of a large deep pond, approximately 12m, wide and up to 1.6m deep. Downstream of the pond the creek narrowed before flowing under the existing rail bridge. Stream banks were undercut in places, and sedges and grasses lined the creek edge. The bed consisted mostly of coarse organic matter overlaying mud. These habitat conditions were considered suitable for acid/wallum-associated species targeted (Honey blue-eye and Oxleyan Pygmy Perch).</p> <p>The water quality and structural habitats present at Site D, together with Site E, had the greatest potential of all sites in the corridor to support target “wallum” habitat species, i.e. <i>Melaleuca</i> and sedgeland habitat well developed upstream of site; acidic, tannin-stained waters. These habitats were however highly degraded, and unlikely to provide viable habitat for these two species in the long-term, due to high level of bank degradation (sedimentation and weed infestations) and high abundance of <i>Gambusia</i>. Due to the disturbed nature of this site, it does in some respects represent a partial ‘barrier’ between downstream environs and the high quality habitats within the adjacent national park.</p>
	Site E	<p>Site E represents a well-developed forest with a canopy cover dominated by <i>Melaleuca quinquenervia</i>, <i>Eucalyptus robusta</i> and <i>Allocasuarina littoralis</i> and is contiguous with more extensive forest areas to the south. However, this wetland and drainage channel has previously been disturbed and supported a high level of weed infestation. The dominant land use immediately upstream of the site was urban.</p> <p>Water depths at the time of sampling were generally 0.5 to 1m. The channel was undercut in sections, although the extensive groundcover has resulted in relatively stable banks overall.</p>

LOCATION	SURVEY REFERENCE	OBSERVATIONS
		The water quality and structural habitats present at site E were considered suitable for the target “wallum” habitat species, and represents a waterway in which Oxleyan Pygmy Perch has previously been recorded. Together with Site D, this area had the highest potential for supporting the two-target fish species Oxleyan Pygmy Perch and Honey Blue-eye. However, high densities of <i>Gambusia</i> reduce habitat values for these two species.
Coochin and Back Creek	Site F	<p>Coochin Creek is situated ~ 1.5km south of the town of Beerwah. The riparian vegetation upstream and downstream of the rail reserve (i.e. the proposed rail corridor) was comprised of tall Eucalypt forest with a mesic understorey, which was typically >30m wide and had a canopy cover >75%. However, within the rail reserve canopy cover was <5%, with groundcover consisting of maintained and rank grassland.</p> <p>At the time of sampling, creek flows were typically >0.2-0.3m/second where the creek was constricted near the pedestrian bridge and within the rail reserve, although the creek upstream of this area consisted of deep (1 to 1.5m) slow flowing, and a small shallow backwater habitat with no detectable flow. The bank and bed structure was mostly stable with some moderate erosion and undercutting present on the outside of meander bends.</p> <p>Although the Oxleyan Pygmy Perch has previously been recorded in the Coochin Creek system, this site is considered to represent marginal habitat for this species due to a lack of preferred habitats and high abundance of <i>Gambusia</i>.</p>
	Site G	<p>Back Creek is a southern tributary of Coochin Creek. Site G is situated in a semi-rural environment ~ 1.6km north of Glass House Mountains. Riparian vegetation has largely been cleared from the existing rail easement, although drainage channel outside the existing easement was fringed with a <i>Melaleuca quinquenervia</i> dominated community. A small dam was located in the corridor and was fringed with a sedge understorey, with a sparse shrub to low tree layer of <i>Lantana camara</i> and <i>Melaleuca quinquenervia</i>.</p> <p>The stream channel within the rail reserve varied in width from ~2m toward the existing rail line and extended out to a width of 5-6m adjacent to Old Landsborough Rd. Water depths were generally 0.5 to 1m. Flows were relatively high at the time of sampling (0.2 to 0.6m/second), decreasing in the wider creek sections downstream of the rail easement. The stream channel displayed moderate erosion and undercutting.</p> <p>The water quality and structural habitats present at this site, particularly the <i>Melaleuca</i> downstream of the existing rail crossing, prove generally suitable for the target “wallum” habitat species.</p>
Coonowrin Creek	Site H	<p>Located on the northern tributary. This site consisted of an ephemeral drainage channel that was typically <1m wide and 0.5m deep. Canopy cover was >75% in places and was primarily comprised of weed species. Waters at this site were dark brown in colour and were generally clear. Large quantities of iron ‘flocs’ covered the bed throughout the drainage and it is suspected that the deep brown colour of creek waters is due to high levels of dissolved iron.</p> <p>The bed and banks were stable with only isolated areas of erosion and undercutting.</p> <p>At the time of sampling, pH was near neutral (pH = 7.06) and had low electrical conductivity of 153µS/cm, a turbidity level of 40 NTU and a dissolved oxygen concentration of 120.1% saturation.</p> <p>The temporary nature of waters, water quality conditions and structural habitats present at this site were generally unsuitable for the target “wallum” habitat species.</p>

LOCATION	SURVEY REFERENCE	OBSERVATIONS
	Site I	Located on the southern tributary. The vegetation community was comprised of pine plantation with mixed native and exotic species, and has been degraded by past clearing for pine plantation. The canopy was dominated by <i>Melaleuca quinquenervia</i> 12-16m in height and 60-70% cover. Riparian vegetation was typically >30m wide upstream and downstream of the existing rail reserve, with a canopy cover of 25-75%. There was little woody vegetation within the rail reserve. There was moderate erosion and undercutting of the banks and bed, which were largely stabilised by instream weeds within the rail easement and woody vegetation and <i>Lomandra</i> outside the easement. Stream width was variable, ranging between ~4 and 9 m, and had a water depth >1m. The site represents marginal habitat for target “wallum” fish species due to limited presence of wallum vegetation, high abundance of <i>Gambusia</i> and water quality outside the normal range in which the species are typically found.
Tibrogargan Creek	Site J	The waterbody consisted of a deep (up to 1m) run (current ~0.25m/second in places), with a channel width of ~4 to 9m. A thin (up to 30m) riparian vegetation corridor occurred along the creek directly adjacent to the rail easement. Canopy cover within these areas was generally between 25-75%. Within the rail easement there was little woody vegetation. The stream channel exhibited limited erosion and undercutting, and the site represents marginal habitat for target “wallum” fish species due to the high level of disturbance and high abundance of <i>Gambusia</i> .
	Site J1	<p>The vegetation at Site J1 was comprised of a <i>Melaleuca</i> wetland, with a canopy cover up to 75%. The upstream sections of the creek, situated immediately adjacent to a grazed paddock, consisted of a deep waterhole, unlikely to be a natural feature. Downstream of this waterhole within the wetland and proposed rail corridor, the creek was generally narrow (>2m wide) and poorly defined in some areas.</p> <p>At the time of sampling, waters were slightly acidic (pH 6.35), had low electrical conductivity (106µS/cm) but comparatively elevated turbidity (73.8 NTU).</p> <p>The water quality and structural habitats present at this site were within the range of conditions that are suitable for the target “wallum/acid” habitat fish species. However, the presence of <i>Gambusia</i> may reduce habitat values of this waterbody.</p>

7.3.8 Pests

The PMST results identified 19 pest animal and 12 weeds of national environmental significance as potentially occurring within the search area. Pest animals were comprised of eight birds, one frog and 10 mammals. PMST results are provided in full in the Ecological Findings Report (Appendix B).

The Queensland *Biosecurity Act 2014* and *Biosecurity Regulations 2014* lists invasive plants requiring management.

Evidence of weed infestations were recorded by SMEC (2016 and 2019) during field surveys. Most sites inspected were lightly to moderately affected by weed species due to the fragmented landscape and habitat disturbance. A list of restricted invasive plants that were observed commonly throughout the Project Area during the field investigation is given in Table 45.

Table 45: Restricted invasive plants recorded in the Project Area

SCIENTIFIC NAME	COMMON NAME	CATEGORY
<i>Cinnamomum camphora</i>	Camphor laurel	3
<i>Baccharis halimifolia</i>	Groundsel bush	3
<i>Lantana camara</i>	Lantana	3
<i>Ligustrum lucidum</i>	Broad-leaf privet	3
<i>Ligustrum sinense</i>	Small-leaf privet	3
<i>Sphagneticola trilobata</i>	Singapore Daisy	3

7.4 Potential Impacts

7.4.1 Vegetation Clearing

The Project Area has been extensively cleared of native vegetation for State Forest plantations, agriculture and more recently for urban development. Areas of remnant and native vegetation are now confined to narrow bands along waterways and drainage lines within the rail and road reserves and steep slopes unsuitable for development, such as the Glasshouse Mountains and their foot slopes. Most areas of native vegetation are affected by weed invasion.

The B2N Project would require native bushland and disturbed, exotic vegetation to be cleared for rail and road infrastructure, temporary facilities and access tracks associated with construction. Endangered, Of Concern and Least Concern RE vegetation is present within the Project alignment and would be removed to permit construction of the B2N Project. Further surveys for threatened plants will be required to determine their presence.

The B2N Project may impact Plunkett mallee (*Eucalyptus curtisii*), which is listed as 'near threatened' under the NC Act, and/or *E. curtisii* supporting habitat (defined as all suitable vegetation within a 100m radius of the individuals). If the individuals are considered to be 'in the wild' under the NC Act, a Clearing Permit (Protected Plants) will be required under the NC Act.

The B2N Project will impact on sections of Beerburrum State Forest, including areas of native vegetation and the former nursery operations site. The B2N Project has been designed so as to avoid intrusion into areas of National Parks.

7.4.2 Habitat Loss and Degradation

Vegetation clearing will be required for the B2N Project infrastructure, temporary facilities and access tracks associated with construction, and will ultimately result in the removal of fauna habitat from the Project Area. The biodiversity value and overall importance of this habitat for species of conservation significance is related to patch size, structural complexity and its contribution to local movement corridors. Habitats may also be altered as a result of changes to hydrology caused by road and rail crossings.

There are 21 threatened and migratory fauna species listed under the NC Act and the EPBC Act that have a moderate or high likelihood of occurring within the Project Area. The removal of remnant vegetation would result in a reduction

of available habitat and resources for fauna within the Project Area, which may result in a localised decrease in fauna abundance.

Further assessment is required to determine the potential impacts on threatened fauna species.

7.4.3 Habitat Fragmentation and Landscape Barriers

The B2N Project will occur in a landscape that is already subject to human influence. The southern third and far northern extent of the alignment are associated with larger areas of native and exotic forest in state forest and national park and relatively low levels of habitat fragmentation. The middle and northern areas of the alignment are associated with higher levels of human activity (agriculture, urban areas). Thus, there are a number of threats (e.g. habitat fragmentation, vehicle strike, weed invasion) already occurring in the Project Area that would influence the quality of the vegetation and the presence of threatened species.

Current habitat patchiness across the alignment varies, and the presence of existing linear barriers, including the North Coast Line and Steve Irwin Way, already contribute to habitat fragmentation. Existing movement barriers can occur over short (e.g. road) to longer (e.g. paddock) distances, depending on species behaviour (e.g. propensity to cross gaps of different widths) and intervening landscape characteristics (e.g. presence of scattered paddock trees).

The B2N Project will require the construction of further linear infrastructure within the Project Area. The alignment currently required by the B2N Project will largely follow the existing railway, but also diverge slightly at times.

The B2N Project will intersect a number of drainage lines and waterways and will require the construction of new culvert and bridge infrastructure. If poorly designed, culverts can act as a waterway barrier and restrict fish passage, limiting their availability of habitat, gene transfer and impact on their lifecycle.

Culvert and bridge structures that consider terrestrial and aquatic fauna movement can mitigate the impact of habitat fragmentation. Drainage lines and waterways represent important movement corridors for terrestrial fauna species. Movement habitat is important to provide gene flow at a local scale via dispersal within or between populations ranging to landscape-scale migratory movements.

7.4.4 Edge Effects

A corollary of habitat fragmentation is the creation of edge effects. Edge effects are a consequence of altered ecological processes along the edge of habitats due to changes in the biotic and abiotic environment due to factors such as variations in wind speed, light, humidity and the presence of predators. An important manifestation of edge effects is an increased dominance of exotic plant species. Many fauna species also show a behavioural aversion to habitat edges and edges may be associated with increased predation rates. An increase in habitat fragmentation would in turn result in the increased operation of edge effects within the Project Area. Edge effects can be minimised by weed control measures and by undertaking some revegetation along disturbed edges (refer to Section 7.6 Mitigation Measures).

7.4.5 Mortality

Increased mortality of fauna species may arise from the B2N Project during construction and due to an increase in the width of cleared movement barriers, the creation of additional linear movement barriers and train strike due to increased rail movements. Increased mortality has the potential to impact fauna species by affecting population viability or by attaining sufficient rates of mortality to provide an effective movement barrier (see fragmentation effects above). Long-lived, slow breeding species are most sensitive to relative small changes in mortality rates (Oli 2004). Mortality impacts can be mitigated by actions such as the engagement of a fauna spotter-catcher through the clearing stage of the B2N Project and by the installation of fauna exclusion fencing in key areas during both construction and operation (Refer to Section 7.6 Mitigation Measures).

7.4.6 Loss of Foraging Resources

Habitat to be removed by the B2N Project contains a variety of foraging resources for resident fauna. Of particular note to threatened and migratory species is the loss of seasonal nectar and fleshy fruits. Across the Project Area there is a sufficient diversity of flowering trees to potentially provide nectar throughout much of the year. Tallowwood and particularly Scribbly Gum are widespread in the locality. However, they have small flowers and short flowering periods. Because of these characteristics, these species are not well used by vertebrates, including the Grey-headed Flying-fox (Eby and Law 2008). Summer to autumn flowering species, such as *Corymbia* spp. and Broad-leaved Paperbark are present. Winter to spring flowering species such as Forest Red Gum, Tindale's Stringybark, Swamp Mahogany and Grey Ironbark are present to varying degrees. All these species are important to nectarivorous species

(e.g. Eby and Law 2008). There is possibly a deficiency of nectar in mid to late spring before *Angophora* spp. flower in early summer. The loss of nectar resource would impact on the Swift Parrot (winter only), Regent Honeyeater and Grey-headed Flying-fox.

Several sites (40, 54 and 55 in particular) support a variety of rainforest trees producing fleshy fruit. These sites would be used seasonally by the Grey-headed Flying-fox. At Sites 40, 54-55, the proposed B2N Project alignment abuts the existing railway. Thus, the alignment would include existing disturbed areas immediately along the current rail corridor. The removal of habitat containing fleshy fruit has not been quantified, but it is expected to be minor.

7.4.7 Loss of Hollow-bearing Trees

Hollow-bearing trees provide shelter and breeding sites for a wide range of fauna species. Numerous hollow-bearing trees are located within the B2N Project alignment and would be removed. Their distribution was strongly influenced by the presence of mapped RE vegetation. RE 12.5.3 (Scribbly Gum on old sandy plains) generally contained a higher proportion of ecologically mature trees containing hollows compared to other RE types. Roadside vegetation dominated by Scribbly Gum, but not mapped as RE vegetation, also support hollow-bearing trees. This is likely to be a reflection of the lower productivity of the Sites supporting RE 12.5.3 or similar vegetation, resulting in less historic clearing and disturbance. Landzone 3 (alluvium) also supported a moderate number of tree hollows, presumably because remnant trees were historically left in riparian areas.

Due to the existing habitat fragmentation within the Locality, these hollow-bearing trees are not generally expected to provide breeding sites for threatened fauna species. However, they may be used by a variety of common fauna, such as microbats, possums and lorikeets.

7.4.8 Loss of Logs

Fallen logs can provide animal shelter and breeding sites (e.g. hollow logs) and can provide suitable microhabitats for fossorial species (e.g. burrowing skinks) beneath rotting logs. Fallen logs were present at many Sites (refer to Ecological Findings Report in Appendix B), but the overall abundance was low. Fallen logs were somewhat associated with areas of remnant vegetation and the presence of hollow-bearing trees (as both can be a sign of ecologically mature habitat), however, there were also a number of Sites that had fallen logs but not hollow-bearing trees. Thus, the loss of fallen logs would constitute the loss of animal breeding places.

7.4.9 Weeds

Although weeds are already present within the Project Area, there is a potential to further spread existing weeds during ground disturbance and vegetation clearing in the construction phase of the B2N Project. There is also the potential for new weed species to be introduced (e.g. on machinery) and to become established in disturbed areas. The management (identification, removal, disposal) of weeds during the construction phase of the B2N Project will be detailed in a CEMP. During the operational stage, increased train movements will also result in an increase in the risk of weed spread and the introduction of new weed species.

7.4.10 Erosion and Sedimentation

Erosion and sedimentation are potential B2N Project impacts during the construction phase. The use of heavy machinery may lead to bank compaction and erosion, resulting in potential flow-on effects to riparian vegetation and aquatic habitats. Soil disturbance resulting from earth works has the potential to lead to sediments entering stream environments, resulting in habitat degradation (i.e. turbidity and sedimentation). This may result in impacts on threatened species (e.g. fish and frogs) and animal breeding places (e.g. platypus). Measures to control erosion and sedimentation will be developed in a CEMP.

7.5 Proposed Mitigation Measures

To reduce potential B2N Project impacts, proposed mitigation measures applicable to design, construction and operation are outlined below.

7.5.1 Design

- Conduct detailed flora survey to accurately map the extent of RE boundaries.
- Minimise the width of clearing in areas where the rail corridor passes through TECs, REs and habitat for threatened species.
- Conduct a targeted search for threatened flora species, focusing on species with a moderate to high likelihood of occurring.

- Discussions should be entered into with DES to confirm if the Plunkett mallee (*Eucalyptus curtisii*) identified growing in advanced regeneration are considered to be 'in the wild' and therefore protected under the NC Act. A clearing permit under the NC Act may be required.
- Frog surveys in accordance with the Survey Guidelines for Australia's Threatened Frogs (DEWHA 2010) are recommended to determine the presence and distribution of threatened frogs (acid frogs, Giant Barred Frog, Tusked Frog) within the Project Area. This will enable a more detailed assessment of Project impacts on these species and facilitate better targeting of compensatory measures, such as exclusion fencing and the installation of fauna underpasses. These surveys will consider both species presence and the presence of animal breeding habitat.
- Due to the proximity of Grey-headed flying fox (*Pteropus poliocephalus*) roost sites to the rail line at Palmwoods, survey of these sites should be undertaken once the design and disturbance footprint is confirmed.
- The loss of foraging resources (flowering trees, fleshy fruits) for the Regent Honeyeater, Swift Parrot, Grey-headed Flying-fox will need to be quantified. This can be achieved by deriving seasonal food resource maps based on existing vegetation descriptions (i.e. species composition) and mapping.
- Animal breeding place surveys are required to document their distribution and abundance (e.g. hollow-bearing trees, creeks and other waterbodies). Pre-clearing surveys of these structures will be required to determine whether the structure is an actual animal breeding place.
- Confirm the need for Species Management Programs (SMPs) for Least Concern, Endangered, Vulnerable or Near Threatened fauna species impacted by the Project (i.e. are any species likely to breed within the Project Area).
- Conduct an assessment of significance under the EPBC Act for all TECs and threatened and migratory species known or likely to occur within the Project Area. A conclusion of a significant impact on any MNES would require an EPBC Act Referral to the Commonwealth Department of Environment for a controlled action determination.
- Design bridge structures to facilitate fauna passage at the following creek crossings: Tibrogargan Creek, Coonowrin Creek, Mellum Creek and Bluegum Creek. Bridges are to be used in preference to culverts as they allow revegetation and easy fauna movement.
- Design new culverts with fauna friendly design features, and ensure culvert sizing allows both conveyance of flows and fauna passage. Ideally separate culverts should be provided to allow passage for dry fauna.
- Fauna friendly bridges and culverts should be designed with reference to the TMR Fauna Sensitive Road Design Volume 1 and Volume 2 (DTMR 2000 and DTMR 2010).
- Fauna passage at Beerburrum East State Forest should consider the need for rope bridge structures over the Project Area.
- Fencing of the rail corridor to encourage fauna to use provided crossings and exclude fauna from other areas. Generally, fauna fencing should extend for 200m either side of a fauna crossing, to guide fauna to the crossing point. In many places, fauna fencing could be designed to exclude fauna from the road network as well as the rail corridor. Some rationalisation of fauna fencing lengths at the nominated fauna crossing locations may be required due the location of the new (or upgraded) rail corridor in relation to the road network. In some locations, 200m either side of a nominated fauna crossing location is not practical and further assessment and design will be required.
- Integrate escape opportunities for fauna that inadvertently enter the rail corridor.
- Revegetate areas disturbed during construction of bridges and culverts using native ground and shrub species. This is especially important for Sites D and E in Bluegum Creek, Site G at Back Creek, Site J1 in the Tibrogargan Creek system and Site A in Little Rocky Creek which have a high likelihood of supporting threatened "wallum" fish species.
- Design culvert structures to achieve fish passage in accordance with DAF's 'Accepted development requirements for operational work that is constructing or raising waterway barrier works'.
- Within waterways and riparian areas, erosion and sediment control measures should prioritise soft engineering measures to achieve stabilisation where possible (i.e. geofab, jute matting, planting).
- Bridge design should seek to avoid placement of piers in the low flow channel of waterways in accordance with DAF's 'What is not a waterway barrier work' fact sheet, and should retain the existing waterway channel form and hydraulic function where possible.

7.5.2 Construction

- Locate temporary works in previously disturbed areas and outside areas containing significant vegetation communities such as remnant vegetation or TECs.
- Ensure works within waterways comply with DAF's 'Accepted development requirements for operational work that is constructing or raising waterway barrier works'.
- Areas of vegetation outside of direct impacts should be clearly marked by temporary fencing. All construction staff should be made aware of the importance of such habitats. Machinery and storage of equipment should not occur within vegetated areas. All contractors and construction personnel should be aware of the value of existing vegetation.
- Clearly delineate haulage roads and stock piles on design drawings and within information provided to construction team.
- Develop and implement a Weed Management Plan, including vehicle wash down, identification of infestations at construction sites and within the clear and grub zone, certification of material imported to the site as weed free.
- In areas known or likely to support species of conservation significance, install temporary signage with species profile and picture to inform construction team of species and what to do if found.
- Vegetation clearing to be conducted in a manner that minimises impact to surrounding vegetation, including the use of suitably sized equipment.
- Hollow logs and branches shall be retained where possible and located outside of the B2N Project corridor to retain habitat values.
- Fill or remove suitable habitat subsequent to dispersal or relocation of target fauna within the B2N Project Area, immediately prior to clearing to reduce risk of fauna returning.
- Establish fauna crossing structures and opportunities early in the construction process.
- Develop an ESCP as per the requirements of TMR Specification MRTS52 Erosion and Sediment Control for a High risk site. Within waterways and riparian areas, both temporary and permanent erosion and sediment control measures should prioritise soft engineering measures to achieve stabilisation where possible (i.e. geofab, jute matting, planting of low-growing species of local province such as shrubs, sedges and native grasses).
- All areas disturbed during construction that are not required during operation should be stabilised.
- Within waterways and riparian areas, all areas disturbed during construction that are not required during operation shall be revegetated. Waterways should be given priority and only native plant species used in rehabilitation. It is suggested short, low-growing species of local province be used in creek lines such as shrubs, sedges and native grasses.
- Rehabilitate areas adjacent to fauna crossing structures as early as possible.
- Monitor fauna movements and exclusion fencing in the vicinity of construction activities.
- Monitor embankment stability.

7.5.3 Operation

- If the current rail line is to be decommissioned, the existing chain wire fence should be removed from both sides to allow faunal movement, or it should be replaced with one that is designed to allow fauna movement if the rail corridor is to be retained.
- Weeds should be managed until native vegetation becomes established.
- Implement corridor management procedures, particularly for declared weed species, including ongoing inspection and treatment

7.6 Residual Impact Assessment

An impact assessment of the B2N Project on flora and fauna values is provided in Table 46. Based on this assessment, the impacts of the B2N Project following implementation of mitigation measures is expected to be predominately minor and moderate. This assessment is based on the findings of investigation undertaken to date and should be updated following completion of the additional investigation recommended in Section 7.5.1.

Table 46: Residual Impact Assessment, Flora and Fauna

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Flora							
Weeds	Construction	Spread of declared weeds and other weeds as a result of construction vehicle movements and materials	Develop and implement a Weed Management Plan (as part of CEMP), including vehicle wash down, identification of infestations at construction sites and within the clear and grub zone, certification of material imported to the site as weed free. Rehabilitation and landscape treatments for construction zone and B2N Project footprint, and appropriate off-maintenance period to ensure stabilisation.	No new weed infestations or spread of existing infestations as a result of construction activities	Temporary during construction, particular earthworks disturbance	Possible	Minor
Weeds	Operation	Spread of weeds along the corridor and into adjoining vegetated areas	Implementation of corridor management procedures, particularly for declared weed species, including ongoing inspection and treatment	The new section of corridor remains free of declared pest species, with outbreaks of declared pests treated in accordance with statutory obligations	Long term	Possible	Minor
Remnant vegetation	Design and Construction	Loss and/or disturbance to remnant vegetation and decrease in biodiversity values. Indirect impacts through weed incursion.	Restrict clearing to that which is necessary to complete the works. Where possible, locate temporary works in previously disturbed areas and outside areas containing significant vegetation communities such as RE's or TEC. Clearly delineate haulage roads and stock piles on design drawings and within information provided to construction team.	Reduced local extent of mapped regional ecosystems/ remnant vegetation. Increased edge effects and exposure to weed intrusion/ habitat degradation.	Long term	Certain	Moderate

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			<p>Clearly mark the vegetation clearing limits and flag 'no go' areas to avoid impacts to vegetation outside the footprint.</p> <p>Vegetation clearing to be conducted in a manner that minimises impact to surrounding vegetation, including the use of suitably sized equipment.</p> <p>Rehabilitation/stabilisation of construction zone outside the operational rail corridor and associated infrastructure.</p>				
Threatened ecological communities	Design and Construction	Potential loss and/or disturbance to TECs (to be confirmed following additional field survey).	<p>Flora survey of areas supporting RE 12.3.1 to confirm presence of TEC.</p> <p>Restrict clearing to that which is necessary to complete the works. Where possible, locate temporary works in previously disturbed areas and outside areas containing significant vegetation communities such as RE's or TEC.</p> <p>Clearly delineate haulage roads and stock piles on design drawings and within information provided to construction team</p> <p>Clearly mark the vegetation clearing limits and flag 'no go' areas to avoid impacts to vegetation outside the footprint.</p> <p>Vegetation clearing to be conducted in a manner that minimises impact to surrounding vegetation, including the use of suitably sized equipment.</p>	<p>Reduced local extent of mapped regional ecosystems/ remnant vegetation.</p> <p>Potential loss of TEC.</p> <p>Increased edge effects and exposure to weed intrusion/ habitat degradation.</p>	Long Term	Possible	Moderate

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Interactive effects of vegetation removal	Design and construction	Removal of vegetation, causing isolated patches and habitat fragmentation. Resultant edge effects. Impact to fauna movement.	Minimise clearing footprints through design. Utilisation of native species in landscaping treatments, particularly for post-construction rehabilitation works in areas mapped as habitat or REs. Provision of sufficient habitat connectivity through culvert and bridge design.	Reduced habitat extents and fragmentation of habitats	Medium Term	Likely	Moderate
Threatened flora species – <i>Eucalyptus curtisii</i> (Plunkett mallee)	Design	Clearing <i>Eucalyptus curtisii</i> (Plunkett mallee)	Where possible, the design is to avoid impacting this species and the species' supporting habitat. Where impacts are unavoidable, confirmation is to be sought with DES regarding the requirement for a clearing permit and offsetting.	Loss of threatened flora species	Medium term	Possible	Moderate
Threatened flora species	Construction	Clearing of previously undocumented threatened flora	Pre-clearing surveys undertaken during planning and design phases of the B2N Project to document species likelihood and presence	No unknown Threatened flora cleared	Short term	Unlikely	Negligible
Fauna							
Fauna corridors	Construction	Temporary severance of fauna movement corridors as a result of construction activity and fencing	Identify opportunities to minimise the duration of fauna corridor and habitat connectivity severance. Bridge and culvert structures to be designed to facilitate fauna passage. Stage vegetation clearing where possible and practical.	Temporary limits to movement of fauna across the B2N Project Area	Short term	Certain	Moderate

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			<p>Monitor fauna movements and exclusion fencing in the vicinity of construction activities.</p> <p>Establish fauna crossing structures and opportunities early in the construction process.</p> <p>Rehabilitate areas adjacent to fauna crossing structures as early as possible</p>				
Fauna corridors	Operation	Reduction in the range and width of fauna movement corridors	<p>Implementation of targeted fauna crossing structures and fauna furniture</p> <p>Rehabilitation of the approaches to fauna crossing structures and other areas within the construction zone previously identified as RE or habitat</p>	Reduction of movement options and reliance on infrastructure solutions to maintain habitat connectivity	Long Term	Certain	Moderate
Wallum Froglet, Wallum Rocket frog, Tusked Frog, Wallum Sedge-frog and Giant Barred Frog	Construction and operation	Loss of breeding and foraging habitat of threatened frog species though clearing of habitat and changes to hydrological regimes.	<p>Survey to verify location and extent of habitat present</p> <p>Survey to confirm presence</p> <p>Clearing footprint to minimise impact to habitat</p> <p>Rehabilitation of habitat following completion of works in the area</p> <p>Works to be timed outside of breeding season</p>	Reduction in the available extent of breeding and/or foraging habitat	Long term	Certain	Moderate
Short-beaked Echidna	Construction and operation	Loss of habitat though clearing of habitat and changes to hydrological regimes.	<p>Survey to verify location and extent of habitat present</p> <p>Survey to confirm presence</p> <p>Clearing footprint to minimise impact to habitat</p> <p>Rehabilitation of habitat following completion of works in the area</p>	Reduction in the available extent of breeding and/or foraging habitat	Long term	Certain	Moderate

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			Works to be timed outside of breeding season				
Common Death Adder	Construction and operation	Loss of habitat through clearing of vegetation and removal of deep litter layer	Survey to verify location and extent of habitat present Survey to confirm presence Clearing footprint to minimise impact to habitat Rehabilitation of habitat following completion of works in the area including provision of deep leaf litter.	Reduction in the available extent of breeding and/or foraging habitat	Long term	Certain	Moderate
Grey-headed Flying Fox, Large-eared Pied Bat, Glossy Black-cockatoo, Regent Honeyeater and Swift Parrot	Construction and operation	Loss of the available nectar, seeds and fleshy fruit for threatened bird species through clearing of vegetation, particularly remnant vegetation	Assess loss of food resources Minimise clearing of remnant vegetation Rehabilitate disturbed areas supporting remnant vegetation outside of the rail/road corridor	Reduction of available food resources	Long term	Certain	Moderate
Native least concern species	Construction and operation	Severance and habitat fragmentation for locally occurring 'common' native fauna	Implementation of targeted fauna crossing structures and fauna furniture Rehabilitation of the approaches to fauna crossing structures and other areas within the construction zone previously identified as RE or habitat	Reduction of movement options and reliance on infrastructure solutions to maintain habitat connectivity	Long Term	Possible	Minor
Fauna Crossings	Design and Operation	Provision of fauna movement opportunities increases risk of predation due to habitat on approaches to crossings or	Optimise height of fauna crossing furniture	Reduced opportunity for predation by native or pest species	Long Term	Possible	Minor

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
		fauna crossing infrastructure	Implement design innovations to address predation risk (exclusion fencing or other solutions)				
Habitat degradation/ edge effects	Design and Operation	Increased areas of previously buffered habitat exposed to edge effects including weed infestation and pest fauna species	Minimise clearing footprints Early establishment of rehabilitation and landscaping Weed management during construction Fencing of the rail	Exposure of newly created edges to urban development and transport function	Long Term	Possible	Minor
Hydrology and hydraulics	Design and Construction	Alteration of overland flow paths and drainage channels Modification of creek banks and beds	Hydrological design to be cognisant of natural flow paths and achieve WQ objectives	Potential risk of altered hydrological regimes to impact aquatic ecosystem health	Long Term	Possible	Minor
Erosion and sedimentation	Construction and Operation	Vegetation clearance and exposure of soils. High rainfall events result in erosion and transport of sediments	Construction ESCP and water quality monitoring objectives targeted to both WQOs and habitat preferences Design treatments to limit the long term potential for erosion of embankments, cuttings and other earthworks Monitoring of embankment stability	Potential risk of erosion and sediments entering waterways due to adverse weather conditions	Short term	Possible	Minor
Erosion and sedimentation	Operation	Drainage lines, embankments and cuttings not designed or stabilised through landscaping or other treatments sufficiently	Implementation of appropriate design and stabilisation treatments Ongoing monitoring of WQOs in proximity to infrastructure corridor for the short term to demonstrate no adverse impacts	Potential risk of erosion and sediments entering waterways due to adverse weather conditions or failure of infrastructure and stabilisation treatments	Short term	Unlikely	Minor

ELEMENT	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Waterway barrier works	Design, construction and operation	Temporary or permanent disruption to fish passage	Design in accordance with DAF Self Assessable Code requirements and approved through Waterway barrier works permitting these requirements cannot be achieved.	Disruption to fish passage through Project Area	Long term	Unlikely	Negligible
Fauna mortality	Construction	Construction vehicles Stress due to clearing and disturbance Predation of disoriented animals	Preclearing fauna reduction surveys and dispersal and identification of animal breeding places. Filling or removal of suitable habitat subsequent to dispersal or relocation of target fauna within the B2N Project footprint, immediately prior to clearing to reduce risk of fauna returning	Fauna mortality	Short Term	Possible	Minor
Fauna mortality	Operation	Vehicle Strike Stress and subsequent disease due to increased noise, light and reduced habitat range	Fencing of the rail corridor and fauna crossing design to encourage use of provided crossings Design in accordance with overhead line equipment design standards Fencing to limit burrowing fauna entering the rail corridor where practical Integrate escape opportunities for fauna that inadvertently enter the rail corridor	Fauna mortality	Short Term	Possible	Minor

8 Cultural Heritage

8.1 Introduction

Niche Environment and Heritage Pty Ltd (Niche) was commissioned by SMEC on behalf of Building Queensland, to prepare a Cultural Heritage Risk Assessment (Indigenous), a cultural heritage assessment of the Beerburrum station master's house, and an assessment of historical heritage (non-Indigenous). This Chapter provides a summary of these reports, which are provided in full in Appendix D, Appendix E and Appendix F.

The Cultural Heritage Risk Assessment was a desktop assessment designed to identify whether the proposed Project Area has the potential to contain Aboriginal cultural heritage values which could be harmed as a result of the proposed activities. The Project Area has been assigned corresponding risk categories that trigger different management methodologies under the *Aboriginal Cultural Heritage Act 2003* (ACHA).

The assessment of historical heritage was a desktop and visual inspection assessment designed to identify historical cultural heritage constraints within the Project Area in order to inform design and to provide an impact analysis of constraints against the preferred solution. Recommendations for additional works required have been provided commensurate with the significance of the impact of the B2N Project on the identified cultural heritage values.

8.2 Assessment Methods

8.2.1 Indigenous Cultural Heritage

The following outlines the methods used to assign risk categories in the Project Area and accordingly trigger the corresponding management methods under ACHA:

- Desktop searches of registers, inventories and relevant lists for cultural heritage, including:
 - DATSIP Aboriginal Cultural Heritage Register and Database
 - National Heritage List
 - Commonwealth Heritage List
 - Queensland Heritage Register
 - LGA's local heritage register and planning scheme.
- A desktop review of cultural heritage studies of relevance to the Project Area (Aboriginal and historical studies) to determine the local archaeological history and archaeological potential of the Project Area.
- A desktop review of environmental studies of relevance to the Project Area to determine the local environment history.
- A desktop analysis of available historical aerial photographs of the Project Area to establish the extent of disturbance caused by past land use activities. In addition, the review will aim to identify any high risk landscapes and/or geographic areas.
- Review of the results of previous assessments including the Trackstar Alliance (2007) and Arup Landsborough to Nambour EIS (2011) cultural heritage reports to identify known Aboriginal cultural heritage issues.
- Initial consultation about the B2N Project with the Kabi Kabi First Nation Registered Native Title Claimant (RNTC).

8.2.2 Non-indigenous Cultural Heritage

The following outlines the methodology used to identify the non-indigenous cultural heritage values and assess the impact.

- a desktop review of known historical heritage issues and identification of potential constraints
- a visual inspection of known and potential places within the Project Area to identify specific features and values
- preliminary impact assessment based on significance of the historical heritage identified
- preparation of mitigation options and identification of approval requirements.

In addition to the above, a more detailed assessment of the Beerburrum station master's house was undertaken. This assessment is described in Appendix F.

The non-indigenous cultural heritage was prepared with reference to the current DES framework for assessing cultural heritage significance in Queensland and was further informed by the principles for heritage conservation set out in the Australia ICOMOS Charter for the Conservation of Places of Cultural Significance (the Burra Charter) and the

Guidelines to the Burra Charter. The thematic analysis was informed by the Queensland Thematic Framework and the Australian National Thematic Framework.

8.3 Existing Environment

8.3.1 Indigenous Cultural Heritage

Register/Database Searches

The Australian Heritage Database lists Commonwealth heritage places registered on the Commonwealth Heritage List (CHL) and the National Heritage List (NHL) which include places of natural, Aboriginal and historical heritage significance to the nation. It also contains details of the Register of the National Estate (RNE) as a non-statutory archive of places of potential national heritage significance.

The DATSIP online portal contains the cultural heritage register and database a range of information that includes Aboriginal cultural heritage which has been identified as significant to Aboriginal people.

The SCC also maintains an overlay code specifically for the identification of heritage of significance at both State and local levels.

Searches of the heritage databases and registers for known Aboriginal cultural heritage objects or places within or in proximity to the Project Area are provided in Table 47. Further detail is provided in Appendix D.

Table 47: Summary of Database and Register Searches

SOURCE	RESULT	NOTES
Australian Heritage Database	National Heritage List – 1 place	Glasshouse Mountains National Landscape (NHL ID 105815) – located within 500m of proposed works.
	Commonwealth Heritage List - Nil	
	Register of the National Estate – 5 places	Glasshouse Mountains Area (RNE ID 100412) – located within 500m of proposed works. Glasshouse Mountains National Parks (RNE ID 8708). Indigenous Place, Beerburrum (RNE ID 8714) – located within 5km of proposed works. Indigenous Place, Glasshouse Mountains (RNE ID 8713)- location and information not available – located within 5km of proposed works. Indigenous Place, Landsborough (RNE ID 8712).
State Heritage	QHR	Glasshouse Mountains National Park and Beerburrum Forest Reserve 1 (QHR ID 602494) – located within 500m of proposed works.
Local planning schemes	Sunshine Coast Council - Nil	Nil.
DATSIP (within proposed alignment)	DATSIP - Nil	There are no previously recorded Aboriginal cultural heritage sites within the existing rail corridor.
DATSIP (outside proposed alignment, but within 500m)	DATSIP – Seven previously recorded Aboriginal cultural heritage sites	There are seven previously recorded Aboriginal cultural heritage sites located within a 500m distance of the existing rail corridor.
DATSIP (outside proposed alignment, but within 5km)	DATSIP – 87 previously recorded Aboriginal cultural heritage sites	There are 87 previously recorded Aboriginal cultural heritage sites located within 5km of the existing rail corridor. Places include: Intangible places (n=3) Artefact Scatters (n=23) Burials (n=6) Cultural sites (n=2) Earthen Arrangements (n=6) Grinding Grooves (n=9) Hearth/Oven (n=1)

SOURCE	RESULT	NOTES
		Isolated find (n=6) Landscape Feature (n=2) Pathways (n=1) Quarry (n=1) Scarred/Carved Tree (n=18) Stone Arrangements/Features (n=7) Story Place (n=1)

Previous Investigations

Assessments of the current Project Area were undertaken in 2007, however at that time, a previously registered Aboriginal Party for the area provided information. Therefore, this revised assessment involving the Kabi Kabi First Nation RNTC was required.

Previous assessments of the B2N Project Area and its surrounds include:

- Trackstar Alliance (2007) – An environmental planning study that looked at Phase 2 of the Caboolture to Landsborough proposed rail upgrade, which includes part of the B2N Project Area. This study included a “Cultural Heritage Review” (dated October 2007).
- Arup (1998) Stage 2 Corridor Assessment Report - An options analysis assessment of the proposed Caboolture to Maroochydore Corridor Project Area.
- Arup (2007) Caboolture to Landsborough Rail Upgrade Study: Beerburrum to Landsborough Corridor Report Addendum.

These assessments were used to inform the current assessment and summaries of these are provided in the Assessment Report in Appendix D.

Landscape and Land History Context

Through an understanding of the geology of the Project Area, predictions can be made regarding what types of raw materials were available for use by Aboriginal people. Similarly, an understanding that soils are derived from the underlying geology, or from fluvial or alluvial processes, reveals their potential to cover or expose cultural heritage sites. As Hughes and Sullivan (1984:35) note:

The results of numerous investigations throughout Australia have shown that the nature and distribution of archaeological sites across the landscape are generally very strongly influenced by environmental factors such as bedrock geology, landforms and associated soils and vegetation, and climate.

These factors influenced the organic raw materials, water, raw materials for stone artefacts, suitable campsites, and landforms and rock surfaces upon which rock art could be executed. They also affected the ease with which people could travel across the land.

Through an understanding of the:

- geology, predictions can be made regarding what types of raw materials were available for use by Aboriginal people
- soils and if they are derived from the underlying geology or from fluvial or alluvial processes, it can be understood if they have the potential to cover or expose cultural heritage sites
- vegetation communities, predictions can be made regarding what plant species were available in the past for exploitation by Aboriginal people
- Aboriginal archaeological record and the culture of the groups known to have resided in the area, predictions can be made regarding likely patterns of behaviours, likely artefacts types and where they may be found, and significance of the heritage
- land-use history, predictions can be made regarding where artefacts are likely to be undisturbed.

A review of factors including soils and geology, vegetation, Ethnographic context and land-use history was undertaken to inform the assessment and are provided in the Assessment Report in Appendix D.

Consultation

Initial contact with the Kabi Kabi First Nation People was made in 2016 to seek their views on the Project Area. Future assessments for the B2N Project will require detailed consultation with the Aboriginal party to ensure compliance with the ACHA and the Duty of Care Guidelines.

8.3.2 Non-indigenous Cultural Heritage

Commonwealth, State and Local heritage registers were searched online to identify any known and potential historical heritage places located within 100m of the Project Area. Databases and inventories searched included the:

- Australian Heritage Database – which includes places entered in the statutory World Heritage List (WHL), NHL and CHL, and the non-statutory archive the RNE.
- Queensland Heritage Register (QHR) – which lists all places entered for their State heritage significance under the QHA.
- DES LHS database – a non-statutory archive of information about places with potential cultural heritage values.

A context history for the Project Area was prepared to identify the important events and historical heritage places associated with the development of the region. Brief histories for each known and potential historical heritage place were prepared to inform the significance assessment. Contextual history research included accessing the following sources as needed:

- State Library of Queensland collections
- Queensland State Archives (QSA)
- National Library of Australia Trove service – for relevant photos, newspaper articles, maps and plans
- SCC – including review of the schedule of local heritage places
- any published and unpublished histories considered to be of relevance to the area
- available secondary sources on Queensland rail history and heritage, including John Kerr's research database (JKD research notes).

The desktop review identified 127 places of potential historical cultural heritage either within or immediately adjacent to the Project Area. Information on historical cultural heritage places within the Project Area, including current listing status, is provided in Table 48. Places immediately adjacent to the Project Area are provided in Appendix E along with further details for all historical cultural heritage places.

Following completion of the desktop assessment tasks, a visual inspection of the places of known or potential historical heritage significance within the Project Area was undertaken. Notes were taken regarding the visible condition of places. Photographs were also taken to illustrate the current condition, integrity and setting. It should be noted that it was not possible to assess the internal condition and significance of the station master's house due to access limitations (private property).

Table 48 also provides a summary of the visual inspection notes and the significance of the Heritage item.

Table 48: Potential Historical Heritage Places within B2N Project Area

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
Beerburum – Glass House Mountains					
1	Beerburum Station	Beerburum Village	Yes	Modern train station complex including recently constructed platforms, station building and footbridge.	Nil
2	Former station masters house, Beerburum	Church St, Beerburum, west of station and south of current station car park; 528CG6252	Yes	<p>Located on Church St, Beerburum and immediately south and west of the Beerburum Station car park on Lot 528CG6252.</p> <p>The building is a timber house on stumps with truncated hipped roof line and U-shaped partially enclosed verandahs on north, east and west aspects. The front and side verandahs appear to retain the original dowel balustrade and verandah posts with decorative Arts and Crafts-style wood brackets, and the verandah has not been modified. However, the undercroft has been built in and is intrusive fabric to the original building.</p> <p>The station master's house has local and regional heritage significance. The Beerburum Station Complex railway was built in c1919-20 as a deviation of the main North Coast railway line to support the settlement. It is significant as it was built in response to local economic growth driven by the short-lived solidier settlement scheme at Beerburum and the requirement of the station to service that population and industry. Reflecting the optimism felt for Beerburum at the time, the station was provided with a station building, rather than just a siding, and a residence for a 5th station master. However, by the mid-1920s many farms were failing and traffic on the railway was in steep decline, and by the 1930s the Soldier Settlement was largely deserted. The station and residence continued to serve the local district until finally closed in 1986.</p> <p>The station master's house is also rare as one of the few known surviving examples of station masters' residences on the North Coast railway and is an example of a standard 2nd class station master's residence built in the early 20th century.</p>	Local and QR
6	Beerburum Forestry Station Barracks	Possibly impacted by road realignment requirements for B2N; Red Road approx. 300m east of Steve Irwin Way, Beerburum	Yes		
7	Road bridge over line, Beerburum Rd (north Beerburum)	Beerburum Rd immediately to the north of the station area	Yes	Beerburum Road over the rail corridor north of Beerburum Station. The bridge is a single road timber construction with 2 timber piers supporting steel girders and upper bridge decking. Piers include 6 timber piles with timber diagonal bracing. Bridge has concrete approach abutments.	Nil

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
8	Flinders Monument, Glass House Mountains	Located <500m north of Tibrogargan Drive, on the west of Steve Irwin Way. Includes monument, plaque and rest area. Now relocated to GHM information centre.	Yes	Located north of Tibrogargan Drive on the southern side of Tibrogargan Creek and to the west of Steve Irwin Way. The place includes a rest area with circular dirt vehicle access, toilet facilities and 4 concrete bench and seat picnic tables. The monument is located close to the eastern edge of the rest area beside the dirt circular loop. It has a c.1m tall mortared stone based cairn with an angled plinth on which a brass plaque has been mounted.	Local
9	Tibrogargan Creek Rail Bridge, Glass House Mountains	Crossing Tibrogargan Creek and Evans Road, Glass House Mountains. Located immediately north-west of the Flinders Monument roadside rest area.	Yes	Crossing Tibrogargan Creek and Evans Road, Glass House Mountains. Located immediately north-west of the Flinders Monument roadside rest area. The bridge is a steel girder and concrete pier design with 3 spans.	Nil
11	Rail bridge over creek / plain, south Glasshouse Mountains station	Multiple span concrete bridge which crosses the creek. Concrete piers, headstocks and girders.	Yes	Multiple span concrete bridge which crosses the creek. Concrete piers, headstocks and girders.	Nil
12	Rail bridge over Burgess Street, south Glasshouse Mountains	Burgess St, Glasshouse Mountains; immediately south of the Glass House Mountains station.	Yes	Single road bridge crossing the rail corridor. Construction is of concrete piers, headstock and steel girder supporting road decking and upper structures.	Nil
Glass House Mountains - Beerwah					
13	Glass House Mountains Station (GHM4)	Passenger station building and footbridge	Yes	Passenger station building and footbridge	Local, QR, possible State (station building only)
14	Small rail bridge over creek, south Beerwah	Located close to Mahogany Court or Reimann Avenue, Beerwah	Yes	Bridge not visible from outside the rail corridor.	Unknown
15	Rail bridge over creek, south Beerwah	At end of Kellos Road off Steve Irwin Way.	Yes	A multi-span concrete bridge crossing Kellos Creek, south of Beerwah Station. The bridge is concreted of concrete piers and girders.	Nil

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
16	Mawhinneys Fig Tree	Fig tree located near the Beerwah town centre, outside Beerwah Garage, Beerwah-Glasshouse Mountain Road, Beerwah.	Yes	Large mature strangler fig tree (<i>Ficus watkinsiana</i>). A bronze plaque, noting the tree was planted by James Mawhinney in 1907, has been erected on the northern side of the tree on a rock plinth.	Local
<u>Beerwah - Landsborough</u>					
18	Beerwah Station (BWH4)	Passenger station building and footbridge. Simpson Street, Beerwah; 115SP179110.	Yes	Station comprises section of duplicated track, two elevated platforms, passenger station building on the up platform, and footbridge.	Nil
20	Small rail bridge (1), north of Beerwah	Alongside Old Landsborough Road near Pinelands Drive.	Yes	Single span steel girder railway bridge spanning small creek. Abutments are concrete. Timber piles of earlier rail bridge are visible within the current creek channel.	Nil
21	Small rail bridge (2), north of Beerwah	Immediately south of Thompson Road intersection with Old Landsborough Road.	Yes	Single span concrete girder railway bridge spanning small creek. Abutments are concrete.	Nil
<u>Landsborough - Mooloolah</u>					
22	Landsborough Station	Passenger station building and footbridge	Yes	Landsborough station is comprised of a duplicated section of track, two raised station platforms, a passenger station building and signal cabin, air raid shelter, crane and fork line.	Local and QR - Station building and signal cabin, crane, fork line, air raid shelter State – air raid shelter
29	Landsborough East Residential Neighbourhood Character Area (CHR7)	Beerwah St, Caloundra St, Landsborough	Yes	A collection of buildings comprising a character area focused on Beerwah St, Caloundra St, Landsborough.	Local
30	Landsborough Shire Council Chambers	4-6 Maleny St Landsborough; 3RP76609, 1RP76609.	Yes	A modest, timber building, has a discreet, civic presence on Maleny Street, Landsborough. The building is a low-set, hip-roofed, rectangular, timber structure with open front verandah. A	Local and State

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
	(Former) (LBH13; QHR ID601915)			narrow, skillion roofed extension has been erected to the west and a large Museum courtyard and building has been constructed to the east.	
31	Landsborough Court House (LBH4)	12 Caloundra St Landsborough; 4CG4024	Yes	A collection of buildings comprising a character area focused on Beerwah St, Caloundra St, Landsborough	Local
32	Landsborough Post Office (Former) (LBH10)	8 Caloundra St Landsborough; 7RP145460.	Yes	A collection of buildings comprising a character area focused on Beerwah St, Caloundra St, Landsborough	Local
35	Old Mellum Cemetery / potential pioneer grave site	Pound Reserve, off Gympie Street North (near intersections with Tunnel Ridge Road and north of Landsborough Village; a memorial stone with brass plaque' and is understood to be the burial site of local pioneers including 'Lawrence Graves and Elizabeth Orrell'' located in the vicinity of 710M332060 and 711CG6392	Yes	No visible cemetery or grave markers are present. The location is marked by a memorial stone with a brass plaque erected "in memory of Early Settlers in the Landsborough District Buried on this site".	Local
84	Landsborough Public Air Raid Shelter and Railway Station (LBH11; QHR ID 602709)	Cribb Street, Landsborough; 121CP827064 (Part), 122CP827064.	Yes		
87	Landsborough Uniting Church (LBH16)	16 Maleny Street, Landsborough	Yes		
Mooloolah - Eudlo					
39	Mooloolah Railway Station	Station off Brays Road, Mooloolah Village.	Yes	Station comprises of duplicated track, single raised platform (incl. temporary platform extensions north and south c1996), single waiting shed.	Local and QR significance
40	Pedestrian Rail Crossing Bridge and Waiting Shed, Bray Rd,	Listed on the RNE; includes that timber footbridge at the level crossing and a timber waiting	Yes	QR Standard "two road" timber pedestrian footbridge with stairs descending to landings to the south. Bridge has been elevated by 1-2m for electrification works.	Local and QR significance

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
	Mooloolah (RNE ID: 100697 - Heritage).	shelter on the Mooloolah Station platform immediately north of the station.			
48	Rail bridge over Highland Rd, Eudlo	Immediately south of Eudlo Station, take Highlands Road which runs just south of station and under line.	Yes	Multi-span steel and concrete girder bridge over Highland Road and the adjacent floodplain to the south	Nil
93	Mooloolah Railway Shelter (MLH4)	Bray Road, Mooloolah, 3CP827039 (Part).	Yes		
<u>Eudlo - Palmwoods</u>					
49	Eudlo Railway Station	Unknown, Eudlo Village.	Yes	Raised platform and modern steel shelters.	Nil
<u>Palmwoods - Woombye</u>					
53	Palmwoods Railway Station and Goods Sheds (PMD6)	Passenger station building and goods shed. Main Street, Palmwoods; 171/SP102276 (Part).	Yes	Palmwoods station is comprised of a single raised platform with a passenger station building, goods shed located opposite, siding and loading banks.	Local and QR significance
54	Palmwoods Timber Sheds	Unknown, possibly goods sheds, located close to station along Main Street.	Yes	Three sheds located along Main Street and adjoining the rail corridor. All are timber framed and chamferboard clad structures with corrugated iron roofing.	Local and QR significance
56	Flooded Gum Tree, Palmwoods Station	Mature gum tree with local aesthetic and natural values, possibly of local significance. Within station listing boundary	Yes	Tree could not be relocated.	Nil

ID	PLACE	LOCATION / DESCRIPTION	IN B2N PROJECT AREA	VISUAL INSPECTION NOTES	SIGNIFICANCE
58	Palmwoods to Buderim Tram Foundation and Formwork Remnants (BDM14) (RNE ID 102155) (QHR 601711) (archaeological potential)	Formation only immediately east of Palmwoods Station, crossing then running parallel to Nicklin Road, then crossing Old Chevallum Road, Palmwoods. 4A Telco Road, Buderim.	Yes	*Noted that this archaeological potential is outside the current boundary of the listing for the Queensland Heritage Register and Register of the National Estate for the Palmwoods to Buderim Tram Route.	Local and QR significance
	<u>Woombye - Nambour</u>				
65	Woombye Station	Passenger station building located at Woombye Station.	Yes	Comprises a section of duplicated track, a single raised platform, passenger station building, and separate timber lavatory building. The complex also includes potential for archaeological evidence of the former Woombye Timber Mill, located opposite the station.	Local and QR
66	Former Woombye Timber Mill, Woombye Train Station	Archaeological potential within the station grounds	Yes	Archaeological potential within the station grounds	Local

8.4 Potential Impacts

8.4.1 Indigenous Cultural Heritage

Identification of Risk Categories

In accordance with the ACHA, all persons in Queensland have a Duty of Care to take all reasonable and practicable measures to ensure they do not harm Aboriginal cultural heritage whenever they undertake an activity. The ACHA provides a number of processes that allow a person undertaking an activity to meet their Duty of Care, including an assessment of the proposed activity against the Duty of Care Guidelines (undertaking a cultural heritage risk assessment).

Through consideration of the following information, a current Duty of Care category under the ACHA is able to be determined:

- searches of relevant registers to identify any previously identified Aboriginal cultural heritage in the Project Area
- the environmental context
- past land use of the Project Area (review of historical aerial photos).

The majority of the Project Area has been subject to Significant Ground Disturbance in the past and the proposed B2N Project activities are considered to be consistent with the levels of past disturbance. Accordingly, the majority of the B2N Project Area is a 'Developed Area'. This means that it is generally unlikely that the activity will harm Aboriginal cultural heritage, no additional assessment is required, and the activity can proceed in compliance with the Duty of Care Guidelines.

Two areas of the Project Area have not been subject to Significant Ground Disturbance or Surface Disturbance in the past (Remnant Vegetation Areas 1 and 2). It is considered likely that additional areas of remnant vegetation could exist within the Project Area, however these will only be identified during on the ground investigations. Any areas of remnant vegetation pose a Cultural Heritage risk to the B2N Project and should be identified via B2N Project Environmental/ Ecological studies and further assessed by a cultural heritage expert as high priority areas for targeted field inspections. B2N Project activities proposed to occur in areas of remnant vegetation are Category 5 activities in accordance with the Duty of Care Guidelines. This means there is a high risk that activities could harm Aboriginal cultural heritage and further assessment is required.

Additionally, the proposed B2N Project activities will traverse, or be in close proximity to, landscapes which have a higher risk of Aboriginal Cultural Heritage being present. High risk landscapes include those where natural landscape features are present, such as rock outcrops, caves, wetlands, permanent water holes, creeks, springs, hills and mound formations. These areas are considered to be Category 4 areas 'previously subject to Significant ground disturbance'.

Summary

The region has a rich Aboriginal history. The results of the database and register searches demonstrate the diversity of previously recorded sites within 5km of the Project Area and are an indicator of the types of sites that could be identified in areas of high potential within the Project Area. Those areas adjacent to sites identified on the DATSIP database should also be considered to have high potential for further finds. Parts of the Project Area have undergone a significant amount of disturbance through the original construction of the rail alignment, however there are areas where works are proposed that have not previously been subject to land disturbance. Areas of remnant vegetation and creek crossings have high archaeological potential.

Table 49 summarises the probability for Aboriginal cultural heritage to be present within the Project Area with further detail regarding locations of the high risk areas in Appendix D.

Table 49: Predictive model for the probability of the existence of Aboriginal cultural heritage within the Project Area

LOCATION	LEVEL OF PRIOR DISTURBANCE	DATSIP RESULTS	COMMONWEALTH HERITAGE REGISTERS	COMMENT
Project Area – current rail alignment	Varied. Construction of railway and vegetation clearing activities have disturbed the majority of the Project Area.	No previously identified Aboriginal cultural heritage sites are recorded within the Project Area. However, there are seven Aboriginal sites within 50m of the Project Area, and 87 Aboriginal sites within 5 km of the Project Area.	This desktop assessment has identified three places of Aboriginal heritage significance listed on the Register of the National Estate. No location data is provided for any of the three places.	There is a low potential to encounter Aboriginal cultural heritage within the majority of the Project Area. There is a high probability of encountering Aboriginal cultural heritage in vegetated area associated with water features within the current rail alignment portion of the Project Area*.
Project Area – outside current rail alignment	Varied. Some parts have been under cultivation or are current dwellings. Other areas contain remnant vegetation.	No previously identified Aboriginal cultural heritage sites are recorded within the Project Area. However, there are seven Aboriginal sites within 500m of the Project Area, and 87 Aboriginal sites within 5km of the Project Area.	This desktop assessment has identified three places of Aboriginal heritage significance listed on the Register of the National Estate. No location data is provided for any of the three places.	There is a low potential to encounter Aboriginal cultural heritage within the majority of the Project Area. There is a high probability of encountering Aboriginal cultural heritage in vegetated areas associated with water features and areas of remnant vegetation within the Project Area*.
*Aboriginal burials can exist in many environments and are usually unmarked. Burials may exist in the Project Area, and are an important consideration in regards to harm to Aboriginal cultural heritage where ground disturbance works will be undertaken.				

The potential for areas of significant intangible Aboriginal cultural heritage values to exist within the Project Area can only be ascertained through consultation with the Aboriginal Party. However, watercourses are identified in the DATSIP Duty of Care Guidelines as having potential for intangible cultural heritage values.

Given the potential for such values to exist and the requirement that will entail to seek agreement with the Aboriginal party, it may be convenient in all the circumstances to engage with the Aboriginal party at an early stage to seek a global Cultural Heritage Management Plan (CHMP) or Aboriginal party agreement for the B2N Project. The benefits of such agreements are that all activities carried out in compliance with the agreements will satisfy the cultural heritage duty of care, and will also provide a defence in relation to the other ACHA statutory offences.

8.4.2 Non-indigenous Cultural Heritage

Beerburum

Upgrades to Beerburum would include provision of new car parking facilities to the east of the current station. The preferred car parking layout was not available at the time of report preparation. However, car parking is proposed for that area extending north from the existing parking area to opposite Hibiscus Avenue, and also south to Acacia Avenue. This extension south may include the resumption of the property on which the former station master's residence is located.

While the current Beerburrum Station complex does not have cultural heritage significance, the former station master's residence which is located to the east of the station is considered a place of local and regional heritage significance. The building would threshold as a place of historical significance, being early 20th century and one of a few known surviving examples of station masters' residences on the North Coast Line; it is also an example of a standard 2nd class station master's residence built in the early 20th century.

Direct impacts may include removal of the former station masters house. This would result in the complete loss of significant fabric and the removal of the last remaining structure associated with the 20th century use of the Beerburrum railway station complex. A design solution that avoids these direct impacts is recommended.

Landsborough

The proposed grade separation at Landsborough will require substantial alterations to the existing road infrastructure to the east and west of the existing rail corridor. In particular, upgrades to Beerwah, Caloundra, Mooloolah and Maleny Streets will have direct impacts on several known heritage places, including:

- ID # 28 Landsborough East Residential Neighbourhood Character Area
- ID # 31 Landsborough Court House (LBH4)
- ID # 32 Landsborough Post Office (Former) (LBH10)
- ID # 30 Landsborough Shire Council Chambers (Former) (LBH1)
- ID # 87 Landsborough Uniting Church (LBH16) – Indirect
- ID # 84 Landsborough Public Air Raid Shelter and Railway Station (LBH11) (QHR ID 602709) – Indirect.

The Landsborough Eastern Residential character area is recognised in the SCC planning scheme for its local cultural heritage significance and contribution to the Landsborough townscape. Values relate to the character of the area created by groups of houses, principally along the southern side of Caloundra Street. The houses in the area are characteristic of 'timber and tin' Queensland houses in the early 20th century. Within this character area are two additional local heritage places - the Landsborough Court House which is a locally significant Federation period (1890s-1910s) bungalow cottage and the Landsborough Post Office (Former) also a Federation period bungalow structure.

Also within the proposed Project Area is the former Landsborough Shire Council Chambers which is recognised on the SCC planning scheme for its local heritage significance, and also as a State heritage place and is entered in the QHR for its historical, social and aesthetic values.

The proposed grade separation works will have a substantial visual and direct physical impact on the values of the neighbourhood character area. This would include acquisition of the rear portion of the Court House property and removal of character houses on Lot 1 of SP201520 (20 Beerwah Street, Landsborough) and Lot 21 of L2589 (14 Caloundra Street, Landsborough). The works would also require acquisition of a portion of land situated within Lot 3 of RP76609 (4 Maleny Street, Landsborough) which includes the SCC and QHR listed former Landsborough Shire Council Chambers.

As the grade separation works are located adjacent to or in proximity to other locally listed heritage places, indirect impacts to the values of these places may also occur though the extent of such impacts cannot be determined at this early design stage.

It is anticipated that upgrades within the Landsborough Station complex will involve substantial reconfiguration of the areas east of the existing rail corridor, the closure of the current level crossing from Caloundra Street, and resumption of part of Railway Street for car parking facilities.

The Landsborough Station complex has local, QR and State heritage significance. It is recognised on the SCC planning scheme for its local heritage significance. The existing station building and signal cabin, crane, fork line, and air raid shelter are recognised by QR and entered in the QR heritage register. The air raid shelter is also listed individually on the QHR as a place of State heritage significance for its historical and architectural significance and rarity.

No alterations are proposed for the main station building and signal cabin on the western platform. Works would be constrained to the eastern platform and the adjacent QR lands. The proposed arrangement will include retention of the fork line which is still in use and as the only surviving turn around for steam locomotives on the North Coast Line, is required to be retained by QR for operational reasons. The crane will also be retained.

Based on the preliminary arrangements provided, direct impacts to significant complex elements, including the air raid shelter, crane, fork line, signal cabin and station building will be minor or avoided completely. This could be further

minimised through further consideration of optimisation of the car parking layouts proposed and also through examination of options for the existing car parking arrangements on the western side of the Station complex.

The potential impacts of the proposed works are therefore considered minor, although car parking arrangement needs to be sympathetic to the known values of the Station complex, in particular, to the continued use of the fork line and design solutions around the crane.

Palmwoods

Proposed works at Palmwoods Station are anticipated to include minor track works south of the station complex and substantial station upgrades including a revised car park reconfiguration. A design for these works was not available at the time of report preparation. However, it is expected that work may include:

- upgrade from a single platform to a dual platform configuration
- installation of a pedestrian overbridge and lifts
- removal of the existing car park adjacent to the station building to another location within the station complex, possibly on the western side of the complex in the currently disused space between the line and Main Street.

Palmwoods Station (station building and goods shed) is recognised on the SCC planning scheme as a place of local heritage significance. The current station building and the goods shed (both built c.1890) are of cultural heritage significance for their historical association with the development of early transportation networks and as good representative examples of rural railway station buildings from the 19th century. The station complex may also retain archaeological elements of the former Buderim to Palmwoods Tramway. Any such remnants are likely to be of local, QR heritage significance, or even possibly State significance.

Retention of the significance elements of the station complex, and design of new elements that minimise impacts to the character of the station complex, are essential.

Retention of the existing platform and station building through the use of a dual platform solution may result in minor impacts to significance. The design will need to consider the location of a new dual platform to avoid direct impacts to the goods shed if possible.

Construction of a new overhead bridge within the Palmwoods Station complex has potential to cause substantial impacts to the character of the station complex. Design needs to consider the most acceptable location to construct an overhead bridge to ensure a minimal visual impact on the character of the station complex.

Woombye

A substantial upgrade of Woombye Station is planned. Proposed works include:

- construction of a new wide island platform immediately south of the existing station platform
- installation of a new temporary side platform west of the existing station
- construction of a new turnout to the east of the station
- closing off of Blackall Street
- construction of a new pedestrian overhead bridge, which will require removal of the station lavatory building
- future car parking west of existing station along Back Woombye Road.

Woombye Station complex is recognised by QR as a place of heritage significance through its entry in the QR Heritage Register. The station complex has historical heritage significance as an example of a station building that pre-dates 1900 and due to its association with the construction of the North Coast Line. Such structures are now considered rare across the QR network.

It is assumed that the proposed creation of a new island platform, with the new platform to be constructed south of the current platform, will require the removal of the existing platform, station building and separate lavatory. The proposed works would also substantially diminish the existing character and setting of the station complex. Future car parks and temporary side platform construction along Back Woombye Road would occur within the area potentially containing archaeological evidence associated with the former Woombye Timber Mill. Direct impacts would therefore include some loss of significant station elements and alter the aesthetic characteristics of the complex.

Indirect impacts may occur to the other heritage places in the centre of Woombye, including to the nearby Woombye Neighbourhood Character Area.

Other Impacts

The Beerburum Forest Station Barracks are recognised on the SCC planning scheme as a place of local heritage significance. It has historical significance as evidence of the expansion of the pine plantations in the Beerburum and SEQ region. The barracks are also of local significance as surviving examples of accommodation for forestry workers in the post-war period. Direct impacts to the Beerburum Forest Station Barracks listing are proposed, though impacts are limited to construction impacts caused by upgrades to Steve Irwin Way. This includes the potential loss of some of the later station barracks buildings (construction mid-1960s) that are located in the northwest corner of the barracks property close to Steve Irwin Way. Design solutions for these works should focus on avoiding impacts altogether, or minimising the likelihood of structures needing to be removed from the station barracks site.

The Flinders Monument is a recognised local heritage place and is included in the SCC planning scheme. The proposed upgrades to Steve Irwin Way at the Matthew Flinders Rest Area would include substantial direct impacts to the monument, which based on the proposed works design, will require relocation. The monument has social significance and is being maintained as is evidenced by the installation of a new plaque in recent years. Any proposed impacts to the monument, including relocation options would require consultation with relevant community stakeholders.

There will be no direct impacts to heritage items located near Glasshouse Mountains and Mooloolah railway stations by the proposed works.

8.5 Proposed Mitigation Measures

8.5.1 Indigenous Cultural Heritage

The following recommendations founded on the results of the desktop review are made:

- if the scope of the B2N Project changes, the Cultural Heritage Risk Assessment will need to be reviewed and updated
- a targeted Aboriginal Cultural Heritage Field Assessment of areas where proposed works will occur in areas of Category 4 and 5 should be undertaken
- high risk areas include:
 - all creek crossings where works will impact the ground surface within the current rail alignment.
 - all creek crossing where works will occur outside the current rail alignment
 - all areas of previously remnant vegetation within the Project Area
 - areas where works will be occurring within proximity of the seven Aboriginal cultural heritage sites (KB:D96; KC:E28; KC:F51; KC:F56; KC:G76; KC:G88; KC-0002-1 and KC-0002-2)) located within 500m of the Project Area.

8.5.2 Non-indigenous Cultural Heritage

Several places of non-indigenous cultural heritage significance were identified within the Project Area. The following is recommended to mitigate potential impacts:

- for all places identified as being significant and potentially impacted by B2N Project works, additional and detailed historical research and significance assessment (using the criteria in the *Queensland Heritage Act 1992*) is undertaken to confirm the preliminary significance assessment and further inform specific recommendations made for mitigation at each place
- where impacts have been identified to significant heritage places, consideration be given to other acceptable design and construction options to avoid or minimise impacts wherever possible
- consultation with SCC is recommended where impacts have been identified to heritage places listed in the SCC planning scheme
- consultation with relevant community stakeholders is recommended for all heritage places that will be impacted
- specific SCC and community stakeholder consultation concerning the possible relocation of the Flinders Monument, Glass House Mountains, be undertaken
- where existing station upgrades are going to impact on the cultural heritage significance of the Landsborough, Palmwoods and Woombye Stations, it is recommended that upgrades retain the local character of station complexes by avoiding or minimising impacts and also through sympathetic design choices
- where removal of significant fabric is unavoidable, archival recording of that fabric is completed prior to its removal.

In order to mitigate inadvertent and indirect impacts, the following is recommended:

- a discoveries procedure for the entire Project Area is implemented for the B2N Project works to ensure compliance with archaeological requirements of the *Queensland Heritage Act 1992*.

8.6 Residual Impact Assessment

With the implementation of the mitigation measures outlined in Table 51, it is anticipated that the B2N Project's potential impacts will be minor and manageable. Where potential impacts on Cultural Heritage values cannot be avoided, the values would be documented and the character maintained through the detailed design of the B2N Project.

Table 50: Residual Impact Assessment, Cultural Heritage

HERITAGE FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Indigenous cultural heritage- places and items	Construction	Loss, damage or disturbance to known and unknown indigenous cultural heritage places, artefacts or sites through lack of awareness.	Implement the CHMP or other Aboriginal party agreement, including: Indigenous cultural heritage induction for all construction staff Representatives of the relevant Aboriginal Party to monitor vegetation clearing and earth excavation works, in specific locations as defined through the CHMP/ Aboriginal party agreement Procedures for notifying, documenting, relocating and storing artefacts	Loss of in-situ cultural heritage values minimised, and documented. Relevant Aboriginal Parties involved in documentation and identification of cultural heritage finds across the Project Area.	Long term	Possible	Minor, subject to the nature of potential finds
Non-Indigenous cultural heritage – places and items	Design and Construction						
Landsborough East Residential Neighbourhood Character Area, including: Landsborough Court House (LBH4) Landsborough Post Office (Former) (LBH10)		Character Area: Court House - the works footprint will require partial acquisition of Lot 4CG4024 (5 Beerwah Street, Landsborough) Removal of character house on Lot 1SP201520 (20 Beerwah Street, Landsborough) Removal of character house on Lot 21L2589 (14 Caloundra Street, Landsborough)	As an SCC local heritage place, consultation with SCC on options for road design at this location. If character houses are removed, archival recording of each house should be completed prior to removal.	Loss of in-situ cultural heritage values avoided where possible. Otherwise documentation of cultural heritage across the Project Area.	Long term	Likely	Moderate, subject to removal of houses not being avoided
Landsborough Shire Council Chambers (Former) (LBH1)		The proposed works footprint will require acquisition of a portion of	As an SCC local heritage place, consultation with SCC on options.	If partial resumption of property can't be avoided, minimal	Long term	Possible	Minor

HERITAGE FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
		land situated within Lot 3RP76609 (4 Maleny Street, Landsborough).	Revise design to avoid direct physical impacts if possible.	impact to in-situ cultural heritage value.			
Landsborough Jewellers Shop (Former) (LBH5)		LBH5 is within the proposed works, but will not be directly impacted.	As an SCC local heritage place, consultation with SCC on options.	Loss of in-situ cultural heritage values avoided where possible.	Long term	Unlikely	Minor
Landsborough School of Arts Memorial Hall (LBH12)		LBH12 is within the proposed works, but will not be directly impacted.	As an SCC local heritage place, consultation with SCC on options.	Loss of in-situ cultural heritage values avoided where possible.	Long term	Unlikely	Minor
Former station masters house, Beerburrrum		This residence is located within the area identified for possible car park expansion for Beerburrrum station. The residence may need to be removed.	Avoid as a preference any direct impacts to the house. If impacts are to occur, a heritage impact assessment must be completed. This should include updates to current assessment, further comparative analysis, and an internal inspection to enhance the current understanding of significance and understanding of impacts. If impacts cannot be avoided, archival recording is to be undertaken to document the structure prior to impacts occurring. A brief is to be prepared for the archival recording in accordance with DES' archival recording guidelines.	Loss of in-situ cultural heritage values avoided where possible. Otherwise documentation of cultural heritage across the Project Area.	Long term	Likely	Moderate, subject to removal of houses not being avoided

HERITAGE FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Landsborough Station (incl. air raid shelter, crane, fork line, signal cabin, station building)		The works footprint will include construction of car park facilities east of the Station infrastructure but within the station complex.	<p>Where stations upgrades are going to impact existing station structures, ensure design seeks to retain the local character of station precincts as a priority</p> <p>As an SCC local heritage place, consultation with SCC on options.</p> <p>As a QR heritage place, consultation on car park options and design.</p> <p>If works are proposed to the west of the station in proximity to the air raid shelter, additional approvals and consultation with DES will be required.</p>	<p>Local character of station maintained.</p> <p>Where possible, works to the west of the station avoided.</p>	Long term	Possible	Minor
Palmwoods Station, including platform and former tramway elements		Final layout for these works was not defined at the time of report preparation. May be minor where a dual platform solution is used.	<p>Where stations upgrades are going to impact existing station structures, ensure design seeks to retain the local character of station precincts as a priority</p> <p>Design solutions that avoid or minimise impacts to the existing station building and goods shed are preferred.</p> <p>The existing platform is considered to be of local significance due to its past association with the rail and tram operations. Design provisions to retain the platform and delineate it from any new additions or extensions are preferred.</p> <p>Impacts to the former tramway elements should be avoided.</p>	<p>Local character of station maintained.</p> <p>Where possible, impacts to existing station building and goods shed avoided.</p> <p>Documentation of cultural heritage across the Project Area</p>	Medium term	Possible	Minor

HERITAGE FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			Procedures for managing the discovery of archaeological features of the former tramway should be implemented during ground disturbance works.				
Woombye Station		Installation of island platform and new station infrastructure may result in loss of significant fabric.	Where stations upgrades are going to impact existing station structures, ensure design seeks to retain the local character of station precincts as a priority. As a QR heritage place, consultation on station layout options and designs is required.	Local character of station maintained. Documentation of cultural heritage across the Project Area.	Long term	Likely	Moderate
Former Woombye Timber Mill, Woombye Train Station		Proposed car parking option along Back Woombye Road may impact on archaeological remains of the mill.	Further investigations into the archaeological potential of this area. Pre-impact testing to determine extent of potential (if any). Implementation of a discoveries procedure to ensure compliance with archaeological requirements of the QHA.	Documentation of potential impacts. Documentation of finds with disturbance of site.	Long term	Possible	Minor, subject to the nature of potential finds
Beerburrum Forestry Station Barracks		The proposed works along Steve Irwin Way will result in the partial loss of a portion of the Beerburrum Forest Station Barracks site.	As an SCC local heritage place, consultation with SCC on options. Revise road design to avoid impacts if possible.	If possible, impacts to Forestry Station Barracks avoided. Documentation of cultural heritage across the Project Area	Long term	Possible	Minor

HERITAGE FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Flinders Monument, Glass House Mountains		The monument and road side rest area will be removed due to proposed alignment changes to rail corridor, including bridging works over Tibrogargan Creek.	As an SCC local heritage place, consultation with SCC on options for relocation. Consultation with relevant local stakeholder groups regarding relocation.	Where possible, relocation of the Monument.	Long term	Unlikely	Minor
Non-indigenous heritage – previously unrecorded sites	Construction	Loss and disturbance of previously undocumented sites that provide insight into the settlement patterns across the Project Area. These include potential rubbish dump sites associated with early families.	Construction staff inductions to include protocols for encountering non-indigenous heritage items.	Documentation of finds, with disturbance of site	Long term	Possible	Minor, subject to the nature of potential finds

9 Noise and Vibration

9.1 Introduction

A noise assessment was undertaken for the B2N Project by Wilkinson Murray Pty Limited (Wilkinson Murray). The Noise Assessment Report is attached as Appendix G. This Chapter provides a summary of the noise assessment report identifying aspects requiring management through design, construction and operation.

9.2 Assessment Methods

The noise study was undertaken by Wilkinson Murray at 27 representative locations in the Project Area between Beerburum and Nambour between Monday 13 June and Tuesday 5 July 2016. Acoustic Research Labs (ARL) NGARA™ real time environmental noise loggers were deployed for 5-7 days at each of the 27 locations, between 13 June and 5 July 2016. The data collected was analysed and used to calibrate the computer noise model.

Future operational rail noise was calculated for the Beerburum to Landsborough section of the proposal using SoundPLAN Version 7.4, a predictive computer noise model. Noise levels were predicted using the Nordic Rail Prediction Method (Kilde Report 130), as implemented in SoundPLAN. Kilde has been used in this assessment as it is accepted by Queensland Rail and Queensland Rail standard emission tables correspond with Kilde methodology.

The noise assessment was carried out in accordance with Queensland Rail's MD-15 series documents and in particular MD-15-318, Noise Modelling Checklist (Environment). Noise modelling was undertaken within 200m either side of the existing and proposed rail lines. Further details of the modelling method and inputs are included in Appendix G.

For the Landsborough to Nambour section, as the works area is not continuous, interpretation of monitoring data for each location was undertaken to predict noise levels in the works areas.

The 24-hour Equivalent Continuous Sound Level (LAeq,24hr) and Single Event Maximum Sound Level rail noise levels were predicted at each of the identified noise-sensitive receiver locations.

Construction noise and vibration impacts were considered separately, with consideration of the likely activities contributing to the noise environment.

The noise study undertaken in 2016 has not been revised for the 2019 REF update as the 200m buffer used in 2016 encompasses changes to the B2N Project Area. One property (1RP177687) was included in the 2016 assessment, but was not identified as a sensitive receptor. A residential dwelling is located on that property in 2019, however the dwelling is approximately 200m outside the 80-87dB(A) modelled area and additional assessment is therefore not considered necessary at this stage of the B2N Project.

9.3 Existing Environment

9.3.1 Ambient Noise Environment

Passenger and freight services currently operate on the North Coast Line between Beerburum and Nambour including:

- commuter services
- long distance passenger services and tilt trains (both diesel and electric services)
- containerised freight services
- heavy haulage single commodity trains
- historic recreational services
- cattle trains.

Types of noise emissions associated with operational railways are identified in Chapter 15 of the Landsborough to Nambour EIS, as follows:

Operating railways generate airborne noise due to the rolling associated with the railway car wheels on the track, engine and exhaust noise of locomotives. Braking, bearings, couplings, traction motors, air conditioning, fans and horns are also sources of operational noise. Gaps, joints and turnouts in the track can also contribute to noise. Tracks that have steeper gradients and tight curves generate additional rolling-stock noise resulting from the need to accelerate and brake, to negotiate these changes in track conditions. Airborne noise may also be generated by fixed railway equipment such as substations, tunnel ventilation

plant and station public announcement systems. Track maintenance also generates noise from rail grinding, tamping and operation of machinery (engines and warning signals).

Other noise sources in the Project Area include urban activity, traffic movements on local roads and Steve Irwin Way.

While the Project Area terrain is generally flat, the surrounding areas are varied, with features such as the Glass House Mountains and hills north of Landsborough. This variable topography, combined with the rural surroundings, can contribute to a perception of a low noise environment.

9.3.2 Sensitive Receptors

The corridor passes through many varied environments between Beerburrum and Nambour including residential, rural and agricultural. More intensive populations are centred around towns and generally localised to small catchments around the train stations.

Schedule 1 of the *Environmental Protection (Noise) Policy (2019)* (EPP Noise) defines acoustic quality objectives for various sensitive receptors including the following:

- residence
- library and educational institution (including a school, college and university)
- childcare centre or kindergarten
- school or playground
- a hospital, surgery or other medical institution
- commercial and retail activity
- a protected area or critical area
- marine park
- a park or garden that is open to the public (whether or not on payment of an amount) for use other than for sport or organised entertainment.

Noise sensitive receptors within 200m of the Project Area are identified in Appendix G. These receptors include residences, schools, nursing homes and recreational parks.

9.3.3 Noise Planning Levels

The EP Act aims to protect Queensland's environment while allowing for development that improves the total quality of life. Under the EP Act, Queensland Rail has a General Environmental Duty to take all reasonable and practicable measures to prevent or minimise Environmental Harm, which includes Environmental Nuisance.

However, under the EP Act notable exclusions from nuisance provisions include:

- noise from the ordinary use of a busway, light rail or rail transport infrastructure
- environment nuisance caused by maintaining a public road, State-controlled road, railway or other infrastructure for public transport.

Queensland Rail aims to meet its General Environmental Duty and to progressively minimise noise impacts associated with its activities through the implementation MD-15 Noise Management series of documents.

MD-15-316 Specification – Noise assessment (Environment) establishes Rail Noise Planning Levels (the Planning Levels) to assist in the assessment and management of rail noise.

Queensland Rail's Planning Levels are as follows:

- 65 dB(A) assessed as a 24-hour average equivalent continuous A-weighted sound pressure level (or LAeq,24 hours)
- 87 dB(A) assessed as a Single Event Maximum Sound Level, defined as the arithmetic average of maximum levels from the highest 15 single events over a given 24-hour period.

Noise modelling or monitoring activities aimed at assessing performance against the Planning Levels, must be undertaken 1m from the most exposed façade of an affected building, 0.5m below the eave height.

MD-15-317 Procedure – Noise Management (Environment) states that all new infrastructure built by or on behalf of Queensland Rail must be designed to satisfy the Planning Levels. MD-15-317 also states changes to infrastructure will

seek to minimise noise exposure at Noise-Sensitive Places. For the purpose of this assessment the Planning Levels have been applied for all Noise-Sensitive Places.

9.4 Potential Impacts

Noise impacts associated with the B2N Project are likely to occur during both construction and operation and are outlined below.

9.4.1 Construction

Noise generated during construction will be temporary (i.e. days to months) as works areas will progress along the Project Area. In some locations activity may be concentrated for extended periods of time, such as cuttings and bridges. Works are expected to predominantly take place during daylight hours i.e. between 7am and 5pm, thereby only causing a minor impact on sensitive receptors in this phase of the development. Where night works are required, as a result of track closure limitations, nearby residents will need to be kept informed of management measures to address construction noise impacts.

Construction activities likely to generate noticeable noise are summarised in Table 51.

Table 51: Noise Generating Construction Activities

ACTIVITY TYPE	EQUIPMENT
Clearing and grubbing operations	Bulldozers, chainsaws, chippers, mulchers.
Earthworks	Graders, scrapers, excavators, rollers/compactors, haulage for the movement/ removal or importation of materials and fill.
Construction of the rail line	Cranes, water carts, concrete haulage, track-laying equipment, tamping equipment, delivery of ballast, ballast placement.
Construction of road realignments and grade separations	Graders, scrapers, excavators, rollers/compactors, haulage for the movement/ removal or importation of materials and fill.
Bridge construction	Pile driving
Materials delivery and waste removal	Trucks transporting material to and from the Project Area

It has been assumed that blasting will not be undertaken on the B2N Project, however if blasting is to occur, further impact assessment and mitigation will be required.

Some haulage routes are located adjacent to residential housing and may require to be accessed via local roads. This may cause some temporary and minor disturbance to nearby residents and local traffic.

The most noticeable noise generating activities will be construction laydown areas, loading, unloading and bulldozing during clearing activities.

Construction activities are likely to generate some localised vibration impacts that may be noticeable, though these are likely to be temporary in nature. Piling operations are likely to generate the most noticeable vibration impacts. Piling will generally occur at bridge construction sites only and local residents will be informed prior to these activities being carried out. Compactors and rollers may also generate some localised vibration. The vibrations generated and experienced will depend on the receivers' proximity to construction plant, the construction plant's operational parameters, and the duration and intensity of construction activity being carried out.

9.4.2 Operation

The Noise Assessment Report included as Appendix G reports the outcomes of the noise modelling and assessment. Noise modelling shows the LAeq,24hr noise levels are predicted to be within the Planning Level of 65dB(A) at all noise sensitive receptors identified.

The modelling shows that the Single Event Maximum Sound Level Planning Level of 87 dB(A) would be exceeded at four noise-sensitive receivers, in Coochin Hills Drive, Beerwah. The four residences are immediately south of a residential subdivision which has an existing 3.5m noise barrier.

Potential noise impacts during the operational phase are attributed to sounds generated by trains, including movement along the tracks, braking, klaxon horns, roof-top air-conditioning units and intake fans, transformers and compressors underneath trains.

Noise at upgraded stations would include public announcement systems, and both vehicle and pedestrian traffic entering and exiting the stations. However, as all stations will remain in their current location, noise level changes are predicted to be negligible.

Minor vibrations may be generated during rail carriage movement along the alignment which is a result of wheel/track interface.

Furthermore, the duplication and passing loop extensions are intended to enable more free-flowing movements on the North Coast Line. Consequently, there should be a reduced frequency of both freight and passenger trains required to wait for a passing opportunity, thus reducing the impact of noise associated with idling trains on local dwellings.

9.5 Proposed Mitigation Measures

9.5.1 Construction

Construction noise will be managed through the implementation of a CEMP, and a Compliance Management Plan. The CEMP will establish work hours, work practices, community liaison requirements, mitigation measures, roles and responsibilities and construction noise monitoring protocols.

9.5.2 Operation

In order to mitigate maximum noise levels at the four residences in Coochin Hills Drive, Beerwah, a 120m long noise barrier is proposed to the south of the existing barrier. The noise barrier would be 3.5m in height in order to attenuate locomotive noise. This height is consistent with the existing barrier. With the installation of this proposed noise barrier, Single Event Maximum Sound Levels are predicted to comply with the Planning Level.

9.6 Residual Impact Assessment

With the implementation of the mitigation measures outlined in Table 52, it is anticipated that the B2N Project's potential impacts during construction will be minor and manageable. Potential impacts during operation are anticipated to be negligible, and not significantly different to those sound levels generated by existing rail operations on the North Coast Line.

Table 52: Residual Impact Assessment, Noise and Vibration

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
<p>Noise and vibration generated by construction activities:</p> <p>Plant and vehicles, Clearing, excavation, piling</p> <p>Construction worker vehicles in residential areas</p> <p>Construction of station facilities</p>	Construction	Community disruption, sleep disturbance, impacts to protected natural areas	<p>Develop and implement a compliance management plan for noise as part of contract documentation.</p> <p>Conduct community consultation and notification prior to construction of works, providing information on the proposed works, nature of noise emissions for the construction phase, noise management measures proposed, and construction time frames. Manage noise complaints promptly and effectively and, undertake response monitoring.</p> <p>Plan construction areas, site office, access tracks etc. away from sensitive receptors or provide adequate protection/ buffering to these areas to minimise disturbance.</p> <p>Install permanent noise protection treatments as early as possible, where practicable (i.e. does not limit construction access or the nature of construction activities)</p> <p>Utilise smaller or less noise generating equipment where practical. Consider this only where the use will not extend the period of noise disruption</p> <p>Implement a noise management plan as part of the CEMP</p>	No validated complaints, reputation maintained	Short term	Possible	Minor

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Damage to buildings from vibration impacts	Construction	Structural damage, community complaints associated with piling or other ground impacting activities.	Conduct dilapidation surveys on buildings predicted to be impacted. Should community complaints identify an issue, this will require investigation/ monitoring and development of remediation / management measures. Pre-emptive vibration monitoring during construction could help to manage community concerns before complaints are raised.	No validated complaints, no structural damage that can be attributed to the construction of the B2N Project, reputation maintained	Short term	Unlikely	Minor
Vibration perceived from nearby dwellings or occupied structures	Operation	Community complaints	Should community complaints identify an issue, this will require investigation and development of management measures.	No actionable complaints, reputation maintained	Long term	unlikely	Negligible
Operational rail noise	Operation	Exceedance of rail operational noise criteria, complaints about new noise sources.	Noise monitoring and modelling has been undertaken to identify requirements for mitigation of rail noise. A 120m long noise barrier is proposed south of the existing noise barrier on Coochin Hills Drive, Beerwah.	Across the wider B2N Project, although noise barriers will mitigate noise impacts to below threshold levels where exceedances are predicted, local communities will experience the change in an existing noise source.	Long Term	Certain	Minor
Noise from associated road upgrades and grade separation	Operation	Exceedances of TMR road noise criteria, complaints about increased road noise	Noise monitoring and modelling has not included noise modelling of local roads, this should be addressed during future stages of design, particularly for the proposed realigned sections of Steve Irwin Way. It is noted that	Change in the location of noise generation, though in most cases the change is marginal.	Long Term	Certain	Minor

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			this State Controlled Road is currently undergoing planning, and noise management would be addressed as part of that project.				
Noise from operation of station precincts	Operation	Noise generated by car parking, acceleration, deceleration of trains, station announcements, conversation.	Integrate appropriate acoustic treatments into station design and PA Systems. Integrate appropriate road traffic control measures into station access design. Noise barriers are not proposed at stations due to safety and security reasons.	Localised activity in the vicinity of stations will generate some noise. The potential for increased development around some station precincts could ameliorate this issue.	Long term	Possible	Negligible
Visual amenity of noise barriers	Operation	Loss of views or vistas, interruption of breezes and shading of gardens, solar panels or solar hot water systems.	Proposed noise barriers are in keeping with the noise barrier immediately to the north. Shading is unlikely to be a concern requiring management, however consultation with adjacent property owners should be undertaken to address this issue.	Loss of views and vistas is unlikely to be mitigated for a small number of dwellings directly adjacent to proposed noise barriers.	Long Term	Certain	Minor
Noise barriers and fauna movement	Operation	Fauna access the rail corridor by climbing noise barriers or other noise treatment structures.	Noise barrier design integrates appropriate treatments in areas where habitat or vegetation abuts noise barriers. This should also include any areas where landscaping planting in front of or in the vicinity of noise barriers is proposed.	Noise barriers do not provide easy access into the rail corridor for fauna	Long term	Possible	Negligible