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Review of Environmental Factors – Update

Beerburrum to Nambour Rail Upgrade

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Abbreviations

ABBREVIATION	MEANING
ACHA	*Aboriginal Cultural Heritage Act 2003*
AEP	Annual Exceedance Probability
AHD	Australian height datum
ASR	Acid sulfate rock
ASRIS	CSIRO Australian Soil Resource Mapping
ASS	Acid Sulfate Soils
B2L	Beerburrum to Landsborough Rail Project
B2N	Beerburrum to Nambour Rail Project
BOM	Bureau of Meteorology
C2L	Caboolture to Landsborough Rail Project
CAMCOS	Caboolture to Maroochydore Corridor Study
CEMP	Construction Environmental Management Plan
CHL	Commonwealth Heritage List
CHMP	Cultural Heritage Management Plan
CLR	Contaminated land register
CPESC	Certified Professional in Erosion and Sediment Control
DAF	Department of Agriculture and Fisheries
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DES	Department of Environment and Science
DNRME	Department of Natural Resources Mines and Energy
DoEE	Department of the Environment and Energy
EHMP	SEQ Healthy Waterways Ecosystem Health Monitoring Program
EIS	Environmental impact statement
EMP	Environmental Management Plan
EMR	Environmental management register
EMS	Environmental Management System
EP Act	*Environmental Protection Act 1994*
EPBC Act	*Environment Protection and Biodiversity Act 1999*

ABBREVIATION	MEANING
EPP (Air)	*Environmental Protection Policy (Air) 2019*
EPP (Water and Wetland Biodiversity)	*Environmental Protection (Water and Wetland Biodiversity) Policy 2019*
EPP Noise	*Environmental Protection (Noise) Policy (2019)*
ESCP	Erosion and sediment control plan
EVNT	Endangered, vulnerable or near threatened
EVs	Environmental values
GDEs	Groundwater Dependant Ecosystems
GIS	Geographic information systems
GPT	Gross pollutant trap
L2N	Landsborough to Nambour
LGA	Local government area
MNES	Matters of National Environmental Significance
NC Act	*Nature Conservation Act 1992*
NEPM	National Environment Protection Measures
NHL	National Heritage List
NPI	National Pollutant Inventory
NTA	*Native Title Act 1993*
PASS	Potential Acid Sulfate Soils
PMST	Protected Matters Search Tool
Project Area	The B2N Project Area defined by TMR in October 2019
QR	Queensland Rail
REF	Review of environmental factors
REs	Regional ecosystems
RNE	Register of the National Estate
RNTC	Registered Native Title Claimant
SARA	State Assessment and Referral Agency
SAT	Spot Assessment Technique
SCC	Sunshine Coast Council
SDPWO Act	*State Development and Public Works Organisation Act 1971*

ABBREVIATION	MEANING
SEQ	South east Queensland
SEQIP	*South East Queensland Infrastructure Plan*
SPP	State Planning Policy
TEC	Threatened ecological community
TMR	Department of Transport and Main Roads
UXO	Unexploded ordnance
VM Act	*Vegetation Management Act 1999*
Water Act	*Water Act 2000*
WHL	World Heritage List
WQOs	Water quality objectives
WSUD	Water sensitive urban design

1 Introduction

1.1 Purpose

This Review of Environmental Factors (REF) was prepared in 2016 to support the Business Case for the Beerburrum to Nambour Rail Upgrade Project (the B2N Project), and has been updated in 2019 to address changes in legislation and the B2N Project design. The REF describes the existing environmental and heritage values within the Project Area as of October 2019, identifies and assesses potential impacts of the B2N Project proposal, and proposes management and mitigation measures. The REF also describes the methods adopted and investigations undertaken to support preparation of the REF, and highlights residual matters requiring further investigation, assessment, management or mitigation in future stages of the B2N Project development and implementation.

The REF has been prepared in accordance with the Department of Transport and Main Roads (TMR) *Environmental Processes Manual* (2013).

1.2 Project Background

The Beerburrum to Landsborough (B2L) section of the North Coast Line is part of the Australian Government's National Land Transport Network. This section caters for a complex mix of traffic with various operating characteristics and stopping patterns, including:

- high speed tilt trains
- commuter services
- long distance passenger services
- containerised freight services
- heavy haulage single commodity trains
- historic recreational services
- cattle trains.

This section of the North Coast Line is forecast to experience the second highest passenger growth rate on the South East Queensland (SEQ) network, however the ability to effectively meet passenger and freight transport demand is hindered by its predominantly single track configuration and poor horizontal and vertical alignment.

The B2N Project builds upon work originally commenced under two separate rail upgrade programs:

- Caboolture to Landsborough Rail Project (C2L) – 2001 to 2009
- Landsborough to Nambour Rail Project (L2N) – 2006 to 2010

1.2.1 Caboolture to Landsborough Rail Project

C2L commenced in 2001. The aim of C2L was to upgrade and duplicate the North Coast Line between Caboolture and Landsborough in response to the need to improve passenger and rail freight services as identified in the *Integrated Regional Transport Plan* (1997). The first stage between Caboolture and Beerburrum was completed and commissioned in 2009.

In 2007, the Beerburrum to Landsborough Track Duplication (B2L) was identified as one of 28 rail projects that formed part of Queensland Rail's *South East Queensland Infrastructure Plan* (SEQIP) Rail program. At that time, Queensland Rail engaged the TrackStar Alliance (TrackStar) to undertake the planning, design and construction of the B2L project. In 2009, before construction could commence, funding for the project was withdrawn and redirected to higher priority drought relief infrastructure projects. In 2011, the corridor identified by TrackStar was formally preserved as 'future railway land' by way of Government Gazette.

1.2.2 Landsborough to Nambour Rail Project

The need to upgrade the North Coast Line between Landsborough and Nambour (L2N) was originally identified in the *SEQ Regional Plan 2005-2026*, the *SEQ Infrastructure Plan and Program 2005-2026*, the *Draft TransLink Network Plan 2005*, and the *Rail Network Strategy for Queensland 2001-2011*. The Landsborough to Nambour (L2N) Rail Corridor Study commenced in 2006, and included route studies, the preparation of a reference design and Environmental Impact Statement for a corridor that may accommodate up to four tracks. The resultant corridor between Landsborough and Nambour is now identified in the State Assessment and Referral Agency (SARA) Development Assessment mapping system as 'future public passenger transport corridor'.

1.2.3 Beerburrum to Nambour Rail Upgrade

The need for improvements to the operation of the North Coast Line is recognised by the Queensland Government, including *Connecting Queensland 2031* (2011), and re-affirmed more recently in the *South East Queensland Capacity Improvement Study* (TMR, 2014) and the *South East Queensland's Rail Horizon* (2016). Furthermore, the *North Coast Line Capacity Improvement Project* (Ranbury, 2015) also identified infrastructure and non-infrastructure solutions for improving capacity on the North Coast Line.

Although the B2L c project was effectively placed on hold in 2009 due to funding constraints, the need for improvements to operation of the North Coast Line was recognised by government and the community. Consequently, a Strategic Analysis of Service Requirements and Preliminary Evaluation were prepared under the Queensland Government's project assurance framework. This included the development of a business case for the Beerburrum to Nambour Rail Upgrade Project in 2016 that investigated the duplication of the North Coast Line between Beerburrum and Landsborough and additional upgrades to the existing infrastructure between Landsborough and Nambour.

1.3 B2N Project Location and Description

The B2N Project is located in the Sunshine Coast Hinterland, shown in Figure 1. It involves:

- duplication of the North Coast Line between Beerburrum and Landsborough
- upgrade of existing stations at Mooloolah Valley, Eudlo, Palmwoods and Woombye
- road realignments where the local road network is impacted by the duplication
- removal of the existing Barrs Road and Caloundra Street level crossings and replacement with grade separation
- passing loop extensions north of Landsborough Station, south of Eudlo Station and south of Woombye Station
- expansion of park and ride facilities at Beerburrum, Landsborough, Palmwoods and Nambour Stations.

The B2N Project will also require new or extended crossings of waterways including Tibrogargan, Coonowrin, Coochin, Blue Gum, Mellum, Addlington and Acrobat Creeks, with crossing structures intended to facilitate fauna passage. Several existing culverts and bridges will be removed from redundant sections of the existing rail corridor once the new corridor is operational.

Passing loops north of Landsborough to Nambour will be located within the existing North Coast Line rail reserve, with station upgrades planned at the current station locations. The Landsborough to Nambour (L2N) Future Public Passenger Transport Corridor protected in 2011 will remain protected, so that it may be implemented in the future.

The expansion of park and ride facilities will occur predominantly within rail reserve, however some additional land may be required.

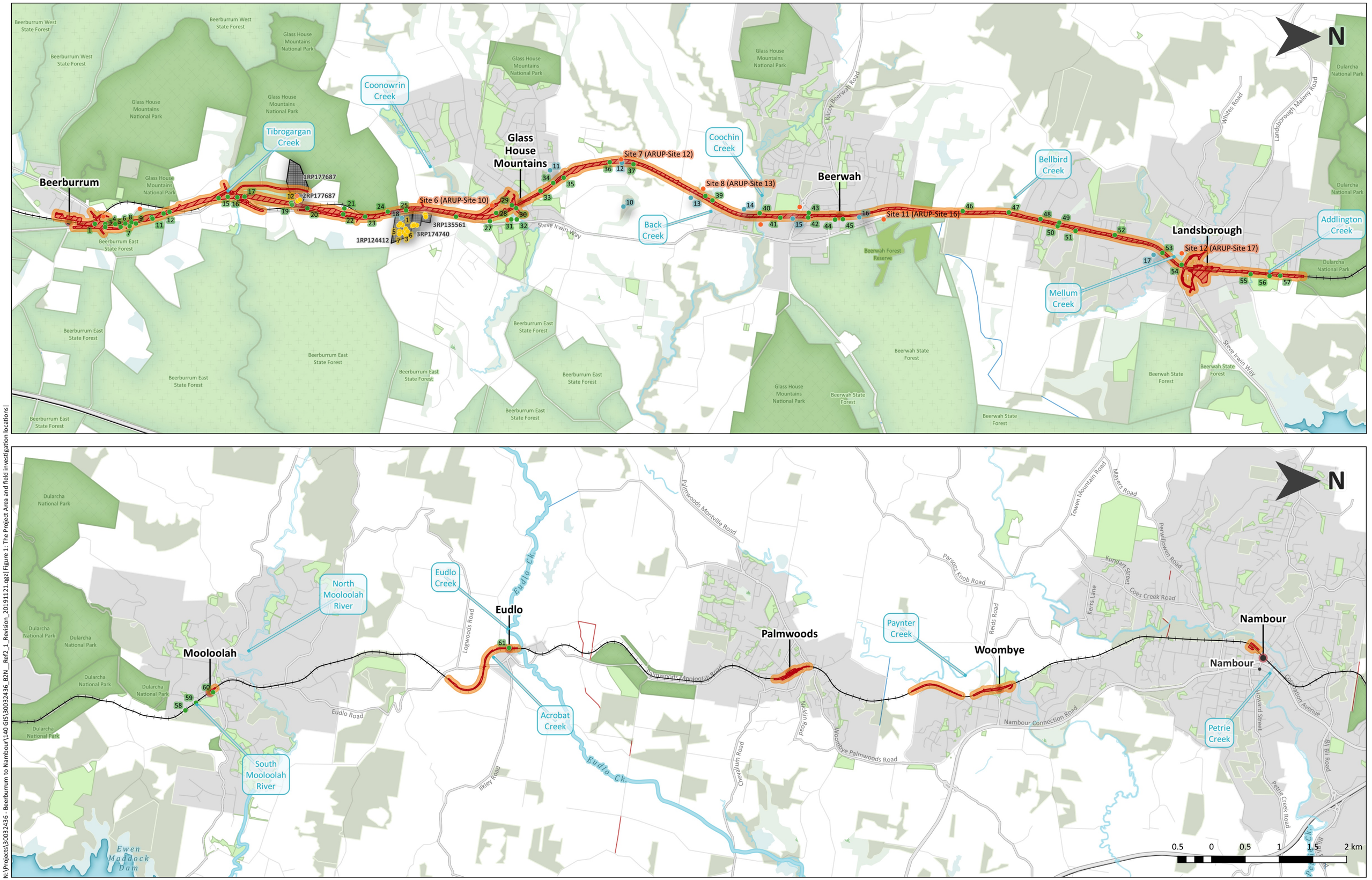
Road realignments proposed between Beerburrum and Landsborough extend beyond the protected corridor. These include realignments at Beerburrum St/ Red Road/ Steve Irwin Way, and also Berteaus Road/ Caves Road, near the Matthew Flinders Rest Area and State Forest Nursery. The Steve Irwin Way will also require realignment to the east between the Matthew Flinders rest area and Moffats Road. As part of the updated design in 2019, TMR are also investigating the possibility of an overpass at Barrs Rd and an underpass (rather than the overpass) at Landsborough, but these are not confirmed.

Table 1 summarises the B2N Project elements assessed in this REF, with property impact discussed further in Chapter 10 Land Use and Planning.

Table 1: Project Elements

LOCATION	PROJECT ELEMENTS
Beerburrum Station	• Expansion of park and ride facilities
Beerburrum to Glass House Mountains Station	• Duplication on improved alignment, utilising parts of the existing and protected corridor. • Road realignments at Beerburrum St/ Red Road/ Steve Irwin Way, Berteaus Road/ Caves Road and the Steve Irwin Way between the Matthew Flinders Rest Area and Moffats Road. • Bridges/ structures at Tibrogargan Creek. • Replacement of Barrs Road Level Crossing, with a road bridge over Coonowrin Creek and new connection to Coonowrin Road on the west of existing railway. • Reconstruction of the Burgess Street road bridge south of its current location. • Provision of fauna passage at new bridges and culverts.
Glass House Mountains to Landsborough	• Duplication of the existing alignment predominantly utilising the existing corridor, with some provision of fauna passage where practical at new or extended culverts.
Landsborough Grade Separation	• Replacement of Caloundra Street level crossing with grade separation (road over rail bridge) to the south of the existing level crossing, crossing old Landsborough road and connecting into Stephens Street/ Maleny Street.
Landsborough Park and Ride	• Extension of Landsborough station car parking on western side of station. • New park and ride facilities on the eastern side of the station.
Landsborough Passing Loop	• Extension of the duplicated track (passing loop) from Gympie Street North for approximately 1km, entirely within the existing rail corridor. A new/extended crossing of Addlington Creek will be required. Passing loop works end at a point between the two sections of Dularcha National Park, with no physical intrusion into the National Park boundary.
Mooloolah Station	• Station upgrade to replace existing platform with dual platforms connected by lifts and overbridge. • The existing timber overbridge will remain in situ.
Eudlo bridge replacement and passing loop	• Extension of the passing loop south of Eudlo Station, and replacement/ duplication of the Highland Road/ Acrobat Creek rail bridge.
Eudlo Station	• Station upgrade to replace existing platform with dual platforms connected by lifts and overbridge. • Federation Walk has been identified as a spatial constraint to station layout.
Palmwoods Station	• Station upgrade to replace existing platform with dual platforms connected by lifts and overbridge. • Expansion of park and ride facilities. • Reconfiguration of track to improve train operations.
Woombye passing loop	• Extension of the passing loop south of the station, to integrate with the new Woombye stabling yard.
Woombye Station	• Station upgrade to replace existing platform with island platform connected by lifts and overbridge.
Back Woombye Road	• Closure of eastern section of Back Woombye Road, and extension of Barts Street to connect at road underpass (height restricted bridge remains).
Nambour	• Expansion of Park and Ride facilities on the western and eastern sides of Nambour Station.

N:\Projects\30032436 - Beerburrum to Nambour\140 GIS\30032436_82N__Ref2_1_Revision_20191121.qgz | Figure 1: The Project Area and field investigation locations



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PAGE SIZE	A3
DATE	21-11-2019
CREATED BY	EH11799
SOURCES	QLD Govt

- Current rail line
- Project Area
- Project Area 50m Buffer
- Additional Project Areas
- Forest Reserve
- National Park
- State Forest
- Reserve

Survey Sites
- WBM 2006
- Trackstar 2007
- SMEC 2016
- SMEC 2019

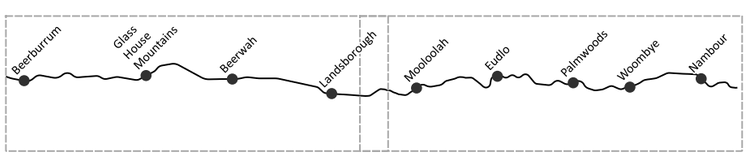


Figure 1: The Project Area and field investigation locations

1.4 Related Projects

The following projects are either spatially or operationally relevant to the B2N Project.

1.4.1 Woombye Stabling Yard

Queensland Rail is currently constructing a new stabling yard south of Woombye station to accommodate up to four six-car trains. The need for additional stabling on the North Coast Line was identified in the South East Queensland Stabling Project, undertaken to accommodate 75 new suburban six-car trains across the South East Queensland City network. Construction of the Woombye Stabling Yard is expected to be complete in 2016.

1.4.2 Nambour Station Upgrade

Nambour Station is being upgraded as part of the Queensland Rail Station Accessibility Upgrade Program. The station upgrade is designed to achieve independent accessibility, meaning that all train platforms can be accessed by passengers independently via paths, ramps or lifts, without the need to use stairs. Construction commenced in early 2016 with preliminary works to build a temporary train platform and shuttle bus stop.

1.4.3 Sunshine Coast Line - Beerwah to Maroochydore (CAMCOS)

The CAMCOS Study, originally completed in 2001 identified a corridor between Beerwah to Maroochydore, which is protected in (SARA) Development Assessment mapping system as 'future public passenger transport corridor'. The Sunshine Coast Line is identified in Connecting SEQ 2031 as providing services between the Sunshine Coast and Brisbane 'in about one hour', recognising 'For South East Queensland, rail investment must be strongly matched to economic development, land use and urban development policies to ensure that the necessary jobs are created in the growing coastal cities.' The Sunshine Coast Line is planning to join the North Coast Line north of Beerwah Station, requiring upgrade works in that location to not preclude the future interconnection with the proposed inter-city rail service.

1.4.4 North Coast Connect Faster Rail

The Australian Government announced the Faster Rail Connecting Capital Cities and Orbital Regional Centres Initiative in 2017-2018. The Initiative's objective was to explore improvements to passenger rail connections via business cases that demonstrate faster rail travel times through new or upgraded rail infrastructure. Under this initiative, the North Coast Connect Consortium (NCCC) completed a business case in early 2019 that investigated options for faster passenger rail from Brisbane to the Moreton Bay and Sunshine Coast regions. It incorporates Stage 1 (Brisbane to Beerburrum), Stage 1b (Beerburrum to Nambour – B2N), and Stage 2 (CAMCOS). The rail upgrade is deemed a 'short term priority initiative' of national significance, based on the population growth and projected high commuter volumes along this corridor.

1.4.5 Steve Irwin Way Upgrades

The B2N Project requires realignment of sections of the Steve Irwin Way, including the Red Road intersection, and a section between the Matthew Flinders Rest Area and Moffats Road. TMR is currently conducting preliminary investigations into upgrading sections of the Steve Irwin Way.

1.4.6 Cross River Rail

The Cross River Rail Business Case is currently with the Queensland Government for consideration. Whilst not related spatially to the B2N Project, the overall functionality of the South East Queensland rail network is dependent on the capacity improvements that Cross River Rail will deliver.

2 Assessment Process

The primary objective of this REF is to document the existing conditions, impacts and management measures for consideration in the Business Case, including further assessment and approval processes and the associated costs for the application of mitigation measures. The REF was prepared in 2016 in parallel with the Business Case design, documenting impacts and management measures based on available design information at the time of writing. It has subsequently been updated in October 2019 to reflect changes in legislation and the B2N Project design. Future design refinements or refinements as part of detailed design may result in the need to revisit these assessments and conclusions.

The following tasks have been delivered as part of the preparation of the REF:

- review of existing information, including review of previous reports, desktop research and analysis, GIS and spatial analysis
- preparation of a scoping review, identifying the key issues requiring consideration in design and environmental management
- field work scoping and definition of land access requirements
- field work including rapid ecological investigations, noise monitoring, cultural heritage
- input into design development
- identification of environmental, social and cultural heritage constraints and issues, based on desktop research and targeted field investigations in 2016 and 2019
- identification of potential impacts and risks as a result of the B2N Project
- identification of appropriate mitigation and management measures for the construction and operation phases of the B2N Project
- identification of future work requirements to ensure environmental, social and cultural heritage matters are addressed in subsequent phases of delivery.

This REF also addresses the following actions recommended in the Preliminary Evaluation:

- targeted flora and fauna surveys
- identification of requirements for species management programs and offsets
- identification of requirements for referral under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
- consideration of works at waterways and structures/ crossing requirements
- cultural heritage risk assessment and updated heritage assessments of state and local government listed heritage features and places
- searches of the contaminated land register and the environmental management register.

2.1 Spatial Extents

A broad area of interest between Landsborough and Nambour was adopted to enable identification of environmental values. Within this area, the Project Area was defined as the updated footprint provided by TMR in October 2019. Survey locations were identified within the Project Area for ecological, noise and geotechnical investigations. The Project Area was used for the description of impacts and mitigation measures. Where appropriate, a buffer was applied to the Project Area. The width of the buffer varied with the assessment and is described in the relevant Chapter.

2.2 Structure of the REF

This REF has been structured to present all available and pertinent information about the potential environmental impacts and management measures at the time of the preparation of the Business Case and subsequent update in 2019. Table 2 lists the various aspects addressed under this assessment of the B2N Project.

Table 2: REF Structure

ASPECT	PROJECT ELEMENTS
Environmental Scoping Review	An Environmental Scoping Review was prepared in accordance with the TMR Environmental Scoping report template to determine the level of risk and investigation warranted for each environmental matter under consideration. This is included in Appendix A of this REF.
Existing Environment	The existing conditions and features are documented in Chapters 3 to 12, based on desktop research and analysis, targeted field investigations and review of previous studies and reports relevant to the Project Area. The Flora and Fauna Field Investigation report is included in Appendix B of this REF.
Potential Impacts	Potential impacts of the B2N Project have been identified and assessed for each environmental aspect based on desktop assessment, field assessments and Project description. Potential impacts are also documented in Chapters 3 to 12.
Mitigation Measures	Mitigation measures identified in response to the potential impacts are identified in Sections 3 to 12. These may be relevant to the design, construction, operation or all phases of the B2N Project.
Residual Impacts	An assessment of the risk of residual impact is also contained in Chapters 4 to 9, and 12 of the REF, considering the potential for impacts after mitigation has been applied.
Approvals and Legislative Review	Approvals and legislative considerations are included in Chapter 13 of the REF. This identifies the permits, approvals and processes relevant to environmental assessment and management during subsequent stages of the B2N Project.
EMP	The Environmental Management Plan (EMP) is included as Appendix C, providing a framework for ongoing environmental management during future stages of design and construction.
Cultural Heritage Risk Assessment	A Cultural Heritage Risk assessment has been prepared by Niche Environment and Heritage. This is included as Appendix D.
Heritage Impact Assessment	A historic heritage impact assessment has been prepared by Niche Environment and Heritage. This is included as Appendix E and a separate assessment of the Beerburrum Station Master's House is included as Appendix F.
Noise Assessment	An operational noise assessment has been prepared by Wilkinson Murray, which is included as Appendix G.

2.3 Impact Assessment Method

To enable consistency across assessment topics in this REF, the impact and risk assessment process illustrated in Figure 2 has been adopted. The assessment framework and criteria adopted for the B2N Project are in accordance with the TMR Risk Assessment Process in use in 2016 and which are still applicable in 2019.

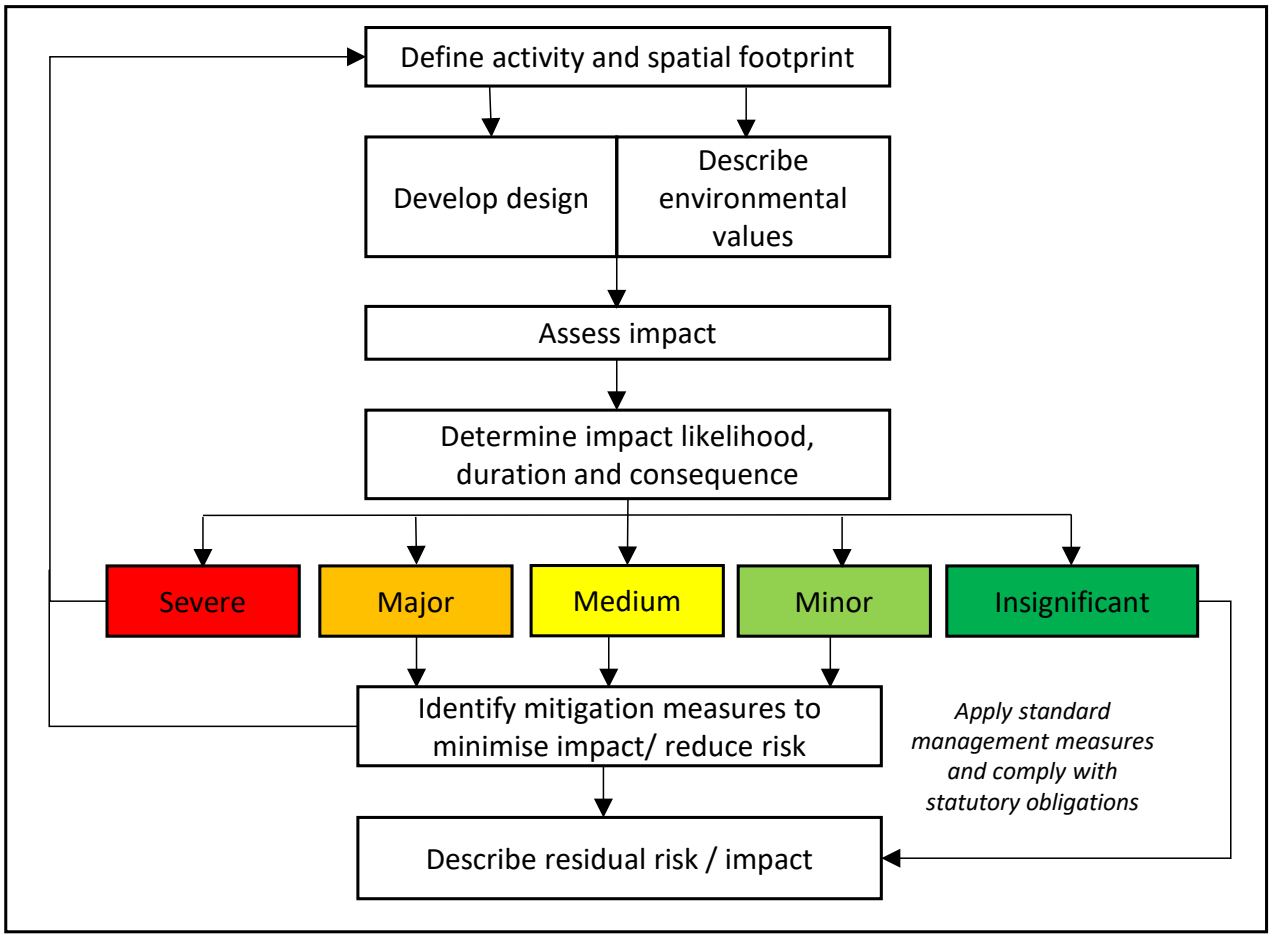


Figure 2: Impact assessment process adopted in this REF

The relative duration of impacts is described in Table 3.

Table 3: Impact duration criteria

DESCRIPTION	DURATION
Temporary	Days to months
Short term	Up to one year
Medium term	From one to five years
Long term	From five to 50 years
Permanent/ irreversible	In excess of 50 years

The impact likelihood criteria adopted for the B2N Project is described in Table 4, and impact consequence is described in Table 5.

Table 4: Impact likelihood criteria

LIKELIHOOD	BRIEF DESCRIPTION	EXPECTED OR ACTUAL FREQUENCY EXPERIENCED (TMR RISK ASSESSMENT AND RATING MATRIX)
Rare	Highly unlikely to occur but theoretically possible.	This event may have happened previously in TMR or in 'like' organisations. However, in the absence of other information or exceptional circumstances it would not be expected to happen in TMR in the foreseeable future. There is less than a 5% chance of the event happening in the next 12 months. It is likely to occur less than once in 15 years.
Unlikely	May occur during construction/life of the Project but not an anticipated outcome.	The event has occurred infrequently in TMR or 'like' organisations. Current controls and circumstances suggest the occurrence would be considered highly unusual. There is between a 5 to 30% chance of the event happening in the next 12 months. It is likely to occur once in eight to 20 years.
Possible	Conditions exist for the impact to occur.	This event may have occurred occasionally in TMR or 'like' organisations. Current controls or circumstances suggest there is a distinct possibility of occurrence. There is between a 30 to 60% chance of the event happening in the next 12 months. It is likely to occur once in five to seven years.
Likely	Greater than 50% chance of occurring during construction or operation.	This event may have occurred in TMR or 'like' organisations on a regular basis. With current controls or circumstances you can expect occurrence within the financial year. There is a 60 to 90% chance of the event happening in the next 12 months. It is likely to occur once in one to four years.
Almost Certain	Very likely to occur as a result of the proposed Project construction and/or operations; could occur multiple times during relevant impacting period.	This event occurs frequently within TMR or with current controls or circumstances you expect an occurrence. There is a greater than 90% chance of the event happening in the next 12 months. It is likely to occur at least once over the next 12 months.
Certain	The impact will occur as a result of the Project.	Not included in TMR framework.

Table 5: Impact consequence

CONSEQUENCE	DESCRIPTION	TMR RISK ASSESSMENT FRAMEWORK		
		Environmental and Cultural Impacts	**Media and Reputational**	**Legal and Compliance**
Severe	These impacts are considered critical to the decision making process. They tend to be permanent, or irreversible, or otherwise long term, and can occur over large scale areas. Receptors are extremely sensitive, and/or the impacts are of national significance.	The event will permanently impact on the environment, air quality or community health. The impact covers a wide area and is difficult to contain. The effects are irreversible. Threat to survival of flora, fauna and/or cultural heritage.	Significant adverse community impact and condemnation (months). Consistent extreme negative media attention (months). Irreconcilable community loss of confidence in the organisation's intentions and capabilities and possibly in government Public Government intervention.	Will result in significant litigation activities and fines. May involve class actions. Will result in a major breach (noncompliance) with regulation/legislation that requires parliamentary enquiry.
Major	These impacts are of importance in the decision making process. They tend to be permanent, or otherwise long to medium term, and can occur over large or medium scale areas. Receptors are high to moderately sensitive, and/or the impacts are of State significance.	Medium to long-term impact on the environment, air quality or community health. Impacts cover a wide area but can be contained. Able to be remedied but will require dedicated expert resources	Considerable and prolonged community impact and dissatisfaction publically expressed. Community loss of confidence in the organisation's capabilities (weeks). Consistent negative media attention (weeks). Ministerial intervention	May result in litigation, requiring significant dedicated time by legal counsel to address liability and consequences. Will result in a major breach (noncompliance) with regulation/legislation.
Moderate	These impacts are relevant to decision making, particularly for determination of environmental management requirements. These impacts tend to range from long to short term, and occur over medium scale areas or focused within a localised area. Environmental receptors are moderately sensitive, and/or the impacts are of regional or local significance.	Medium-term impact on the environment, air quality or community health, limited to a small area. Able to be remedied but may require intervention or management by external parties.	Sectional community impacts and concerns publicly expressed (days). Negative media attention (days). Loss of confidence by the community in the organisation's processes. Ministerial concern expressed.	Would result in a serious issue requiring investigation and advice into legal liability. May require external counsel advice. Will result in non-compliance with regulation or legislation.
Minor	These impacts are recognisable, but acceptable within the decision making process. They are still important in the determination of environmental	Short-term impact on the environment, air quality or community health, limited to a small area.	Local community impacts and concerns. Occasional once off negative media attention.	Would result in more complex legal issues but these are able to be managed by in-house legal staff.

CONSEQUENCE	DESCRIPTION	TMR RISK ASSESSMENT FRAMEWORK		
	management requirements. These impacts tend to be short term, or temporary and at the local scale.	Able to be remedied through existing process. Minimal threat to fauna, flora or cultural heritage.	Isolated local community concerns.	May result in minor non-compliance with regulation/legislation.
Insignificant	Minimal change to the existing situation. This could include for example impacts which are beneath levels of detection, impacts that are within the normal bounds of variation or impacts that are within the margin of forecasting error.	No measurable effect on the environment, air quality or community health. No action required for management or containment Minimal threat to fauna, flora or cultural heritage	Individual's issue-based concerns. No media coverage	Issues arise but are able to be managed by routine procedures. Would not affect compliance with regulation or legislation.
Beneficial	Any beneficial impacts as a result of the Project such as the creation/establishment of new habitat (e.g. re-vegetation or habitat creation), can be assessed as beneficial outcomes of the Project.	Not included in TMR framework	Not included in TMR framework	Not included in TMR framework

Whilst the TMR risk evaluation matrix has been adopted, likelihood criteria for 'certain' has been added to the framework for the B2N Project, given the known nature of some impacts. This adapted risk evaluation matrix is provided in Table 6.

Table 6: Risk evaluation matrix

CONSEQUENCE	LIKELIHOOD					
	Rare	**Unlikely**	**Possible**	**Likely**	**Almost Certain**	**Certain**
Severe	High	High	High	Extreme	Extreme	Extreme
Major	Medium	Medium	High	High	Extreme	Extreme
Moderate	Medium	Medium	High	High	High	High
Minor	Low	Low	Medium	Medium	High	High
Insignificant	Low	Low	Low	Medium	Medium	Medium

The TMR criteria for determining risk treatments and assessment of residual risk has also been applied, as shown in Table 7.

Table 7: Risk treatment criteria

RISK SIGNIFICANCE	CRITERIA	
	Initial Impact (before mitigation)	**Residual Impact (post mitigation)**
Low	In the absence of project-specific mitigation measures, works are likely to result in only minor, short-term impacts to a factor of limited significance. Standard environmental management measures suitable risk management.	Implementation of recommended mitigation measures may still result in impacts occurring but are likely to be minor and / or short-term in nature.
Medium	In the absence of project-specific mitigation measures, major but recoverable impacts to a factor of significance are likely. Site-specific management of this risk is required.	Implementation of recommended mitigation measures may reduce the severity of impacts but are still likely to result in major impacts of short / medium duration.
High	In the absence of project-specific mitigation measures, large-scale, long-term and / or irreversible impacts to a factor of high significance are likely. A project shall consider methods of avoidance, mitigation and management for high significance risks. It may be necessary to consult administrating authorities and public consultation to manage reputational impacts.	Implementation of recommended mitigation measures is unlikely to significantly reduce impacts such that large-scale, long-term and / or irreversible impacts to a factor of high significance are likely.
Extreme	In the absence of project-specific mitigation measures, serious environmental harm will occur/department-wide reputational impacts will occur. A project shall not proceed with an Extreme environmental risk.	Implementation of recommended mitigation measures will not reduce impacts. A project shall not proceed with an Extreme environmental risk.

3 Climate and Climate Change

3.1 Introduction

This Chapter discusses the climatic conditions to be taken into consideration during the design, construction and operational phases of the B2N Project. It also considers the risks of climate change and adaptation measures that should be addressed in future stages of B2N Project implementation.

3.2 Assessment Methods

Climate data for the Project Area was compiled from meteorological records obtained from the Bureau of Meteorology for the Beerburrum Forest, Landsborough and Nambour Weather Stations and comprises the following:

- average monthly rainfall and evaporation
- average monthly high and low temperatures (Beerburrum Forest and Nambour)
- average monthly wind speed and direction at 9 am and 3 pm (Beerburrum Forest).

This information was then interpreted to describe the climate conditions across the length of the Project Area.

Data has also been reviewed from the following sources:

- Climate Change Risks to Australia's Coast (Department of Climate Change, 2009)
- Adaptation of Melbourne's Metropolitan Rail Network in Response to Climate Change (AECOM 2011)
- Adaptation Science: Opportunities and Responses to Climate Change Impacts (CSIRO 2010)
- Climate Q: toward a greener Queensland (Queensland Government)
- *Climate Change in Australia* CSIRO and Bureau of Meteorology, website, cited September 2019
- State Development Assessment Provisions (DILGP 2016)
- State Planning Policy (SPP) (DILGP 2016)
- SPP Mapping, Bushfire Hazard Maps
- Sunshine Coast Council (SCC) Bushfire Hazard and Flood Hazard overlays.

3.3 Existing Climate Conditions

3.3.1 Rainfall

Records for the most recent ten years have been sourced where available, showing monthly, annual and mean monthly rainfall for each year. Mean monthly rainfall is highest between December and March coinciding with the warmer summer months and lowest between July and September coinciding with winter (see Table 8 to Table 10). This trend is indicative of a wet season in warmer periods, however unseasonal heavy rainfall events have also occurred during the traditionally drier months.

Table 8: Mean monthly rainfall: ten years, Beerburrum Forest Weather Station

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	MEAN
2010	100.0	392.6	285.6	136.6	62.4	12.6	43.4	82.2	103.4	287.8	80.6	531.4	2118.6	176.6
2011	675.4	122.6	181.8	132.2	81.0	31.6	16.4	64.8	17.6	72.4	24.6	324.8	1745.2	145.4
2012	555.0	289.0	340.8	128.6	66.8	237.4	62.2	0.8	26.0	22.2	67.4	22.0	1818.2	151.5
2013	413.6	454.8	161.6	182.4	93.2	125.2	61.8	0.2	35.0	31.2	73.2	63.6	1695.8	141.3
2014	91.0	56.4	263.8	137.8	79.8	18.2	13.4	132.8	43.4	28.8	80.8	100.8	1047.0	87.3
2015	309.0	568.0	41.4	157.4	309.8	62.2	8.8	58.0	94.2	91.8	104.2	34.6	1839.4	153.3
2016	111.4	49.2	131.4	68.8	80.6	310.6	24.2	26.0	87.0	28.4	38.4	66.4	1022.4	85.2
2017	118.0	65.0	363.8	15.8	90.2	71.2	26.2	15.8	10.0	268.0	146.0	211.2	1401.2	116.8
2018	48.2		215.0	48.0	45.6	44.0	25.8	31.6	27.2	205.4	9.8	95.0	-	72.3
2019	6.6	64.4	202.0	150.4	60.4	83.6	33.8	5.8	-	-	-	-	-	75.9
Mean	242.8	229.1	218.7	115.8	97.0	99.7	31.6	41.8	49.3	115.1	69.4	161.1	1586.0	-

Table 9: Mean monthly rainfall: ten years, Landsborough Weather Station

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	MEAN
2010	-	-	-	-	-	-	-	-	-	-	116.1	696.2	-	-
2011	720.5	160.0	213.7	276.0	85.6	28.4	40.6	106.8	20.0	86.6	82.2	350.5	2170.9	180.9
2012	533.2	451.2	542.8	147.0	72.2	233.6	74.2	0.4	20.4	20.4	75.2	34.2	2204.8	183.7
2013	522.6	543.8	221.2	143.8	126.6	159.0	84.0	0.2	37.8	28.0	81.4	45.0	1993.4	166.1
2014	96.2	33.0	333.2	90.4	67.2	16.4	10.0	164.8	68.2	13.8	68.5	158.0	1119.7	93.3
2015	-	-	34.6	199.0	202.6	58.6	25.6	103.4	50.0	118.8	107.4	76.4	-	97.6
2016	201.6	134.4	99.2	46.2	87.0	288.0	20.6	21.4	96.6	20.0	33.0	56.2	1104.2	92.0
2017	136.8	52.6	491.9	30.3	77.0	50.2	19.8	14.2	7.6	359.2	216.4	206.0	1662.6	138.5
2018	35.0	400.0	259.6	63.6	116.8	83.2	40.4	12.6	53.4	355.6	17.2	167.8	1605.2	133.8
2019	6.2	70.0	301.2	212.4	61.0	222.6	34.8	14.2	-	-	-	-	-	115.3
Mean	281.5	230.6	277.5	134.3	99.6	126.7	38.9	48.7	44.3	125.3	88.6	198.9	1694.4	-

Table 10: Mean monthly rainfall: ten years, Nambour Weather Station

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	MEAN
2010	115.8		529.5	158.5	54.8	23.0	38.0	77.9	117.0	335.9	102.9	615.6	-	197.2
2011	692.4	189.9	174.8	187.9	83.0	31.8	35.0	150.8	18.7	76.7	67.0	279.5	1987.5	165.6
2012	592.0	438.7	545.1	111.6	66.0	223.0	79.8	0.0	20.3	25.6	81.1	32.2	2215.4	184.6
2013	352.9	535.9	204.3	209.8	106.6	141.1	74.1	0.6	43.5	37.0	83.7	42.8	1832.3	152.7
2014	68.3	44.8	359.4	114.4	83.9	23.1	12.5	161.1	33.8	15.2	127.3	142.4	1186.2	98.9
2015	292.4	499.0	66.8	239.9	177.4	71.8	18.7	90.5	63.7	88.9	89.4	55.4	1753.9	146.2
2016	175.3	63.4	214.2	55.3	73.8	288.0	40.2	39.0	76.7	14.9	19.1	79.5	1139.4	95.0
2017	89.0	70.1	385.9	-	68.6	36.7	21.5	4.7	6.2	370.6	181.3	213.5	-	131.6
2018	48.4	423.2	244.4	70.2	147.3	70.6	30.9	14.4	-	337.8	40.4	-	-	142.8
2019	24.9	102.5		210.1	68.4		58.4	11.8						79.4
Mean	317.5	282.6	264.4	174.9	116.7	115.3	56.7	61.0	55.8	89.0	114.5	168.2	1781.2	-

3.3.2 Temperature

The Beerburrum Forest weather station is located at the southern extent of the Project Area, with Nambour weather station located at the northern end. For the Beerburrum end of the Project Area average monthly maximum and minimum temperatures are 30.0°C and 19.3°C respectively during the summer months and 22.3°C and 9.9°C respectively in the peak of the winter months. On the Nambour end of the Project Area average monthly maximum and minimum temperatures are 29.2°C and 20.2°C respectively during the summer months and 22.2°C and 11.0°C respectively in the winter months. Records are shown in Table 11 and Table 12.

Table 11: Mean temperatures since 1999 for Beerburrum Forest Weather Station

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Season	Summer*			Autumn			Winter			Spring		
Mean Maximum Temp. (°C)	29.7	30.4	29.8	28.7	26.5	24.1	21.7	21.8	23.3	26.0	27.5	28.5
Mean Minimum Temp. (°C)	18.4	19.7	19.9	18.7	15.7	12.7	10.8	9.4	9.4	12.0	14.6	16.5
Seasonal Means	30.0 maximum 19.3 minimum			26.4 maximum 15.7 minimum			22.3 maximum 9.9 minimum			27.3 maximum 14.4 minimum		

Table 12: Mean temperatures since 2007 for Nambour Weather Station

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV
Season	Summer*			Autumn			Winter			Spring		
Mean Maximum Temp. (°C)	28.9	29.5	29.1	28.0	26.2	23.8	21.7	21.6	23.2	25.4	26.5	28.4
Mean Minimum Temp. (°C)	19.4	20.5	20.6	19.8	16.9	13.5	11.8	10.6	10.6	13.4	15.4	17.8
Seasonal Means	29.2 maximum 20.2 minimum			26.0 maximum 16.7 minimum			22.2 maximum 11.0 minimum			26.8 maximum 15.5 minimum		

3.3.3 Wind Records

Beerburrum Forest was the only weather station with wind data situated within the immediate vicinity of the B2N Project Area and therefore is most representative of wind speeds in the area. Wind speeds are recorded at 9am and 3pm for each day. The months of September through to January show higher average wind speeds at both time recordings, whilst months May through to July show lower average speeds. Wind speeds are also on average slower at the 9am time interval for all months in comparison to the 3pm recordings, this is a general response to increased temperatures during the day fuelling convection currents in the atmosphere. Table 13 illustrates these records.

Wind roses showing wind direction were reviewed from outside the Project Area from the Brisbane weather station (closest in proximity to the B2N Project) with 9am recordings displaying primarily southerlies and south-westerlies and 3pm recordings easterlies and north-easterlies.

From a topographical point of view, the Beerburrum to Landsborough section of the Project Area is relatively flat and would experience similar wind speed conditions to those described by the Beerburrum weather station. The Landsborough to Nambour section cuts through the foothills of the range. Wind dynamics through this section are expected to be more variable due to the influence the terrain.

Table 13: Average wind speed records: eleven years, Beerburrum Forest Weather Station

STATISTIC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Mean 9am wind speed (km/h)	8.1	6.8	7.1	6.5	5.3	5.5	5.6	6.6	8.2	8.5	8.2	8.1
Mean 3pm wind speed (km/h)	10.3	9.2	9.2	7.8	6.9	6.8	7.3	8.9	10.3	10.7	10.5	10.3

3.4 Long Term Trends

Climate forecasts documented in Climate Q: toward a greener Queensland and CSIRO and Bureau of Meteorology, Climate Change in Australia website (http://www.climatechangeinaustralia.gov.au/en/) were reviewed during the preparation of this REF. These sources indicate that the Project Area is within the area predicted in the medium to long term to experience increased temperatures across all seasons (mean temperature increased by around 1°C from 1910 to 2013 in the northern part of the east coast of Australia), increase in the number of days above 35°C and an increase in the frequency and intensity of severe weather events, including drought and extreme rainfall events.

The Project Area is not located within a Coastal Management District, and is inland from coastal hazard areas mapped under the Queensland SPP. Consequently, sea level rise has not been considered as directly influential in this phase of the B2N Project.

The Project Area traverses mapped Bushfire Hazard areas, with large extents of very high potential bushfire intensity correlated to areas of State Forest and remnant vegetation. Climate factors influencing bushfire risk include high temperatures, decreasing humidity, drought periods, hot and dry north to westerly winds, and lightning strike (Maunsell 2008). Areas of State Forest under the management of HQ Plantations Queensland are regularly subject to fuel reduction burns, within plantation areas.

3.5 Potential Impacts

Future climatic trends may impact human health and activity, ecosystem health and biodiversity, function and longevity of rail infrastructure. This REF identifies the potential impacts of existing and future climatic conditions relevant to the delivery of the B2N Project.

Hazards and risks associated with existing and projected climatic conditions include construction phase impacts, weather induced infrastructure degradation and extreme weather induced damage.

3.5.1 Construction

Construction during periods of wet weather presents a higher risk of erosion, sediment mobilisation and transport into waterways, with consequential water quality and ecosystem impacts. Conversely, during dry periods, erosion by wind (Aeolian processes) generates dust (particulates), which can later wash into waterways. Human and ecosystem health can also be affected by particulates, or cause nuisance as a result of particulate fall out/ dust deposition.

Extreme weather can also adversely impact the construction program through inundation of worksites as a result of flooding, work stoppages and / or the need to protect work for at risk areas or remediate after the event. Landslip and stability issues can also occur in the event of extreme rainfall.

Extreme weather including drought periods, extreme temperatures and / or lightning strike can cause bushfire, as well as human activity during construction (i.e. overheating machinery, incorrect disposal of cigarettes, prohibited burning of construction or vegetation wastes). The proximity of the Project Area to significant tracts of State Forest, National Park, and native vegetation makes this an important issue to be addressed during construction.

3.5.2 Operation

Rail tracks can buckle during periods of extreme heat, displacing sleepers, causing damage to infrastructure and disrupting operations. In some instances, services could be run at reduced speeds, suspended or delayed until track inspections confirm tracks are functional. Without implementation of safety protocols, derailment may also be possible.

Power supply during heatwaves could also be disrupted, due to increases in peak demand, affecting rail operations and signalling. The effects of heatwave on infrastructure operations should also be considered during the design process, however it is unlikely that this section of the rail network would remain operational if other parts of the metropolitan network were shut down due to heatwave conditions. Comfort levels of patrons and staff at stations is also a consideration during periods of extreme heat.

Storms can damage or disrupt services, through direct lightning strikes, power outages affecting rail operations and signalling, debris on the track, flooding or damage to overhead line equipment. More frequent storms and flash flooding could also result in more frequent maintenance requirements of culverts, fauna crossings and bridge structures.

Prolonged periods of dry hot weather can also affect landscaping works, and increase costs associated with watering and maintaining landscaped areas.

Bushfire can also impact rail operations and in the worst case, destroy rail infrastructure (i.e. OLE, station buildings, signalling, etc.).

Exposure of rail infrastructure to weather extremes can result in wear and tear, reducing the life of infrastructure and increasing maintenance requirements.

3.6 Proposed Mitigation Measures

3.6.1 Design

As the B2N Project is not in a coastal hazard area, the design guidance for the defined stormtide event is not applicable. Flood modelling discussed in Chapter 5 will require further sensitivity testing to determine the impact of extreme weather events beyond that considered in the current models.

Drainage infrastructure and fauna crossings should be designed to account for an increase in the intensity of rainfall events, and to minimise the need for maintenance and rehabilitation after severe weather events. This aspect will be addressed as part of detailed design.

The effects of heatwave on infrastructure delivery and workforce should be considered during the detailed design process. Shading, landscaping, patron and staff comfort at stations should also be considered in the context of future climatic trends.

Specification of construction materials should take into consideration durability with regard to heat stress, rainfall extremes and bushfire risk.

3.6.2 Construction

An erosion and sediment control plan will be required as part of the construction management plans. A severe weather plan will also be required, documenting management measures for extreme weather events (flood, storm, fire) as applicable to particular areas or phases of construction.

These are likely to include:

- stabilisation of exposed areas on completion of works in an area
- sufficient materials for stabilisation and protection in the event of severe weather
- monitoring of weather on a daily and weekly basis to enable severe weather planning
- site evacuation routes and construction of all-weather routes for access to and from the site.

3.6.3 Operation

Bushfire management strategies for operation of the railway are to be implemented. These include fire-fighting protocols, rules for disposal of cleared vegetation, and maintenance of fire breaks and buffers.

Queensland Rail has existing safety protocols for operations during extreme heat and it is expected that these will continue to be implemented when required.

3.7 Residual Impact Assessment

With the implementation of the mitigation measures outlined in Table 14 it is anticipated that the impact of climate during the B2N Project's construction and operation can be managed, however not all risks will be possible to fully mitigate due to the unpredictable nature of severe weather events.

Table 14: Residual impact assessment, climate and climate change

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Extreme weather events (storms, flooding and rainfall)	Construction	Erosion and sedimentation, water quality and ecosystem health impacts	Erosion and sediment control plan include responses / management measures for severe weather events	Risk of exceedance of water quality objectives	Short term	Possible	Minor
	Operation	Impact to services Damage to rail infrastructure	Design for desired flood immunity Maintain vegetation clear of rail infrastructure Maintain drainage structures and clear debris	Risk of power failures on the network beyond B2N Project extents Risk of impact beyond B2N Project extents	Short term	Possible	Minor
Decreased rainfall/ Drought	Construction	Dust and erosion Landscape treatment failures	Erosion and sediment control plan to contain requirements for dust management Landscaping / stabilisation treatments designed for resilience Develop contract conditions to ensure responsibilities for landscaping establishment and maintenance clear	Risk of dust due to extreme conditions Landscaping success dependent on weather conditions at the time	Short term	Possible	Minor
Extreme heat events and solar radiation	Construction	Worker health and safety Landscape treatment failures	Establish severe weather plan and OHS plans Landscaping / stabilisation treatments designed for resilience Develop contract conditions to ensure responsibilities for landscaping establishment and maintenance clear	Landscaping success (and cost to establish) will to a degree be dependent on weather conditions at the time	Short term	Possible	Minor
	Operation	Service interruption/ delays Damage to rail infrastructure	Operational and communication planning for rail operators and customers	Potential risks remain, dependent on weather event.	Short term	Likely	Subject to the nature of the event

4 Air Quality

4.1 Introduction

This Chapter provides an overview of the existing ambient air quality in and around the Project Area, based on desktop analysis of air quality monitoring data and known sources in the air sheds. It identifies the applicable air quality criteria, potential impacts during construction and operation, and recommends mitigation measures to be implemented to address potential impacts.

The main emission types associated with construction is likely to be particulate matter (dust). Existing emissions, likely to be continue after the upgrade of the rail would be diesel emissions, and particulates (dust) generated by train movements.

4.2 Assessment Methods

The assessment method has included review of the following:

- air quality monitoring data summarised in the Q*ueensland Air Monitoring Report 2018* for the National Environment Protection (Ambient Air Quality) Measure (Department of Environment and Science, 2019) – report prepared for the annual reporting requirements for Queensland under clause 18
- data from the National Pollution Inventory (for Beerburrum, Glass House Mountains, Beerwah, Landsborough, Mooloolah Valley, Eudlo, Palmwoods, Woombye and Nambour)
- Bureau of Meteorology climate data for the Beerburrum Forest, Landsborough and Nambour Weather Stations
- National Environment Protection Measures (NEPMs) for Ambient Air Quality and National Pollutant Inventory
- *Environmental Protection Policy (Air) 2019* (EPP (Air)).

Sensitive receptors located in the Project Area plus a 50m buffer between Beerburrum and Landsborough were identified as part of this assessment. As the works proposed north of Landsborough are predominantly within the existing rail corridor, receptors were identified in the vicinity of works and not the full length of the corridor between Landsborough and Nambour.

Impact assessment in this Chapter is based on the reference design and inclusions as described in Chapter 1 of this REF. Should the B2N Project elements change in future phases of Project implementation, this assessment should be updated to reflect the B2N Project at that time.

4.3 Existing Environment

4.3.1 Air Shed Objectives

The Ambient Air Quality NEPM outlines agreed national objectives for protecting and managing the quality of air sheds. This is assisted by providing goals for a variety of emission types and mandating the monitoring of air quality. The National Pollutant Inventory NEPM then mandates the collection of source data so this can also be examined to understand the pressures on the air shed.

The applicable goals outlined in the Ambient Air Quality NEPM are provided in Table 15.

Table 15: Ambient Air Quality NEPM Goals

POLLUTANT	AVERAGING PERIOD	MAXIMUM CONCENTRATION STANDARD	MAXIMUM ALLOWABLE EXCEEDANCES
Particles as PM_{10}	1 day 1 year	50 µg/m^3 25 µg/m^3	None None
Particles as $PM_{2.5}$	1 day 1 year	25 µg/m^3 8 µg/m^3	None None
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None
Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year

On 7 December 2018, a variation to the Ambient Air Quality NEPM was proposed and a Draft Variation to the National Environmental Protection (Ambient Air Quality) Measure for sulfur dioxide, nitrogen dioxide and ozone (May 2019) was prepared for the National Environment Protection Council. The Draft Variation found that there are health effects arising from exposure to ozone, nitrogen dioxide and sulfur dioxide in Australian cities at their current concentrations.

Recommendations for nitrogen dioxide standards from the Draft Variation include:

- the 1-hour standard for nitrogen dioxide in the AAQ NEPM should be retained and the numerical value of the standard should be reduced to 90 ppb
- the annual standard for nitrogen dioxide in the AAQ NEPM should be retained and the numerical value of the standard should be reduced to 19 ppb
- the form of both the 1 hour and annual nitrogen dioxide standards should be the maximum value with no allowable exceedances
- a future 1-hour standard for nitrogen dioxide of 80 ppb is recommended for implementation by 2025 as part of an exposure reduction framework
- a future annual standard for nitrogen dioxide of 15 ppb is recommended for implementation by 2025 as part of an exposure reduction framework.

Recommendations for ozone include:

- the current 1-hour and 4-hour standards for ozone should be removed from the AAQ NEPM
- a rolling 8-hour standard for ozone in the AAQ NEPM should be introduced, and the numerical value of the standard should be 65 ppb
- the 8-hour standard should be reviewed in 2025, with the option of reducing it once there is a better understanding of ozone generation in capital city airsheds
- the form of the 8-hour standard for ozone should be the maximum value with no allowable exceedances (excluding exceptional events)
- an exposure-reduction framework, in the form of a long-term goal for O3, should be considered to reduce population exposure and associated health risk once there is a better understanding of O3 generation in capital city airsheds.

Submissions were sought on the Draft Variation and closed on 7 August 2019. A final recommendation to vary the AAQ NEPM considering all submissions is being prepared for the NEPC. This is not anticipated to have a direct effect on the B2N Project, where mitigation measures are implemented with consideration of the Queensland EPP (Air).

4.3.2 Emission Sources in the Air Shed

Passenger and freight services currently operate on the North Coast Line between Beerburrum 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.

Existing emissions that can be attributed to these services include:

- exhaust emissions from diesel locomotives
- particulates emanating from freight loads
- recirculated dust in the rail corridor
- odour associated with movement of livestock.

Figure 3 provides a summary of the PM_{10} air emissions sources and contributions for each postal area the B2N Project Area passes and is summarised from the database of emissions data collected via the National Pollutant Inventory (NPI). Reporting under the NPI framework is required when a facility has the potential to "release emissions or generate waste transfers that exceed the National Pollutant Inventory (NPI) reporting thresholds for the 93 listed substances in the National Environment Protection (National Pollutant Inventory) Measure 1998"[1]. Governments also calculate diffuse emissions to capture emissions from facilities too small to report individually and everyday household activities such as driving to work, to assist with the broader picture. The majority of facilities reporting under the NPI in the vicinity of the Project Area are poultry farms, with two quarries located south- east and south-west of the Glass House Mountains township. The Landsborough Sewage Treatment Plant and a food processing plant also report in the Landsborough area.

As can been seen in Figure 3, the NPI emissions reporting for facilities from Beerburrum to the Mooloolah Valley are broadly dominated by burning/wildfire. In the northern half (i.e. Eudlo, Palmwoods, Woombye), emissions from motor vehicles from reporting facilities are dominant, and no facilities were identified as reporting under the NPI, with the exception of the Nambour sewage treatment plant, and several construction / mineral facilities more than 2km from the Nambour town centre.

The NPI reporting provides a general picture of the types of sources contributing to air quality in the Project Area. The NPI reporting volumes illustrated in Figure 3 are not directly comparable to the ambient air quality goals listed in Table 15.

[1] Local governments also calculate diffuse emissions to capture emissions from facilities too small to report individually and everyday household activities such as driving to work, to assist with the broader picture

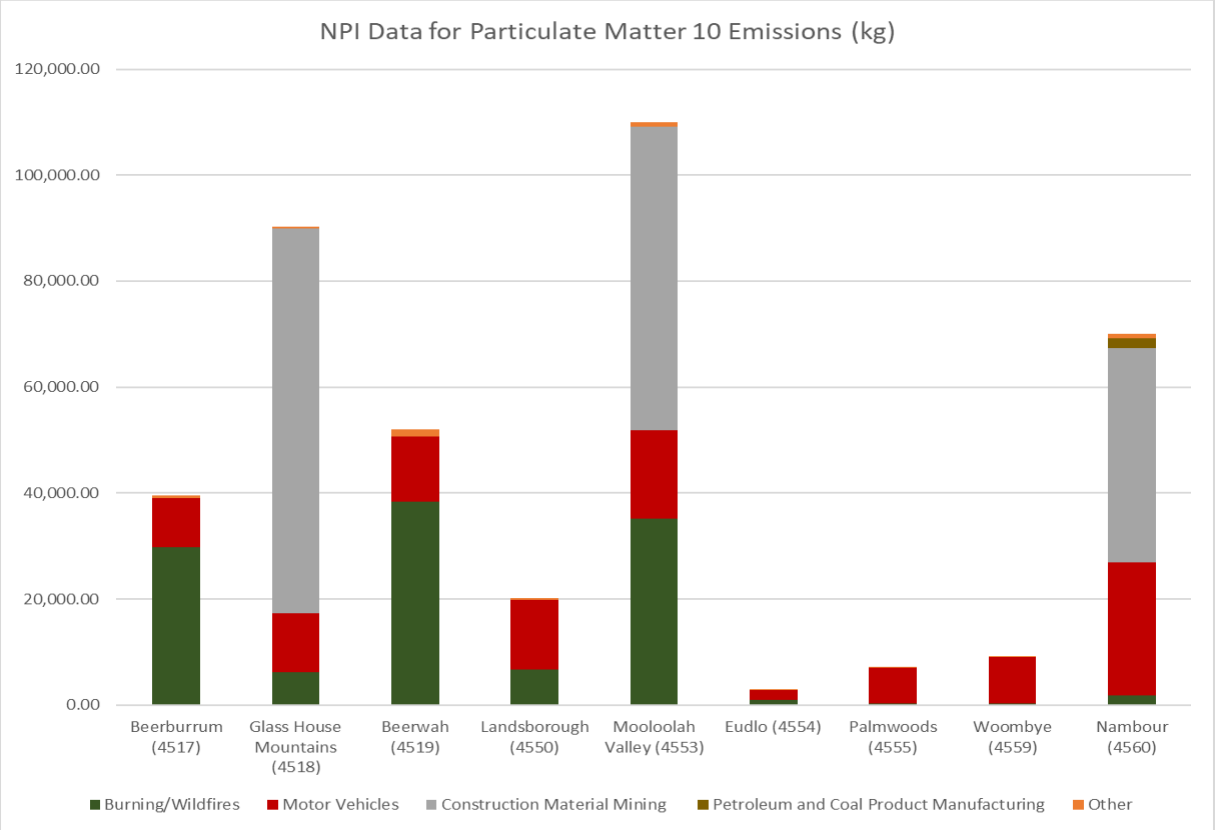


Figure 3: NPI Data for Particulate Matter 10 (PM10) reported for Air Emissions, 2017-2018

4.3.3 Air Quality Monitoring in the Air Shed

Mountain Creek is the closest air quality monitoring site to the Project Area, located 14km to the east. It is located within the Sunshine Coast Region airshed and is considered an appropriate representation of air quality for the region. The Mountain Creek site is part of the network of monitoring stations set up to address the requirements of the Ambient Air Quality NEPM. A summary of the monitoring results recorded at Mountain Creek during 2018 is provided in Table 16. The major pollutant sources associated with the Mountain Creek site are major roads, forestry and agricultural burning and it is considered a reasonable representation of the air quality expected along the Project Area.

PM_{10} data exceeded the NEPM goal on five occasions between 1 September 2018 and 3 December 2018. These exceedances were recorded as being due to dust storms (1 September 2018, 23 and 28 November 2018) and smoke from bushfires on 3 December 2018.

Table 16: Air Quality Information: Mountain Creek 2018

POLLUTANT	AVERAGING PERIOD	MAXIMUM (µG/M3)	ANNUAL MEAN (PPM)	DATA RECOVERY (%)	AAQ NEPM STANDARDS
Ozone	1-hr	0.055		94.4	0.10 ppm
	4-hr	0.049			0.08 ppm
Nitrogen Oxides	1-hr	0.032	0.004	95.4	0.12 ppm (1-hr average)
PM_{10}	24-hr	94.6	19.6	97.4	50 µg/m^3

4.3.4 Air Quality Objectives for Projects

Air quality objectives for individual projects are set out in the EPP (Air) and are to be measured at the locations of the closest sensitive receptors. The applicable objectives for the B2N Project are outlined in Table 17.

Table 17: Air quality objectives, EPP (Air)

POLLUTANT	ENVIRONMENTAL VALUE	AIR QUALITY OBJECTIVE		PERIOD	DAYS
		µG/M3	PPM		
Total Suspended Particles	Health and wellbeing	90		1 year	
PM_{10}	Health and wellbeing	50		24 hours	
		25		1 year	
$PM_{2.5}$	Health and wellbeing	25 8		24 hours 1 year	
Nitrogen Dioxide	Health and wellbeing	250 62	0.12 0.03	1 hour 1 year	1 day each year
	Health and biodiversity of ecosystems	33	0.016	1 year	
Ozone	Health and wellbeing	210 171	0.10 0.08	1 hour 4 hours	1 day each year 1 day each year
Ozone (measured as accumulated exposure over a threshold of 40ppb during daylight hours)	Protecting agriculture		0.2 ppm-hr 3 ppm-hr	5 days 3 months	
	Health and Biodiversity of ecosystems (for semi-natural vegetation)		3ppm-hr	3 months	
	Health and Biodiversity of ecosystems (for natural or uncultivated areas)		10 ppm-hr	6 months	

4.3.5 Sensitive Receptors

The EPP (Air) defines the environmental values to be protected in order to provide a conducive air environment for the protection of ecosystems, human health and wellbeing, aesthetics of the environment including the appearance of buildings, structures and other property, and agricultural use (s7 of the EPP (Air)).

The NSW "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" defines sensitive receptors as a location where people are likely to work or reside and may include a dwelling, school, hospital, office or public recreational area. For the purposes of this REF, sensitive receptors between Beerburrum and Landsborough within a 50m buffer of the Project Area have been identified using the following criteria:

- residential – properties zoned as residential in the Planning Scheme that occur or partly occur within the B2N Project Area and 50m buffer
- education – educational institution properties that occur or partly occur within the B2N Project Area and 50m buffer
- hospitals – hospital properties that occur or partly occur within the B2N Project Area and 50m buffer
- commercial – properties zoned as commercial in the Planning Scheme that occur or partly occur within the B2N Project Area and 50m buffer.

It is acknowledged that, while a property may occur or partly occur within the 50m buffer of the Project Area, depending on the nature of the property and the activities undertaken at that place, it may not meet the criteria of a "sensitive receptor".

The majority of sensitive receptors identified in this assessment are located adjacent or in close proximity to the existing North Coast Line. Sensitive receptors identified based on the criteria listed above include:

- Beerburrum: No sensitive receptors were identified within the B2N Project Area, however there was one school, five commercial properties and 23 residential properties identified within the 50m buffer.
- Glass House Mountains: There are 5 residential and 4 commercial properties located within the B2N Project Area and an additional 27 residential and 17 commercial properties located within the 50m buffer. Residential properties are located along a 365m section of rail re-alignment that will bring the line closer to these properties.
- Beerwah: There are 21 residential properties and one commercial property located within the B2N Project Area at Beerwah. There are a further 28 residential, 12 rural residential and 28 commercial properties as well as a school located within the 50m buffer.
- Landsborough: In Landsborough, there are 32 residential properties and one school located within the B2N Project Area. An additional 64 residential, 21 rural residential and 66 commercial properties are located within the 50m buffer.

North of Landsborough, proposed works will not result in a change of location of the existing corridor, therefore identification of receptors and sensitive receptors has been completed for receptors in the vicinity of the works (i.e. 50m of passing loop extension or station upgrade works), not the entire corridor. Potential air quality impacts during construction will be managed through the implementation of construction environmental management plans.

Table 18 identifies the sensitive receptors located both within the B2N Project Area and within the 50m buffer that may experience air quality impacts as a result of the Project.

Table 18: Sensitive receptors located both within the Project Area and the 50m buffer

LOCATION	COMMERCIAL	HOSPITALS	RESIDENTIAL / RURAL RESIDENTIAL	EDUCATION
Beerburrum	5	-	23	1
Glass House Mountains	21	-	32	-
Beerwah	29	-	49/12	1
Landsborough	70	-	96/21	1
Mooloolah Valley	4	-	5	-
Eudlo	1	-	1	1
Palmwoods	13	-	23	-
Woombye	-	-	2	-
Nambour	13	-	5	-

4.4 Potential Impacts

The construction and operation of the Project has the potential to cause localised air quality impacts. Prevailing weather conditions also have a bearing on the dispersion of emissions and transport of particulates and other air emissions.

4.4.1 Construction

Air quality emission sources requiring management during construction to avoid adverse impacts include:

- exhaust emissions from site plant, equipment and vehicles (NOx, PM_{10}, VOC, CO, SO_2)
- fugitive dust emissions from:
  - earthworks, excavation and demolition
  - loading and unloading of vehicles
  - wind erosion along exposed areas
  - wind erosion on stockpiles
  - vehicle movements within the Project Area
- dust and exhaust emissions from the movement of construction vehicles, personnel and haulage vehicles on the existing road network
- works within the existing rail corridor or in the vicinity of contaminated or potentially contaminated sites.

Emissions from construction activities are dependent on the type of construction vehicle, including vehicle size and fuel type consumed. Soil type, moisture content of the soil, the size of cleared areas/stockpiles, revegetation progress and management measures applied also have a bearing on the generation of dust within the Project Area.

If not effectively controlled, fugitive dust emissions can lead to dust nuisance at sensitive receptors. This includes deposition of particulates and dust on houses, windows, cars, which can potentially result in respiratory issues. Flora and fauna and sensitive habitats can also be impacted through deposition on vegetation and potential ingestion by herbivores.

Dust nuisance is exacerbated during dry and windier conditions, as moisture assists to prevent particles becoming airborne, and wind both contributes to erosion and encourages the particles to remain airborne over larger distances. The use of the local road network for haulage and site access can spread these effects if not managed appropriately.

4.4.2 Operation

Between Beerburrum and Landsborough, the upgrade and track duplication is located in close proximity to the existing North Coast Line. North of Landsborough, the extension of passing loops in discrete localities and stations

upgrades will be located within the existing rail corridor and station precincts. Proximity of rail operations to sensitive receptors will not change significantly as a result of the Project.

Whilst the improvements proposed to the North Coast Line are intended to facilitate the continued and growing use of the North Coast Line, the increase in rail movements on this section of the corridor are in response to a combination of factors, not just the additional capacity available on this section of the network. Furthermore, rail traffic increases are more likely to occur in commuter (electric) services, with a continuation of the existing level of freight services in the corridor. The continuation of commuter services and long distance passenger services (electric) are anticipated to generate minimal change to the nature and extent of air emissions and air quality impacts currently generated in the vicinity of the Project. Impacts may include:

- dust generated by train movements, including braking and recirculation of dust within the corridor
- dust generated by maintenance works in the corridor
- vehicle emissions (connecting bus services, private vehicles), from station precincts.

The continued operation of freight services is also anticipated to generate minimal change to the nature and extent of air emissions and air quality impacts currently generated in the vicinity of the Project.

Track duplication and passing loops on this section of the corridor will result in the following benefits:

- less congestion on the rail network, and the reduction in dwelling time for freight locomotives and other diesel services that need to wait for pass-by opportunities in this section of the corridor
- faster movement as a result of less congestion
- reduction in emissions as a result of improved horizontal and vertical radii (i.e. higher standards of track) between Beerburrum and Landsborough
- an increase in rail movements, moving closer to receiver locations, at discrete locations.

In some discrete locations sensitive receptors will be located marginally closer than they were previously to the North Coast Line. These changes may be more perceptible as a result of the increase in rail traffic.

4.5 Proposed Mitigation Measures

4.5.1 Design

As noted above, the duplicated track, extended passing loops and duplication of tracks at stations is expected to reduce dwelling time within the corridor, future stages of design should aim to further improve capacity by optimising train paths.

Future stages of design should also aim to minimise the footprint required to deliver the works. By minimising the extent of earthworks and ground disturbance, this will reduce areas exposed to eroding processes, and reduce the extent of stabilising / rehabilitation treatments to be required.

4.5.2 Construction

The two main potential air quality impacts identified during construction activities are exhaust from vehicles and machinery, and dust emissions from bulk earthworks, construction vehicles and wind erosion. The following mitigation measures are proposed to manage these impacts:

- exhaust emissions from site plant, equipment and vehicles
  - maintain construction plant, equipment and vehicles in accordance with operating procedures
- dust emissions
  - avoid works in dry, high-wind weather conditions where possible and practical
  - apply dust suppression measures to access tracks and exposed areas
  - maintain reduced speed limits on access tracks
  - minimise use of informal access tracks
  - implement an erosion and sediment control plan for access and egress from the site including vehicle wash down / removal of mud and dirt, covered loads, rock pads, etc.
  - implement an erosion and sediment control plan for the site
  - progressively stage clearing and stabilise works areas
  - stabilise inactive stockpiles

- no unauthorised burning of cleared stockpiled vegetation or wastes
- implement pre-construction and construction monitoring and reporting of emissions, particularly dust and particulates, from across the Project Area, including sensitive habitats
- conduct community consultation and notification prior to and during construction of works, providing information on the proposed works, nature of air emissions, construction time frames, and contact details for complaints or comments.

4.5.3 Operation

During operation, the main air quality impact is anticipated to be fugitive dust emissions associated with trains utilising the corridor. This can be managed by ensuring loads are covered, maintaining the corridor (i.e. minimising areas of exposed soil) and responding to any air quality complaints as they are raised. QR's existing Environmental Management System would continue to apply for rail operations on the corridor.

4.6 Residual Impact Assessment

Table 19 provides an assessment of the residual impacts once the proposed management measures outlined in Section 4.5 have been applied. It is anticipated that the B2N Project's potential impacts will be minor and manageable during both construction and operation.

Table 19: Residual impact assessment, air quality

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Exhaust emissions from site plant, equipment and vehicles	Construction	Localised nuisance, community complaints.	Maintain construction plant, equipment and vehicles in accordance with operating procedures	Localised emissions only, no discernible impact at sensitive receptors	Short term	Possible	Negligible
Fugitive dust emissions generated by onsite earthworks, excavation, demolition and loading / unloading of vehicles	Construction	Transport of airborne particulates and dust, with deposition at sensitive receptors, impacting amenity, human health, and flora and fauna impacts. Community complaints.	Avoid works in dry, high-wind weather conditions where possible and practical Implement pre-construction and construction monitoring and reporting of emissions, particularly dust and particulates, from across the Project Area, including sensitive habitats Minimise use of unformed access tracks Apply dust suppression measures to access tracks and exposed areas Progressively stage clearing and stabilise works areas No unauthorised burning of cleared stockpiled vegetation or wastes Implement erosion and sediment control plan for the site. Conduct community consultation and notification prior to and during construction of works, providing information on the proposed works, nature of air emissions, construction time frames, and contact details for complaints or comments.	Localised emissions only, no discernible impact at sensitive receptors, minimal community complaints	Short term	Possible	Minor
Emissions from construction vehicles	Construction	Localised nuisance, community complaints.	Minimise use of unformed access tracks Apply dust suppression measures to access tracks and exposure areas	Localised emissions only, no discernible impact at sensitive receptors,	Short term	Possible	Negligible

FACTOR	PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
			Maintain reduced speed limits on access tracks				
Fugitive dust emissions generated by wind erosion from exposed areas and stockpiles	Construction	Localised nuisance, community complaints.	Avoid works in dry, high-wind weather conditions where possible and practical Apply dust suppression measures to exposed areas Progressively stage clearing and stabilise works areas Seed inactive stockpiles	Localised emissions only, no discernible impact at sensitive receptors, minimal community complaints	Short term	Possible	Minor
Fugitive dust emissions generated by construction vehicles utilising the local road network	Construction	Transport of airborne particulates and dust, noticeable deposition on local roads, nuisance to adjoining residents and occupants, eventual run-off into waterways. Community complaints and visible evidence of poor practices.	Implement erosion and sediment control plan for access and egress from the site, including vehicle wash down / removal of mud and dirt, covered loads, rock pads, etc. Conduct community consultation and notification prior to and during construction of works, providing information on the proposed works, nature of air emissions, construction time frames, and contact details for complaints or comments.	Minimal community complaints. No complaints or prosecutions from Council or DES No deposition of mud or material from site on local roads used for construction site access	Short term	Possible	Minor
Fugitive dust emissions	Operation	Localised deposition within the corridor and immediate surroundings.	Ensure loads are covered, maintain the corridor (i.e. minimising areas of exposed soil) and respond to complaints as they are raised.	Minimal community complaints	Long term	Unlikely	Negligible

5 Water

5.1 Introduction

This Chapter provides a discussion on the existing water environment of the Project Area, assesses the potential impacts of the Project on those waters and proposes mitigation measures. The waters considered include surface waters for the applicable catchments as well as directly impacted streams, flooding impacts and groundwater.

The discussion of flooding has been informed by a flood investigation undertaken for the Beerburrum to Landsborough section of the B2N Project. Surface water and groundwater assessments have primarily been drawn from desktop assessments, complemented by site visits to visually confirm the existing surface water findings.

Key issues identified for management include surface water quality during construction, and minimisation of impacts at waterway crossings through the sensitive design of bridges and culverts.

5.2 Assessment Methods

5.2.1 Surface Water Quality

The assessment of the existing surface water quality within each of the catchments traversed by the B2N Project involved the following:

- review of mapping and available water quality assessments undertaken in the catchment areas to identify waterways and source information on their stream health and hydrogeological factors
- review of aerial photography and regional and local planning documents in order to describe the existing and future land uses which may contribute to water quality
- site visits in 2016 to accessible waterway crossing points in order to visually assess the existing water quality, in-stream morphology and riparian values of the waterway and immediately surrounding ecosystems
- review of regional water quality planning to identify objectives.

This existing environment information along with climatic conditions identified in Chapter 3 and soil characteristics identified in Section 6.3 was then used to inform potential impacts of the corridor on surface water quality.

5.2.2 Flooding

The assessment of the flooding environment involved a review of:

- SCC flood hazard mapping
- results from the flood study for the Beerburrum to Landsborough section of the Project Area
- available flooding assessments undertaken for previous versions of the B2N Project.

A flood study was undertaken in 2016 for the Beerburrum to Landsborough section of the B2N Project to determine the following:

- waterway structure sizes and configurations
- track vertical alignment with respect to track levels required to achieve the desired level of flood immunity
- impact of the rail embankment on flood behaviour compared to existing conditions.

The flood study analysed the existing conditions and potential impacts associated with crossing the catchments of three major creeks (Tibrogargan Creek, Coonowrin Creek and Coochin Creek) and their associated tributaries, (Bluegum Creek, Bellbird Creek and Mellum Creek). The flood study informed the sizing and type of waterway crossing structures for the reference design.

Flood investigations north of Landsborough were not in scope as works are within the existing rail corridor, and were deemed not necessary at this stage of design development. Modelling inputs, assumptions and outcomes are documented in a separate flooding report – *Hydrologic & Hydraulic Modelling Beerburrum to Nambour Reference Design Phase* (SMEC 2016a).

5.2.3 Groundwater

The groundwater assessment for the Project Area was determined by undertaking:

- a review of recent available groundwater assessments undertaken for previous studies undertaken in the region

- a review of regional groundwater uses along the Project Area
- a review of available information from registered bores contained in the Department of Natural Resources, Mines and Energy's (DNRME) groundwater database
- a review of the Bureau of Meteorology (BOM) Groundwater Database (Australian Groundwater Explorer)
- an assessment using the collated data along with topographical data to establish the groundwater context
- identification of groundwater dependent ecosystems in the vicinity of the B2N Project.

5.3 Existing Environment

5.3.1 Waterways

The Fisheries Queensland GIS layer: Queensland Waterways for Waterway Barrier Works has been reviewed as part of the REF. This information source categorises Queensland waterways into four colours, for the assessment of development approvals for Waterway Barrier Works, as discussed in O'Brien et al. (2016) and summarised in Table 20.

Table 20: Waterway Barrier Works Description

COLOUR / RISK	DESCRIPTION
Purple (Major)	Large stream orders with smaller low slopes, extended flow periods and maintain good quality habitat, and fish species in these areas are very diverse with both weak and strong swimmers
Red (High)	Similar to purple waterways in that they are larger stream orders, but can be smaller in size, they have extended flood periods and maintain good quality habitat, and these systems have diverse fish species in number, size and community.
Amber (Moderate)	Tend to be higher in the catchment with less gentle slopes, they have smaller stream orders, contain moderate to good instream habitats, and their species diversity is generally less and the swimming ability of those species is greater than that of a Red waterway.
Green (Low)	Generally smaller in size, are smaller stream orders, their slopes are greater, have faster flows which can cease quickly, they are generally in the top of the catchment, and the species of fish in these areas are usually strong swimmers, which means they require less assessment as development impacts are much lower than the other colour codes.

The *Water Act 2000* (Water Act) provides for regulation of defined watercourses, including water licencing and riverine protection permits.

The existing North Coast Line traverses the waterways listed in Table 21. Waterway Barrier Work classifications, and status of the B2N Project watercourses under the Water Act and stream order are also identified in Table 21. These waterways are also illustrated in Figure 4.

Table 21: Waterways/ Watercourses in the Project Area

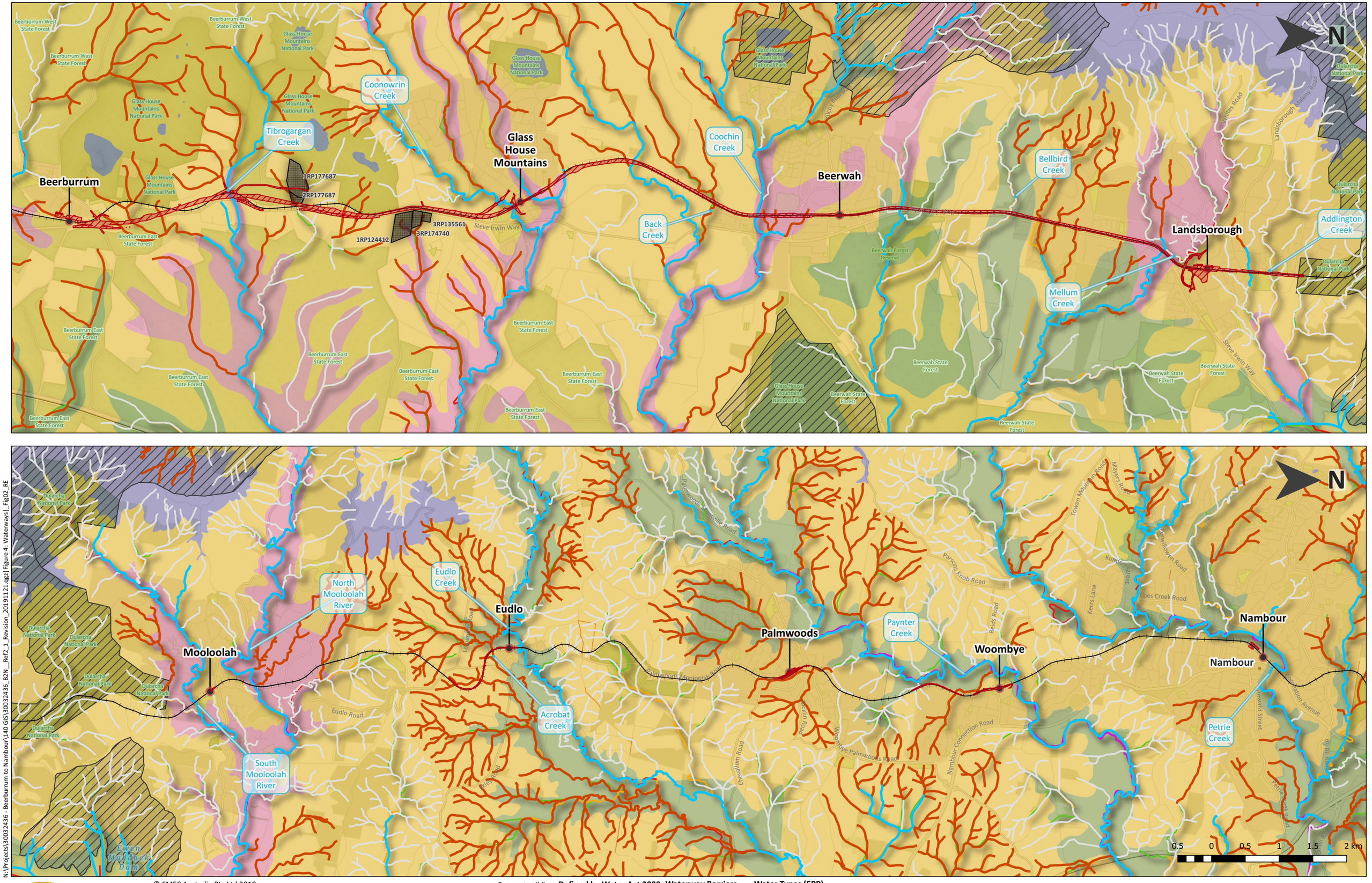
WATERWAY	WATERWAY BARRIER WORKS	STATUS UNDER THE WATER ACT
Pumicestone Passage Catchment		
UT Tibrogargan Creek	1 Low, Green	
Tibrogargan Creek	2 Moderate, Amber	Defined watercourse
Tibrogargan Creek	2 Moderate, Amber	
UT Tibrogargan Creek	1 Low, Green	
UT Tibrogargan Creek	1 Low, Green	
Coonowrin Creek	3 High, Red	Defined watercourse
Coonowrin Creek	3 High, Red	Defined watercourse
UT Coonowrin Creek	1 Low, Green	Defined watercourse

WATERWAY	WATERWAY BARRIER WORKS	STATUS UNDER THE WATER ACT
UT Coonowrin Creek	Not mapped	Defined watercourse
UT Back Creek	1 Low, Green	
Back Creek	2 Moderate, Amber	Defined watercourse
Coochin Creek	4 Major, Purple	Defined watercourse
UT Bluegum Creek	1 Low, Green	
Bluegum Creek	1 Low, Green	Defined watercourse
Bellbird Creek	2 Moderate, Amber	
UT Mellum Creek	2 Moderate, Amber	
Mellum Creek	3 High, Red	
Mellum Creek	3 High, Red	
Mooloolah River Catchment		
UT Addlington Creek	1 Low, Green	
Addlington Creek	2 Moderate, Amber	Defined watercourse
UT Mooloolah River	2 Moderate, Amber	
South Mooloolah River	3 High, Red	
Maroochy River Catchment		
Acrobat or UT Acrobat Creek	Not classified	
Eudlo Creek	3 High, Red	Defined watercourse
Paynter Creek	4 Major, Purple	Defined watercourse
Petrie Creek	4 Major, Purple	Defined watercourse

UT – unnamed tributary

5.3.2 Catchments

The B2N Project passes through the three water catchments of the Maroochy Basin shown in Figure 5, defined by both Healthy Land and Water and the Department Environment and Science (DES): the Maroochy River, Mooloolah River and Pumicestone Passage catchments. Water Plans prepared by the DNRME have defined these catchments slightly differently to DES, however the Maroochy River Catchment correlates to the Maroochy River Subcatchment and the Mooloolah River Catchment correlates to the Mooloolah River Subcatchment defined under the *Water Plan (Mary Basin) 2006*. The catchment for the Pumicestone Passage correlates to the Pumicestone Creeks Subcatchment defined under the *Water Plan (Moreton) 2007*.



N:\Projects\30032436 - Beerburrum to Nambour\140 GIS\30032436_B2N__Ref2_1_Revision_20191121.qgz|Figure 4: Waterways|_Fig02_RE

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CREATED BY	EH11799
SOURCES	QLD Govt

- Current rail line
- Project Area
- Additional Project Areas
- Bore data

Defined by Water Act 2000
- Spring
- Downstream limit
- Lake
- Drainage feature
- Watercourse
- Unmapped

Waterway Barriers
- 1 - Low
- 2 - Moderate
- 3 - High
- 4 - Major
- High ecological value freshwater
- DIWA Nationally Important Wetlands (2016)

Water Types (EPP)
- coastal streams
- lowland streams
- upland streams
- wallum streams
- middle estuary
- upper estuary

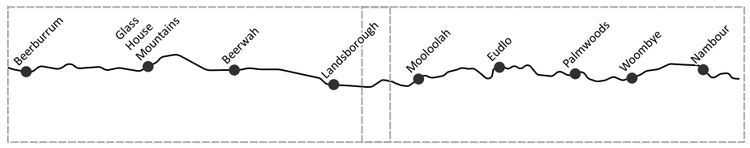
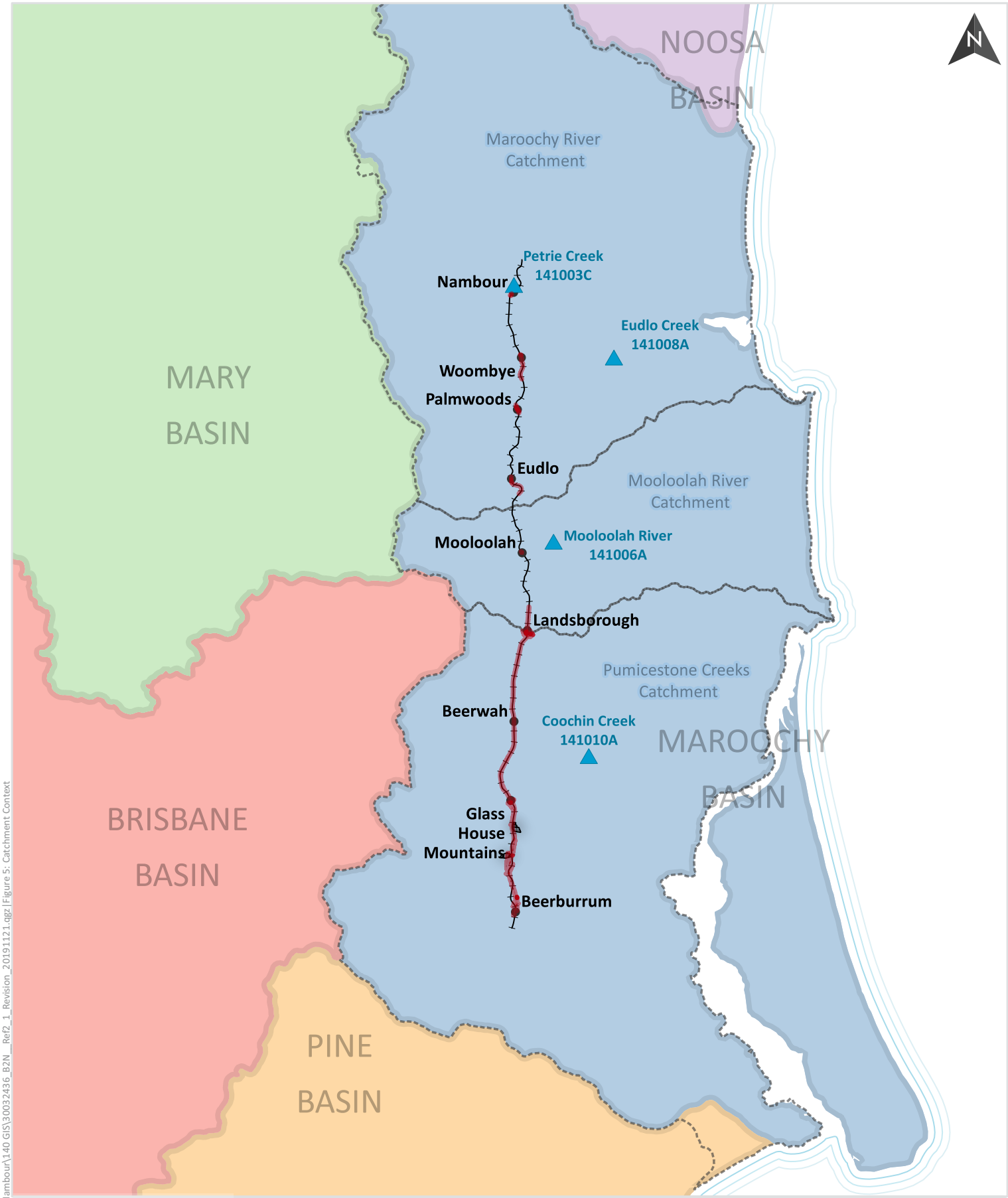


Figure 4: Waterways



Legend

- Rail station
- DNRME open gauging stations
- Current rail
- Catchment Boundary
- Project Area
- Additional Project Areas

Figure 5: Catchment Context

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Filepath: N:\Projects\30032436 - Beerburrum to Nambour\140 GIS\30032436_B2N__Ref2_1_Revision_20191121.qgz | Figure 5: Catchment Context

The Maroochy River Catchment has an area of 630km^2 and extends 22km inland from the coast (Maroochy Waterwatch Inc., 2016). The steep Blackall Ranges (north and west) and the Mooloolah Range (south) form the boundary of the catchment, which drains to the east onto low lying floodplains on the coastal plain, and a tidal estuary near the mouth. The land uses are diverse but are characterised by agricultural land undergoing urbanisation. The area is subdivided by five subcatchments including Eudlo Creek, Paynter Creek, Petrie Creek, Coolum and Yandina Creeks, and Stumers Creek.

The Mooloolah River Catchment covers 223km^2 and extends 26km inland from the coast (Maroochy Waterwatch Inc., 2016). The Mooloolah Range (north), Balmoral Ridge (west) and Mount Mellum (south) form the boundary of the headwaters of the catchment, which drains to the east onto low lying floodplains on the coast plain, and a tidal estuary near the mouth. The riparian vegetation is largely intact in the upper reaches, while the lower reaches have been altered with housing and canal estates (Healthy Waterways, 2016). Major waterways within the catchment include Mooloolah River and tributaries, Mountain, University, Sippy and Addlington Creeks, and Currimundi and Tooway Lakes. Approximately 5km east (and downstream) of the Project Area, the Lower Mooloolah River is mapped as a Nationally Important Wetland. Ewen Maddock Dam is located on Addlington Creek and is part of the South East Queensland's drinking water supply.

Seqwater manages Ewen Maddock Dam, and the Seqwater Development Guidelines (2017) provide an assessment framework to manage the risk of development activities in the drinking water catchments in South East Queensland. The guidelines outline the planning framework to protect water quality and identifies the *State Planning Policy 2017* (SPP) and *ShapingSEQ: South East Queensland Regional Plan 2017* as key planning instruments that include protections for drinking water quality. The development of management measures for construction should be consistent with the Seqwater Development Guidelines (2017). The catchment area for the Pumicestone Passage is approximately 785km^2 and encompasses the waters on Bribie Island and coastal creeks including Bells, Coochin, Mellum, Coonowrin, Hussey, Beerburrum, Ningi and Elimbah Creeks. With a population of approximately 61,000 in urban areas, the major industries include forestry and other primary production including pineapples, strawberries, turf and tree cropping (MBRC, 2016). The Sunshine Coast and Moreton Bay Regional Council's Pumicestone Passage and Catchment Action Plan 2013-2016 cites agriculture, sewage, forestry and urban development as the greatest impacts on the Passage.

The Pumicestone Passage is a shallow enclosed waterway located between the mainland and Bribie Island (HLW, 2018). It is part of the Moreton Bay Ramsar site (wetland of international importance), and is also recognised as a nationally important wetland. Tidal flushing of the southern passage from Deception Bay dominates the estuary and there is a net northern movement of water through the Passage. This shallow narrow water body provides a wide range of habitat types including salt marshes, mud flats, seagrass beds and extensive mangrove systems. This habitat supports a wide range of plant and animal species including endangered species such as dugong, turtles and over 370 species of birds. The Pumicestone Passage has been recognised as an internationally significant wetland and is protected under the Ramsar Convention. Within the Pumicestone Passage Catchment, three areas are mapped as nationally important wetlands, two located to the east of the Project Area within Beerwah State Forest and Beerwah Forest Reserve, and one associated with a portion of Glass House Mountains National Park, immediately adjacent to the existing rail corridor.

The SEQ Healthy Waterways Ecosystem Health Monitoring Program (EHMP) is administrated by Healthy Land and Water and monitors catchments and waterways on a monthly basis and provides an annual overview of the health of SEQ waterways, which is summarised in Table 22. Monitoring is undertaken on a catchment wide basis with assessments of both freshwater and estuarine waterways.

Table 22: EHMP Report Card Scores for 2018

CATCHMENT	OVERALL GRADE	DESCRIPTION
Maroochy	C+	The overall environmental condition of the Mooloolah catchment is fair. Sediment loads attributed to the surrounding landscape have increased. However, the health of freshwater creeks in the catchment remain fair and the health of the estuary is excellent.
Mooloolah	C+	The overall environmental condition of the Mooloolah catchment is fair. The catchment has been heavily modified for urban uses however, still provides high recreational value to surrounding communities The health of the estuary is excellent. Stream bank vegetation is fair and the wetland extent is poor across the freshwater reaches.
Pumicestone	B+	The overall environmental condition of Pumicestone is good. Estuarine habitat is excellent and supports excellent recreational fishing benefits, which are under pressure from very high sediment and nutrient loads. Good riparian vegetation and excellent stream health.
Source: Healthy Land and Water, 2019		

5.3.3 Water Quality Objectives

The quality of natural waters in Queensland are protected under the *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (EPP (Water and Wetland Biodiversity)). The EPP (Water and Wetland Biodiversity) achieves the object of the *Environmental Protection Act 1994* (EP Act) to protect Queensland's waters while supporting ecologically sustainable development. Queensland waters include water in rivers, streams, wetlands, lakes, aquifers, estuaries and coastal areas.

Environmental Values (EVs) and Water Quality Objectives (WQOs) have been established by DES for each of the water types within the three catchments crossed by the B2N Project. The EVs define the uses of the water by aquatic ecosystems and for human uses, and the WQOs define objectives for the physical characteristics of the water.

Under the process outlined in the EPP (Water and Wetland Biodiversity), these EVs and WQOs take precedence over broader guidelines such as the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC and ARMCANZ, 2000). Where indicators, notably toxicants, are not included in the EVs and WQOs, ANZECC guidelines remain the principal source of quality objective. Table 23 summarises WQOs from the EPP (Water and Wetland Biodiversity)[2] for catchments traversed by the B2N Project.

[2] Note that while the EPP (Water and Wetland Biodiversity) was updated in 2019, the EVs and WQOs for catchments affected by the B2N Project have not been updated and still refer to the *Environment Protection (Water) Policy 2009*.

Table 23: Water Quality Objectives

WATER TYPE	MANAGEMENT INTENT	TURBIDITY	SUSPENDED SOLIDS	CHLOROPHYLL A	TOTAL NITROGEN	OXIDISED N	AMMONIA N	ORGANIC N	TOTAL PHOSPHORUS	FILTERABLE REACTIVE PHOSPHORUS	DISSOLVED OXYGEN (SATURATION)	PH	SECCHI DEPTH	CONDUCTIVITY
Wallum/ tannin-stained streams	Aquatic ecosystem-moderately disturbed	<20 NTU	<6 mg/L	<5 ug/L	<500 ug/L	<60 ug/L	<20 ug/L	<420 ug/L	<50ug/L	<20ug/L	85 – 110%	5.0 – 7.0	n/a	500uS/cm
Coastal and Lowland freshwater	Aquatic ecosystem-moderately disturbed	<10 NTU	<6 mg/L	<5 ug/L	<500 ug/L	<60 ug/L	<20 ug/L	<420 ug/L	<50ug/L	<20ug/L	85 – 110%	6.5 – 8.0	n/a	500uS/cm
Upland freshwater	Aquatic ecosystem-moderately disturbed	<5 NTU	<6 mg/L	<2 ug/L	<250 ug/L	<40 ug/L	<10 ug/L	<200 ug/L	<30ug/L	<15ug/L	90 – 110%	6.5 – 8.2	n/a	500uS/cm

Source: DERM, 2010, Environmental Protection (Water) Policy 2009 Maroochy River environmental values and water quality objectives

DERM, 2010, Environmental Protection (Water) Policy 2009 Mooloolah River environmental values and water quality objectives

DERM, 2010, Environmental Protection (Water) Policy 2009 Pumicestone Passage environmental values and water quality objectives

The EVs identified for each of the waters crossed by the Project Area are provided in Table 24.

Depending on the water type and the EV, the Aquatic Ecosystem WQO can be nominated from Table 23, as these are typically the most stringent. However, where EVs other than for aquatic ecosystems are identified in Table 24, other more stringent WQOs may be applicable.

Table 24: Environmental Values for Freshwater Waters

WATER	AQUATIC ECOSYSTEM	IRRIGATION	FARM SUPPLY/USE	STOCK WATER	AQUACULTURE	HUMAN CONSUMER	PRIMARY	SECONDARY RECREATION	VISUAL RECREATION	DRINKING WATER	INDUSTRIAL USE	CULTURAL AND SPIRITUAL VALUES
Maroochy River Catchment[1]												
Petrie Creek	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Paynter Creek	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Eudlo Creek	✓	✓	✓	✓			✓	✓	✓		✓	✓
Mooloolah River Catchment[2]												
Upper Mooloolah River	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓
Ewen Maddock Dam	✓						✓	✓	✓	✓		✓
Addlington Creek	✓								✓			✓
Pumicestone Passage Catchment[3]												
Mellum Creek	✓	✓	✓	✓	✓	✓		✓	✓			✓
Elimbah Creek	✓	✓	✓	✓	✓	✓		✓	✓			✓

Source: [1] DERM, 2010, Environmental Protection (Water) Policy 2009 Maroochy River environmental values and water quality objectives

[2] DERM, 2010, Environmental Protection (Water) Policy 2009 Mooloolah River environmental values and water quality objectives

[3] DERM, 2010, Environmental Protection (Water) Policy 2009 Pumicestone Passage environmental values and water quality objectives

5.3.4 Water Quality Sampling Data

Physio-chemical water quality sampling of waterway crossings from Beerburrum to Landsborough was undertaken by WBM Oceanics Australia in March 2006 and reported in Caboolture to Landsborough rail upgrade study: Beerburrum to Landsborough Corridor (QT/ Arup 2007). Water quality sampling was also undertaken by BMT WBM in late 2007 and early 2008 as part of the aquatic surveys for sites between Landsborough and Nambour and was reported in the Landsborough to Nambour Rail Project Environmental Impact Statement (TMR/ Arup 2009). Publicly available monitoring data collected from the DNRME website (https://water-monitoring.information.qld.gov.au/) was available for the following locations in the vicinity of the Project Area:

- Coochin Creek at Mawsons Road (141010A)
  This monitoring point is located approximately 6km downstream of the Project Area and includes the waters from a number of streams crossed by the existing corridor. At the location of the monitoring point, the waters are classed as lowland freshwater with the environmental values as identified for Mellum Creek in Table 24 and the WQOs as identified for "Coastal and Lowland Freshwater" in Table 23.
  Monitoring commenced at this location in 2006 and ceased in October 2014.
- Mooloolah River at Mooloolah (141006A)
  This monitoring point is located approximately 2km downstream of the Project Area and includes the water from a number of streams crossed by the existing rail corridor. At the location of the monitoring point, the waters are classed as lowland freshwater with the environmental values as identified for Upper Mooloolah River in Table 24

and the WQOs as identified for "Coastal and Lowland Freshwater" in Table 23.
Monitoring commenced at this location in 1964 and ceased in July 2015.

- Eudlo Creek at Kiels Mountain (141008A)
  The monitoring point is located approximately 9km downstream of the Project Area and includes the water from a number of streams crossed by the existing rail corridor. At the location of the monitoring point, the waters are classed as wallum/tannin freshwater with the environmental values as identified for Eudlo Creek in Table 24 and the WQOs as identified for "Wallum/ tannin-stained streams" in Table 23.
  Monitoring commenced at this location in 1981 and ceased in September 2015.
- Petrie Creek at Warana Bridge (141003C)
  The monitoring point is located approximately 1km downstream of the Project Area and includes the water from a number of streams crossed by the existing corridor. At the location of the monitoring point, the waters are classed as wallum/tannin freshwater with the environmental values as identified for Petrie Creek in Table 24 and the WQOs as identified for "Wallum/ tannin-stained streams" in Table 23.
  Monitoring commenced at this location in 1979 and ceased in July 2015.

Table 25 provides a summary of the monitoring results for each of those locations.

Data collected at each of the monitoring points indicated elevated turbidity/suspended solids and nutrients, as compared to the Lowland Freshwater WQOs listed in Table 23. Elevated turbidity and suspended solids can be caused by a variety of factors including clearing of riparian vegetation, urban development and agriculture. Elevated levels of nutrients (i.e. nitrogen and phosphorus) may also be attributed to agricultural and residential land uses in the catchment.

The pH results in Table 25 shows neutral to higher pH levels, which reflects the elevated topography, with a lower likelihood of acid sulfate soils away from coastal areas. Dissolved oxygen was recorded in mg/L and therefore is not directly comparable to the WQOs.

Table 25: Summary of DNRME Water Monitoring Results

WATER QUALITY PARAMETER	LOWLAND FRESHWATER WQOS	COOCHIN CREEK	MOOLOOLAH RIVER	WALLUM/ TANNIN FRESHWATER WQOS	EUDLO CREEK	PETRIE CREEK
Stream Water Level (m)	NA	0.5	0.46*	NA	0.6	1.2
Water Temperature (field) (°C)	NA	21.0	18.6	NA	19.0	20.2
Dissolved Oxygen	85-110% saturation	7.4 (mg/L)	4.9 (mg/L)	85-110%	6.8 (mg/L)	8.4 (mg/L)
Turbidity	<10 NTU	18.5	18.2	<20 NTU	37.0	25.2
Suspended Solids	<6 mg/L	18.3	32.7	<6 mg/L	28.6	52.2
Total Nitrogen	<500 ug/L	2800	400	<500 ug/L	600	400
Ammonia N	<20 ug/L	31	47	<20 ug/L	22	27
Total Phosphorus	<50ug/L	41	153	<50ug/L	45	67
pH	6.5 – 8.0	6.8	7.6	5.0 – 7.0	7.2	7.6
Conductivity	500 uS/cm	130.6	430.7	500uS/cm	137.9	322.5

Notes: * Median value adopted as maximum value of 9999.99m depth skewing mean value
Red: exceeds WQO for coastal and lowland freshwater
Amber: marginal exceedance
Green: within objective limits
No colour: comparison not possible

A review of water quality data reported in the Beerburrum to Landsborough Ecological Assessment (WBM, 2007) was undertaken, and summarised in Table 26. Although this information is dated, it provides an indication of the variable nature of the creeks.

Previous water quality sampling indicates similar results for turbidity and pH in the creek systems traversed by the Project Area.

Table 26: Water Monitoring Results, WBM 2007

CREEK	DATE	TEMP (°C)	CONDUCTIVITY US/CM	PH	DISSOLVED OXYGEN % SAT	DISSOLVED OXYGEN MG/L	TURBIDITY (NTU)
Tibrogargan Creek (trib)	10/3/06	25.7	106	6.35	75.4	6.1	73.8
Tibrogargan Creek	1/3/06	23.05	131	5.53	34.7	3.0	50.1
Coonowrin Creek	10/3/06	24.21	122	6.72	81.6	6.2	28.5
Coonowrin Creek (north trib)	10/3/06	23.4	153	7.06	120.1	10.4	40.0
Back Creek	10/3/06	23.4	104	6.49	73.1	6.2	7.3
Coochin Creek	10/3/06	23.5	99	6.54	77.6	6.4	10.9
Bluegum Creek (south)	9/3/06	26.34	96	6.23	147.0	11.7	23.5
Bluegum Creek (north)	9/3/06	26.15	86	6.15	18.3	1.5	20.9
Bellbird Creek	9/3/06	24.82	104	6.55	161.3	12.7	61.4
Little Rocky Creek (south trib)	9/3/06	26.49	43	6.12	95.4	7.5	44.6
Little Rocky Creek (north trib)	9/3/06	25.03	43	5.72	43.3	3.2	51.5
Mellum Creek	9/3/06	23.9	171	7.27	151.9	13.0	98.6

Red: exceeds WQO for coastal and lowland freshwater
Amber: marginal exceedance
Green: within objective limits
No colour: comparison not possible

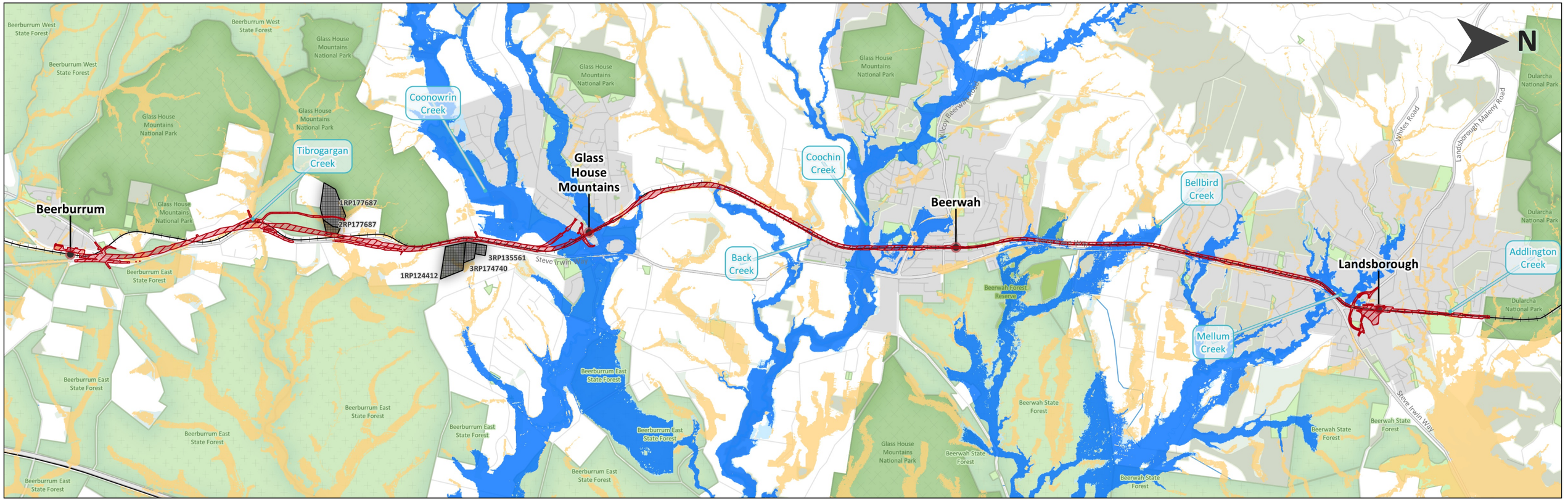
5.3.5 Flooding

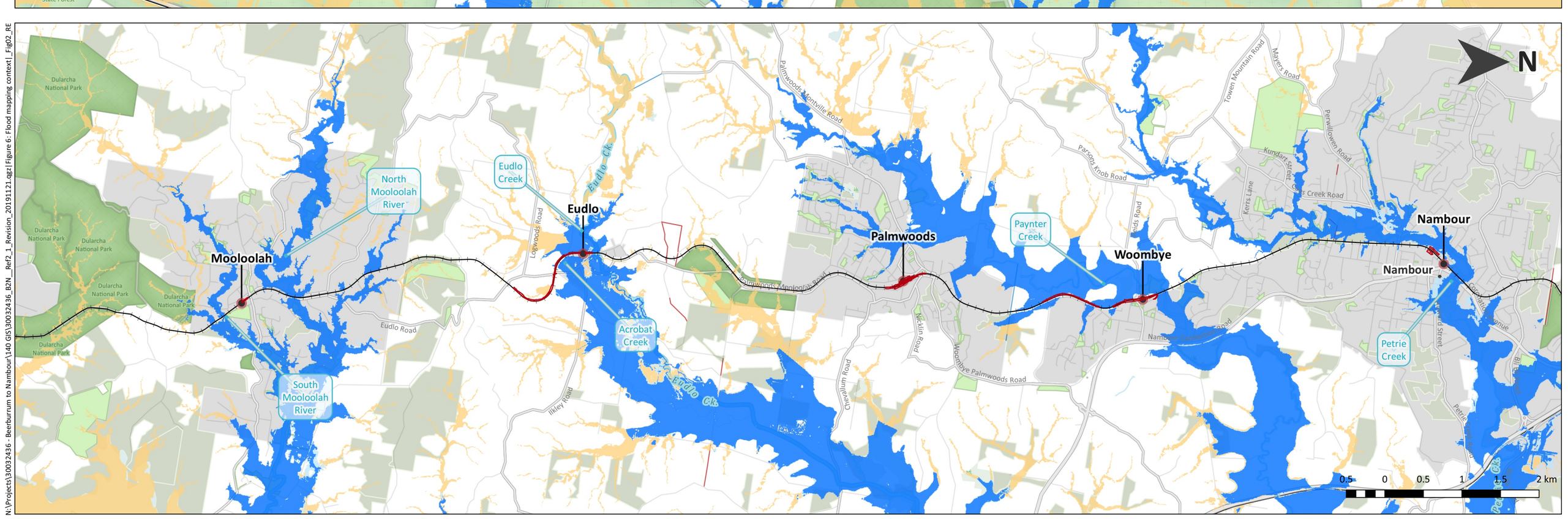
The flood investigation undertaken for the Beerburrum to Landsborough section of the B2N Project examined the catchments of three major creeks (Tibrogargan Creek, Coonowrin Creek and Coochin Creek) and their associated tributaries, (Bluegum Creek, Bellbird Creek and Mellum Creek). All three catchments are within the Pumicestone Passage Catchment, described in Section 5.3.1. Table 27 summarises the existing conditions, based on modelling outputs.

A review of the SCC flood mapping for the combined defined flood and storm tide events for a 1% AEP shows that the majority of creeks within the Project Area are subject to significant flooding, as shown in Figure 6.

Table 27: Existing Conditions, Beerburrum to Landsborough

FLOOD CATCHMENT	DESCRIPTION
Tibrogargan Creek	Existing North Coast Line impacted by the 1% AEP at six locations Steve Irwin Way impacted by the 2% AEP at five locations, with the existing Steve Irwin Way bridge over Tibrogargan Creek impacted during the 5% AEP due to creek flows, with approximately 0.75m of water over the road.
Coonowrin Creek	The analysis showed that the existing rail has less than 5% AEP flood immunity in two locations, and properties located along the northern Coonowrin Creek tributary (Paul Place) just north of Coonowrin Road are flooded during the 1% AEP event. Properties and businesses located at the downstream end of Coonowrin Creek tributary (Railway Parade) are also flooded during the 1% AEP event.
Coochin Creek	The existing NCL has less than 1% AEP flood immunity in four locations. Steve Irwin Way has less than 2% AEP flood immunity in four locations. Old Landsborough Road has less than 5% AEP flood immunity in four locations, similar to the Steve Irwin Way.





N:\Projects\30032436 - Beerburrum to Nambour\140 GIS\30032436_B2N__Ref2_1_Revision_20191121.qgz|Figure 6: Flood mapping context|_Fig02_RE

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SOURCES	QLD Govt

- Current rail line
- Project Area
- Additional Project Areas
- Forest Reserve
- National Park
- State Forest
- Reserve

Flood Risk
- Current climate riverine flooding
- Future climate riverine flooding
- Possible flooding beyond model boundary
- Modified flood extent

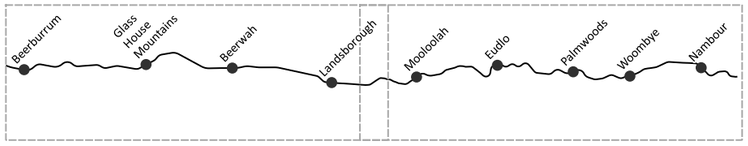

Figure 6: Flood mapping context

5.3.6 Groundwater Context

The Project Area is located in a region where the hydrogeology is classified as "porous with extensive aquifers of low to moderate productivity" (i.e. how easily the groundwater can be pumped) (BOM, 2019). BOM mapping also maps the Project Area as non-saline (total dissolved solids <3000mg/L; BOM 2019). Where the aquifers coincide with a surface stream, the aquifer is also associated with quaternary sediments.

There are few groundwater monitoring data points contributing to trends analysis, however those in proximity to the B2N Project, the two in Palmwoods and the two East of Mooloolah (both located within Palmview), indicated a trend of rising groundwater levels rom 2009-2014. This is consistent with trends identified across most of Australia that suggest the declining 10-year levels reflect several factors including climate (i.e. the millennium drought (2001-2009) and the rising five-year levels reflect La Nina rains (2010-2011), land use change, and extractions (BOM 2019). More recent groundwater level data is available from BOM, however there is no more recent groundwater level data available for the monitoring points relevant to the Project Area.

Where the DNRME has identified valuable groundwater areas that require management, these are identified in the corresponding surface waters Water Resource Plan. The *Water Plan (Mary Basin) 2006*, and the *Water Plan (Moreton) 2007* do not identify any Groundwater Management Areas in the vicinity of the Project Area.

5.3.7 Groundwater Quality Objectives

As described for surface waters, the B2N Project crosses the three catchments of the Maroochy Basin including the catchment for the Pumicestone Passage, Mooloolah River Catchment and Maroochy River Catchment. The EVs for groundwater in the three catchments are provided in Table 28. The WQOs for all catchments specify that, where ground waters interact with surface waters, groundwater quality should not compromise identified EVs and WQOs for those waters.

Table 28: Environmental values for groundwater

CATCHMENT	AQUATIC ECOSYSTEMS	IRRIGATION	FARM SUPPLY/USE	STOCK WATER	DRINKING WATER
Pumicestone Passage Catchment[1]	✓	✓	✓	✓	✓
Mooloolah River Catchment[2]	✓	✓	✓	✓	✓
Maroochy River Catchment[3]	✓	✓	✓	✓	✓

Source: [1]DERM, 2010, Environmental Protection (Water) Policy 2009 Maroochy River environmental values and water quality objectives

[2]DERM, 2010, Environmental Protection (Water) Policy 2009 Mooloolah River environmental values and water quality objectives

[3]DERM, 2010, Environmental Protection (Water) Policy 2009 Pumicestone Passage environmental values and water quality objectives

5.3.8 Groundwater Data

A review of the Groundwater Database managed by BOM (Australian Groundwater Explorer) identified 17 registered bores within 200m of the Project Area, the installation purpose of all were listed as unknown. Given the nature of the surrounding land uses, it could be assumed that these may be installed for agricultural water supply purposes.

The DNRME Water Monitoring Information Portal providing the locations and data for current monitoring stations of the Department does not list any mainland groundwater bores within the Maroochy Basin.

In 2008 a review of the groundwater resources was undertaken as part of the preliminary geotechnical study for the Beerburrum to Landsborough Rail Upgrade Project (B2L) (Trackstar, 2008). A series of groundwater monitoring rounds were conducted between September 2007 and January 2008. Analysis of the monitoring found the following:

- Groundwater levels remained reasonably static for the period September to December 2007 with little fluctuation observed through the length of the corridor. A general rise was observed early December to mid-January consistent with the increased rainfall during that period.
- Water levels indicated that groundwater is close to the surface. In 11 of the 18 bores monitored, groundwater was within one metre of the ground surface from early December to mid-January. Prior to the rainfall period, five bores were recorded to have levels within a metre of ground level. Generally, these bores were associated with alluvial deposits associated with streams, gullies, and wetlands.
- The average depth to groundwater across the area from September 2007 to January 2008 was 1.88m below ground level.
- A review and analysis of climate data for the region and groundwater levels in response to the increased rainfall determined that it was likely that the groundwater levels were relatively high compared to periods of inconsistent rain, the implications being to design and construction that the observed levels were likely within their upper range.
- Changes in flows at three sites indicated the potential for artesian conditions, however it appeared to be more likely that the circumstances being observed were an effect of increased hydraulic head due to stream flow conditions or bore clogging due to flooding. It was therefore determined that further monitoring for baseline data was required to assess seasonal groundwater variations and their implications for construction.
- Pump tests at three sites showed that the impact of groundwater on the B2N Project was likely to be of a localised nature. The groundwater resources within the Landsborough Sandstones were typically within the extremely weathered sandstone layers or the overlying alluvial deposits associated with streams, gullies, and wetlands. The transmissive and storage values for the Landsborough Sandstone were relatively consistent at the locations tested and there was indication that this would remain the case.
- The bore location and yield data from the ground water database indicated that groundwater resources were limited and generally associated with geological features.
- Further investigation was recommended should cuttings or structures be likely to intersect the extremely weathered sandstone layers or alluvial deposits.

Given this investigation occurred prior to the ending of the millennium drought (2001-2009), the observed increases in groundwater levels associated with rainfall during the monitoring period, and the five-year trend of rising groundwater levels in the region (see Regional Context), it is recommended that detailed analysis of the groundwater along the corridor is undertaken to better understand the seasonal groundwater context, both from an engineering and ecological perspective.

5.3.9 Groundwater Dependent Ecosystems

Mapping of Groundwater Dependant Ecosystems (GDEs) in Queensland is produced by the DES. It draws on existing information including wetland mapping, regional ecosystem mapping, a spring and small waterholes database and drainage lines to show known and likely areas of GDEs.

The mapping shows different confidence levels from known (according to expert knowledge and supporting evidence like field validation, the mapped ecosystem has been accurately identified as having some degree of groundwater dependence) through to low confidence (according to expert knowledge there is a low confidence in the mapping rule set and therefore in the prediction that the mapped ecosystem has some degree of groundwater dependence).

Mapping of Surface and Terrestrial GDEs with moderate confidence are extensive through the region, indicating the potential for GDEs to exist. These derived GDEs are associated with creeks, dams and drainage features across the Project Area, and also tend to correlate to areas mapped as remnant regional ecosystems along waterways.

5.4 Potential Impacts

5.4.1 Construction

Surface Water

New waterway crossings, including bridges and culverts, and extensions to culverts will be required for both rail and road components of the Project. Table 29 summarises the waterways and crossing types proposed along the B2N Project. All structures on waterways mapped for waterway barrier works will need to be designed and constructed so as to allow fish passage. Dry passage for fauna will also need to be considered at bridge structures and major habitat linkages along the rail corridor, especially at Tibrogargan Creek, Coonowrin Creek and Mellum Creek. At the time of assessment, no waterway diversions were identified to facilitate the proposed works.

Surface water quality impacts from construction can include:

- the removal of riparian vegetation, resulting in increased risk of erosion and sedimentation, and consequent deterioration in water quality
- direct disturbance to waterways as a result construction of new bridges and culverts, extension of culverts, or removal of existing structures to address flooding or afflux issues
- mobilisation of contaminants from within lots listed on the Environmental Management Register (EMR), including the existing rail corridor
- the introduction or spread of exotic vegetation that could undermine the quality of riparian vegetation communities
- spills and accidents which may affect water quality.

Works may result in impacts to water quality and surface water flows, particularly immediately downstream or further downstream in the catchment. These impacts can be biological, where the health of the stream ecology degrades, and physical, impacting water users where the water quality may no longer be suitable for previous uses (e.g. recreational or agricultural purposes).

As previously discussed, the B2N Project passes through the headwaters of three catchments: Maroochy River, Mooloolah River and Pumicestone Passage catchments. The potential to directly degrade waters in the upper streams is discussed above, however there is also the potential to have indirect impacts downstream.

Construction will have temporary impacts that will be managed at the source, however impacts may also include the temporary reduction in water quality downstream including the potential for:

- increased turbidity/suspended solids due to disturbed soils/erosion entering the waterways
- increased nutrients from rehabilitation activities, i.e. fertilisers mobilising into the waterways
- transport of contaminants from earthworks within EMR listed lots
- increased hydrocarbons and chemicals in the waters from spills and accidents.

Changes in pH and conductivity are usually a result of soil characteristics, and investigations indicate that this is not likely to be an issue in this area, as soils do not show signs of acidity or salinity. However, changes to stream flows may occur as a result of construction works introducing impediments to stream flows, or changing the geomorphology of the streams.

The Pumicestone Passage has been recognised as an internationally significant wetland and is protected under the Ramsar Convention. 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.

Ewen Maddock Dam is part of the south-east Queensland drinking supply network. The B2N Project crosses Addlington Creek and three tributaries of Addlington Creek that flow into the dam. As discussed above, construction works would only occur across Addlington Creek and one of the tributaries. Addlington Creek is a second order stream, and the tributary is a first order stream.

The construction works would occur approximately 1.4km upstream from the dam with a range of land uses occurring in the immediate vicinity including residential, services, intensive horticulture, agriculture and manufacturing. Waters from the catchment then enter an area of marsh/wetland before entering the dam. Given the creek and tributaries are already crossed by both the rail and multiple roads, the already heavily impacted area, and the distance to the dam, it is expected that construction can be managed to avoid downstream impacts to the dam.

Table 29: Waterway Crossings

WATERWAY	WATERWAY BARRIER WORKS RISK LEVEL	STATUS UNDER THE WATER ACT	CROSSING/ IMPACT TYPE	COMMENTS
Pumicestone Passage Catchment				
UT Tibrogargan Creek	1 Low, Green		Rail- extend existing culvert	
Tibrogargan Creek	2 Moderate, Amber	Defined watercourse	Rail- new bridge	The existing rail bridge is proposed for removal, to mitigate flood impacts
Tibrogargan Creek	2 Moderate, Amber		Berteaus Road/ Caves Road – new culverts	Fauna passage provisions to be incorporated in future design
UT Tibrogargan Creek	1 Low, Green		Berteaus Road/ Caves Road– new culverts	
UT Tibrogargan Creek	1 Low, Green		Rail – new culverts	
Coonowrin Creek	3 High, Red	Defined watercourse	Rail – bridge widening	Fauna passage provisions to be incorporated in future design
Coonowrin Creek	3 High, Red	Defined watercourse	Barrs Road – new road bridge over creek	Fauna passage provisions to be incorporated in future design
UT Coonowrin Creek	1 Low, Green	Defined watercourse	Rail – extend existing culvert	
UT Coonowrin Creek	Not mapped	Defined watercourse	Rail – extend existing culvert	
UT Back Creek	1 Low, Green		Rail– extend existing culvert	
Back Creek	2 Moderate, Amber	Defined watercourse	Rail– widen bridge	Also accommodates Youngs Road
Coochin Creek	4 Major, Purple	Defined watercourse	Rail – on existing bridge	Bridge upgraded to accommodate duplication during previous works at Beerwah
UT Bluegum Creek	1 Low, Green		Rail – extend existing culvert	
Bluegum Creek	1 Low, Green	Defined watercourse	Rail -– extend existing culvert	Creek named differently between DNRME and Fisheries data layers
Bellbird Creek	2 Moderate, Amber		Rail– extend existing culvert	Named as Bluegum Creek in Fisheries layer
UT Mellum Creek	2 Moderate, Amber		Rail– extend existing culvert	
Mellum Creek	3 High, Red		Rail	

WATERWAY	WATERWAY BARRIER WORKS RISK LEVEL	STATUS UNDER THE WATER ACT	CROSSING/ IMPACT TYPE	COMMENTS
Mellum Creek	3 High, Red		New road bridge, grade separation of Caloundra Street	Design to be developed to minimise impacts on Mellum Creek and riparian corridor / habitat along the creek
Mooloolah River Catchment				
UT Addlington Creek	1 Low, Green		Rail –extend existing culvert	
Addlington Creek	2 Moderate, Amber	Defined watercourse	Rail –extend existing culvert	
UT Mooloolah River	2 Moderate, Amber		Rail – new bridge	No change to existing crossing, south of station works
South Mooloolah River	3 High, Red		Rail – new bridge	Replacement of existing bridge with duplicated bridge
Maroochy River Catchment				
Acrobat or UT Acrobat Creek	Not classified		New rail bridge over road and waterway	Inconsistency between DNRME and Fisheries data, appears as Acrobat Creek in DNRME layer
Eudlo Creek	3 High, Red	Defined watercourse	Station works stop south of bridge, no change	No change to existing crossing
Paynter Creek	4 Major, Purple	Defined watercourse	Station works stop south of bridge, no change	No change to existing crossing
Petrie Creek	4 Major, Purple	Defined watercourse	Area identified adjacent to creek for potential future car park	Subject to inclusion of car park in scope of future works

Flooding

During construction, there is the risk that severe weather may occur resulting in flooding of local catchments, and inundations of works areas, particularly where new or upgraded waterway and drainage crossings are under construction. This can also result in impacts to private properties and or the local road network, and generate adverse media coverage and community concerns, with potential for third party claims.

Temporary works within watercourses, including bunding, culvert construction or extension, construction of temporary access tracks or diversion of clean water around works areas has the potential to impede or reduce the conveyance of flows. This could create localised flooding with both upstream and downstream effects possible.

Groundwater

Key construction risks to groundwater include:

- activities which cause a localised decrease in water level such as dewatering activities and earthworks, particularly at cuttings
- activities which cause the spill or leaching of contaminants ultimately reducing the groundwater quality
- direct impact on bores, or removing access to local users.

Table 30 identifies bores directly impacted by the B2N Project.

Table 30: Bores directly impacted by construction works

FACILITY NUMBER	STATUS	FACILITY NUMBER	STATUS
14100075	Decommissioned	144835	Functional
79621	Functional	144843	Functional
121175	Functional		

5.4.2 Operation

Surface Water

Catchment and water quality impacts during operation are anticipated to be minimal. The potential for incidents and spills will need to be taken into consideration during future stages of design, adopting a risk-based approach to determining requirements to achieve water quality objectives. Some maintenance activities would be required that may have the potential to impact riparian vegetation communities, introduce the risk of spills and accidents, or spread exotic vegetation/ weeds. Weed management within the rail corridor has the potential to impact water quality if environmental controls are not followed correctly.

Flooding

The flood investigation assessed the area between Beerburrum and Landsborough to inform the Business Case Reference design. This assessment informed the rail level and sizing of culverts and structures to achieve the desired flood immunity for both rail and road infrastructure, and minimise off-property impacts. The key outcomes of the flood investigation are summarised in Table 31.

The flood investigation shows that the desired flood immunity will be achieved, except in existing constrained locations where it is not possible to alter the vertical geometry of the rail. All new roads or road realignments have been designed to achieve the desired flood immunity.

The construction of the new rail and road bridges and decommissioning of the existing bridge at Tibrogargan Creek will require significant works to achieve the desired level of flood immunity in this location. This area is also environmentally sensitive and likely to trigger community concerns due to its proximity to the nearby Matthew Flinders Rest Area, which will also be impacted. The construction methodology will need to be defined to determine whether a waterway diversion will be required to construct the works.

Table 31: Summary of Flood Assessment, Beerburrum to Landsborough

CATCHMENT	ASSESSMENT
Tibrogargan Creek	The proposed rail alignment has been designed with immunity for the 1% AEP. However, modelling shows that the Steve Irwin Way will continue to be impacted in at least one location by the 2% AEP, with a minor increase in depth (from 0.1m to 0.13m). The Steve Irwin Way bridge over Tibrogargan Creek will continue to be overtopped in the 2% AEP, with a predicted increase in depth from 0.75m to 1.0m, as a result of creek flooding. All proposed new local roads have been designed to achieve immunity for the 5% AEP. In order to reduce the afflux upstream of the proposed Tibrogargan Rail Bridge, it is proposed to that the existing rail bridge is removed, and provide a waterway opening (i.e. area under the new bridge structure) approximately 80m. This would require removal of part of the existing embankment, formation and rail bridge structure. It is also recommended that a bridge is constructed with an opening of 30m for the new section of Caves Road crossing Tibrogargan Creek upstream of the proposed railway line. A bridge has been elected as culverts would create a considerable afflux in the upstream section of the creek. Analysis showed that the proposed new road bridge and new rail bridge across Tibrogargan Creek creates an afflux of approximately 0.04m in a 1% AEP design event in the upstream section of Tibrogargan Creek. Aerial images show that a number of properties are located within the afflux zone, which appear to be plantation timber or native vegetation. The increase in flood depth is a result of the redirection of flows and constraints posed by Caves Road.
Coonowrin Creek	The proposed rail alignment has been designed with immunity for the 1% AEP. Barrs Road, including the proposed bridge crossing of Coonowrin Creek has been designed to achieve immunity in the 5% AEP. There are no proposed changes to the Steve Irwin Way in this catchment. Some localised afflux is predicted.
Coochin Creek	The proposed railway along the Coochin Creek catchment only consists of duplication of the existing rail, with no rail realignment proposed within this area. Some culvert upgrades, including five new culverts and upgrades to existing culverts were identified in order to minimise flooding on the rail for the 1% AEP event. New and upgraded culverts also create a greater discharge and cause an afflux downstream of the rail alignment. However, the modelling showed that no properties are affected. Analysis indicated that the additional track across Coochin Creek creates a maximum afflux of 0.05m upstream of the rail during the 1% AEP event. As a result of the proposed new and upgraded culverts and crossing structures, existing overtopping depth was reduced at three locations on the North Coast Line in a 1% AEP flood event, improving on the existing conditions.

Groundwater

As the Project Area is co-located or in close proximity to the existing rail corridor, little change is likely to occur to infiltration or groundwater expression. Areas of steep cuttings may require ongoing monitoring to ensure groundwater levels are not impacted, however these are not anticipated to be located in wetland areas or areas dependent on shallow groundwater. The potential for incidents and spills will need to be taken into consideration during future stages of design, adopting a risk-based approach to determining requirements to achieve water quality objectives.

5.5 Proposed Mitigation Measures

5.5.1 Design

The railway infrastructure will impact on the environment in a number of ways, which must be mitigated. The design of drainage structures should ensure that scour and flow velocities should meet environmental criteria. Other environmental impacts associated with the drainage infrastructure include causing breaks in riparian corridors and impacts on fauna movement, including fish passage. The drainage infrastructure must be designed to provide for fauna connectivity and fish passage, and be progressed in consultation with relevant agencies such as DAF. Riparian habitat restoration and weed management will also be key requirements for future design development and contract administration.

Surface Water

Water quality treatment measures (including water sensitive urban design (WSUD) measures) and spill containment devices may be required in future stages of design, taking into consideration the water quality objectives, level of risk, maintenance requirements and physical space within the corridor to accommodate treatment devices. This should also include consideration of any locations where additional scour protection may be required to minimise erosion risk and maintain watercourse stability.

Where possible, culverts and bridges should be designed to avoid the need to divert or retrain watercourses. In-stream works should be minimised through sensitive design of bridges, culverts and culvert extensions. All culverts should be designed in accordance with DAF's '*Accepted development requirements for operational work that is constructing or raising waterway barrier works*'.

An erosion and sediment control plan must be developed by a Certified Professional in Erosion and Sediment Control (CPESC) during the design phase, to identify risk areas and reasonable treatments for costing and contract administration purposes.

Water quality monitoring of existing water courses should be undertaken (prior to any works) for a 12-month period to establish a baseline for reporting during construction.

A construction water supply strategy should also be developed, to quantify how much, and sources of water for construction activities. Water extraction approval and exemption requirements would also be identified at this stage.

Flooding

Structure size and configuration at each waterway took into account an appropriate design flood (1% AEP), with the design process aimed at minimising adverse impacts on other infrastructure / development, scouring / siltation and floodplain flow distributions. Factors such as acceptable velocity, acceptable afflux, overtopping and duration of inundation were considered, as well as potential benefits.

At the date of this report, 137 waterway structures have been identified, as follows:

- 12 bridges
- 125 culvert structures (including 99 existing culvert structures).

Further modelling is required during subsequent design stages to assess more detailed information as it becomes available on alignments, topography, structures, etc. which will enable more accurate representation of the proposed railway duplication.

Other issues that will need to be addressed during further design stages include details of bridges with piers and superstructure, blockage considerations, acceptable afflux, freeboard assessment and further verification. Scour protection should also be assessed during further design stages.

Groundwater

A risk-based approach to the design and inclusion of water quality treatment devices will be required to determine the level of protection required. This will also need to consider the potential for incidents and spills during operation. Groundwater monitoring at cuttings may be required, if identified in the geotechnical investigations.

5.5.2 Construction

Surface Water

An erosion and sediment control plan and Construction Environmental Management Plan (CEMP) will be required for the works. This should comply with the requirements of the TMR Technical Specification 52 Erosion and Sediment Control (MRTS52). TMR Technical Standards are updated periodically, and the version current at the time of contract preparation would apply to the works.

High risk construction activities such as bulk earthworks should be avoided during wet weather, and a severe weather management plan developed with emergency protocols for works and watercourse protection.

Construction activities should be conducted in a manner to minimise disturbance to stream banks and beds, with rapid rehabilitation on completion of works, or stabilisation of exposed areas if works areas are left for any extended period of time (i.e. more than 7 days). Rehabilitation planting and stabilisation treatments should be undertaken once active construction areas are no longer required.

Any environmental incident that impacts water quality of watercourses should be reported in accordance with the B2N Project's CEMP. Following a reportable incident, the habitat should be restored or repaired to its natural state or as directed by the regulatory authority.

Storage of fuels, chemicals etc. should be within bunded areas, at least 50m from waterways and drainage lines. Refuelling of construction machinery should be undertaken in approved construction areas.

Construction water supply would be sourced in accordance with the construction water supply strategy, and any necessary permits or approvals would be obtained prior to construction commencing.

Flooding

Areas at risk of flooding or inundation during construction are to be identified as part of construction planning activities, to determine the level of analysis and assessment required to fully understand the potential for third party property impacts or road network impacts. Where the potential for risks to third parties is identified, determine suitable mitigation measures based on a range of severe weather scenarios. Community liaison protocols for at risk property owners or occupiers would also need to be established as part of this process. These areas would also be identified in the severe weather management plan, along with procedures for work protection in the event of flooding.

Groundwater

If construction water is to be sourced via bores or groundwater extraction, the necessary permits and approvals are to be in place prior to extraction.

Groundwater monitoring at discrete locations during construction may be required (i.e. at cuttings), subject to the outcome of design.

5.5.3 Operation

Surface Water

Management of impacts during the operational phase should be documented in the rail corridor operator's environmental management system (EMS). This should include ongoing monitoring of the condition of the rail, associated stormwater management devices (if any) and inspection of culverts and structures for obstruction, blockages and scour. Procedures for herbicide use and responding to spills and incidents should also be documented in the operator's EMS.

Flooding

Whilst the vertical geometry of the reference design has been developed to minimise or improve upon existing conditions, some flood risk still exists. Existing QR operational procedures would apply in the event of flooding impacting the rail corridor.

Groundwater

No specific mitigation measures are proposed as no ongoing groundwater impacts are anticipated.

5.6 Residual Impact Assessment

With the implementation of the mitigation measures outlined in Table 32, it is anticipated that the B2N Project's potential impacts will be manageable during construction, and negligible during operation, under normal conditions. In the event of spills or incidents, emergency management requirements would apply.

Table 32: Residual Impact Assessment, Water

PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Design Construction	Degradation of environmental values associated with loss of riparian vegetation.	Minimise the area cleared for construction. Rehabilitate areas temporarily disturbed following construction as soon as possible on completion of works in an area. Establish a baseline water quality monitoring program to enable accurate identification of construction and operational water quality issues, which provides sufficient information to understand seasonal variation.	Short term disruption to natural conditions as riparian areas are re-established	Short term	Possible	Minor
Construction	Soil erosion, resulting in sediments and nutrients entering watercourses after vegetation removal, and/or during excavation and earthworks resulting in: Impacts to aquatic fauna and flora. Water quality negatively impacted.	Erosion and sediment control plan (ESCP) developed and certified by CPESC for construction phase taking into account local flow paths and constraints to the use of 'traditional' erosion and sediment controls such as retention basins. Constraints along the alignment are likely to include shallow groundwater systems that render excavation for the construction of retention basins in these areas unsuitable. The ESCP will 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; and • requirements for rehabilitation and stabilisation works. • establish a surface water quality monitoring program to monitor the condition of impacted waterways. The program shall include:	Potential risk for water quality objectives to be exceeded as a result of adverse weather events.	Short term	Possible	Moderate

PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
		• requirements for monitoring upstream and downstream of the works site; • monitoring to commence prior to construction and end post-construction; and • monitoring is to be weekly or immediately following storm events in accordance with the relevant design manual.				
Construction	Inappropriate storage and handling of dangerous good, or refuelling practices resulting in spills. Hydrocarbons/oil or chemical leaks, entering waterways.	• develop and implement stormwater management plan that includes use of on-site stormwater treatment where required • storage of all chemicals should be within a suitably sized bund in accordance with AS1940 The storage and handling of flammable and combustible liquids and be located at least 50m away from waterways or drainage lines • where required, on-site refuelling of vehicles to be undertaken at least 50m away from waterways or drainage lines, with appropriate controls in place in the event of spills • implement emergency control plans for spillages • notify emergency services of large spills and implement containment measures (i.e. booms, sandbags, absorbent materials) in accordance with the EP Act	Potential risk for emergency situations or adverse weather to result in spills	Short term	Unlikely	Moderate
Construction	Litter and rubbish entering waterways from construction work and workers	• provide adequate disposal facilities for all types of construction waste • visual monitoring of the waterways when construction activities are occurring within the vicinity of the waterway • environmental induction of construction personnel.	No construction waste entering waterways	Short term	Unlikely	Negligible
Design	Road and rail runoff of litter, sediment, heavy metals, petroleum,	Minimise runoff from road and rail that enters the watercourse in the first instance by maximising vegetated areas in the transport corridors and reserves	A detectable increase in pollutants entering waterways, which	Long term	Possible, depending on maintenance of	Minor to Moderate

PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Operation	hydrocarbons and polynuclear aromatic hydrocarbons and nutrients (phosphorus and nitrogen).	and treat any stormwater runoff through implementation of appropriately designed water sensitive urban design measures (WSUD), such as: • installation of GPTs (gross pollutant traps), on stormwater drains • bio-retention swales to capture run-off where there is sufficient area and grade or bio-retention basins where site constraints favour end-of-line treatment. • Details of the WSUD strategy should be developed in accordance with the Water by Design WSUD design guidelines current at the time of detailed design and suitable best practice load-based stormwater quality design objectives. • Any WSUD devices installed will require maintenance in accordance with their design specifications. • Design and incorporation of WSUD measures is to be undertaken with an understanding of their long term efficacy and maintenance requirements.	could be attributed to the Project design or maintenance of pollution control devices		WSUD devices	
Design Construction	Contamination of surface water and groundwater from inappropriate management of contaminated soil	• investigate the presence of potentially contaminated soils prior to construction to allow for appropriate planning and management, particularly on those lots identified on the EMR • implement temporary bund structures for onsite storage of contaminated soils and overburden • treat contaminated material in accordance with regulatory obligations prior to reuse or disposal (i.e. obtain soil disposal permit) • no placement of contaminated or potentially contaminated spoil (i.e. material excavated from the rail corridor) near environmentally sensitive areas.	Contamination is not identified during construction activities, remains in-situ	Long term	Unlikely	Minor

PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
Construction	Discharge of contaminated concrete washout water impacts local water quality	Areas for washout established away from creeks and drainages lines with sufficient buffering, and remediated on completion of works.	Areas established for washout require remediation	Short term	Likely	Negligible
Design and Construction	Sediment or contaminants enter upper tributaries feeding Ewen Maddock Dam	Culvert extension works on Addlington Creek and other drainage features that flow to Ewen Maddock Dam are completed rapidly with implementation of significant erosion and sediment control measures. Consultation with Seqwater to agree management and monitoring requirements.	Short term disruption to natural conditions as riparian areas are re-established.	Short term	Possible	Minor
Construction	Cross-contamination of underlying aquifers from piling activities, if required.	Undertake dry piling (i.e. no drilling fluids) to reduce the risk of cross-contamination of underlying aquifers. Where this is not possible, use non-toxic polymer-based drilling fluid.	No cross contamination of groundwater.	Long Term	Unlikely	Negligible
Design Construction	Changes to local hydrology and drainage patterns as a results of B2N Project design/construction	Maintain hydraulic regime by: • compliance with the requirements of *Environment Protection (Water and Wetland Biodiversity) Policy 2019* and catchment management plans prepared for local waterways by council, Seqwater and relevant catchment groups • optimise the design to maintain as much as practicable, the current catchment areas and the associated hydrological regime • avoid creek diversions where feasible • manage flows, velocities and afflux through appropriately sized drainage infrastructure • integrate stormwater detention and treatment devices where necessary to maintain water quality objectives • avoid placement of bridge piles or piers in the low flow channel of waterways	Existing hydraulic conditions maintained	Long Term	Certain	Minor

PHASE	POTENTIAL IMPACT (WITHOUT MITIGATION)	MITIGATION AND MANAGEMENT	RESIDUAL EFFECTS	DURATION	LIKELIHOOD	IMPACT ASSESSMENT
		• conduct flood risk assessment to identify at risk properties during construction phase and development mitigation and communication strategies.				
Design	Changes to hydraulic and hydrological conditions as a result of climate change	Integrate best available climate change scenarios into hydraulic modelling and flood assessment, including assessing the frequency and likely occurrence of inundation over design life to determine degree of flood immunity required/ Comply with current Qld government policy.	Reduced risk of inundation or climate impacts associated with this section of the rail network	Long Term	Possible	Minor
Construction	Reduction in surface water volume/flow through extraction of surface waters for construction purposes.	Develop construction water supply plan. Apply for relevant permits if construction water is to be taken from waterways or local bores, where exemption conditions cannot be achieved.	Temporary reduction in surface water flows or availability to downstream users	Short Term	Possible	Negligible