Appendix 10: Traffic Impact Assessment

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Prepared for
Santos Ltd
ABN: 80007550923

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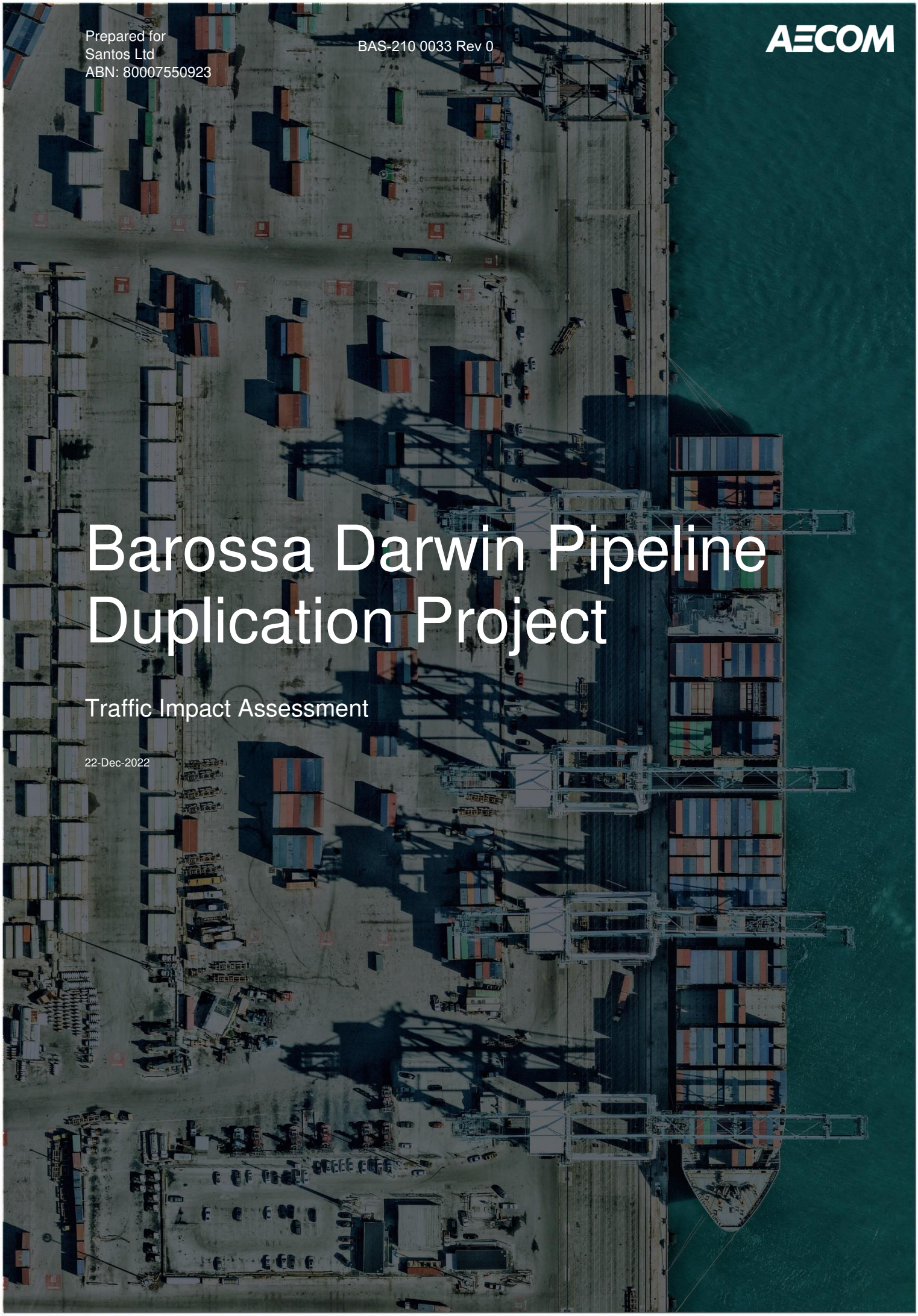
AECOM



Barossa Darwin Pipeline Duplication Project

Traffic Impact Assessment

22-Dec-2022

Barossa Darwin Pipeline Duplication Project

Traffic Impact Assessment

Client: Santos Ltd

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Quality Information

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Revision History

Rev	Revision Date	Details	Authorised	
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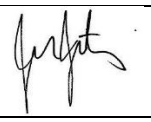
0	22-Dec-2022	For Submission	J.Jentz Technical Director - Civil Infrastructure	

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Executive Summary

Overview

Santos proposes to construct and operate a new pipeline segment, the Darwin Pipeline Duplication Project (the Project), enabling natural gas from the Barossa Field in the Timor Sea to be transported to the Santos-operated Darwin Liquified Natural Gas (DLNG) Facility at Wickham Point. The new gas pipeline would extend the existing Barossa Gas Export Pipeline and would comprise of approximately 100 kilometres of pipeline in Northern Territory waters and 23 kilometres of pipeline in Commonwealth waters.

The purpose of this report is to assess the potential traffic and transport impacts associated with the Project. This assessment will inform the preparation of the Supplementary Environmental Report (SER) for the DPD Project which will be submitted to the Northern Territory Environmental Protection Authority (NT EPA) for assessment in accordance with the Northern Territory Environmental Protection Act 2019 (NT EP Act).

Existing conditions

An existing transport conditions review was undertaken, which was informed via a combination of desktop reviews, site visit, crash/traffic data analysis and review of relevant policies and legislation. The key existing condition findings are summarised below:

- The road network within the study area is comprised of several Territory roads including Arnhem Highway and Stuart Highway. The Stuart Highway is the most heavily trafficked road in the area, with up to 27,800 vehicles travelling on the road on an average day.
- Stuart Highway, Tiger Brennan Drive and Berrimah Road all form part of the National Land Transport Network. Heavy vehicles (>3 axles) account for between 3.6% and 27.4% of traffic volumes on these roads.
- Traffic volumes on key roads in the study area generally peak during the month of September. Reduced levels of traffic are observed during the wet season (November to April).
- Arnhem Highway, Stuart Highway, Tiger Brennan Drive, Berrimah Road, Kirkland Road, Elrundie Avenue, Jenkins Road, Channel Island Road and Wickham Point Road all form part of the approved network for 53.5 m Road Train vehicles.
- Dedicated cyclist infrastructure in the study area is limited to an on-road bicycle lane on the eastern side of Berrimah Road between Marlow Road and Wishart Road. Several shared footpaths are provided adjacent to key roads in the study area including Berrimah Road, Tiger Brennan Drive, Stuart Highway and Arnhem Highway.
- There are no existing or proposed public bus services within 400 m of the DLNG facility or the intermediate stockpile site at Darwin Port, however CDC Northern Territory operates seven regular public bus services on roads forming part of the proposed Project haulage routes.
- The Adelaide-Darwin railway alignment is located approximately 750 m north-west of the intermediate stockpile site at Darwin Port. This railway line is grade separated from Berrimah Road at East Arm. However, two level railway crossings are located on Kirkland Road and one is located on Channel Island Road.
- In the five-year period from 2015 to 2019, a total of seven fatalities occurred on key roads in the study area. Five of these fatalities occurred on Tiger Brennan Drive.

Impact assessment

The key findings of the construction phase impact assessment are as follows:

- Mid-block capacity: a mid-block capacity assessment was undertaken for key roads in the study area to assess the impact of the Project on road capacity. The results indicate that all roads would operate under capacity in 2024 with the exception of Stuart Highway (between Temple Terrace and Howard Springs Road) and Wishart Road during the AM peak hour. Project-generated traffic would

account for a very minor proportion of traffic on the local road network in 2024 and where the available capacity of a road has been exceeded, it is not a result of Project traffic.

- Intersection capacity and performance: traffic modelling using SIDRA Intersection (version 9.0) was performed to assess the impacts of the Project on the capacity and performance of three critical intersections. The modelling results indicate additional traffic movements generated by the construction of the Project in 2024 would result in negligible impacts.
- Preliminary haulage route assessment: routes have been established based on the approved road network for 53.3 metre Road Train vehicles. No road upgrades are anticipated to be required to accommodate Project traffic.

Overall, impacts to the local transport network during Project construction are expected to be negligible given the very low proportion of Project-generated traffic on the local road network.

Mitigation measures

To mitigate the potential impacts of the Project, the following mitigation measures have been recommended:

- All vehicle movements associated with the Project should be planned to occur outside of the identified AM and PM peak hours
- Group transport, such as shuttle buses and car-pooling schemes, should be implemented where practical to reduce the number of light vehicle movements on the local road network
- Heavy vehicle movements should be scheduled to minimise traffic disruption to the road network. This may include:
    - Scheduling of the movement of rock, equipment and other materials to occur outside of the identified AM and PM peak hours
    - Scheduling heavy vehicle movements to be evenly dispersed as far as practical to minimise the potential of convoying or platoons on the road network.
- The loading and unloading of heavy vehicles should be planned so that the capacity of each individual vehicle is fully utilised to reduce the total number of movements on the local road network
- A separate Traffic Management Plan (TMP) should be prepared, approved and implemented during the construction phase of the Project. The TMP will confirm final haulage routes and provide the necessary mitigation measures to ensure that construction vehicle movements can be accommodated on the local road network with minimal impacts.
- Coordination and consultation with key stakeholders to manage the interface of other projects occurring in the study area at the same time. This may include the coordination of traffic management arrangements between projects and the provision of regular project updates.
- Investigation of potential alternative haulage routes in the event that road closures or access restrictions are required to facilitate other projects in the study area.

Abbreviations

Abbreviation	Term
AADT	Average Annual Daily Traffic
AECOM	AECOM Australia Pty Ltd
DIPL	Department of Infrastructure, Planning and Logistics
DLNG	Darwin Liquified Natural Gas
DOS	Degree of saturation
FCGT	Flood / Clean / Gauge / Testing
Km	Kilometre
Km/h	Kilometres per hour
LOS	Level of service
M	Metre
NT	Northern Territory
OD	Over-dimensional vehicle
OSOM	Oversize Overmass
SER	Supplementary Environmental Report
TIA	Transport Impact Assessment
TMP	Traffic Management Plan
ToR	Terms of Reference

Glossary

Term	Description
AADT	This measurement provides the total volume of vehicle traffic of a road for a year divided by 365 days.
Access track	Tracks that are built by the project to facilitate construction, operation and maintenance.
Average delay	This is the average amount of time it takes a vehicle to negotiate an intersection, including the time to negotiate corners and the time stopped in queues or waiting for a green signal.
DOS	Ratio of demand to capacity. A DOS of 1.0 or more in theory represents saturated conditions where the demand exceeds the capacity. For a signalised intersection, a DOS of 0.9 is usually adopted as the capacity threshold.
Land	Any land, whether publicly or privately owned, and includes groundwater.
Landholder	A general term used to refer to the legal owner or manager of a parcel of land. It may be private landholder, Government or private utility, or a Government Agency responsible for management of a particular parcel of Crown land (e.g., National Parks or Forestry areas).
LOS	This is an alpha-numeric rating of the overall performance of an intersection, ranging from LOS A (very good) to LOS F (very poor).
Mid-block	A location around the mid-point between two intersections.
OD vehicle	Over-dimensional (OD) vehicles are those that exceed 5.0 metres wide/high or 30.0 metres long or 100.0 tonnes gross mass. OD vehicles should be reviewed for transportation with the DIPL permit process to permit travel. Other additional permits/conditions are required for access, such as escorts, travel times, etc.
OSOM vehicle	All vehicles travelling on NT roads must comply with the maximum dimension limits and maximum standard mass limits unless the vehicle has been given an exemption. The maximum vehicle dimensions for standard haulage vehicles are 4.3m height and 2.5m width and 22.5m tonne mass limit. Vehicles which fall outside of these dimensions are considered Oversized and/or Overmass and must apply for a permit to operate.
Trenching	Excavation of a trench for burial of a cable or pipeline system.

1.0 Introduction

1.1 Background

AECOM Pty Ltd Australia (AECOM) has been engaged by Santos NA Barossa Pty Ltd (Santos) to prepare a Traffic Impact Assessment (TIA) for the Barossa Darwin Pipeline Duplication Project (the Project). This assessment forms part of the Supplementary Environmental Report (SER) for the Project and has been undertaken to address the comment received from the Department of Infrastructure, Planning and Logistics (DIPL) – Transport and Civil Services Division relating to traffic and transport. Specifically:

> **Issue:** Insufficient information has been provided to assess the risks to land based transport networks. Traffic and transport regimes have changed considerably in this locality since the original establishment of Darwin LNG but are also expected to increase in the near future as a result of further industrial developments in this area. This will result in greater risks to road users and transport infrastructure along the routes to and from the proposal.
>
> **Recommended Action:** The proponent to submit a Traffic Impact Statement (TIS) to assess the road traffic impacts, to ensure the road authority can measure the proponent's acknowledgement of the risks associated with the works impact on NTG Roads, infrastructure and road safety. The assessment is to include, but is not limited to: details on what materials will be transported and their loads, traffic volumes and types of vehicles used for the transportation including the haulage routes and duration of the haulage operation specific to onshore movements including a risk assessment as part of the process to reflect how all roads and infrastructure on a local and regional level will be affected.

The SER and supporting TIA will be submitted to the Northern Territory Environmental Protection Authority (NT EPA) for assessment in accordance with the Northern Territory Environmental Protection Act 2019 (NT EP Act).

1.2 Project overview

Santos proposes to construct and operate a new pipeline segment, the Darwin Pipeline Duplication Project (the Project), enabling natural gas from the Barossa Field in the Timor Sea to be transported to the Santos-operated Darwin Liquified Natural Gas (DLNG) Facility at Wickham Point. The new gas pipeline would extend the existing Barossa Gas Export Pipeline and would comprise of approximately 100 kilometres of pipeline in Northern Territory waters and 23 kilometres of pipeline in Commonwealth waters. Project construction activities will include pre-lay works, including trenching of section of the pipeline route, installation of the pipeline and installation of rock armour along some sections of the pipeline.

The Project has been split into three geographical areas. These areas are:

- **Offshore NT waters** – the offshore Project Area extends from the Territorial waters limit, with a typical water depth of between 30-40 metres (m), through to the limit of Darwin Harbour, as shown in Figure 1-1. It includes a proposed spoil disposal ground directly adjacent to the existing INPEX Ichthys spoil ground.
- **Darwin Harbour** – the Darwin Harbour part of the Project area includes the Project Area from the outer boundary of Darwin Harbour to the location of the shore crossing at the existing DLNG facility as shown in Figure 1-1. The Project pipeline within Darwin Harbour follows the route of existing Bayu-Undan and Ichthys gas pipelines.
- **Shore crossing and onshore** – the shore crossing and onshore location for the Project is within the existing DLNG facility disturbance envelope at Wickham Point within the Middle Arm Peninsula industrial area, approximately 6 km south-to-south-east of Darwin (Figure 1-1).

The key phases of the Project are:

- Surveys
- Construction, including:
    - Pre-lay works
    - Spoil disposal
    - Pre-lay span rectification and foundation installation
    - Cable crossings
    - Onshore construction
    - Pipeline installation and pre-commissioning
- Commissioning and operations
- Decommissioning.

The Project phases of relevance to this TIA are discussed in Section 7.0. Subject to regulatory approval, construction of the Project is anticipated to commence in Quarter 4 of 2023 and is expected to be complete by the end of 2024, with first gas from the Barossa Field expected in the first half of 2025. The key components required for the construction of the Project include:

- **Pipeline** – approximately 23 km of pipeline would be constructed in Commonwealth waters and 100 km in NT waters and lands. The Project pipeline will run parallel to the existing Bayu-Undan to Darwin pipeline and comes onshore at the DLNG facility.
- **Shore crossing** – the pipeline will be trenched and buried at the shore crossing. The length of pipeline trenching onshore will be approximately 300 m.
- **Spoil disposal ground** – spoil that is collected during the trenching activities will be disposed at a location north-east of Darwin Harbour (Figure 1-1).
- **Onshore facilities** – all onshore facilities including the shore pull, laydown and ancillary facilities would be located within the existing DLNG disturbance envelope (Figure 1-1).
- **Quarry** – rock would be used to provide pipeline protection and stability within Darwin Harbour. The rock is proposed to be sourced from the HB Quarry at Mount Bundey (approximately 85 km south-east of Darwin.

Activities within the Project area will be vessel-based, for construction activities in Offshore NT waters and Darwin Harbour, or shore-based, for construction activities at the shore crossing and onshore at the DLNG facility. Transfer of personnel, materials and equipment via road networks will therefore be to vessel loading points in Darwin Harbour (primarily East Arm wharf, in the case of rock movements) and to the onshore/shore-crossing area at the DLNG facility.

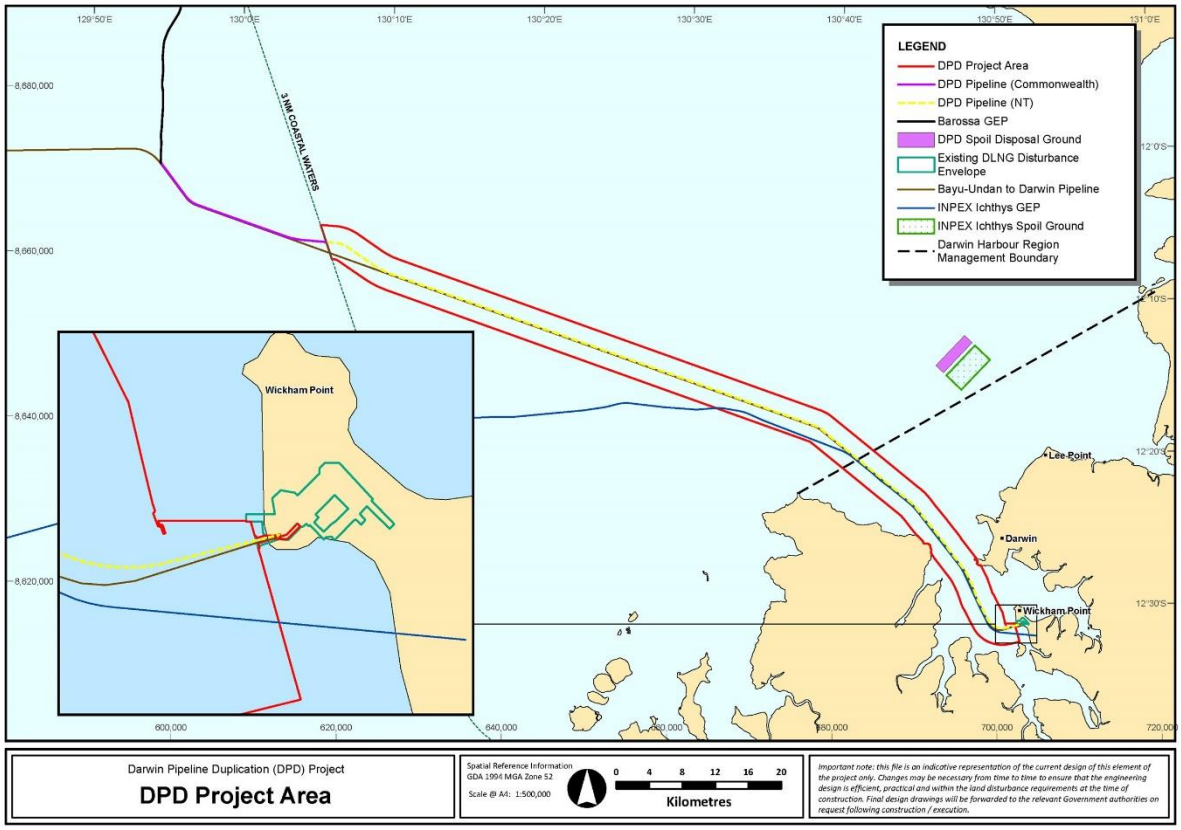

Figure 1-1 Project Area

Image source: Santos, 2021

2.0 Terms of Reference

The ToR for the Project SER identifies requirements for assessment and mitigation of impacts on transport and traffic in terms of social surroundings. This assessment addresses the requirements of the ToR.

Requirements of particular relevance to this report and where they have been addressed within this report are summarised as follows:

- Describe land traffic and transport activities during construction and operation including details on access, haulage routes, vehicle types, volumes of traffic (Section 7.0, 8.0, 9.0).
- Describe and quantify the potential impacts of Project infrastructure and activities, such as land transport and traffic impacts (Section 9.0, 10.0, 11.0)
- Address all potential impacts and risks identified through the impact assessment, and identify measures to avoid, reduce or mitigate these impacts (10.0, 11.0, 12.0)

3.0 Evaluation Framework

The assessment will consider legislation, policy and standards relevant to transport along with specific assessment criteria that have been derived for the purposes of the study.

3.1 Legislation, policy, guidelines and standards

The legislation, policy, guidelines and standards relevant to this study are summarised in Table 3-1.

Table 3-1 Legislation, policy, guidelines and standards relevant to the assessment

Document title	Summary	Relevance to the project
National		
Austroads – Guide to Traffic Management Part 3: Traffic Studies and Analysis	The *Guide to Traffic Management Part 3: Traffic Studies and Analysis* (Austroads, 2018) is concerned with the collection and analysis of traffic data for the purpose of traffic management and traffic control within a network. It serves as a means to ensure some degree of consistency in conducting traffic studies and surveys. It provides guidance on the different types of traffic studies and surveys that can be undertaken, their use and application, and methods for traffic data collection and analysis.	The *Guide to Traffic Management Part 3: Traffic Studies and Analysis* has been used to guide the collection and analysis of traffic data used in this assessment.
Austroads – Guide to Traffic Management Part 12: Integrated Transport Assessments for Developments	The *Guide to Traffic Management Part 12: Integrated Transport Assessments for Developments* (Austroads, 2020) is concerned with identifying and managing the impacts on the road system arising from land use developments. It provides guidance on the need and criteria for impact assessments, and a detailed procedure for identifying, assessing and mitigating traffic impacts. The aim is to ensure consistency in the assessment and treatment of traffic impacts, including addressing the needs of all road users and the effect upon the broader community.	The *Guide to Traffic Management Part 12: Integrated Transport Assessments for Developments* has been used to guide the structure and development of this assessment.
Austroads – Guide to Road Design Part 3: Geometric Design	The *Guide to Road Design Part 3: Geometric Design* (Austroads, 2021) provides road designers and other practitioners with information about the geometric design of road alignments. The purpose of the guide is to provide the information necessary to enable designers to develop safe and coordinated road alignments that cater for the traffic demand at the chosen speed. The guide also presents information leading to the choice of appropriate cross-section standards.	The *Guide to Road Design Part 3: Geometric Design* has been used to determine the potential impacts of the Project and associated traffic generation on the local road network.
Austroads – Guide to Road Design Part 4: Intersections and Crossings	The *Guide to Road Design Part 4: Intersections and Crossings* (Austroads, 2021) provides guidance on intersection design such as design considerations, design process, choice of design vehicle, pedestrian and cyclist crossing treatments, provision for public transport and property access.	The *Guide to Road Design Part 4: Intersections and Crossings* has been used to determine the potential impacts of the Project and associated traffic generation on intersections and crossings.

Document title	Summary	Relevance to the project
Northern Territory		
Northern Territory Environment Protection Act 2019	The *Northern Territory Environment Protection Act* aims to promote ecological sustainable development, manage significant disturbances through an environmental approval process, provide for broader community involvement and recognise the importance of participation of Aboriginal people and communities in environmental decisions. Under the Act, the NT EPA regulates the environment impact assessment process to identify potential environmental impacts of development proposals. There are four assessment methods provided for within the NT approvals process: 1) Assessment on referral information (Tier 1) 2) Assessment on a Supplementary Environmental Report (SER) (Tier 2) 3) Assessment by Environmental Impact Statement (EIS) (Tier 3) 4) Assessment by inquiry.	This impact assessment has been prepared to support the assessment by Supplementary Environmental Report (SER).
Control of Roads Act 1953	The Act, subject to section 64 of the *Planning Act 1999* and Part 12.3 of the *Local Government Act 2019*, stipulates that all roads in the Northern Territory, are under the care, control and management of the Minister. The Act outlines the process in which public roads can be opened and closed.	Any closure or change of access to a public road as a result of the Project would be required to follow the provisions of the *Control of Road Act 1953*.
Traffic Act 1987	The objective of this Act is to regulate traffic, which includes provisions in relation to the erection and operation of traffic control devices. Traffic control devices refer to signals, signs or markings displayed for the purpose of regulating, warning, or guiding traffic.	Under the *Traffic Act 1987*, consent from the applicable competent authority would be required prior to the erection and operation of traffic control devices.
Development Guidelines for Northern Territory Government Controlled Roads 2015	The *Development Guidelines for Northern Territory Government Controlled Roads* (Department of Transport, 2015) sets out the requirements for any development or infrastructure project that may impact the road or that will ultimately be transferred to the NTG for ongoing care, control and management. These Guidelines also outline the Department of Transport's involvement in the assessment of land use development applications under the Planning Act and provide details of the Department's approval processes.	The Project would be required to follow the requirements of the Guidelines.
Towards Zero Action Plan 2018-2022	The *Towards Zero Road Safety Action Plan* (DIPL, 2018) outlines a vision of zero deaths or accidents on roads within the Northern Territory. The plan establishes a strategy to reducing road deaths and accidents using a 'Safe Systems' approach, which considers how the whole road system can be more forgiving to reduce the consequence of mistakes by road users.	Road safety considerations represent a critical focus of this TIA.

Document title	Summary	Relevance to the project
Territory 2030 Strategic Plan	The Territory 2030 Strategic Plan (Northern Territory Government, 2009) provides a 20-year roadmap for development across the Northern Territory. The Plan foreshadows the establishment of Darwin as a key centre for oil and gas operations, maintenance and workforce.	The Project supports the Plan by further securing Darwin's place as an oil and gas hub.
Greater Darwin Plan 2012	The *Greater Darwin Plan 2012* (Northern Terriory Government, 2012) outlines seven strategic directions to support growth and sustainable development within the Greater Darwin area in the context of the broader strategic framework provided by the *Territory 2030 Strategic Plan*. The plan identifies that economic growth in the Darwin area will likely be sustained over the next decade and beyond by the oil and gas industries, as well as the mining and defence sectors. As such, the release of suitable land for industrial development is essential to realising the opportunities offered by economic growth.	The Project aligns with the Plan by further expanding Darwin's gas-based industry.
10 Year Infrastructure Plan 2019-2028	The *10 Year Infrastructure Plan* (DIPL, 2019) aims to provide transparency in planning and prioritises projects that have been identified as supporting future growth and prosperity of the Northern Territory. The Plan identifies natural resources, such as gas, to be integral to the growth of the Northern Territory's economy.	The Project will further grow and diversify the Northern Territory's gas industry in line with the Plan's vision.
Local Government		
City of Palmerston Development Guidelines 2015	The *Development Guidelines 2015* (City of Palmerston, 2015) establish the approvals and permits required for development within the City of Palmerston and provide minimum standards acceptable for a new development. The guidelines specify that a developer shall avoid obstruction or damage to roadways and footpaths, drains and watercourses and any public utility or other services on or adjacent to the site which are visible or the location of which can be ascertained by the developer from the appropriate authority and shall have any obstruction removed immediately and at own cost shall have made good all damage caused.	Ensuring access to and maintenance of the road network and adjacent public infrastructure represents a key consideration of this TIA.

3.2 Assessment criteria

The assessment criteria relevant to this TIA are outlined below.

TIAs include an evaluation against relevant State/Territory and industry guidelines (as summarised in Table 3-1) whilst also addressing specific local government planning clauses where applicable.

Ultimately the findings and proposed mitigation measures detailed in the TIA need to be agreed with the relevant road authorities. Once planning approval has been obtained for the project, those stakeholders will be consulted regarding the development of a Traffic Management Plan (TMP). Additionally, where

secondary approvals are required under transport legislation, these approvals would be sought from the relevant road authorities.

4.0 Consultation and Engagement

Development of the project and preparation of the TIA have been informed by consultation with key stakeholders. Feedback from the Department of Infrastructure, Planning and Logistics (DIPL), local councils and other statutory parties is summarised in Table 4-1.

Table 4-1 Feedback from key stakeholders in relation to traffic and transport

Stakeholder feedback	Consideration in project design or impact assessment
Department of Infrastructure, Planning and Logistics (DIPL)	
A meeting with DIPL was held on Monday 19 September 2022, with the following feedback received: • There are several road projects proposed along the haulage route from HB Quarry to Darwin Port. Alternative haulage routes to Darwin Port will need to be considered in the event road closures are required to facilitate these road projects. • Impacts to level railway crossings, including traffic queuing and delays to trains, will need to be considered. • Transportation of staff, including vehicle type and timing of movements in relation to peak traffic periods, will need to be discussed. • Construction of the new overpass at the intersection of Tiger Brennan Drive and Berrimah Road will likely require traffic to be diverted. The assessment will need to consider the impacts of cumulative traffic diversion, including general traffic, project related traffic and traffic generated by other concurrent projects. • There are several other projects in the area (including mining projects) utilising Port Darwin. Traffic activity and use of the port by other projects will need to be aligned with the project, particularly as there is only one route in/out of Port Darwin.	The items outlined have been considered as reasonably possible at this planning stage of the Project, with the following items addressed in this TIA report: • Transportation of Project staff has been discussed in Section 9.1.1. • A cumulative impact assessment has been completed to assess the potential impacts of concurrent Projects. This assessment is included in Section 11.0.
City of Darwin and City of Palmerston	
Not undertaken at this stage, comments to be received as part of TRG process.	TBC

5.0 Methodology

The following tasks have been undertaken to complete the traffic and transport impact assessment for the Project:

- An initial review of the existing site and network conditions in the context of the Project.
- A review of relevant strategic plans to: contextualise this Project within the greater Darwin region; identify proposed cumulative impact of development; and identify relevant proposed network upgrades for land-based traffic that may impact this Project.
- A desktop analysis of the Project area to: establish existing traffic conditions; identify multi-modal networks and services; identify safety and accessibility issues particularly for heavy vehicles on proposed haulage routes.
- The collection and analysis of traffic data representative of existing site and network operations.
- A review of recent crash history for the Project study area to assist definition and avoidance of existing problem areas.
- Route selection and rock haulage duration associated with the construction of the Project, based on sourcing of rock material from the HB Quarry at Mount Bundey, fleet operation assumptions and heavy vehicle route restrictions.
- A review of the proposed Barossa Darwin Pipeline Duplication Project and estimated traffic generation based on an indicative construction program, construction transport fleet options and proposed hours of construction works and proposed operational activities and workforce.
- Undertake traffic impact assessment of the Project for the construction and operational phases. The assessment includes:
    - Haulage route option identification from the HB Quarry at Mount Bundey, to determine appropriate travel routes and any approvals required Project access.
    - Assessment of construction and operational traffic generation, including:
        - Traffic generation during the construction and operation of the Project, with the peak hour frequencies identified for the impact analysis
        - Potential impacts on the local road network, specifically mid-block road capacity assessments and intersection modelling
        - Undertake traffic impact review and summarise the potential impacts to multi-modal networks and services.
- Evaluation of potential cumulative impacts (where relevant) caused by the concurrent construction of the Project and other existing or proposed projects in the study area.
- Following the assessment of the potential Project traffic and transport impacts, recommendations for management and potential mitigation measures identified impacts have been made.

6.0 Existing Conditions

6.1 Study area

The study area for this impact assessment consists of the transport network servicing Darwin Port at East Arm, the DLNG facility at Wickham and the HB Quarry at Mount Bundey. The key roads of relevance to this impact assessment are shown in Figure 6-1 and include:

- Arnhem Highway
- Stuart Highway
- Tiger Brennan Drive
- Berrimah Road
- Wishart Road
- Kirkland Road
- Elrundie Avenue
- Jenkins Road
- Channel Island Road
- Wickham Point Road.

These roads are described in further detail in Section 6.2.

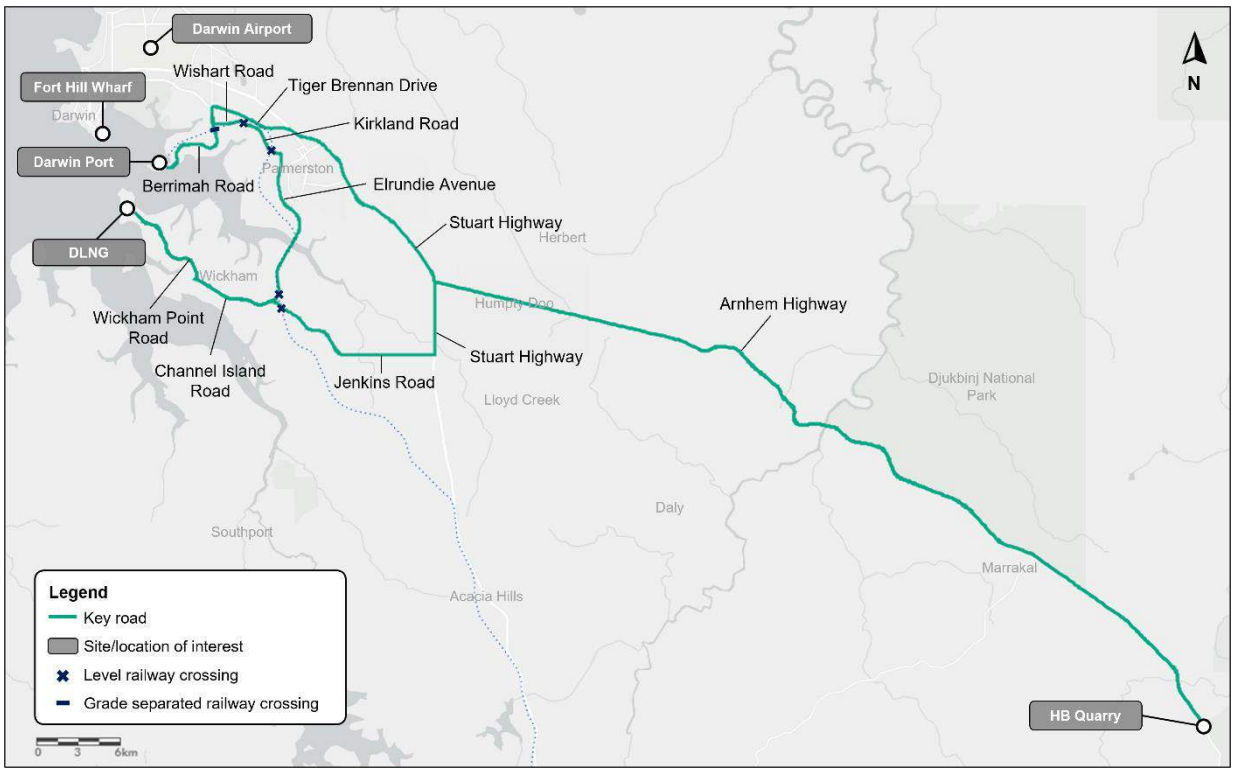

Figure 6-1 Study area

Basemap source: Esri

6.2 Existing road network

6.2.1 Arnhem Highway

The Arnhem Highway is a sealed road extending approximately 230 kilometres in the east-west direction between the outer rural area of Darwin and the Kakadu National Park. The road is classified as a State road and generally comprises a single carriageway with one traffic lane in each direction. The road features relatively narrow sealed shoulders along its entire length. A typical cross section of the Arnhem Highway is shown in Figure 6-2.

The posted speed limit of the Arnhem Highway varies along the proposed haulage route. Between the Stuart Highway and Kennedy Road at Humpty Doo, the road has a posted speed limit of 80 kilometres per hour (km/h). A variable speed limit zone is located adjacent to the Humpty Doo town centre with a speed limit of 60 km/h or 80 km/h typically enforced. Between Edwin Road at Humpty Doo and Anzac Parade at Middle Point, the Arnhem Highway has a posted speed limit of 100 km/h. The posted speed limit increases to 110 km/h east of Anzac Parade.

The western terminus of the Arnhem Highway connects with the Stuart Highway via a signalised intersection located 35 kilometres south-east of Darwin. There are no other signalised intersection treatments located along the Arnhem Highway.

Figure 6-2 Arnhem Highway west of Barr Road, facing east
Image source: Google Street View, December 2021

6.2.2 Stuart Highway

The Stuart Highway (A1) is a sealed major highway extending approximately 2,700 km from Darwin, NT to Port Augusta, South Australia (SA). The road forms part of the National Land Transport Network and functions as the principal north-south route for freight and passenger movements between the NT and SA.

In the study area, the Stuart Highway is a four-lane, two-way dual carriageway road with a grass median. The road reservation east of Yarrawonga Road is typically 50-55 m wide, expanding to provide dedicated right and left turn lanes at signalised intersections. A typical cross section of the Stuart Highway in the vicinity of the study area is shown in Figure 6-3. The road has a posted speed limit of 100 km/h in the study area.

Figure 6-3 Stuart Highway north of Sayer Road, facing north-west
Image source: Google Street View, December 2021

6.2.3 Tiger Brennan Drive

Tiger Brennan Drive (A15) is a major arterial road providing east-west connectivity between Darwin and Palmerston. The road forms part of the National Land Transport Network and generally extends parallel to the Stuart Highway, providing the most direct route for vehicles travelling to and from the port facilities at East Arm. In the study area, Tiger Brennan Drive is a two-lane, two-way dual carriageway road with a grass median. A typical cross section of Tiger Brennan Drive is shown in Figure 6-4.

Posted speed limits on Tiger Brennan Drive vary from 100 km/h in undeveloped and heavy commercial zones, to 60 km/h as the road approaches the Darwin CBD. The majority of major junctions on Tiger Brennan Drive are signalised with some residential streets connected via limited access slip roads. At its eastern end, Tiger Brennan Drive merges onto Stuart Highway via a grade separated interchange with Roystonea Avenue.

Figure 6-4 Tiger Brennan Drive west of Marjorie Street, facing west
Image source: Google Street View, December 2021

6.2.4 Berrimah Road

Berrimah Road is a major arterial road that provides north-south connectivity between the Stuart Highway at Berrimah and the port facilities at East Arm. Between the Stuart Highway and Tiger Brennan Drive, Berrimah Road is a single carriageway road with one lane in each direction. The road is a two-lane, two-way dual carriageway road between Tiger Brennan Drive and Cochrane Road at East Arm. South of Cochrane Road, Berrimah Road continues as a single carriageway road with one lane in each direction. A typical cross section of Berrimah Road is shown in Figure 6-5.

The posted speed limit of the Berrimah Road varies from 70 km/h between the Stuart Highway and Tiger Brennan Drive, to 80 km/h just south of Tiger Brennan Drive and 60 km/h approaching the port facilities at East Arm. A 40 km/h school zone exists near College Road from 7 am until 5 pm on school days.

Figure 6-5 Berrimah Road north of Tiger Brennan Road, facing south
Image source: Google Street View, December 2021

6.2.5 Wishart Road

Wishart Road provides a direct east-west connection from Berrimah Road to Tiger Brennan Drive and Kirkland Road. Wishart Road typically has one lane in each direction with dedicated left and right turn lanes provided at its intersection with Berrimah Road and Tiger Brannan Drive. The posted speed limit of Wishart Road is 80 km/h. A typical cross section of the road in the vicinity of the study area is shown in Figure 6-6.

Figure 6-6 Wishart Road between Tiger Brennan Drive and Kirkland Road, facing west
Image source: Google Street View, December 2021

6.2.6 Kirkland Road

Kirkland Road facilitates east-west travel between Tivendale and Palmerston. The road is generally a single carriageway road with one lane in each direction. The carriageway widens to provide dedicated left and right turns onto Woodlake Boulevard, Bree Street, Toft Road, Fowlestone Road and Syrimi Road. Figure 6-7 shows a typical cross section of Kirkland Road.

At its western end, Kirkland Road becomes a dual carriageway road and connects to Wishart Road via a signalised intersection. At its eastern end, Kirkland Road connects to Elrundie Avenue and University Avenue via a dual lane roundabout. Kirkland Road has a posted speed limit of 100 km/h reducing to 80 km/h at the intersections with Elrundie Avenue and Wishart Road. It has two level crossings for trains on the carriageway that are not grade separated, consequently resulting in some delay to traffic when barriers are activated. These are located at 200 m west of Woodlake Boulevard (Figure 6-8) and 50 m south of Wishart Road (Figure 6-9).

Figure 6-7 Kirkland Road
Image source: Google Street View, December 2021

Figure 6-8 At grade level crossing Kirkland Road facing west, 200 m west of Woodlake Boulevard
Image source: Google Street View, December 2021

Figure 6-9 At grade level crossing Kirkland Road facing north, 50 m south of Wishart Road
Image source: Google Street View, December 2021

6.2.7 Elrundie Avenue

Elrundie Avenue extends south from Kirkland Road and provides access to several residential areas at Driver, Marlow Lagoon, Moulden and Bellamack. At its southern end, Elrundie Avenue continues as Channel Island Road. Elrundie Avenue is a single carriageway road with one lane in each direction. The road has a posted speed limit of 80 km/h. A typical cross section of Elrundie Avenue is shown in Figure 6-10.

Figure 6-10 Elrundie Avenue south of Kirkland Road, facing north
Image source: Google Street View, December 2021

6.2.8 Jenkins Road

Jenkins Road extends in the east-west direction between the Stuart Highway and Channel Island Road. The road connects to the Stuart Highway via a signalised intersection and Channel Island Road via a

priority ('Stop') controlled T-intersection. Jenkins Road is a single carriageway road with one lane in each direction. A typical cross section of Jenkins Road is shown in Figure 6-11.

Jenkins Road has a posted speed limit of 100 km/h. A level railway crossing is located on the road approximately 600 m east of its intersection with Channel Island Road (Figure 6-12).

Figure 6-11 Jenkins Road west of the Stuart Highway, facing west
Image source: Google Street View, December 2021

Figure 6-12 At grade level crossing Jenkins Road facing west, 600 m east of Channel Island Road
Image source: Google Street View, December 2021

6.2.9 Channel Island Road

Channel Island Road provides access to several industrial facilities at Wickham including the Weddell Power Station and Channel Island Power Station. The road extends south from Elrundie Avenue over

Elizabeth River before heading in the western direction to Channel Island where it terminates. Channel Island Road is a single carriageway road with one lane in each direction.

The road has a posted speed limit of 80 km/h. A typical cross section of Channel Island Road is shown in Figure 6-13. A level railway crossing is located on the road approximately 400 m north east of its intersection with Jenkins Road (Figure 6-14).

Figure 6-13 Channel Island Road south of Elizabeth River, facing south
Image source: Google Street View, December 2021

Figure 6-14 At grade level crossing Channel Island Road facing north, 400 m north east of Jenkins Road
Image source: Google Street View, December 2021

6.2.10 Wickham Point Road

Wickham Point Road extends in the northern direction from Channel Island Road and provides access to the DLNG facility and Ichthys Liquefied Natural Gas Plant. The road connects to Channel Island

Road via a channelised T-intersection. Wickham Point Road is a single carriageway road with one lane in each direction. The road has a posted speed limit of 80 km/h. A typical cross section of Wickham Point Road is shown in Figure 6-15.

Figure 6-15 Wickham Point Road north of Channel Island Road, facing north
Image source: Google Street View, May 2008

6.2.11 Heavy vehicle networks

The approved roads for 53.5 m Road Train vehicles are shown in Figure 6-16 and include the Arnhem Highway, Stuart Highway, Tiger Brennan Drive, Berrimah Road, Kirkland Road, Elrundie Avenue, Jenkins Road, Channel Island Road and Wickham Point Road (Northern Territory Govenment, 2011).

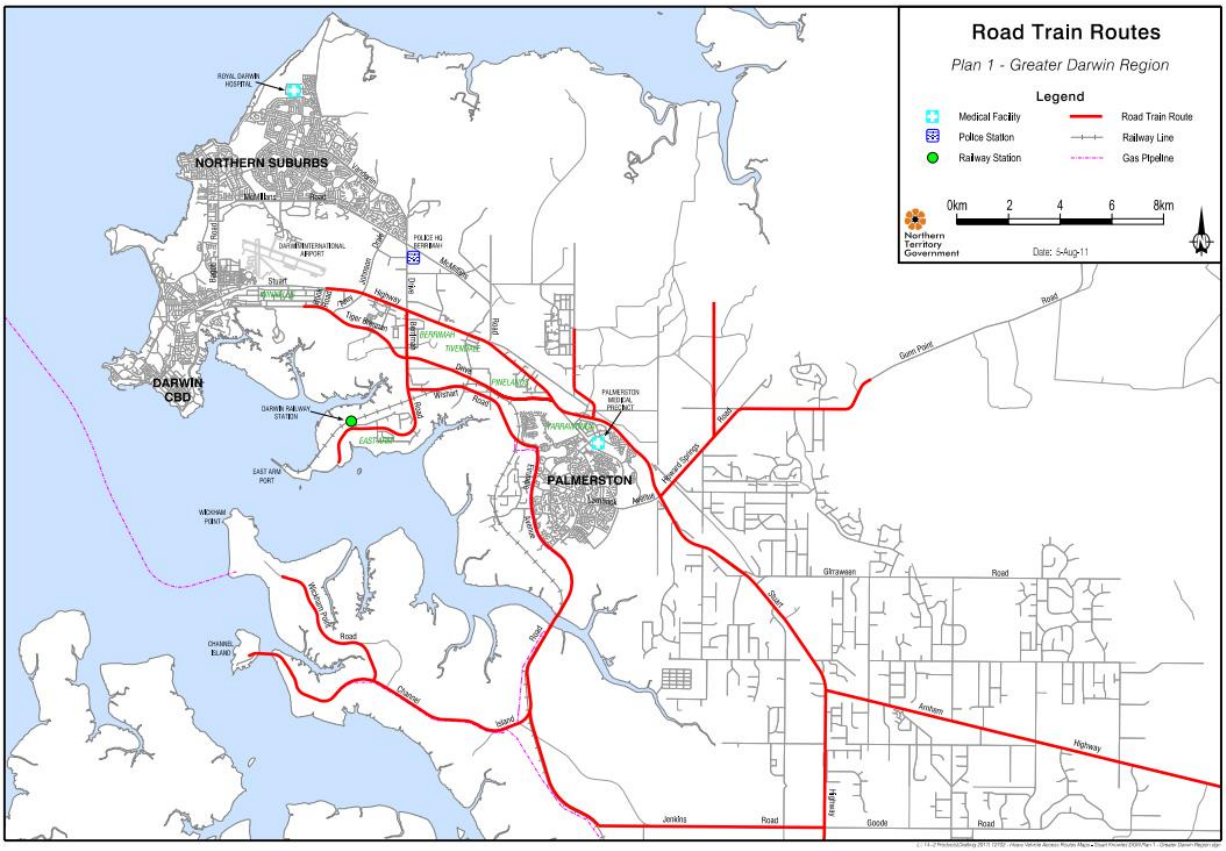

Figure 6-16 Approved roads for 53.5 m Road Train vehicles in the vicinity of the study area

Image source: Northern Territory Government, 2011

6.3 Existing traffic volumes

Traffic count data was extracted from DIPL's Annual Traffic Report for key roads within the study area (DIPL and Territory Traffic Surveys, 2021). A summary of the count stations is provided in Table 6-1 and the location of each count stations is shown in Figure 6-17.

Table 6-1 Traffic count stations on key roads in the study area

Road	Station ID	Location of station
Arnhem Highway	UDVDP019	500 m east of Stuart Highway
	RDVDP007	2 km west of Adelaide River Bridge
Berrimah Road	UDVDP028	400 m south of Tiger Brennan Drive
	UDVDP029	350 m west of Casey Street
Channel Island Road	UDVDC072	South of Elizabeth River Bridge
Elrundie Avenue	UDVDC062	100 m North of Chung Wah Terrace
Kirkland Road	UDVDP085	500 m west of West of Wishart Road
Stuart Highway	UDVDP017	500 m west of Howard Springs Road
	UDVDP020	500 m north of Arnhem Highway
	UDVDP034	500 m south of Bees Creek Road
Tiger Brennan Drive	UDVDP022	800 m west of Berrimah Road

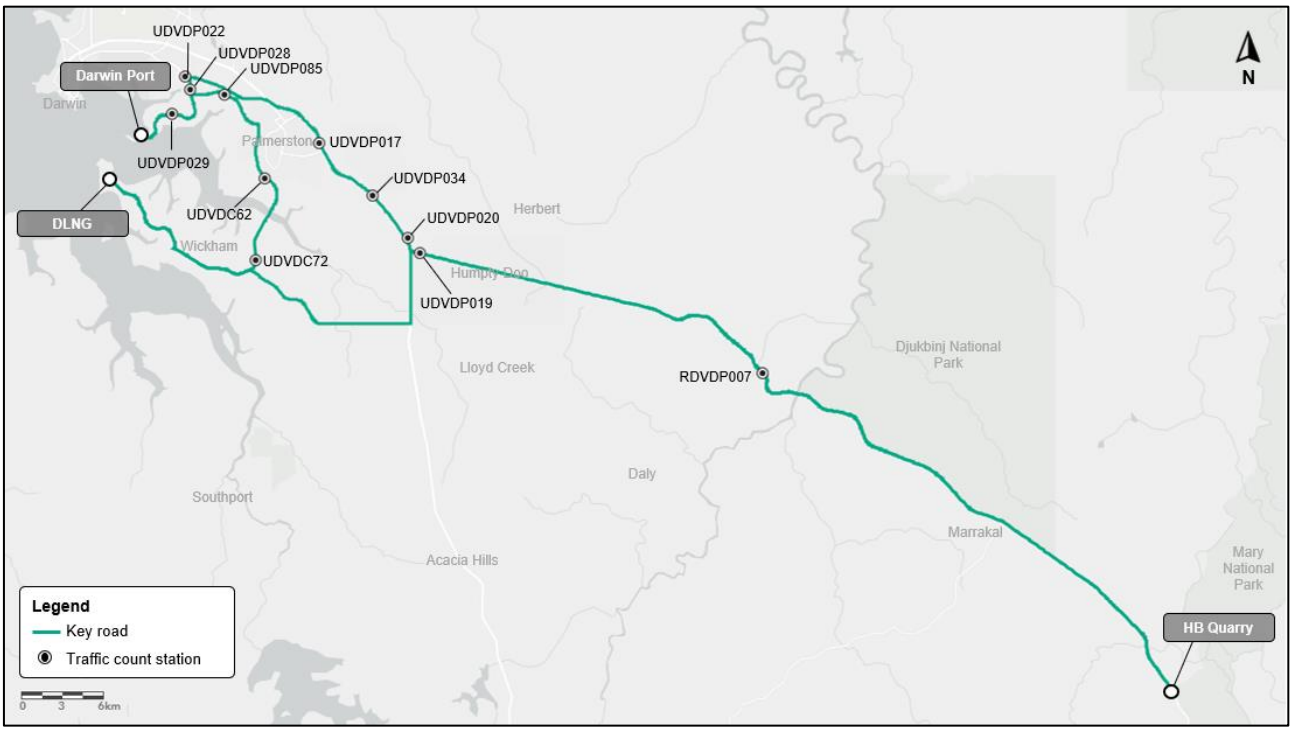

Figure 6-17 Locations of traffic count stations in the study area

Basemap source: Esri

A summary of the Annual Average Daily Traffic (AADT) volumes over the past five-year period (2017-2021) is shown in Table 6-2. The Stuart Highway experiences the highest traffic volumes in the study area, with an average of 27,790 vehicles travelling on the road each day west of Howard Springs Road. West of Berrimah Road, approximately 20,880 vehicles travelled Tiger Brennan Drive on an average day.

Traffic volumes on the Arnhem Highway typically range between 1,400 and 7,700 vehicles per day. The western end of Arnhem Highway experiences the highest volume of traffic due to a high proportion of vehicles entering and exiting the road from the surrounding residential land uses at Humpty Doo. Approximately 7,330 vehicles travel along Berrimah Road each day near Tiger Brennan Drive. Towards the port facilities at East Arm, traffic volumes on Berrimah Road reduce to 1,180 vehicles per day. Traffic volumes on Channel Island Road are relatively low with an average of 1,670 vehicles using the road each day.

Table 6-2 AADT volumes by year (2017-2021)

Road	Station ID	Station location	Direction of travel	Year				
				2017	2018	2019	2020	2021
Arnhem Highway	UDVDP019	500 m east of Stuart Highway	Inbound	3773	3703	3487	3465	3891
			Outbound	3732	3641	3442	3392	3829
			Both	7505	7344	6929	6857	7720
	RDVDP007	2 km west of Adelaide River Bridge	Inbound	629	599	588	567	693
			Outbound	657	621	613	559	704
			Both	1286	1220	1201	1126	1397
Berrimah Road	UDVDP029	350 m west of Casey Street	Inbound	609	677	606	514	576
			Outbound	630	696	623	533	602
			Both	1239	1373	1229	1047	1178
	UDVDP028	400 m south of Tiger Brennan Drive	Inbound	4784	4663	4291	4139	4201
			Outbound	3670	3729	3460	3117	3124
			Both	8454	8392	7751	7256	7325
Channel Island Road	UDVDC072	South of Elizabeth River Bridge	Inbound	1520	1821	950	741	829
			Outbound	1535	1810	944	737	842
			Both	3055	3631	1894	1478	1671
Elrundie Avenue	UDVDC062	100 m north of Chung Wah Terrace	Inbound	2835	2889	2670	2576	2980
			Outbound	2765	2734	2520	2428	2857
			Both	5600	5623	5190	5004	5837
Kirkland Avenue	UDVDP085	500 m west of Wishart Road	Inbound	6134	5898	5757	5668	5798
			Outbound	5806	5543	5449	5281	5481
			Both	11940	11441	11206	10949	11279
Stuart Highway	UDVDP017	500 m west of Howard Springs Road	Inbound	13666	13523	12765	12265	14101
			Outbound	13350	13158	12331	12209	13688
			Both	27016	26681	25096	24474	27789
	UDVDP020	500 m north of Arnhem Highway	Inbound	5875	5853	5595	5431	7051
			Outbound	6525	6431	6119	5940	7630
			Both	12400	12284	11714	11371	14681
	UDVDP034	500 m south of Bees Creek Road	Inbound	No data available	6666	6460	6023	6916
			Outbound		6850	6431	6229	6881
			Both		13516	12891	12252	13797
Tiger Brennan Drive	UDVDP022	800 m west of Berrimah Road	Inbound	10335	10490	10295	9868	10794
			Outbound	9134	9390	9581	8965	10087
			Both	19469	19880	19876	18833	20881

Data source: DIPL and Territory Traffic Surveys, 2021

Monthly average daily traffic volumes are shown in Figure 6-18 to Figure 6-22. Traffic volumes in the study area generally peak during the month of September. Reduced traffic volumes are observed during the wet season (November to April).

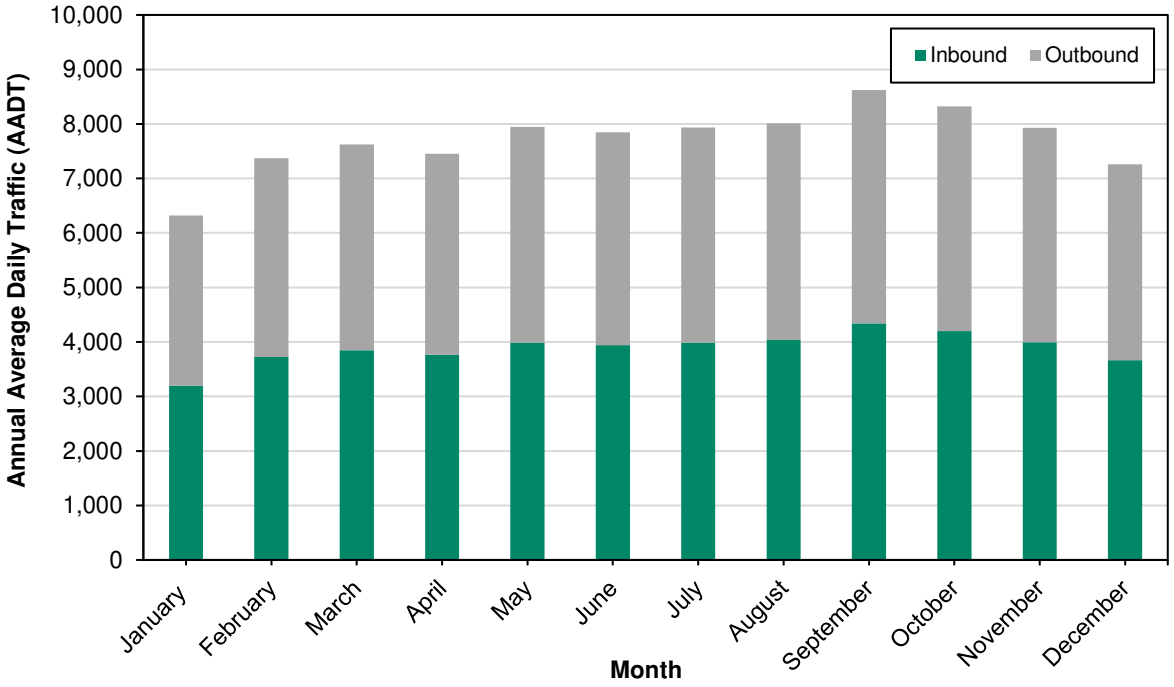

Figure 6-18 Traffic volumes on Arnhem Highway east of Stuart Highway (Station UDVDP019) by month of year

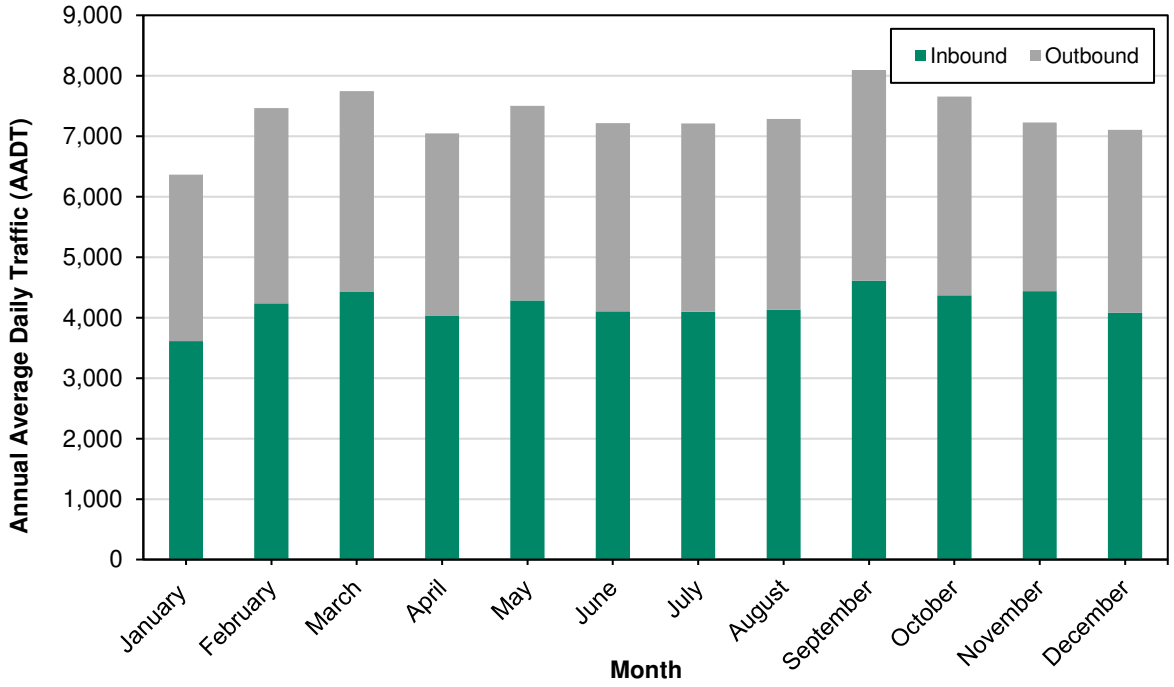

Figure 6-19 Traffic volumes on Berrimah Road south of Tiger Brennan Road (Station UDVDP028) by month of year

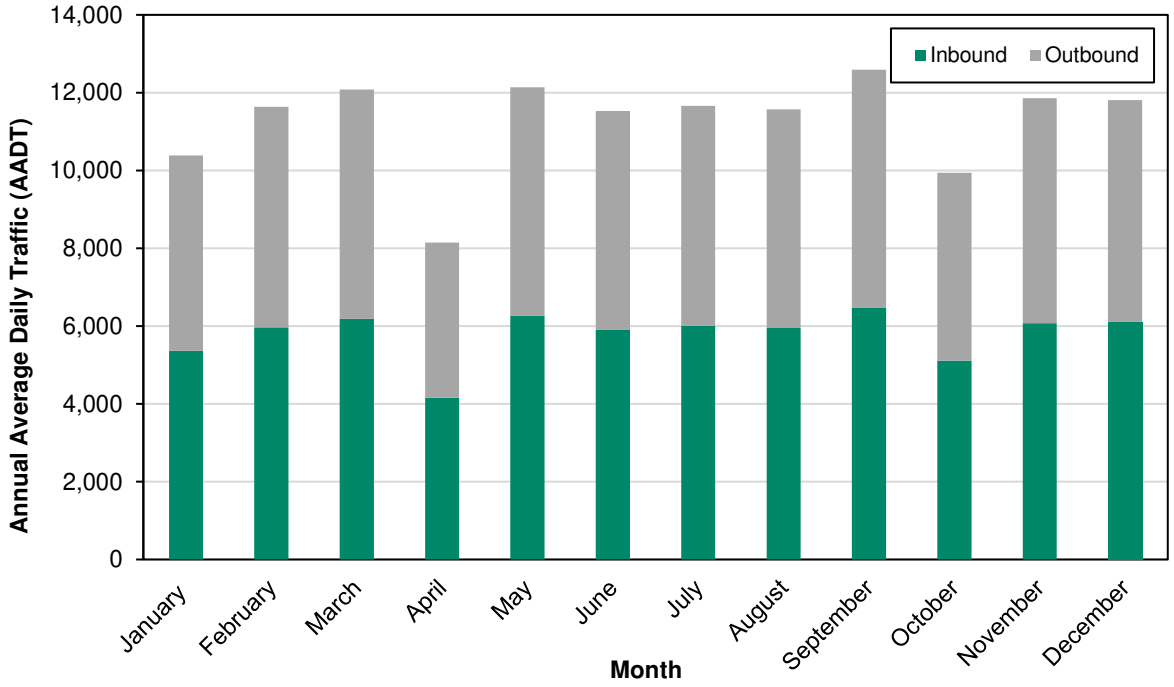

Figure 6-20 Traffic volumes on Kirkland Avenue (Station UDVDP085) by month of year

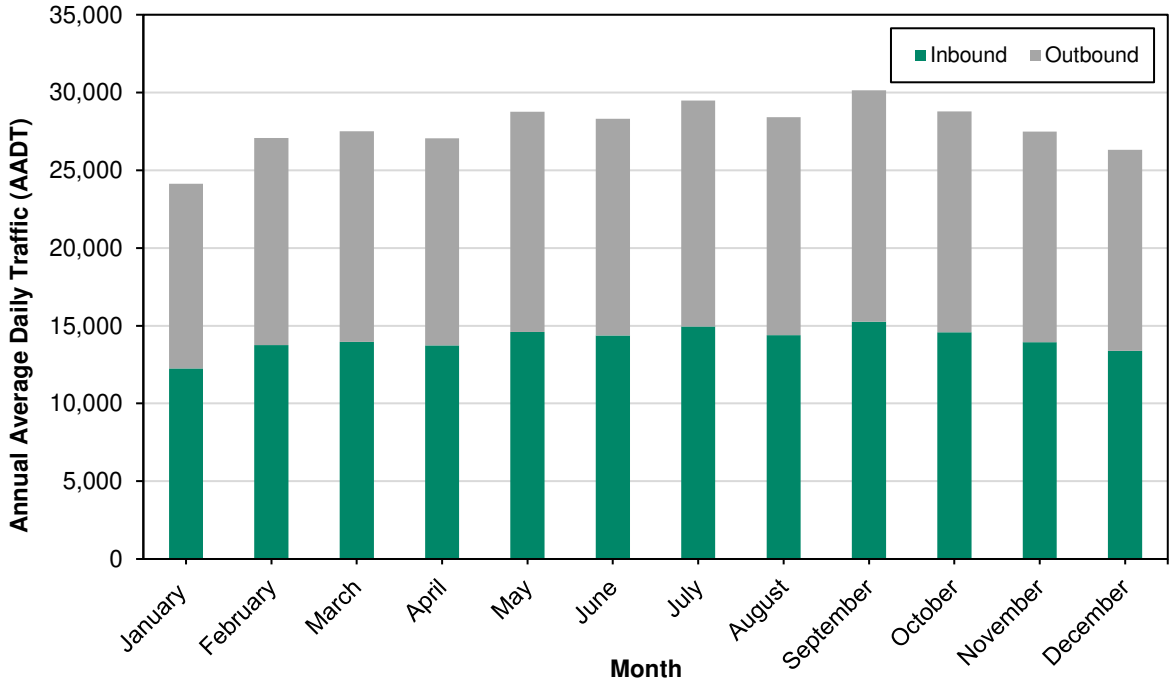

Figure 6-21 Traffic volumes on Stuart Highway (Station UDVDP017) by month of year

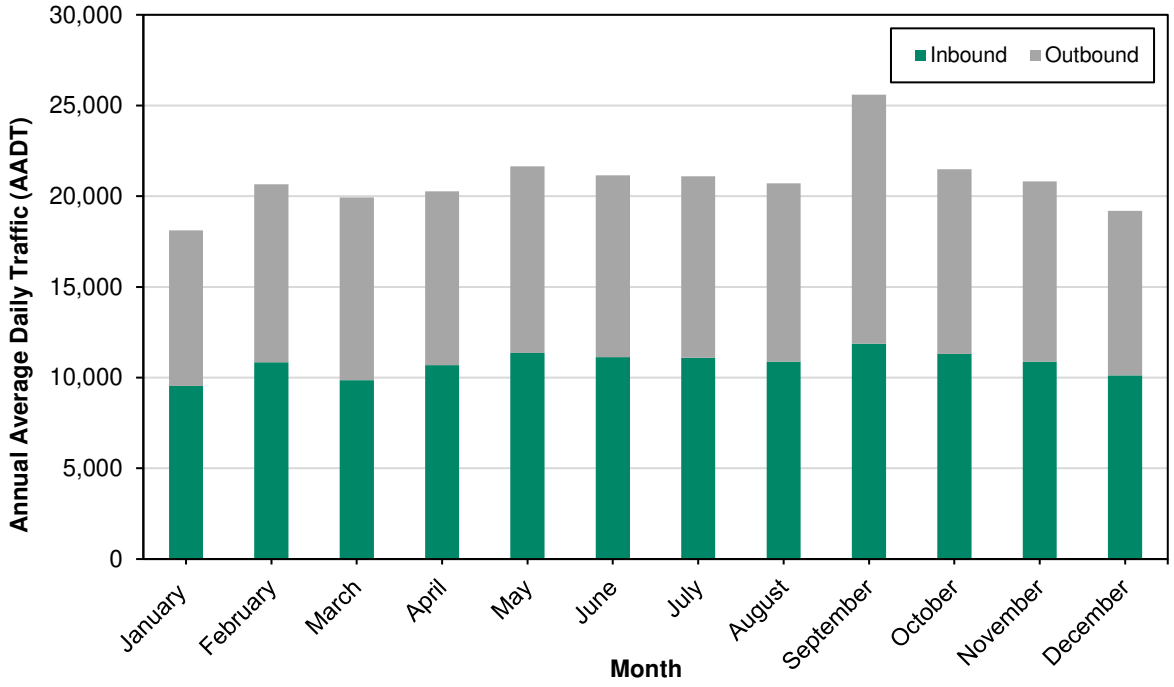

Figure 6-22 Traffic volumes on Tiger Brennan Drive (Station UDVDP022) by month of year

Table 6-3 shows a breakdown of traffic volumes by vehicle classification. Light vehicles (≤3 axles) account for the majority traffic on the local road network. Heavy vehicles (>3 axles) account for 3.6% of traffic volumes on the Arnhem Highway near the Stuart Highway and 11.6% of traffic volumes west of the Adelaide River Bridge.

Berrimah Road forms part of the National Land Transport Network, and as such, experiences a relatively high proportion of heavy vehicles (8.3% to 27.4%). The proportion of heavy vehicles increases on Berrimah Road west of Casey Street upon the approach to the port. It should be noted that while Tiger Brennan Drive also forms part of the National Land Transport Network, a low proportion of heavy vehicles is reflected in Table 6-3 as the count station is located to the west of Berrimah Road (where vehicles divert to access the port and rail facilities at East Arm).

Table 6-3 Traffic volume composition by vehicle classification

Road	Station ID	Station location	Direction of travel	Composition of traffic volume (%)		
				Light vehicles (≤3 axles)	Heavy vehicles (3 - 6 axles)	Long vehicles (>6 axles)
Arnhem Highway	UDVDP019	500 m east of Stuart Highway	Inbound	96.5	1.6	2.0
			Outbound	96.4	1.6	2.1
			Both	96.4	1.6	2.0
	RDVDP007	2 km west of Adelaide River Bridge	Inbound	87.8	3.2	9.0
			Outbound	89.0	2.6	8.4
			Both	88.4	2.9	8.7
Berrimah Road	UDVDP029	350 m west of Casey Street	Inbound	71.1	6.8	22.1
			Outbound	74.0	6.1	19.9
			Both	72.6	6.4	21.0
	UDVDP028	400 m south of Tiger Brennan Drive	Inbound	92.1	3.2	4.7
			Outbound	91.1	3.6	5.3
			Both	91.7	3.4	4.9

Road	Station ID	Station location	Direction of travel	Composition of traffic volume (%)		
				Light vehicles (≤3 axles)	Heavy vehicles (3 - 6 axles)	Long vehicles (>6 axles)
Stuart Highway	UDVDP017	500 m west of Howard Springs Road	Inbound	Data not available		
			Outbound			
			Both			
	UDVDP020	500 m north of Arnhem Highway	Inbound			
			Outbound			
			Both			
	UDVDP034	500 m south of Bees Creek Road	Inbound	96.3	1.5	2.1
			Outbound	96.6	1.4	1.9
			Both	96.5	1.5	2.0
Tiger Brennan Drive	UDVDP022	800 m west of Berrimah Road	Inbound	99.9	0.1	0.0
			Outbound	99.9	0.1	0.0
			Both	99.9	0.1	0.0
Channel Island Road	UDVDC072	South of Elizabeth River Bridge	Inbound	97.2	2.0	0.9
			Outbound	97.5	1.7	0.8
			Both	97.3	1.8	0.8
Elrundie Avenue	UDVDC062	100 m north of Chung Wah Terrace	Inbound	96.8	2.2	1.0
			Outbound	97.1	2.0	0.9
			Both	96.9	2.1	1.0
Kirkland Avenue	UDVDP085	500 m west of Wishart Road	Inbound	97.9	1.3	0.9
			Outbound	98.0	1.1	0.9
			Both	98.0	1.2	0.9

Data source: DIPL and Territory Traffic Surveys, 2021

6.4 Critical intersections

This section describes the intersections that are expected to be impacted most by additional traffic volumes generated by the Project. The key intersections include:

A. Quarry Access Road / Arnhem Highway

B. Arnhem Highway / Stuart Highway

C. Stuart Highway / Henning Road / Girraween Road

D. Stuart Highway / Lambrick Avenue / Howard Springs Road

E. Stuart Highway / Temple Terrace / Glyde Point Road

F. Tiger Brennan Drive / Wishart Road / Tivendale Road

G. Tiger Brennan Drive / Berrimah Road

H. Berrimah Road / Wishart Road

I. Stuart Highway / Jenkins Road

J. Stuart Highway / Channel Island Road

K. Channel Island Road / Wickham Point Road.

The layout of each intersection is shown in Figure 6-23.

A) Quarry Access Road / Arnhem Highway
(uncontrolled intersection)

B) Stuart Highway / Arnhem Highway
(signalised intersection)

C) Stuart Highway / Henning Road
(signalised intersection)

D) Stuart Highway / Lambrick Avenue
(signalised intersection)

E) Stuart Highway / Temple Terrace
(signalised intersection)

F) Tiger Brennan Drive / Wishart Road
(signalised intersection)

G) Tiger Brennan Drive / Berrimah Road
(signalised intersection)

H) Berrimah Road / Wishart Road
(signalised intersection)

I) Stuart Highway / Jenkins Road
(signalised intersection)

Figure 6-23: Key intersections in the study area
Basemap source: Google Maps

6.5 Existing sustainable modes of transport

6.5.1 Pedestrians and cyclists

The active transport network surrounding the Project site is shown in Figure 6-24 and includes the following infrastructure for pedestrians and cyclists:

- An on-road bicycle lane on the eastern side of Berrimah Road between Marlow Road and Wishart Road
- A shared footpath on the southern side of Tiger Brennan Drive between Berrimah Road and the Darwin CBD
- A shared footpath on the northern side of the Stuart Highway between Coolalinga and the Darwin CBD
- A shared footpath on the southern side of the Arnhem Highway near Humpty Doo
- A shared footpath along the western side of Berrimah Road between Marlow Road the Stuart Highway.

Figure 6-24 Active transport network

Basemap source: Esri

6.5.2 Public transport

Seven regular public bus routes operate on roads forming part of the site access routes. These routes are operated by CDC Northern Territory and generally facilitate travel between Darwin, Palmerston and Humpty Doo, as shown in Figure 6-25. The frequencies of weekday bus services are shown in Table 6-4. Approximately 55 bus services travel along the proposed haulage routes on an average weekday (Northern Territory Government, 2022).

There are no existing or proposed public bus services within 400 m of the Project site at the DLNG facility or the intermediate stockpile site at Darwin Port, a distance that best represents the walkable catchment for access to bus stops.

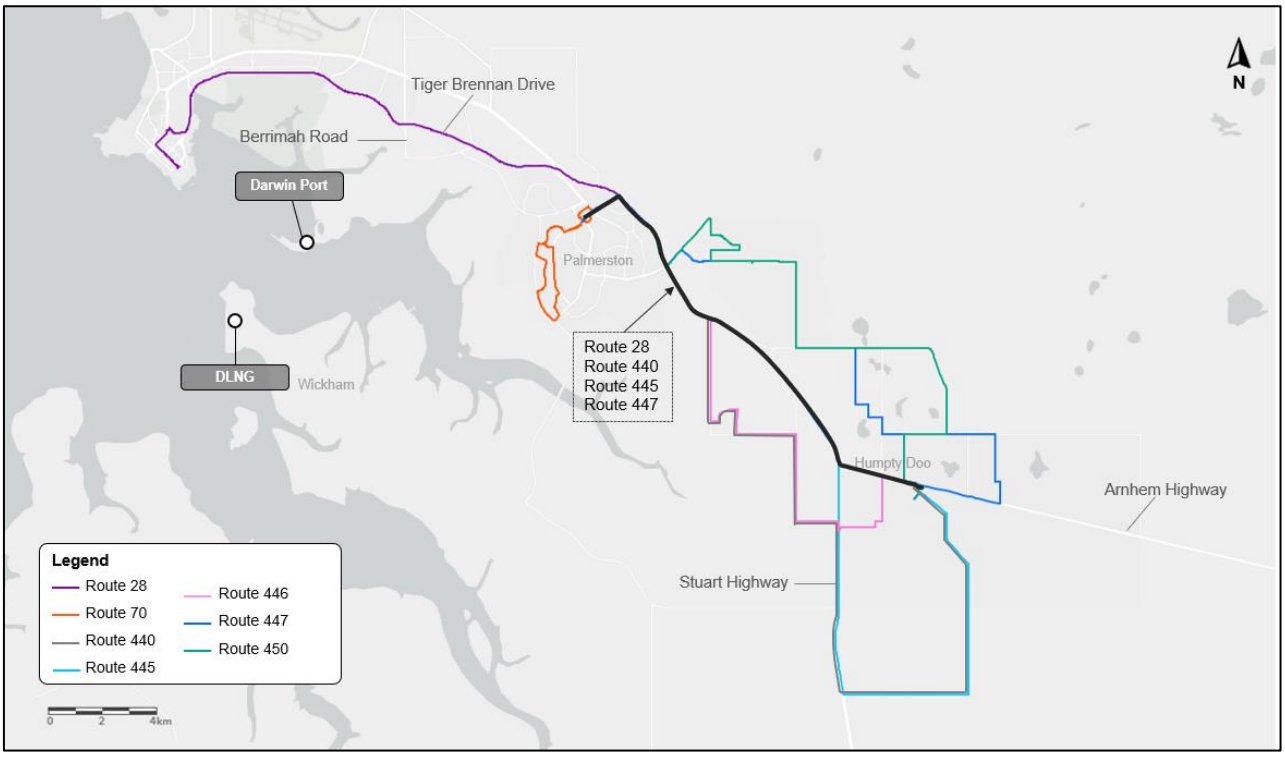

Figure 6-25 Public bus routes in the study area

Basemap source: Esri

Table 6-4 Public bus routes that travel along the proposed site access routes

Bus route	Direction	Number of weekday services	
		AM	PM
28	Humpty Doo Park and Ride to Darwin via Coolalinga Park and Ride and Palmerston	3	0
	Darwin to Humpty Doo Park and Ride via Palmerston and Coolalinga Park and Ride	0	3
70	Palmerston to Palmerston via Driver and Moulden	10	18
440	Humpty Doo Park and Ride to Humpty Doo Park and Ride via Coolalinga Park and Ride, Virginia, Noonamah and Palmerston	1	1
445	Humpty Doo Park and Ride to Palmerston via Cox Peninsula, Noonamah and Coolalinga Park and Ride	2	0
	Palmerston to Humpty Doo Park and Ride via Coolalinga Park and Ride, Noonamah and Cox Peninsula Road	0	3
446	Bees Creek to Palmerston	2	
	Palmerston to Bees Creek		3
447	Humpty Doo Park and Ride to Palmerston via McMinns Lagoon and Howard Springs	2	1
	Palmerston to Humpty Doo Park and Ride 447 via Howard Springs and McMinns Lagoon	0	4

Bus route	Direction	Number of weekday services	
		AM	PM
450	Humpty Doo Park and Ride to Palmerston via Girraween and Howard Springs	1	0
	Palmerston to Humpty Doo Park and Ride via Howard Springs and Girraween	0	1
	Total	**21**	**34**

Source: Northern Territory Government, 2022

The Adelaide-Darwin railway alignment is located approximately 750 m north-west of the intermediate stockpile site at Darwin Port. This transcontinental railway line serves both passenger and freight traffic and extends in the north-south direction between Adelaide and Darwin via Alice Springs.

The Ghan is a passenger service operated by the Great Southern. Two passenger services are provided per week from June until September and one service is provided per week during all other months. The Ghan passenger service originate / terminates at the Darwin Train Station located on Saloo Street, East Arm. Aurizon (formerly One Rail Australia) provides six weekly freight services between Adelaide and Darwin (Aurizon, 2022). A number of additional bulk trains operate on the line between various mine sites and the Port of Darwin.

The Adelaide-Darwin railway line is grade separated from Berrimah Road at East Arm. However, two level railway crossings are located on Kirkland Road and one is located on Channel Island Road.

6.6 Crash history

A review of historical crash data was undertaken to provide an assessment of crash statistics and trends associated with key roads in the study area. A summary of the results is provided in Table 6-5. It should be noted that the results include crashes recorded on the entire length of the carriageway and therefore some crashes may have occurred outside of the study area.

In the five-year period from 2015 to 2019, a total of 135 crashes were recorded on the Stuart Highway. 19 of these crashes occurred at the intersection of the Stuart Highway and Howard Springs Road and 13 occurred at the intersection of the Stuart Highway and Lambrick Avenue. Several road improvements works are proposed for the Stuart Highway corridor, including the road safety upgrades at Coolalinga and intersection works at Howard Springs Road and Lambrick Avenue.

Tiger Brennan Drive recorded a total of 91 crashes over the five-year period resulting in a total of five fatalities. Seven crashes occurred intersection of Tiger Brennan Drive and Berrimah Road. A grade-separated overpass is proposed to be constructed at the Tiger Brennan Driver and Berrimah Road. The overpass will enable the continuous flow of traffic along Tiger Brennan Drive and separate major traffic flows, reducing the crash risk at the intersection.

Berrimah Road recorded a total of 19 accidents of which one was fatal. Five of accidents occurred at the Wishart intersection and seven occurred at the Tiger Brennan Drive intersection. Much of the network has undergone upgrades since these incidents occurred, particularly at key, high profile intersections such as Stuart Highway / Howard Springs Road and intersections on Wishart Road.

Table 6-5 Crash history (2015-2019)

Road	Total accidents	Intersection	Total persons	
			Fatal	Admitted to hospital
Berrimah Road	19	Wishart Road – 5	1	2
		Tiger Brennan Drive – 7		
Kirkland Road	36	Elrundie Avenue – 2	0	9

Road	Total accidents	Intersection	Total persons	
			Fatal	Admitted to hospital
		Wishart Road – 6		
		University Avenue – 2		
Stuart Highway	135	Howard Springs Road – 19	1	33
		Roystonea Avenue – 4		
		Lambrick Avenue – 13		
		Tiger Brennan Drive – 1		
Tiger Brennan Drive	91	Tivendale Drive – 17	5	23
		Wishart Road – 6		
Wishart Road	18	Berrimah Road – 2	0	4
		Kirkland Road – 5		
		Tiger Brennan Drive – 4		

Source: Darwin Ship Lift Traffic Impact Assessment, 2021

7.0 Project Description

7.1 Construction

7.1.1 Construction schedule

While construction activities may begin in Q3, subject to regulatory approvals, for the purposes of the TIA an indicative construction schedule commencing in Quarter 4 of 2023 has been used which extends over a duration of approximately 12 months. This indicative construction schedule is shown in Figure 7-1, noting the precise timing and duration of construction activities will be subject to the Project design refinement and construction requirements.

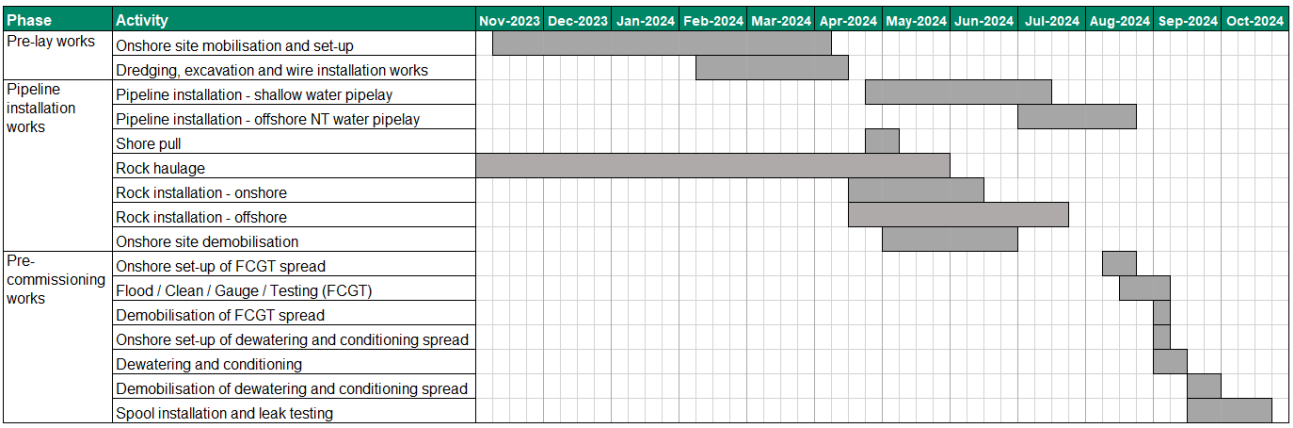

Figure 7-1 Indicative construction schedule

7.1.2 Construction hours

To enable the construction of the Project to be completed within the proposed timeline, construction activities are proposed to be undertaken on a 24-hour day and seven days per week basis. The current planning is two 12-hour shifts each day, commencing at 6:00 am and 6:00 pm.

7.1.3 Overview of construction traffic generating activities

7.1.3.1 Pre-lay works

Mobilisation at shore crossing

The onshore crossing site is located within the existing DLNG disturbance envelop at Wickham Point. This site would support the shore pull scope of works and would be used for the flood, clean, gauge, testing (FCGT) scope once the Project pipeline has been fully installed.

Mobilisation at the shore crossing would involve the following activities:

- Vegetation regrowth clearing
- Civil works and grading of the onshore shore pull site location, construction of a levelled lay-down area for the winch foundation
- Import of clean fill
- Preparation of lay down areas, access roads, hardstand (geotextile and road base) and site fencing
- Installation of the winch spread, including winch pad, holdback anchor and/or sheet piling
- Installation of bedding rock and or rollers for the shore pull
- Installation of facilities including offices, amenities, chemical and fuel storage, ASS storage and treatment.

Dredging and excavation

In shallower waters, some sections of the Project pipeline will require stabilisation due to exposure to waves, currents and tidal movement, and impact protection from third-party activities (i.e. anchors). As such, some sections of the Project pipeline will be installed in a trench in the seafloor to protect it from such instabilities and activities. Trenching will be required in both the Darwin Harbour (i.e. nearshore) and shore crossing locations.

Dredging vessels will be used to perform trenching within Darwin Harbour. Excavators would be used from onshore to dig the trench through the shore crossing at the DLNG facility. To support this, some temporary shoreline modifications may be required, including the construction of a cofferdam using sheet piling to help retain trench walls and a temporary groyne so the excavators can operate further from the current shoreline. The temporary groyne would be built with imported rock and fill and pushed out with the tide.

7.1.3.2 Pipeline installation

Shallow water and deep-water pipelay

The Project pipeline will be laid using a continuous assembly pipe-welding installation method, which involves the assembly of the single pipe joins (approximately 12 m in length) in a horizontal working plane onboard the pipelay vessel. The Project pipeline is proposed to be sequentially laid, beginning at the shore crossing and moving through Darwin Harbour. Shallow water pipelay, including waters of Darwin Harbour, will be performed using a shallow water pipelay barge. A deepwater pipelay vessel will be used in deeper water outside of Darwin Harbour. Some shallow water and deep-water pipelay may occur concurrently.

Pipeline shore pull

The Project pipeline will be pulled ashore from the pipelay vessel using a conventional winch operation. The arrangement for the shore pull consists of a winch spread installed on a winch pad and attached to a hold back anchor located onshore. The pulling arrangement will allow for the shore pull to be completed as a continuous operation, which may take approximately two weeks.

Trench backfill

The primary method of maintaining pipeline stability on the seabed will be through the concrete weighted pipeline coating. It will also be necessary to install localised secondary stabilisation/protection for sections within Darwin Harbour where the concrete weighted coating alone is not considered sufficient to provide stability and/or protection. Backfilling will be required at trench locations in Darwin Harbour and shore crossing to maintain pipeline stability and protection.

Rock is proposed to provide pipe stabilisation and protection. Rock placement works would likely occur via fallpipe vessel or side dump vessel; self-propelled dynamically-positioned vessels that are used to install rock the seabed with support barges used to transport rock. Backhoe dredges shall also be used to install rock in shallow water at the shore crossing with the rock being bought alongside the Backhoe dredges on barges.

The rock material is proposed to be sourced onshore from the HB Quarry at Mount Bundey and would be delivered via the road network to an intermediate stockpile located at Port Darwin (East Arm Wharf). The rock material would be internally transferred from the intermediate stockpile to quayside by means of trucks. Approximately two or three cranes would place the rock onto the vessel for rock placement activities.

A smaller proportion of rock material would be transported via the road network to the DLNG site for rock installation works at the shore crossing.

7.1.3.3 Pre-commissioning

Flood / Clean / Gauge / Testing (FCGT) and dewatering

Once installed, the Project pipeline internal surfaces need to be cleaned, tested and preserved in preparation to carry hydrocarbons. This is conducted through pigging. A series of pigs (inspection gauge used to manage liquid accumulation) will be pushed through the pipeline to clean the pipeline, gauge the pipeline and ensure all air is removed during the flooding process. Pig launcher/receivers

(PLRs) will be installed on the pipeline end termination point in Commonwealth waters and at the shore crossing.

7.1.3.4 Demobilisation at shore crossing

Following the completion of shoreline construction activities (i.e. shore pull and winch spread) and pre-commissioning activities, the pipeline will be backfilled with the remaining 20-30 m (at the DLNG end) left in the ground unburied for a period of time ready for plant tie-in. Following these works the pipeline trench will be completely backfilled, and the site returned to an agreed condition.

7.2 Operation

Operation of the Project is anticipated to commence in the first half of 2025. The activities associated with the operations phase include:

- Commissioning and transport of dry hydrocarbons through the pipeline
- Inspection, maintenance and repair (IMR) of the installed infrastructure.

Operations and maintenance of the Project pipeline is expected to follow the same, or very similar management procedures currently used by Santos to operate and manage the Bayu-Undan to Darwin pipeline. Routine planned vessel-based IMR activities are expected to occur on a scale of year/s between surveys. Therefore vessel-based activities during operations will be far lesser than for construction.

7.3 Decommissioning

The Project field life is expected to be approximately 25 years. At the end of the Project, the Project pipeline and associated facilities would be decommissioned in accordance with regulatory requirements at that time.

7.4 Site access

7.4.1 DLNG site

The DLNG site at Wickham Point would be accessed from Wickham Point Road. Access to the DLNG site would be required for the construction, operation and decommissioning phases of the Project. Normal pipeline operations will not require additional personnel over and above normal staffing of the DLNG facility.

Travel between the DLNG site and major centres located to the north of the Project, including Darwin and Palmerston, would be via Wickham Point Road, Channel Island Road and Elrundie Avenue. The delivery of rock materials to the DLNG site from the HB Quarry would occur via Wickham Point Road, Channel Island Road, Jenkins Road, Stuart Highway and Arnhem Highway. This haulage route is further discussed in Section 8.1.

7.4.2 Darwin Port

Darwin Port would be accessed via a secure gated entrance on Berrimah Road. Access to Darwin Port would be required during the construction phase of the Project for the delivery of rock materials to the intermediate stockpile. The proposed haulage route between the HB Quarry and Darwin Port is detailed in Section 8.1.

8.0 Heavy vehicle route assessment

8.1 Rock haulage route

The proposed transportation route of rock materials from the supplier, HB Quarry at Mount Bundey, to the stockpile area in Darwin Port at East Arm and DLNG facility at Wickham is have been reviewed for this TIA. Two routes are explored as below:

- **To DLNG** – Approximately 102 km from HB Quarry, estimated one-way trip – 1 hr 7 minutes.
- **To Darwin Port** – Approximately 98 km from HB Quarry, estimated one-way trip – 1 hr 11 minutes.

8.1.1 Darwin Port

The majority of rocks will be transported to the intermediate stockpile area at Darwin Port to provide pipe stabilisation and protection.

This haulage route will begin at HB Quarry and trucks will travel westbound on Arnhem Highway to reach the signalised intersection with Stuart Highway in Humpty Doo. The route will continue northbound via a dedicated right turn to stay on Stuart Highway and eventually merging with Tiger Brennan Drive (grade separated). Upon reaching the signalised interchange with Wishart Road, trucks will turn left, then make another left at Berrimah Road before reaching Darwin Port at the end of the road. It is expected that the same route will be taken in reverse for outbound trips.

This journey provides a direct and efficient route to Darwin Port. Additionally, these roads and intersections currently provide access for heavy vehicles meaning there are no additional provisions required and no concerns regarding turning movements.

The route will bypass the following intersections:

- Arnhem Highway / Stuart Highway
- Tiger Brennan Drive / Berrimah Road
- Berrimah Road / Wishart Road

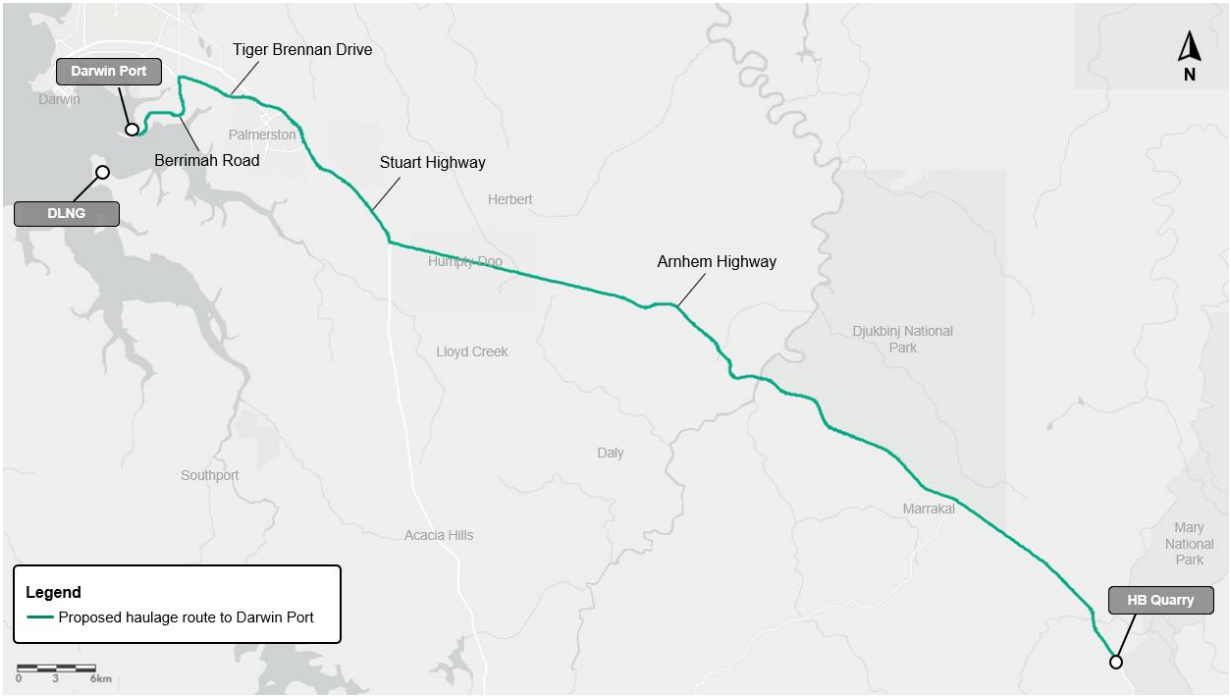

Figure 8-1: Proposed haulage route to Darwin Port

Source: Google Maps © 2022

8.1.2 DLNG

A small proportion of rock materials would be transported via the road network to the DLNG site for rock installation works at the shore crossing.

The haulage route to DLNG will begin at HB Quarry and take the same route as Darwin Port until the intersection of Arnhem Highway and Stuart Highway in Humpty Doo. Trucks will turn at the priority controlled left turn leg and continue on Stuart Highway then turn right at the Jenkins Road and Stuart Highway signalised intersection. At the end of Jenkins Road, the route will continue by taking a left onto Channel Island Road and then a right at Wickham Point Road intersection where the DLNG will be found at the end of the road. It is expected that the same route will be taken in reverse for outbound trips.

This haulage route provides the most direct and efficient route to DLNG. It uses roads and intersections which currently provide access for heavy vehicles meaning there are no additional provisions required and no concerns regarding turning movements.

The route will bypass the following intersections:

- Arnhem Highway / Stuart Highway
- Stuart Highway / Jenkins Road
- Jenkins Road / Channel Island Road
- Channel Island Road / Wickham Point Road

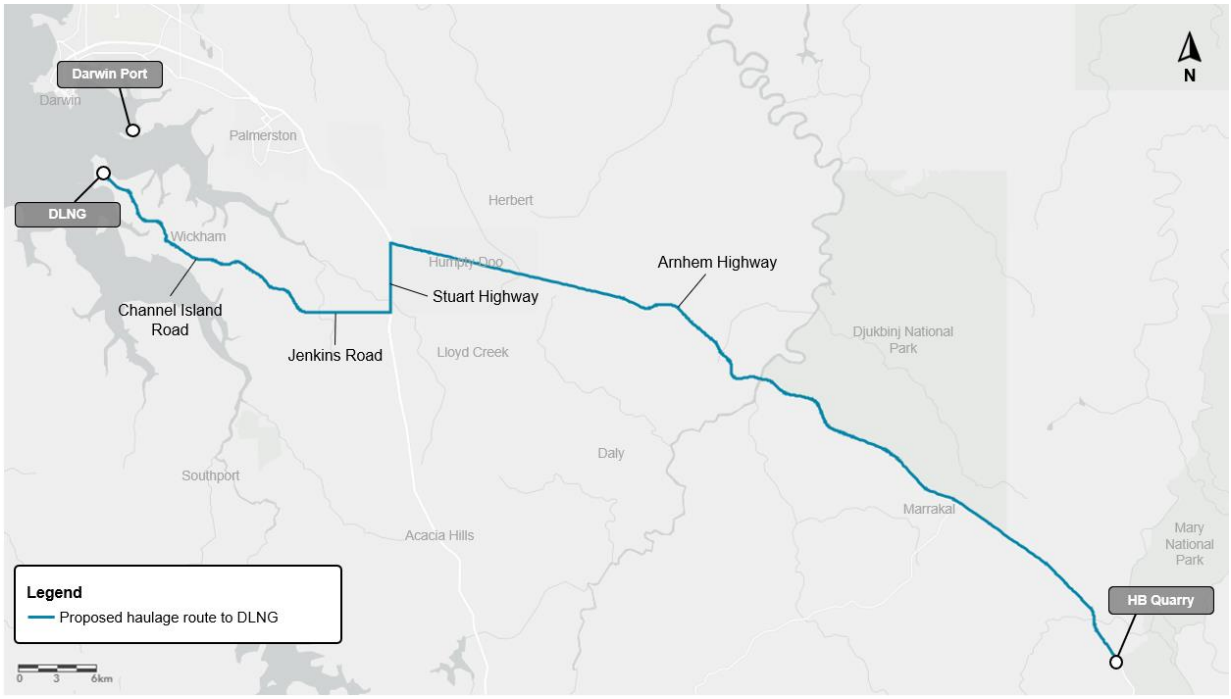

Figure 8-2: Proposed haulage route to DLNG

Source: Google Maps © 2022

8.2 Other haulage routes

General construction equipment (e.g. earth moving machinery and cranes) would likely be sourced from the greater Darwin region. As there may be multiple locations of suppliers, the exact haulage route will need to be planned prior to transportation by the relevant contractor. The routes must follow the road train route outline in Figure 8-3. In general, the Greater Darwin region is within 20 minute drive from the Darwin Port and accessible to many road train approved roads.

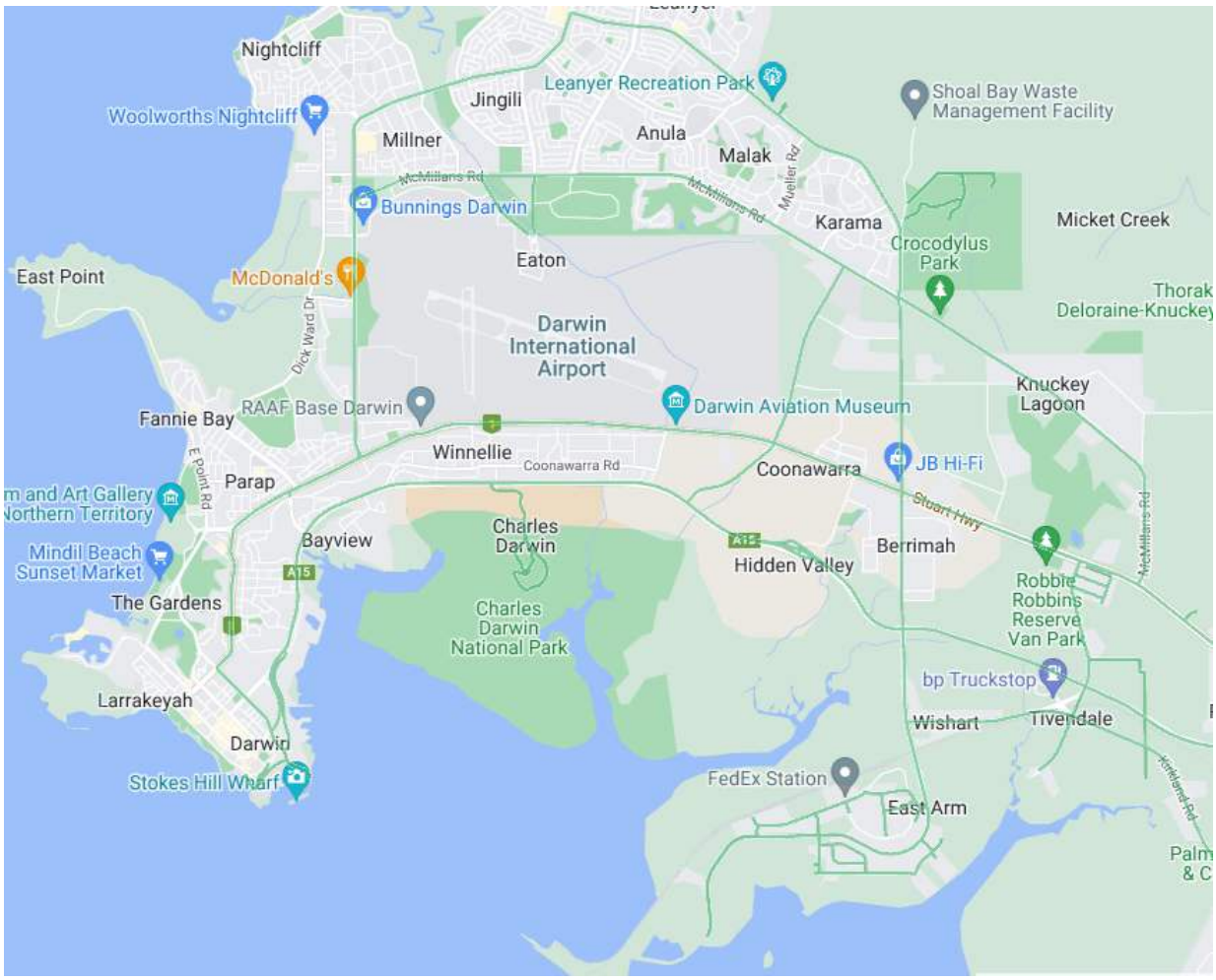

Figure 8-3: Road Train 53.5m approved networks in Greater Darwin

9.0 Traffic Generation

9.1 Construction phase

The traffic generating activities associated with the construction of the Project include the transportation of staff, haulage of rock and delivery of equipment and materials to Darwin Port, the DLNG site and Fort Hill Wharf. Further details on these traffic generating activities are provided in the sections below.

9.1.1 Construction staff

Accommodation would be provided on the Project vessel fleet for the majority of construction staff. Liveaboard construction staff are expected to be sourced from two locations. A portion of liveaboard construction staff will arrive at Darwin Airport and would be transported to the Fort Hill Wharf where staff will transfer to the vessels. Bus movements are anticipated to peak in July 2024, with up to seven buses transporting 364 personnel to the Fort Hill Wharf for the deep-water pipelay component of the Project every month.[1] There will also be liveaboard staff sourced locally in the Darwin region who will transfer daily between Fort Hill Wharf and residential areas within Darwin. The liveaboard construction staff will be responsible for the pipeline installation, offshore rock installation and dredging and excavation works.

Construction staff associated with the onshore works would likely commute daily to the DLNG site from an established workforce accommodation facility which is still to be determined. For the purpose of this TIA, the workforce accommodation facility is assumed to be located at Bladin Village, noting that any change to this arrangement may necessitate further assessment. Bladin Village can accommodate up to 750 people and is located approximately 8 km from the DLNG site on Channel Island Road. Staff are anticipated to travel to and from the DLNG site using a mix of light vehicles including cars, light utility trucks and vans.

Figure 9-1 provides a breakdown of the anticipated number of onshore based staff by construction activity. The number of staff commuting to the Project daily is expected to peak at 160 in March 2024. Approximately 120 staff would commute to the DLNG site each day, with the remaining 40 staff commuting to either the HB Quarry or Port Darwin to support the rock haulage scope of works. The majority of staff movements to the DLNG site would be split between the two 12-hour shifts commencing at 6:00 am and 6:00 pm. Staff movements associated with the site mobilisation and rock haulage activities are assumed to occur over the 12-hour day shift only. Staff are expected to arrive within the 30-minute period prior to shift start and depart within the 30-minute period after shift end. As such, the peak hours of traffic generation would be from 5:30 am to 6:30 am and 5:30 pm to 6:30 pm. The indicative peak number of light vehicle movements during construction is summarised in Table 9-1.

Table 9-1 Indicative light vehicle movements during peak construction

Site	AM Peak (5:30am-6:30am)		PM Peak (5:30pm-6:30pm)	
	To site	From site	To site	From site
DLNG	22	0	0	22
Port Darwin	18	0	0	18
HB Quarry	20	0	0	20
Fort Hill Wharf	50	50	50	50

[1] A bus capacity of 55 passengers has been assumed in this TIA

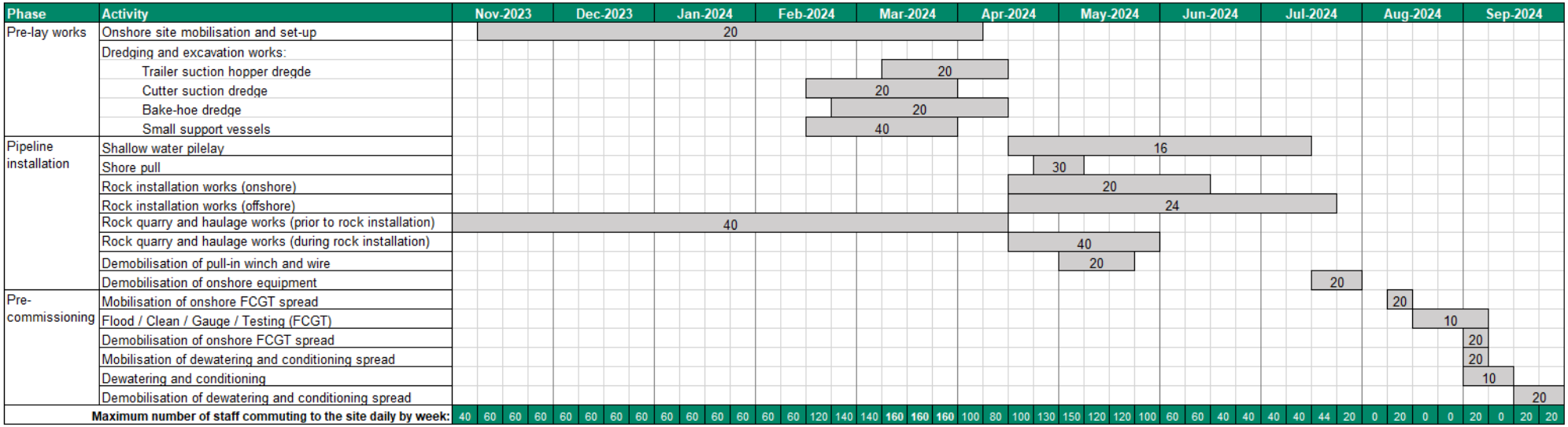

Figure 9-1 Indicative staff movements during construction of the Project

9.1.2 Rock haulage

As discussed in Section 7.1, large quantities of rock will be required to provide pipeline protection and stability within Darwin Harbour. The rock is proposed to be sourced from the HB Quarry at Mount Bundey and would be transported via the road network to Port Darwin and the DLNG site. The proposed haulage routes to are discussed in Section 7.1.2.

It is anticipated that 175,000 tonnes of rock will be required for the Project. The majority of rock (87.5%) will be delivered to the intermediate stockpile at Port Darwin, with the remaining rock (12.5%) delivered to Project area at the DLNG site.

The indicative number of one-way heavy vehicle movements generated by the transportation of rock summarised in Table 9-2. For the purpose of this impact assessment, the number of movements has been conservatively estimated by assuming the rock will be transported by Triple Road Trains (75 tonne payload). However, it is acknowledged that the local road network would support Quadruple Road Trains (100 tonne payload), which may achieve higher productivity and reduce the total number of heavy vehicle movements required.

Approximately 75% of the rock (1,750 loads) are proposed to be transported prior to the start of the rock placement works. The remaining 25% of rock (585 loads) would be transported while rock installation is ongoing. As shown in Table 9-3, the duration of rock installation works is anticipated to be 6.5 weeks, requiring approximately 13 loads to be delivered per day. The majority of heavy vehicle movements are expected to occur seven days a week during daylight hours.

Table 9-2 Indicative number of heavy vehicle movements required for rock transportation

Destination	Rock type	Quantity (tonnes)	Number of heavy vehicle movements (one-way)[1]
Port Darwin	Bedding	7,900	105
	Filter 30mm	42,800	570
	Armour 400mm	102,500	1,365
	Total	**153,200**	**2,040**
DLNG facility	Bedding	870	10
	Filter 30mm	1,400	20
	Armour 500mm	19,700	265
	Total	**22,000**	**295**

Table notes:

[1] Based on a vehicle payload of 75 tonnes and values have been rounded to the nearest five.

Table 9-3 Indicative daily and hourly heavy vehicle movements

	Indicative timing / duration	Number of loads per day	Number of one-way movements per hour[1]
Prior to rock placement works[2]	52 weeks	5	1
During rock placement works	Mid-April to May 2024 (6.5 weeks)	13	2

Table notes:

[1] Deliveries are assumed to be evenly distributed over a 12-hour period and occur seven days per week.

[2] Rock haulage prior to placement works is assumed to occur over a 52-week period.

9.1.3 Equipment and materials

Pipe for the offshore component of the pipeline would be shipped from international waters and transferred to the pipelaying vessel offshore. Pipe required to construct the onshore component of the pipeline is proposed to be transported to the Project area via the road network. Other equipment that would be transported to the DLNG site via the road network is detailed in Table 9-4.

General construction equipment (e.g. earth moving machinery and cranes) would likely be sourced from the greater Darwin region. Specialist equipment required for the pre-commissioning scope of works (FCGT and dewatering) is expected to originate from Perth. This equipment would be transported via the road network to a designated staging area located outside of Darwin prior to being transported to the DLNG site.

Heavy vehicle movements associated with the delivery of equipment and materials are expected to peak in September 2024 during the demobilisation of the FCGT spread and mobilisation of the dewatering spread. Up to 66 vehicles would be required, generating up to 132 one-way movements (66 movements to the DLNG site and 66 movements from the DLNG site) over a two-day period. Assuming heavy vehicle movements are evenly distributed over the two-day period and would occur over a 10-hour window, up to four inbound and four outbound movements would be generated each hour.

Table 9-4 Equipment to be transported to/from the DLNG site

Activity	Equipment	Delivery vehicle type	Number of vehicles	Indicative timings and duration	
				Mobilisation	Demobilisation
Earth moving	Offices/storage containers/workshop	Flatbed	6	November 2023 to March 2024 (30 days)	June 2024 (14 days)
	Gensets and miscellaneous equipment	Flatbed	2		
	Excavators	Low-loader	3		
	Front-end loaders	Low-loader	2		
	Moxies	Moxies	4		
	Dozer	Low-loader	1		
Crane[1]	100T self-drive crane	Crane	1	November 2023 to March 2024 (30 days)	September 2023 (10 days)
	20T self-drive Franna crane	Crane	1		
	Telehandlers	Low-loader	2		
Winch spread (pipe-pull to shore)	Linear winch	Flatbed	1	December 2023 to March 2024 (90 days)	May 2024 (14 days)
	Winch drums[2]	Low-loader	2		
	Control cabin and power packs	Flatbed	3		
Pipe (onshore pipelaying sections)	700m of onshore pipe[3]	Flatbed	30	November 2023 to March 2024 (30 days)	June 2024 (14 days)
	Telehandler	Low-loader	1		
	Side booms or excavators	Low-loader	4		
	Offices/storage containers /workshop	Flatbed	6		
	Gensets and miscellaneous equipment	Flatbed	2		
Flood / Clean / Gauge / Testing (FCGT)	20m^3 Iso Tanks for waste/condensate and hydrosure chemicals	Flatbed/ semi-trailer	3	August 2024 (3 days)	September 2023 (2 days)
	Hoses	Flatbed/ semi-trailer	2		
	Ablutions	Flatbed/ semi-trailer	2		

Activity	Equipment	Delivery vehicle type	Number of vehicles	Indicative timings and duration	
				Mobilisation	Demobilisation
	Stores container, workshop container, test cabin	Flatbed/ semi-trailer	3		
	Office	Flatbed/ semi-trailer	1		
	Water Winning Pontoon	Flatbed/ semi-trailer	1		
	Water Winning HDPE pipe	Flatbed/ semi-trailer	3		
	Frank tank	14.5 m wheeled trailer	1		
	Gensets and miscellaneous equipment	Flatbed/ semi-trailer	3		
	Pumps	Flatbed/ semi-trailer	3		
	Fuel tank	Flatbed/ semi-trailer	1		
	FCGT Pig launcher	Flatbed/ semi-trailer	1		
Dewatering	Compressors	Flatbed/ semi-trailer	16	September 2023 (2 days)	September 2023 (10 days)
	Air dryers	Flatbed/ semi-trailer	4		
	Nitrogen membrane units	Flatbed/ semi-trailer	4		
	Booster compressors	Flatbed/ semi-trailer	4		
	20m^3 Iso Tanks for MEG	Flatbed/ semi-trailer	10		
	Hoses and miscellaneous equipment	Flatbed/ semi-trailer	3		
	Hydrotest/dewatering Pig Launcher	Flatbed/ semi-trailer	1		

Table notes:

[1] Assumed to remain onsite for both pipelay and pre-commissioning scope of works

[2] Removed from site only

[3] Delivered to site only

9.2 Operation phase

Typical operation of the Project would involve the transportation of gas through the pipeline and the inspection, maintenance and repair of subsea and onshore infrastructure. Once construction of the Project has been completed, the DLNG facility would revert to the previous operational arrangements that have been in place since 2006. As such, operation of the Project is not expected to generate additional traffic movements on the local road network relative to existing operations and will not be further considered in this impact assessment.

9.3 Decommissioning phase

At the end of the Project, the Project pipeline and associated facilities would be decommissioned in accordance with regulatory requirements at that time. Traffic generated by the decommissioning phase of the Project would therefore be dependent on a Project decommissioning plan to be prepared and approved at a later date. As such, the decommissioning phase will not be further considered in this impact assessment.

10.0 Traffic Network Impact

10.1 Criteria and assumptions

10.1.1 Traffic generation and distribution

A summary of the traffic generation and distribution assumptions applied to this TIA is provided in Table 10-1.

Table 10-1 Summary of traffic generation and distribution assumptions

Assumption	
Liveaboard construction staff	
1.	The portion of liveaboard construction staff arriving at Darwin Airport travelling to Fort Hill Wharf would consist of up to 7 buses every 3-8 weeks and will avoid peak hour traffic.
2.	As the number of trips generated by the fly-in liveaboard staff is low and only occurs during the non-peak period once every 3-8 weeks, the impact is considered negligible and will not be considered in further detail.
3.	The exact routes and origin location of liveaboard staff residing in Darwin and transfer daily to and from the site are unknown at this stage. However, it can be assumed that the transfer routes and timings are unlikely to coincide. Alongside the low transfer volumes, the impact can be considered negligible and will not be considered in further detail.
Onshore construction staff	
4.	All staff commuting to the Project daily would originate from the existing workforce accommodation facility located at Bladin Village.
5.	All light vehicle movements generated by construction staff would occur within the 30-minute period prior to shift start and after shift end (i.e. 5:30 am to 6:30 am and 5:30 pm to 6:30 pm).
6.	The traffic generation rate in the peak periods would be one light vehicle per construction worker (i.e. no car-pooling or buses have been assumed).
7.	Construction staff would commute to the Project using a mix of light vehicles including cars, light utility trucks and vans.
8.	Staff movements associated with onshore site mobilisation/demobilisation and rock haulage activities would occur over the 12-hour day shift only.
9.	A cumulative maximum of 20 staff would be needed to support onshore mobilisation and demobilisation activities.
10.	Staff movements associated with general construction activities would be split between the two 12-hour shifts commencing at 6:00 am and 6:00 pm.
11.	Staff supporting the rock haulage scope of works would be split between the HB Quarry and the rock destination sites at Port Darwin and DLNG. An 87.5/12.5 percent staff split between Port Darwin and DLNG has been assumed in proportion to the rock distribution between the two sites.
Rock haulage activities	
12.	A vehicle payload of 75-tonnes has been assumed to provide a conservative impact assessment. It is acknowledged that the local road network would support Quadruple Road Trains (100 tonne payload), which may achieve higher productivity and reduce the total number of heavy vehicle movements required.

Assumption	
13.	Heavy vehicle movements generated by the rock haulage activities would occur seven days per week and be evenly distributed over daylight hours.
14.	Approximately 75% of the rock would be transported prior to the start of the rock placement works. The remaining 25% of rock would be transported over a 6.5 week period while the rock installation works is ongoing.
Equipment and material deliveries	
15.	Heavy vehicle movements associated with the delivery of equipment and materials would be evenly distributed over a 10-hour delivery window.

10.1.2 Lane capacities

Uninterrupted flow facilities

Section 4.2 in Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis* establishes the capacity for a two-lane highway to be 1,700 passenger car units per hour (pcu/h) for each traffic lane. Accordingly, a capacity of 1,700 pcu/h for each traffic lane has been adopted for highways in the study area including the Arnhem Highway and Stuart Highway.

Interrupted flow facilities

Table 5.1 in Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis* sets out typical one-way mid-block capacities for various types of urban roads with interruptions from cross and turning traffic at minor intersections. A capacity of 900 pcu/h for each traffic lane has been adopted for:

- Berrimah Road
- Wishart Road
- Kirkland Road
- Elrundie Avenue
- Jenkins Road
- Channel Island Road.

As Tiger Brennan Drive is a dual carriageway road with flaring at major intersections and absence of parking, a higher mid-block capacity of 1,200 pcu/h for each traffic lane has been adopted in accordance with Section 5.2.1 in Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis.*

10.1.3 Annual background traffic growth

Growth factors have been applied to the 2022 traffic volumes in order to consider background traffic growth between existing conditions and the peak year of construction activity (2024).

The annual background traffic growth rates used in this study has been estimated based on the average growth in Annual Average Daily Traffic (AADT) observed over the last five-year period (2017-2021). As shown in Table 10-2, the Arnhem Highway has observed an average annual traffic growth rate of 2.2% near the Adelaide River Bridge since 2017. The Stuart Highway has experienced the highest average traffic growth rate in the study area at 4.6%. Several roads in the study area observed a decrease in AADT volumes including Berrimah Road, Channel Island Road and Kirkland Road. A growth rate of 0.0% has been adopted in this study for these roads to provide a conservative assessment.

Table 10-2 Growth in AADT on key roads within in the study area (2017-2021)

Road	Station	Location of station	Data range	Average annual traffic growth rate (%)[1]
	UDVDP019	500 m east of Stuart Highway	2017-2021	0.7

Road	Station	Location of station	Data range	Average annual traffic growth rate (%)[1]
Arnhem Highway	RDVDP007	2 km west of Adelaide River Bridge	2017-2021	2.2
Berrimah Road	UDVDP028	400 m south of Tiger Brennan Drive	2017-2021	-3.3
	UDVDP029	350 m west of Casey Street	2017-2021	-1.2
Channel Island Road	UDVDC072	South of Elizabeth River Bridge	2017-2021	-11.3
Elrundie Avenue	UDVDC062	100 m North of Chung Wah Terrace	2017-2021	1.1
Kirkland Road	UDVDP085	500 m west of West of Wishart Road	2017-2021	-1.4
Stuart Highway	UDVDP017	500 m west of Howard Springs Road	2017-2021	0.7
	UDVDP020	500 m north of Arnhem Highway	2017-2021	4.6
Tiger Brennan Drive	UDVDP022	800 m west of Berrimah Road	2017-2021	1.8

Table notes:

[1] Where the growth rate is negative, a value of 0.0% has been adopted to provide a conservative assessment

10.1.4 Passenger car unit equivalency factors

A passenger car unit equivalent (PCE) value of 2 will be used for heavy vehicles as per Table 4.1 in Austroads *Guide to Traffic Management Part 3: Traffic Studies and Analysis.*

10.2 Road mid-block capacity impact

10.2.1 Traffic volume data

Table 10-3, Table 10-4 and Table 10-5 compare the projected background 2024 traffic volumes with the estimated 2024 total traffic volume inclusive of construction volumes for each peak hour. The volumes have been calculated to represent a conservative estimate of the maximum traffic generated by the project on the road network at any given point. It is noted that these estimates are considered conservative as some works are unlikely to occur simultaneously following further refinement of the construction program for the Project.

The traffic volumes have been estimated based on the following:

- 2022 SCAT's data provided by DIPL (insert date provided)
- AADT data provided by DIPL (converted to peak hour volumes where SCAT's was not provided)
- Growth rates and other assumptions detailed in Section 10.1
- Construction traffic generation estimated in Chapter 9.0

The full assessment can be found in Appendix A.

The following conclusions are drawn from these findings:

- Berrimah Road, Wishart Road and Tiger Brennan Drive are used by heavy vehicles significantly more relative to the other assessed roads

- Traffic volumes are much lower in the midday peak than the AM or PM peaks for high use roads
- Project generated traffic makes up only a very small amount of the projected 2024 traffic.

Table 10-3 Two-Way Traffic generation AM peak

Road	Road Section	Without construction of Project (2024)			With construction of Project (2024)		
		LV	HV	HV%	LV	HV	HV%
Arnhem Highway	East of Stuart Highway	914	34	3.7	934	36	3.8
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	835	315	37.7	835	325	38.9
Channel Island Road	South of Elizabeth River Bridge[1]	141	4	2.7	158	12	7.4
Elrundie Avenue	North of Chung Wah Terrace[1]	506	12	2.3	523	20	3.7
Jenkins Road	West of Stuart Highway	206	1	0.7	226	6	2.8
Kirkland Avenue	East of Wishart Road[1]	43	1	2.1	63	3	4.6
Stuart Highway	Between Temple Terrace and Howard Springs Road	4837	175	8.8	4837	177	3.7
Tiger Brennan Drive	West of Berrimah	2862	165	5.8	2862	167	5.8
Wishart Road	East of Berrimah Road	645	243	37.7	662	251	38.0

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

Table 10-4 Two-Way Traffic generation midday peak

Road	Road Section	Without construction of Project (2024)			With construction of Project (2024)		
		LV	HV	HV%	LV	HV	HV%
Arnhem Highway	East of Stuart Highway	315	16	5.1	315	18	5.8
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	391	148	37.7	391	158	40.3
Channel Island Road	South of Elizabeth River Bridge[1]	141	4	2.7	141	12	8.3
Elrundie Avenue	North of Chung Wah Terrace[1]	506	16	3.2	506	24	4.8
Jenkins Road	West of Stuart Highway	269	8	3.0	269	13	4.8

Road	Road Section	Without construction of Project (2024)			With construction of Project (2024)		
		LV	HV	HV%	LV	HV	HV%
Kirkland Avenue	East of Wishart Road[1]	38	1	1.7	38	3	6.9
Stuart Highway	Between Temple Terrace and Howard Springs Road	2546	91	3.6	2546	93	3.7
Tiger Brennan Drive	West of Berrimah	1832	189	10.3	1832	191	10.4
Wishart Road	East of Berrimah Road	251	95	37.7	251	103	40.9

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

Table 10-5 Two-way Traffic generation PM peak

Road	Road Section	Without construction of Project (2024)			With construction of Project (2024)		
		LV	HV	HV%	LV	HV	HV%
Arnhem Highway	East of Stuart Highway	730	27	3.7	750	29	3.8
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	694	262	37.7	694	272	39.2
Channel Island Road	South of Elizabeth River Bridge[1]	106	3	2.7	123	11	8.8
Elrundie Avenue	North of Chung Wah Terrace[1]	380	12	3.2	397	20	5.1
Jenkins Road	West of Stuart Highway	232	6	2.6	250	11	4.4
Kirkland Avenue	East of Wishart Road[1]	77	1	1.4	97	3	3.2
Stuart Highway	Between Temple Terrace and Howard Springs Road	3676	131	3.6	3676	133	3.6
Tiger Brennan Drive	West of Berrimah	2727	189	6.9	2727	191	7.0
Wishart Road	East of Berrimah Road	620	234	37.7	638	242	38.0

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

10.2.2 Mid-block capacity assessment

The results of the mid-block capacity assessment for the AM peak, midday peak and PM peak periods are shown in Figure 10-1, Figure 10-2 and Figure 10-3, respectively. It illustrates and compares the midblock volume to capacity ratio (V/C) of the existing road network and the construction volume added road network. Where a road's V/C is greater than 1, the volume of the road is deemed to have exceeded the capacity of the road and may affect the performance of road users.

The mid-block capacity has been assessed based on the following:

- Traffic volume data for the mid-block is sourced from Section 10.2.1
- Road capacity and other assumptions detailed in Section 10.1
- Where multiple sections of one road have been assessed, results are shown for the section of road presenting the maximum V/C ratio

The full assessment can be found in Appendix A.

The following conclusions are drawn from these findings:

- All roads in the study area would operate under capacity with the exception of the following two roads during the AM peak hour:
  - Stuart Highway between Temple Terrace and Howard Springs Road
  - Wishart Road
- Where V/C exceeds 1, it has already surpassed capacity in the existing case and is not a result of additional project volume
- On average, V/C is higher for most roads during the peak hour and lower during the midday peak.

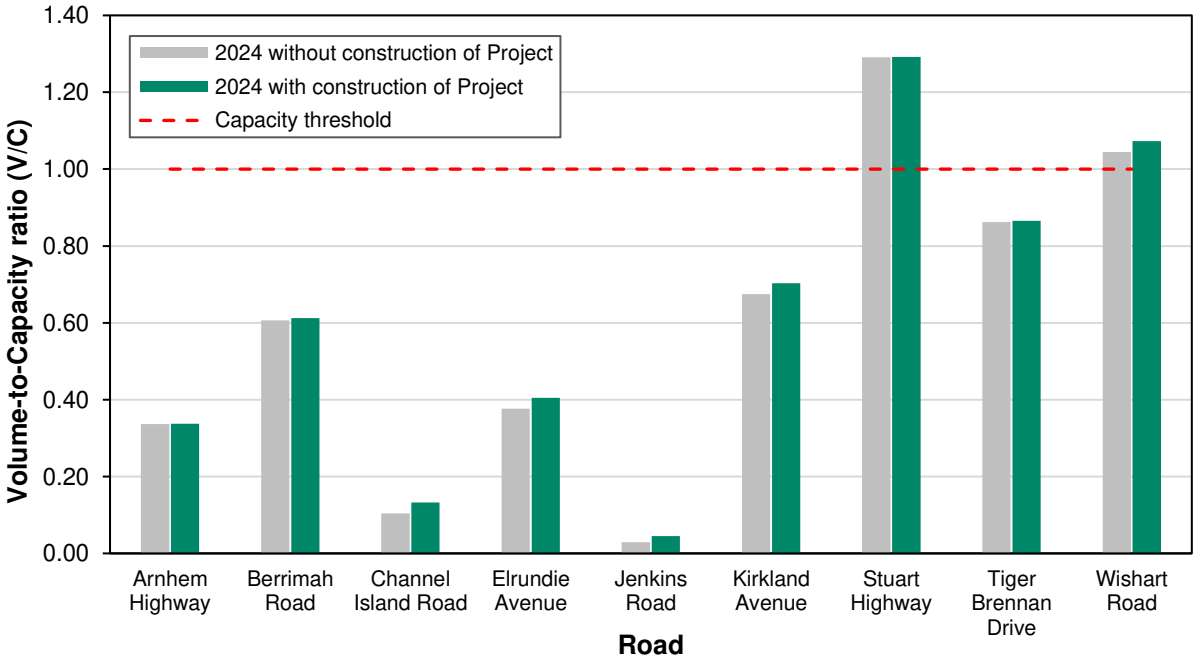

Figure 10-1 Mid-block capacity results for the 2024 AM peak

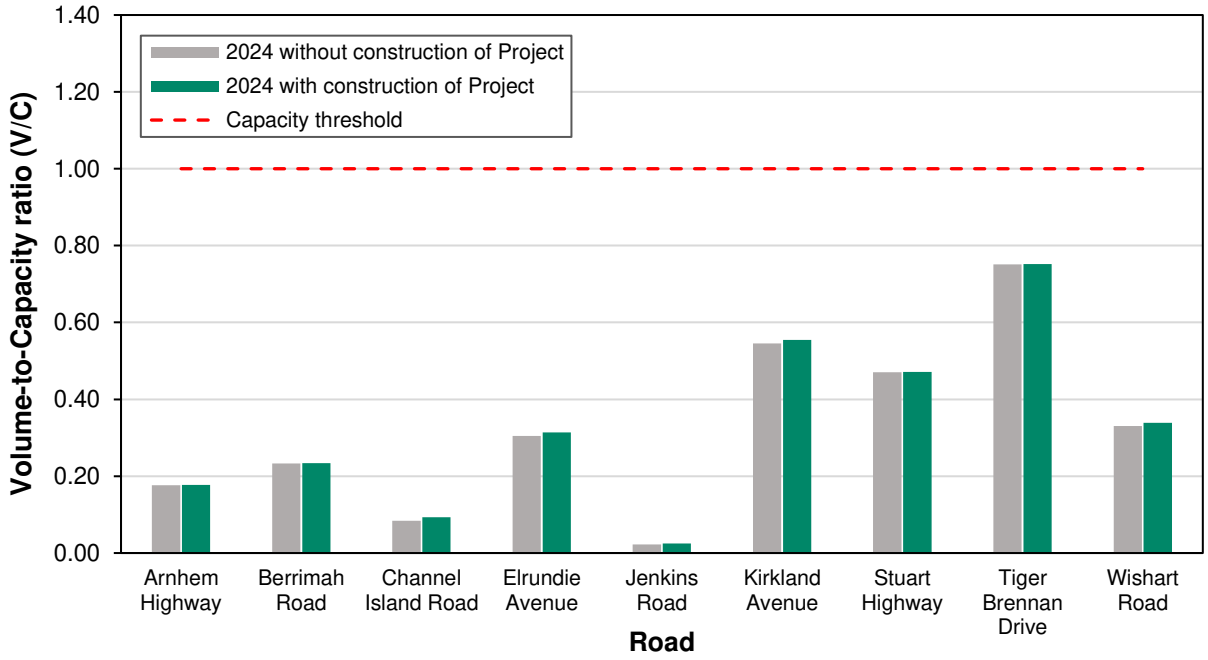

Figure 10-2 Mid-block capacity results for the 2024 midday peak

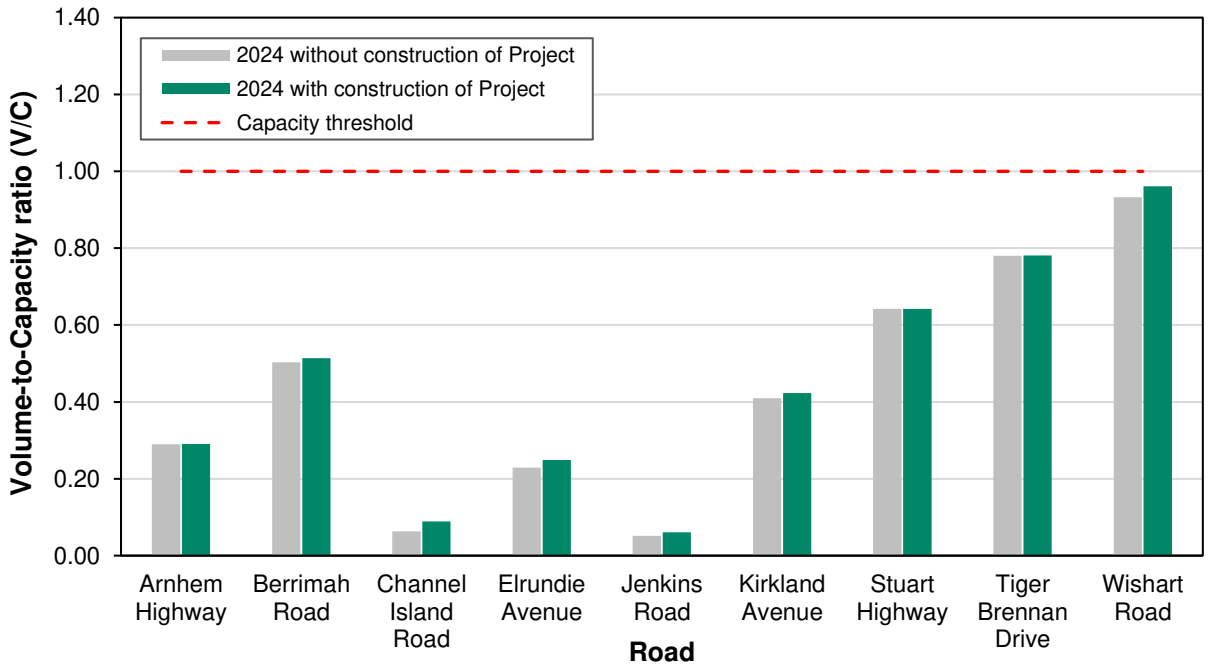

Figure 10-3 Mid-block capacity results for the 2024 PM peak

10.3 Intersection capacity and performance impact

To determine whether further intersection modelling and analysis was necessary, the critical intersections identified in Section 6.4 were assessed based on the following:

- Number of additional turning movements (particularly right turns) resulting from the Project
- Number of additional Project related movements compared to the overall volume of the intersection
- A high V/C midblock ratio for any roads within the intersection
- Any known intersection capacity issues.

From this assessment, the following intersections were deemed to have triggered further modelling and analysis:

- Tiger Brennan Drive / Wishart Road / Tivendale Road
- Tiger Brennan Drive / Berrimah Road
- Berrimah Road / Wishart Road.

Models for the critical intersections were developed using the SIDRA Intersection (version 9.0) software package. SIDRA Intersection is a micro-analytical tool used to evaluate intersection performance in terms of Degree of Saturation (DoS), delay, Level of Service (LoS), queue length and a variety of other performance measures. Key intersection performance measures are further discussed in Section 10.3.1.

It should be noted that the following constraints and assumptions are relevant to the intersection capacity and performance assessment:

- Intersection modelling was undertaken for the AM and PM peak hours only as these hours represent the periods when the road network experiences the maximum traffic demand and the available spare capacity of the road network is at its most limited. As such, the modellings results are indicative of a worst-case scenario as the traffic volumes throughout the remainder of the day decrease significantly. All intersections are assumed to perform adequately during the midday peak period.
- Signal cycle timing and phasing is based on Friday 9 September 2022 SCATS data. Average cycle time was determined via SCATS and individual phase times were determined by SIDRA.
- Background traffic growth has been assumed as per Section 10.1.3 of the report
- No calibration or validation has been undertaken as part of this assessment.

10.3.1 Performance indicators and targets

10.3.1.1 Level of Service

The criteria for evaluating the operational performance of intersections in summarised in Table 10-6. For signalised intersections, the performance is based on the average delay per vehicle across all movements. This average vehicle delay is equated to a corresponding Level of Service (LoS) from A (best) to F (worst). LoS D is typically considered as the minimum desirable performance level; a deterioration of LoS under this level would imply suitable remedial measures should be sought to improve performance.

Table 10-6 Level of Service definitions for signalised intersections

Level of Service	Average delay (seconds per vehicle)	General description
A	≤ 10	Free flow
B	11 to 20	Stable flow (slight delays)
C	21 to 35	Stable flow (acceptable delays)

Level of Service	Average delay (seconds per vehicle)	General description
D	36 to 55	Approaching unstable flow (tolerable delays)
E	56 to 80	Unstable flow (intolerable delay)
F	>80	Forced flow (jammed)

Source: SIDRA and Highway Capacity Manual 2016

10.3.1.2 Degree of Saturation

The Degree of Saturation (DoS) is defined as the ratio of arrival flow (demand) to the approach capacity. In general, a lower DoS indicates a better level of traffic service. A DoS greater than 1.0 indicates oversaturated conditions in which long queues of vehicles build up on the critical approaches. In theory, a DoS of 1.0 means that the intersection is operating at maximum capacity. However, a lower practical DoS is normally used, depending on the intersection control type. For signalised intersections, the practical DoS is 0.9. The intersection DoS is based on the highest DOS of all movements.

10.3.1.3 95th percentile queue

95th percentile queue is the length (in metres) below which 95% of all observed cycle queues lengths fall. In other words, this queue length is expected to be exceeded only for 5% of observed queues. Ideally, the 95th percentile queue should fit within the provided turning lane without spilling into adjacent lanes.

10.3.1.4 Average delay

Average delay refers to the average additional amount of time it takes a vehicle to pass through the intersection compared to free flow conditions. The average delay is measured in seconds per vehicle.

10.3.2 Intersection impact results

The results for the 'without construction of Project' (without vehicles generated by the construction of the Project) and 'with construction of the Project' (with vehicles generated by the construction of the Project) scenarios are presented in Table 10-7 for the AM and PM peak hours. The full assessment results can be found in Appendix B.

The following conclusions are drawn from the analysis:

- The model results indicate that all critical intersections are expected to operate at LoS D or above in 2024 without the construction of the Project. No critical intersection is expected to experience a deterioration in LoS due to additional traffic volumes generated by the construction of the Project.
- All critical intersections are expected to operate at a satisfactory DoS in 2024 with the exception of Tiger Brennan Drive / Berrimah Road during the AM peak hour. The DoS of this intersection is anticipated to exceed the generally accepted practical DoS value of 0.9 for signalised intersections. However, the Tiger Brennan Drive intersection will be upgraded to an overpass during the rock haulage period and this will likely impact on the use of this intersection. It is likely that the Project will instead use Wishart Road during these works.
- The maximum increase in average delay as a result of the Project is anticipated to be approximately two seconds and would occur at the intersection of Tiger Brennan Drive / Wishart Road / Tivendale Road during the PM peak hour. The increase in average delay at all remaining intersections is expected to be less than one second.

Therefore, the construction of the Project is expected to have an imperceptible impact on the capacity and performance of the critical intersections.

Table 10-7 Intersection performance results

Intersection	Peak Period	Without construction of Project (2024)				With construction of Project (2024)			
		Degree of Saturation	Average intersection delay (seconds)	Level of Service	95th percentile queue length (metres)	Degree of Saturation	Average intersection delay (seconds)	Level of Service	95th percentile queue length (metres)
Tiger Brennan Drive / Berrimah Road	AM	0.933	42.0	D	389.1	0.933	42.2	D	389.1
	PM	0.857	34.4	C	345.5	0.880	34.9	C	348.3
Tiger Brennan Drive / Wishart Road / Tivendale Road	AM	0.592	39.1	D	180.5	0.593	39.1	D	180.9
	PM	0.801	39.8	D	286.0	0.844	41.8	D	317.4
Berrimah Road / Wishart Road	AM	0.524	21.0	C	69.3	0.524	20.9	C	69.3
	PM	0.545	15.0	B	56.9	0.579	15.2	B	61.5

10.4 Recommended mitigation measures

To mitigate the potential impacts of the Project on road capacity and performance, the following mitigation measures are recommended:

- All vehicle movements associated with the Project should be planned to occur outside of the identified AM and PM peak hours
- Group transport, such as shuttle buses and car-pooling schemes, should be implemented where practical to reduce the number of light vehicle movements on the local road network
- Heavy vehicle movements should be scheduled to minimise traffic disruption to the road network. This may include:
    - Scheduling of the movement of rock, equipment and other materials to occur outside of the identified AM and PM peak hours
    - Scheduling heavy vehicle movements to be evenly dispersed as far as practical to minimise the potential of convoying or platoons on the road network.
- The loading and unloading of heavy vehicles should be planned so that the capacity of each individual vehicle is fully utilised to reduce the total number of movements on the local road network
- A separate Traffic Management Plan (TMP) should be prepared, approved and implemented during the construction phase of the Project. The TMP will confirm final haulage routes and provide the necessary mitigation measures to ensure that construction vehicle movements can be accommodated on the local road network with minimal impacts.

11.0 Cumulative Impacts

11.1 Coolalinga Road Safety Upgrades

The Northern Territory Government aims to improve road safety for all road users, improve accessibility to Stuart Highway and support future planning through the proposal of:

- 2 new signalised intersections on the Stuart Highway
- Multiple road extensions (service roads, roads behind Coolalinga Central, Henning Road)
- New road link between the Stuart Highway and Henning Road
- Reduced posted speed limit to 60km/h on the Stuart Highway

The construction of this project is scheduled for commencement by 2023. At the time of writing this report, the project has completed the first stage of detailed design shown in Figure 11-1.

Figure 11-1: Coolalinga Road Safety Upgrades Plan

Figure source: Northern Territory Government, 2022

Assuming the construction of the Coolalinga Road Project begins in January 2023, this construction period may overlap with the timings of the Barossa Darwin Pipeline Duplication Project (Figure 7-1). The Coolalinga signalisation project may result in the full or partial closure of Stuart Highway; a key road along the rock haulage route. If these closures coincide with the Project's rock delivery schedule, there is a potential that an alternate route may need to be considered.

11.2 Tiger Brenan Drive / Berrimah Road overpass works

Figure 11-2 Tiger Brennan Drive / Berrimah Road Overpass Plan

Figure source: Northern Territory Government, 2022

The Northern Territory Government is in partnership with the Australian Government to improve road safety at the Tiger Brennan Drive and Berrimah Road intersection through the construction of a new overpass (Northern Territory Government, 2022). This will separate the major traffic flow on Tiger Brennan Drive from those on Berrimah Road.

The project will enhance safety, reduce traffic delays during peak hours and improve connectivity for freight transport to East Arm Wharf through the proposal of:

- An overpass with Berrimah Road passing over Tiger Brennan Drive
- Realignment of Tiger Brennan Drive
- Improvements to Berrimah Road catering to requirement for road trains
- On and off ramps
- Earthworks, drainage works, pavement construction, asphalt works, line marking and road safety barriers
- Street lighting, traffic lights, improved pedestrian and cyclist accessibility
- Landscaping and urban design

The construction of the Tiger Brennan Overpass Project has commenced, with site and early works being undertaken at the time of writing this report. While these early works should not impact of traffic movements, construction is likely to extend through to mid 2024 there will likely be a cumulative traffic impact should construction be staged as described in the Traffic Impact Assessment AECOM prepared for Sitzler Pty Ltd (Figure 11-3). Potential detours may occur during the detailed design stage predicted to occur in early 2023.

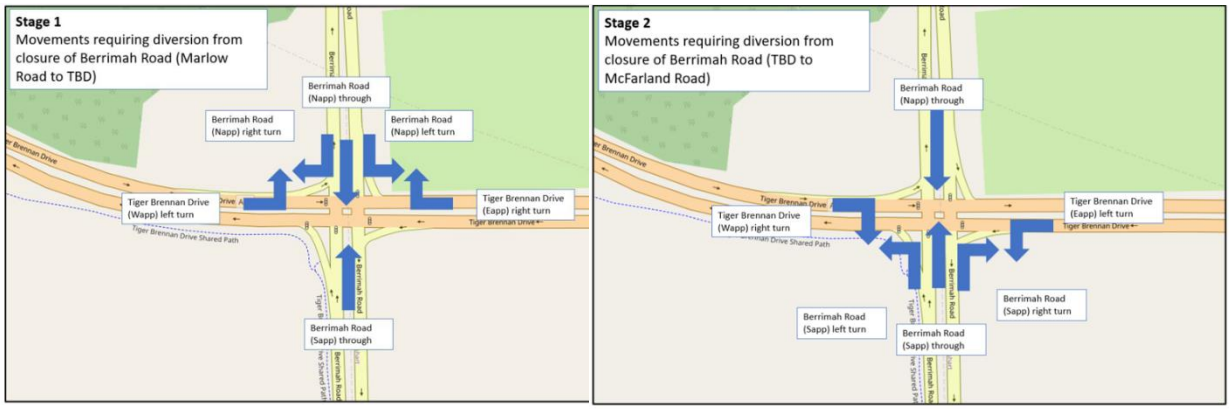

Figure 11-3: Potential construction staging for Tiger Brennan Drive and Berrimah Road overpass

Figure source: AECOM 2022

11.3 Darwin Ship Lift

The Northern Territory Government is delivering the Darwin Ship Lift Project to establish Darwin as a thriving maritime services industry hub. The Darwin Ship Lift facility will be designed to meet the needs of the general maritime sector, current long-term needs of the Department of Defence and the Australian Border Force, while supporting local jobs and economic growth in the Territory.

In reference to the indicative concept design construction schedule in the Darwin Ship Lift Project draft preliminary documentation (Figure 11-4), construction work is planned to begin in quarter 3 of 2022.

Works	2021			2022				2023				2024				2024			
	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Approvals																			
Contractor procurement																			
Site preparation																			
Transport of fill materials																			
Dredging																			
Land reclamation																			
Service installation, pavement sealing and paving																			
Piling																			
Infrastructure component and installation																			
Facility practical completion																			

Figure 11-4: Darwin Ship Lift indicative construction schedule

Figure source: AECOM 2021

In reference to the traffic impact assessment AECOM completed for the Darwin Ship Lift Project in 2021, during the 24 months of project construction there will be heavy vehicle traffic generated on the last 20km section of the Barossa project's haulage route outlined in Section 8.0 (Figure 11-5). Whilst the additional heavy vehicle traffic has the potential to create additional trips on the network at the same time as the Project, the approximate traffic generation at peak would be approximately 10 heavy vehicle trips per hour. If the additional heavy vehicle trips occur during the off peak period as per the recommendations made in the report, there is likely to be a negligible cumulative impact on traffic.

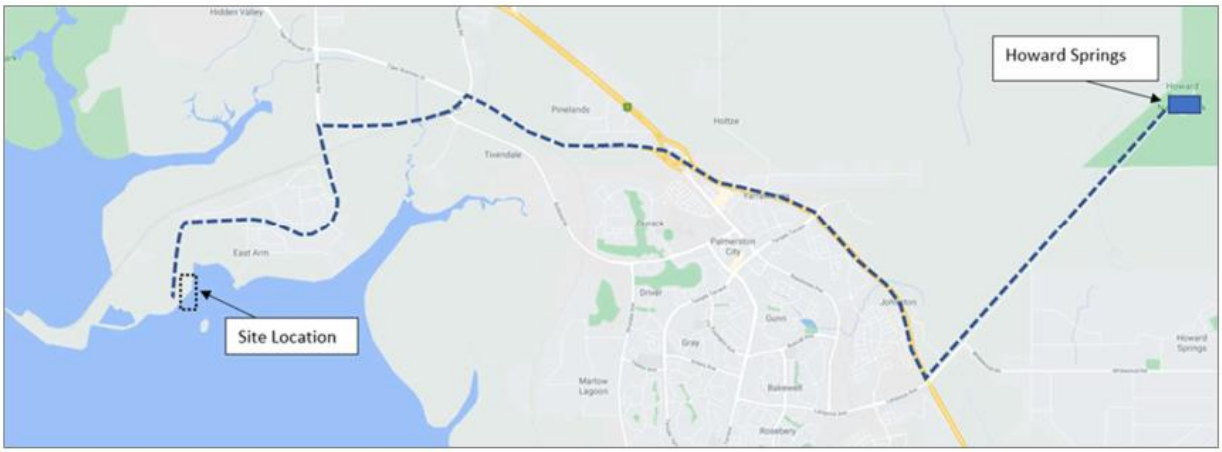

Figure 11-5: Darwin Ship Lift Project haulage route

11.4 Recommended mitigation measures

To mitigate the potential cumulative impacts of the Project and other concurrent projects, the following mitigation measures are recommended:

- Coordination and consultation with key stakeholders to manage the interface of projects occurring at the same time. This may include the coordination of traffic management arrangements between projects and the provision of regular project updates.
- Investigation of potential alternative haulage routes in the event that road closures or access restrictions are required to facilitate other projects.

12.0 Other Impacts and Mitigation Measures

12.1 Pedestrians and cyclists

As shown in section 6.5.1, there are a number of shared footpath and on-road bicycle paths on and around the project haulage routes. In addition, ad-hoc movements of recreational cyclists using highways and pedestrians through local roads can be expected.

Therefore, the Project should consider appropriate traffic management measures to ensure safe pedestrian (including school children in vicinity of school bus stops) and cyclist passage on nominated routes during construction (and if deemed required operation stage), in accordance with relevant road design standards and in consultation with relevant road authorities. The local community and road users should be notified in advance of any changes in transport conditions including details of any proposed road and traffic lane closures.

12.2 Public transport

As shown in section 6.5.2, multiple regular public bus routes operate on the proposed haulage route, notably between Darwin, Palmerston and Humpty Doo. Heavy vehicle movements associated with the Project would likely operate during bus operating times. Therefore, the Project must consider reducing potential impact if conflicts are unable to be suitably managed.

Consultation with local councils and bus operators during the development of the TMP to ensure any affected school routes have appropriate diversions in place that still service necessary stakeholders and deliver acceptable travel time changes should be considered. It is recommended that ongoing consultation with relevant stakeholders would be undertaken to manage the potential disruptions on bus services.

12.3 Road maintenance

This Project is expected to increase the number of axle repetitions the road pavement is exposed to, particularly during the construction period. It is assumed that the road pavements in the study area have been designed to withstand a certain number of axle repetitions which are forecast during the design life of the road due to the existing demand of heavy vehicles on the network.

However, the additional number of heavy vehicles forecast to be generated by the Project is expected to increase the wear on the pavement and increase the likelihood that minor maintenance might be required. With no assessment of the roads in the study areas outlining the current condition or age of the pavement, it is not possible at this time to quantify the impact the Project might have on the road surfaces. It is recommended that a pavement condition program be implemented to monitor the impact and identify any deterioration to the road pavement over the duration of construction. In order to do this a baseline study must be completed to identify the existing conditions of the existing public routes, which are to become part of the haulage routes.

All loads being transported to and from the site will be secured in accordance with the relevant legislation. All vehicles must be correctly licenced and compliant with relevant up to date legislation. Legislation: NT Traffic Regulations 1999.

12.4 Driver fatigue

During the construction there is the potential risk of driver fatigue due to the volume of materials required for completion of the works. This risk will be managed through the appropriate implementation of a Fatigue Management System (FMS) in accordance with the Northern Territory Road Transport Fatigue Management Code of Practice.

This code of practice, this has been developed “to assist transport operators to implement management systems which meet occupational health and safety obligations under the Work Health Act in relation to driver fatigue”.

12.5 Incident management

Due to the nature of the Project, it is expected that relevant guidelines will be adhered to. It is expected that an Incident Management Plan will be utilised in order to set out processes and response measures that are to be implemented in case of a non-compliance to relevant guidelines or should an emergency situation arise.

13.0 Summary and Conclusions

This report details the traffic and transport impact assessment for the Barossa Darwin Pipeline Duplication Project. The report findings are summarised below.

Existing conditions

An existing transport conditions review was undertaken, which was informed via a combination of desktop reviews, site visit, crash/traffic data analysis and review of relevant policies and legislation. The key existing condition findings are summarised below:

- The road network within the study area is comprised of several State roads including Arnhem Highway and Stuart Highway. The Stuart Highway is the most heavily trafficked road in the area, with up to 27,800 vehicles travelling on the road on an average day.
- Stuart Highway, Tiger Brennan Drive and Berrimah Road all form part of the National Land Transport Network. Heavy vehicles (>3 axles) account for between 3.6% and 27.4% of traffic volumes on these roads.
- Traffic volumes on key roads in the study area generally peak during the month of September. Reduced levels of traffic are observed during the wet season (November to April).
- Arnhem Highway, Stuart Highway, Tiger Brennan Drive, Berrimah Road, Kirkland Road, Elrundie Avenue, Jenkins Road, Channel Island Road and Wickham Point Road all form part of the approved network for 53.5 m Road Train vehicles.
- Dedicated cyclist infrastructure in the study area is limited to an on-road bicycle lane on the eastern side of Berrimah Road between Marlow Road and Wishart Road. Several shared footpaths are provided adjacent to key roads in the study area including Berrimah Road, Tiger Brennan Drive, Stuart Highway and Arnhem Highway.
- There are no existing or proposed public bus services within 400 m of the DLNG facility or the intermediate stockpile site at Darwin Port, however CDC Northern Territory operates seven regular public bus services on roads forming part of the proposed Project haulage routes.
- The Adelaide-Darwin railway alignment is located approximately 750 m north-west of the intermediate stockpile site at Darwin Port. This railway line is grade separated from Berrimah Road at East Arm. However, two level railway crossings are located on Kirkland Road and one is located on Channel Island Road.
- In the five-year period from 2015 to 2019, a total of seven fatalities occurred on key roads in the study area. Five of these fatalities occurred on Tiger Brennan Drive.

Impact assessment

The key findings of the construction phase impact assessment are as follows:

- Mid-block capacity: a mid-block capacity assessment was undertaken for key roads in the study area to assess the impact of the Project on road capacity. The results indicate that all roads would operate under capacity in 2024 with the exception of Stuart Highway (between Temple Terrace and Howard Springs Road) and Wishart Road during the AM peak hour. Project-generated traffic would account for a very minor proportion of traffic on the local road network in 2024 and where the available capacity of a road has been exceeded, it is not a result of Project traffic.
- Intersection capacity and performance: traffic modelling using SIDRA Intersection (version 9.0) was performed to assess the impacts of the Project on the capacity and performance of three critical intersections. The modelling results indicate additional traffic movements generated by the construction of the Project in 2024 would result in negligible impacts.
- Preliminary haulage route assessment: routes have been established based on the approved road network for 53.3 metre Road Train vehicles. No road upgrades are anticipated to be required to accommodate Project traffic.

Overall, impacts to the local transport network during Project construction are expected to be negligible given the very low proportion of Project-generated traffic on the local road network.

Mitigation measures

To mitigate the potential impacts of the Project, the following mitigation measures have been recommended:

- All vehicle movements associated with the Project should be planned to occur outside of the identified AM and PM peak hours
- Group transport, such as shuttle buses and car-pooling schemes, should be implemented where practical to reduce the number of light vehicle movements on the local road network
- Heavy vehicle movements should be scheduled to minimise traffic disruption to the road network. This may include:
    - Scheduling of the movement of rock, equipment and other materials to occur outside of the identified AM and PM peak hours
    - Scheduling heavy vehicle movements to be evenly dispersed as far as practical to minimise the potential of convoying or platoons on the road network.
- The loading and unloading of heavy vehicles should be planned so that the capacity of each individual vehicle is fully utilised to reduce the total number of movements on the local road network
- A separate Traffic Management Plan (TMP) should be prepared, approved and implemented during the construction phase of the Project. The TMP will confirm final haulage routes and provide the necessary mitigation measures to ensure that construction vehicle movements can be accommodated on the local road network with minimal impacts.
- Coordination and consultation with key stakeholders to manage the interface of other projects occurring in the study area at the same time. This may include the coordination of traffic management arrangements between projects and the provision of regular project updates.
- Investigation of potential alternative haulage routes in the event that road closures or access restrictions are required to facilitate other projects in the study area.

14.0 References

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Appendix A

Mid-block capacity assessment

Appendix A Mid-block capacity assessment

Table 0-1 Mid-block capacity results for the AM peak

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
Arnhem Highway	East of Stuart Highway	AM	Eastbound	1	1700	382	14	409	0.24	402	15	431	0.25
			Westbound	1	1700	532	20	572	0.34	532	21	574	0.34
	West of Adelaide River Bridge[1]	AM	Eastbound	1	1700	51	10	72	0.04	71	8	87	0.05
			Westbound	1	1700	45	9	64	0.04	72	10	92	0.05
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	AM	Northbound	2	1800	622	235	1092	0.61	622	240	1102	0.61
			Southbound	2	1800	213	80	373	0.21	213	85	383	0.21
	Between Wishart Road and Cochran Road	AM	Northbound	2	1800	145	55	255	0.14	145	56	257	0.14
			Southbound	2	1800	152	58	268	0.15	170	59	287	0.16
	West of Casey Street[1]	AM	Northbound	1	900	47	18	82	0.09	47	19	84	0.09
			Southbound	1	900	27	10	48	0.05	45	11	68	0.08
Channel Island Road	South of Elizabeth River Bridge[1]	AM	Northbound	1	900	89	2	93	0.10	106	6	119	0.13
			Southbound	1	900	52	1	55	0.06	52	5	63	0.07
Elrundie Avenue	North of Chung Wah Terrace[1]	AM	Northbound	1	900	319	10	339	0.38	336	14	364	0.40
			Southbound	1	900	187	1	190	0.21	187	5	198	0.22
Jenkins Road	West of Stuart Highway	AM	Eastbound	1	900	18	0	18	0.02	38	1	40	0.04
			Westbound	1	900	25	1	26	0.03	25	2	28	0.03
Kirkland Avenue	East of Wishart Road[1]	AM	Northbound	1	900	603	2	607	0.67	621	6	633	0.70
			Southbound	1	900	355	1	357	0.40	355	5	365	0.41
Stuart Highway	Between Tiger Brennan Drive and Temple Terrace	AM	Eastbound	2	3400	709	26	761	0.22	709	27	763	0.22
			Westbound	2	3400	2375	86	2547	0.75	2375	86	2547	0.75
	Between Temple Terrace and Howard Springs Road	AM	Eastbound	2	3400	744	26	796	0.23	744	27	798	0.23
			Westbound	2	3400	4094	148	4391	1.29	4094	149	4393	1.29
	Between Howard Springs Road and Girraween Road	AM	Eastbound	2	3400	587	21	630	0.19	587	22	632	0.19
			Westbound	2	3400	1255	46	1346	0.40	1255	47	1348	0.40
	North of Arnhem Highway	AM	Eastbound	2	3400	544	20	583	0.17	544	21	585	0.17

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
			Westbound	2	3400	884	33	949	0.28	884	34	951	0.28
	South of Arnhem Highway	AM	Eastbound	2	3400	236	9	254	0.07	236	10	256	0.08
			Westbound	2	3400	415	15	445	0.13	435	16	467	0.14
	North of Jenkins Road	AM	Eastbound	2	3400	245	9	263	0.08	245	10	265	0.08
			Westbound	2	3400	77	2	81	0.02	97	3	103	0.03
Tiger Brennan Drive	West of Berrimah	AM	Eastbound	2	2400	854	1	856	0.36	854	5	864	0.36
			Westbound	2	2400	2008	31	2070	0.86	2008	35	2078	0.87
	Between Berrimah Road and Wishart Road	AM	Eastbound	2	2400	651	10	670	0.28	651	11	672	0.28
			Westbound	2	2400	1931	2	1935	0.81	1931	3	1937	0.81
	Between Wishart Road and Stuart Highway	AM	Eastbound	2	2400	529	54	637	0.27	529	55	639	0.27
			Westbound	2	2400	1002	111	1225	0.51	1002	112	1227	0.51
Wishart Road	East of Berrimah Road	AM	Eastbound	1	900	109	41	192	0.21	109	45	200	0.22
			Westbound	1	900	536	202	940	1.04	553	206	965	1.07

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

Table 0-2 Mid-block capacity results for the midday peak

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
Arnhem Highway	East of Stuart Highway	Midday	Eastbound	1	1700	36	1	39	0.02	36	2	41	0.02
			Westbound	1	1700	279	10	300	0.18	279	11	302	0.18
	West of Adelaide River Bridge[1]	Midday	Eastbound	1	1700	26	6	38	0.02	26	7	40	0.02
			Westbound	1	1700	44	10	64	0.04	44	11	66	0.04
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	Midday	Northbound	2	1800	230	87	404	0.22	230	92	414	0.23
			Southbound	2	1800	161	61	283	0.16	161	66	293	0.16
	Between Wishart Road and Cochran Road	Midday	Northbound	2	1800	239	90	419	0.23	239	91	421	0.23
			Southbound	2	1800	84	32	148	0.08	84	33	150	0.08
	West of Casey Street[1]	Midday	Northbound	1	900	38	14	66	0.07	38	15	68	0.08
			Southbound	1	900	36	14	64	0.07	36	15	66	0.07
Channel Island Road	South of Elizabeth River Bridge[1]	Midday	Northbound	1	900	72	2	76	0.08	72	6	84	0.09
			Southbound	1	900	69	2	73	0.08	69	6	81	0.09
Elrundie Avenue	North of Chung Wah Terrace[1]	Midday	Northbound	1	900	258	8	274	0.30	258	12	282	0.31
			Southbound	1	900	248	8	264	0.29	248	12	272	0.30
Jenkins Road	West of Stuart Highway	Midday	Eastbound	1	900	20	0	20	0.02	20	1	22	0.02
			Westbound	1	900	18	1	19	0.02	18	2	21	0.02
Kirkland Avenue	East of Wishart Road[1]	Midday	Northbound	1	900	488	2	491	0.55	488	6	499	0.55
			Southbound	1	900	470	1	473	0.53	470	5	481	0.53
Stuart Highway	Between Tiger Brennan Drive and Temple Terrace	Midday	Eastbound	2	3400	945	34	1014	0.30	945	35	1016	0.30
			Westbound	2	3400	939	34	1007	0.30	939	35	1009	0.30
	Between Temple Terrace and Howard Springs Road	Midday	Eastbound	2	3400	1055	37	1130	0.33	1055	38	1132	0.33
			Westbound	2	3400	1491	54	1599	0.47	1491	55	1601	0.47
	Between Howard Springs Road and Girraween Road	Midday	Eastbound	2	3400	887	31	950	0.28	887	32	952	0.28
			Westbound	2	3400	883	24	931	0.27	883	33	949	0.28
	North of Arnhem Highway	Midday	Eastbound	2	3400	264	10	283	0.08	264	11	285	0.08
			Westbound	2	3400	531	20	570	0.17	531	21	572	0.17

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
	South of Arnhem Highway	Midday	Eastbound	2	3400	301	11	323	0.09	301	12	325	0.10
			Westbound	2	3400	306	11	328	0.10	306	12	330	0.10
	North of Jenkins Road	Midday	Eastbound	2	3400	94	3	101	0.03	94	4	103	0.03
			Westbound	2	3400	64	2	67	0.02	64	3	69	0.02
Tiger Brennan Drive	West of Berrimah	Midday	Eastbound	2	2400	610	1	611	0.25	610	5	619	0.26
			Westbound	2	2400	567	8	582	0.24	567	12	590	0.25
	Between Berrimah Road and Wishart Road	Midday	Eastbound	2	2400	588	13	614	0.26	588	14	616	0.26
			Westbound	2	2400	574	1	575	0.24	574	2	577	0.24
	Between Wishart Road and Stuart Highway	Midday	Eastbound	2	2400	1499	152	1802	0.75	1499	153	1804	0.75
			Westbound	2	2400	333	37	407	0.17	333	38	409	0.17
Wishart Road	East of Berrimah Road	Midday	Eastbound	1	900	169	64	297	0.33	169	68	305	0.34
			Westbound	1	900	82	31	143	0.16	82	35	151	0.17

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

Table 0-3 Mid-block capacity results for the PM peak

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
Arnhem Highway	East of Stuart Highway	PM	Eastbound	1	1700	271	10	291	0.17	291	11	313	0.18
			Westbound	1	1700	77	10	97	0.06	77	11	99	0.06
	West of Adelaide River Bridge[1]	PM	Eastbound	1	1700	45	6	57	0.03	65	7	79	0.05
			Westbound	1	1700	421	159	739	0.41	421	164	749	0.42
Berrimah Road	Between Tiger Brennan Drive and Wishart Road	PM	Northbound	2	1800	273	103	479	0.27	273	108	489	0.27
			Southbound	2	1800	516	195	906	0.50	534	196	925	0.51
	Between Wishart Road and Cochran Road	PM	Northbound	2	1800	39	15	69	0.04	39	16	71	0.04
			Southbound	2	1800	28	11	50	0.06	46	12	69	0.08
	West of Casey Street[1]	PM	Northbound	1	900	27	10	48	0.05	27	11	50	0.06
			Southbound	1	900	54	1	57	0.06	54	5	65	0.07
Channel Island Road	South of Elizabeth River Bridge[1]	PM	Northbound	1	900	52	1	55	0.06	69	5	80	0.09
			Southbound	1	900	193	6	206	0.23	193	10	214	0.24
Elrundie Avenue	North of Chung Wah Terrace[1]	PM	Northbound	1	900	186	6	198	0.22	204	10	224	0.25
			Southbound	1	900	46	0	46	0.05	46	1	48	0.05
Jenkins Road	West of Stuart Highway	PM	Eastbound	1	900	31	1	33	0.04	51	2	55	0.06
			Westbound	1	900	366	1	368	0.41	366	5	376	0.42
Kirkland Avenue	East of Wishart Road[1]	PM	Northbound	1	900	353	1	355	0.39	370	5	380	0.42
			Southbound	1	900	1819	66	1950	0.57	1819	67	1952	0.57
Stuart Highway	Between Tiger Brennan Drive and Temple Terrace	PM	Eastbound	2	3400	1020	37	1094	0.32	1020	37	1094	0.32
			Westbound	2	3400	2038	72	2182	0.64	2038	73	2184	0.64
	Between Temple Terrace and Howard Springs Road	PM	Eastbound	2	3400	1638	59	1756	0.52	1638	60	1758	0.52
			Westbound	2	3400	987	36	1058	0.31	987	37	1060	0.31
	Between Howard Springs Road and Girraween Road	PM	Eastbound	2	3400	728	26	781	0.23	728	27	783	0.23
			Westbound	2	3400	894	32	959	0.28	894	33	961	0.28
	North of Arnhem Highway	PM	Eastbound	2	3400	558	21	599	0.18	558	22	601	0.18
			Westbound	2	3400	473	17	507	0.15	493	18	529	0.16

Road	Location	Peak period	Direction of travel	Number of lanes	Capacity (pcu/h/direction)	2024 without construction of Project				2024 with construction of Project			
						LV	HV	PCU	V/C	LV	HV	PCU	V/C
	South of Arnhem Highway	PM	Eastbound	2	3400	340	12	365	0.11	340	13	367	0.11
			Westbound	2	3400	232	8	249	0.07	252	9	271	0.08
	North of Jenkins Road	PM	Eastbound	2	3400	115	3	121	0.04	115	4	123	0.04
			Westbound	2	3400	1855	2	1858	0.77	1855	6	1866	0.78
Tiger Brennan Drive	West of Berrimah	PM	Eastbound	2	2400	872	11	895	0.37	872	15	903	0.38
			Westbound	2	2400	1828	23	1873	0.78	1828	24	1875	0.78
	Between Berrimah Road and Wishart Road	PM	Eastbound	2	2400	819	1	821	0.34	819	2	823	0.34
			Westbound	2	2400	1499	152	1802	0.75	1499	153	1804	0.75
	Between Wishart Road and Stuart Highway	PM	Eastbound	2	2400	333	37	407	0.17	333	38	409	0.17
			Westbound	2	2400	478	181	840	0.93	496	185	865	0.96
Wishart Road	East of Berrimah Road	PM	Eastbound	1	900	142	54	249	0.28	142	58	257	0.29
			Westbound	1	900	271	10	291	0.17	291	11	313	0.18

Table notes:

[1] Peak hour traffic volumes have been estimated from AADT data

Appendix B

SIDRA Intersection results

Appendix B SIDRA Intersection results

MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: Without Project 2024 - AM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
1	L2	290	24	305	8.3	0.659	56.9	LOS E	18.6	139.6	0.95	0.85	0.95	35.2
2	T1	232	19	244	8.2	*0.839	78.3	LOS E	9.1	68.0	1.00	0.90	1.29	28.9
3	R2	11	1	12	9.1	0.155	81.1	LOS F	0.8	6.1	0.99	0.68	0.99	28.5
Approach		533	44	561	8.3	0.839	66.7	LOS E	18.6	139.6	0.97	0.87	1.10	32.0
East: Tiger Brennan Drive														
4	L2	24	0	25	0.0	0.018	12.0	LOS B	0.4	2.6	0.27	0.67	0.27	65.7
5	T1	1687	2	1776	0.1	*0.868	31.1	LOS C	55.5	389.1	0.90	0.86	0.93	54.2
6	R2	223	0	235	0.0	*0.885	83.6	LOS F	17.8	124.9	1.00	0.92	1.28	28.3
Approach		1934	2	2036	0.1	0.885	36.9	LOS D	55.5	389.1	0.90	0.86	0.97	49.1
North: Berrimah Road														
7	L2	105	8	111	7.6	0.106	8.2	LOS A	1.0	7.8	0.21	0.63	0.21	62.2
8	T1	225	17	237	7.6	0.811	75.6	LOS E	8.7	64.7	1.00	0.89	1.24	29.7
9	R2	67	5	71	7.5	*0.933	97.4	LOS F	5.7	42.6	1.00	0.96	1.61	24.8
Approach		397	30	418	7.6	0.933	61.5	LOS E	8.7	64.7	0.79	0.84	1.03	33.2
West: Tiger Brennan Drive														
10	L2	115	0	121	0.0	0.090	13.1	LOS B	2.2	15.2	0.31	0.69	0.31	61.8
11	T1	552	1	581	0.2	0.271	17.5	LOS B	10.3	71.9	0.57	0.49	0.57	67.8
12	R2	188	0	198	0.0	0.746	73.4	LOS E	13.6	95.0	1.00	0.85	1.08	31.3
Approach		855	1	900	0.1	0.746	29.2	LOS C	13.6	95.0	0.63	0.60	0.65	53.4
All Vehicles		3719	77	3915	2.1	0.933	42.0	LOS D	55.5	389.1	0.84	0.80	0.92	44.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Berrimah Road												
P1	Full	5	5	64.1	LOS F	0.0	0.0	0.96	0.96	238.4	226.5	0.95
West: Tiger Brennan Drive												
P4	Full	5	5	64.1	LOS F	0.0	0.0	0.96	0.96	236.8	224.5	0.95
All		10	11	64.1	LOS F	0.0	0.0	0.96	0.96	237.6	225.5	0.95

Pedestrians

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: Without Project 2024 - AM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, D, E, F, G
Output Phase Sequence: A, D, E, F, G

Phase Timing Summary

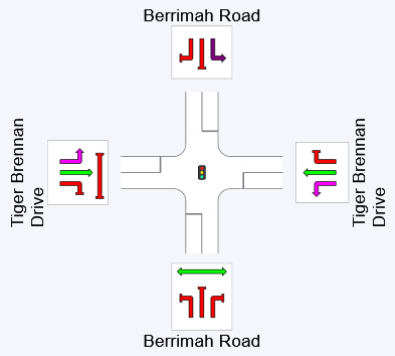
Phase	A	D	E	F	G
Phase Change Time (sec)	0	83	96	101	114
Green Time (sec)	77	6	***	6	20
Phase Time (sec)	84	13	5	12	26
Phase Split	60%	9%	4%	9%	19%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

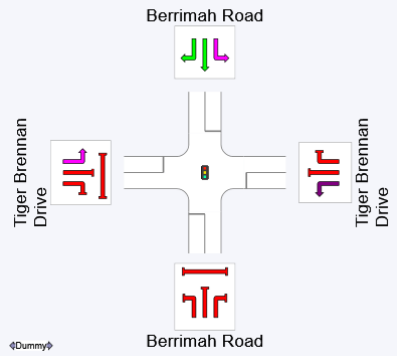
*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified. If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.

Output Phase Sequence

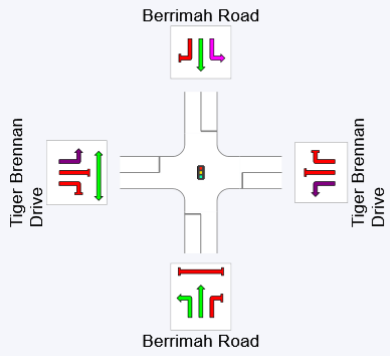
Phase A **REF**



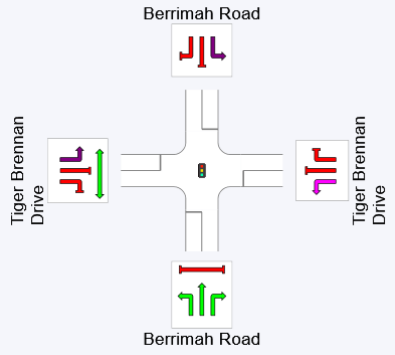
Phase D



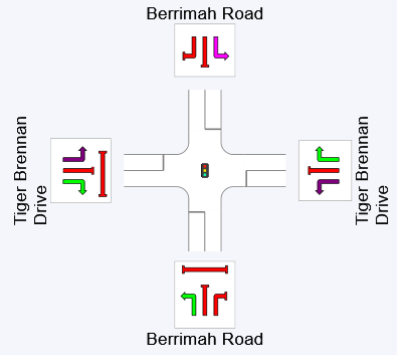
Phase E



Phase F



Phase G



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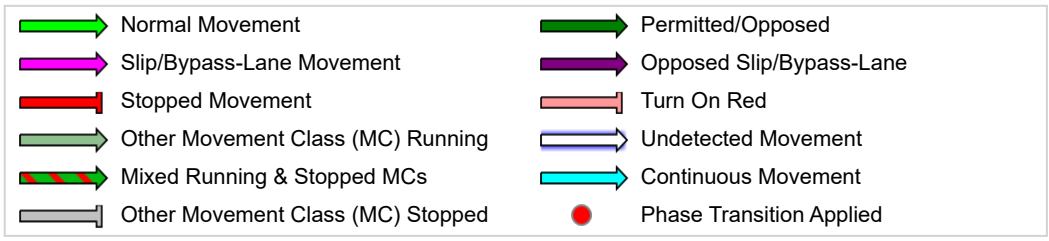
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: Without Project 2024 - AM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Wishart Road														
1	L2	327	33	344	10.1	0.506	41.8	LOS D	17.6	134.2	0.81	0.82	0.81	38.9
2	T1	184	18	194	9.8	* 0.592	59.8	LOS E	12.3	93.3	0.97	0.81	0.97	30.5
3	R2	50	5	53	10.0	* 0.531	80.7	LOS F	3.7	28.2	1.00	0.75	1.01	26.6
Approach		561	56	591	10.0	0.592	51.2	LOS D	17.6	134.2	0.88	0.81	0.88	34.4
East: Tiger Brennan Drive														
4	L2	172	17	181	9.9	0.141	11.7	LOS B	2.6	19.9	0.27	0.70	0.27	62.3
5	T1	867	87	913	10.0	* 0.591	33.2	LOS C	23.7	180.5	0.83	0.73	0.83	52.4
6	R2	52	7	55	13.5	0.188	62.2	LOS E	3.2	25.2	0.89	0.76	0.89	32.5
Approach		1091	111	1148	10.2	0.591	31.2	LOS C	23.7	180.5	0.74	0.73	0.74	52.1
North: Tivendale Road														
7	L2	39	4	41	10.3	0.138	58.9	LOS E	2.4	18.2	0.88	0.73	0.88	32.0
8	T1	109	11	115	10.1	0.351	54.7	LOS D	6.9	52.7	0.92	0.74	0.92	31.6
9	R2	10	1	11	10.0	0.106	76.0	LOS E	0.7	5.4	0.98	0.68	0.98	27.8
Approach		158	16	166	10.1	0.351	57.1	LOS E	6.9	52.7	0.92	0.73	0.92	31.4
West: Tiger Brennan Drive														
10	L2	32	3	34	9.4	0.025	10.8	LOS B	0.4	2.9	0.22	0.67	0.22	60.6
11	T1	450	45	474	10.0	0.307	28.5	LOS C	10.6	80.4	0.71	0.60	0.71	56.2
12	R2	166	17	175	10.2	* 0.589	66.7	LOS E	11.2	85.1	0.97	0.82	0.97	30.4
Approach		648	65	682	10.0	0.589	37.4	LOS D	11.2	85.1	0.75	0.66	0.75	47.0
All Vehicles		2458	248	2587	10.1	0.592	39.1	LOS D	23.7	180.5	0.79	0.73	0.79	44.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: Without Project 2024 - AM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, D, E, G
Output Phase Sequence: A, D, E, G

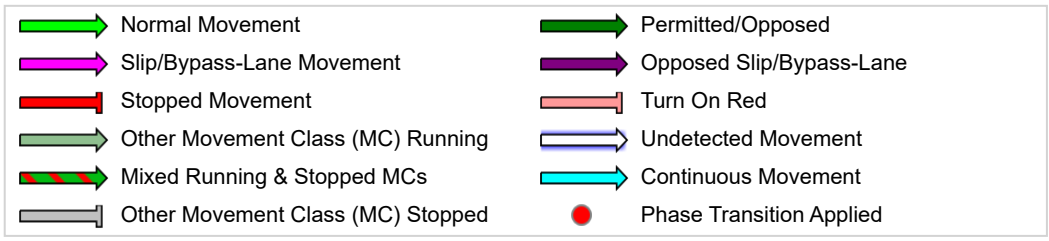
Phase Timing Summary

Phase	A	D	E	G
Phase Change Time (sec)	0	65	79	110
Green Time (sec)	59	8	25	24
Phase Time (sec)	65	14	31	30
Phase Split	46%	10%	22%	21%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence

REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: Without Project 2024 - AM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
2	T1	136	37	143	27.2	0.130	15.3	LOS B	1.5	12.8	0.73	0.57	0.73	60.0
3	R2	64	18	67	28.1	* 0.435	37.6	LOS D	2.0	17.7	0.98	0.76	0.98	38.9
Approach		200	55	211	27.5	0.435	22.4	LOS C	2.0	17.7	0.81	0.63	0.81	51.2
East: Wishart Road														
4	L2	1	0	1	0.0	0.001	8.3	LOS A	0.0	0.0	0.26	0.61	0.26	64.3
6	R2	721	198	759	27.5	* 0.524	20.0	LOS B	8.0	69.3	0.75	0.81	0.75	48.0
Approach		722	198	760	27.4	0.524	20.0	LOS B	8.0	69.3	0.75	0.81	0.75	48.0
North: Berrimah Road														
7	L2	83	23	87	27.7	0.080	8.7	LOS A	0.4	3.2	0.26	0.65	0.26	56.6
8	T1	210	58	221	27.6	* 0.501	28.0	LOS C	3.2	28.0	0.97	0.76	0.97	49.7
Approach		293	81	308	27.6	0.501	22.5	LOS C	3.2	28.0	0.77	0.73	0.77	51.5
All Vehicles		1215	334	1279	27.5	0.524	21.0	LOS C	8.0	69.3	0.77	0.76	0.77	49.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: Without Project 2024 - AM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 60 seconds (Site User-Given Cycle Time)

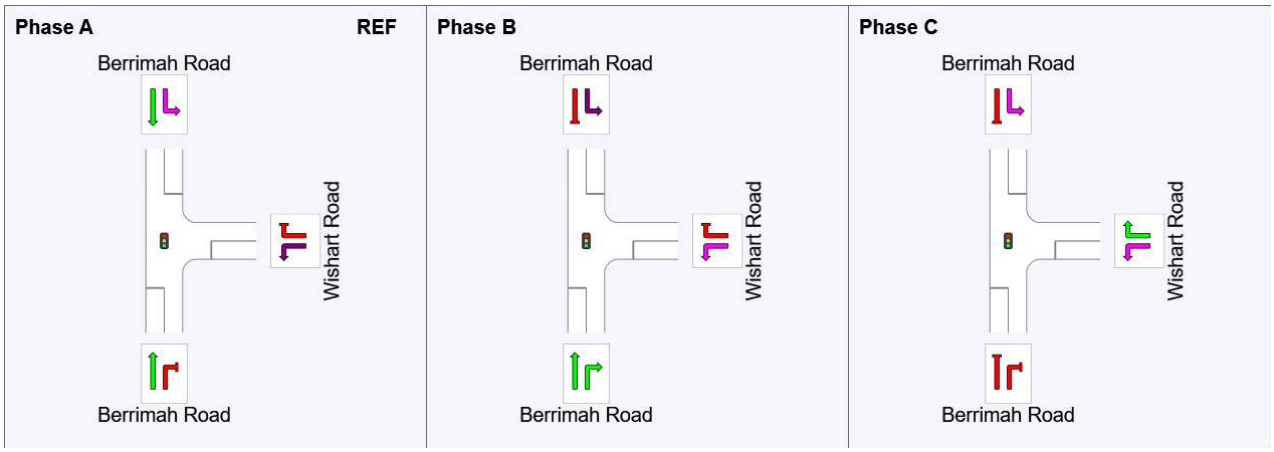
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

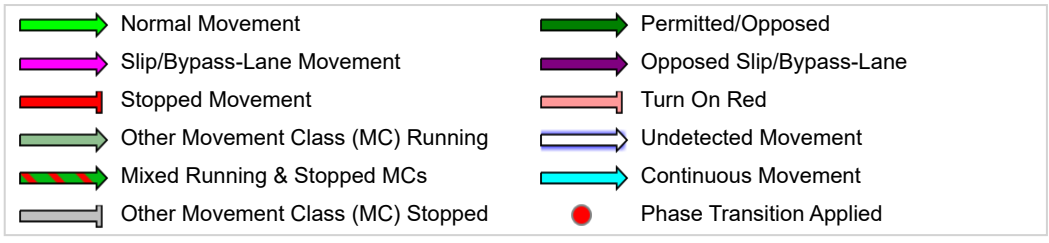
Phase	A	B	C
Phase Change Time (sec)	0	14	26
Green Time (sec)	8	6	28
Phase Time (sec)	14	12	34
Phase Split	23%	20%	57%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: Without Project 2024 - PM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
1	L2	76	6	80	7.9	0.185	49.0	LOS D	4.0	29.9	0.83	0.76	0.83	38.1
2	T1	182	15	192	8.2	*0.841	75.2	LOS E	6.7	50.3	1.00	0.89	1.35	29.6
3	R2	28	2	29	7.1	0.361	76.8	LOS E	1.9	14.5	1.00	0.72	1.00	29.6
Approach		286	23	301	8.0	0.841	68.4	LOS E	6.7	50.3	0.95	0.84	1.17	31.5
East: Tiger Brennan Drive														
4	L2	8	0	8	0.0	0.006	11.3	LOS B	0.1	0.7	0.26	0.66	0.26	66.5
5	T1	756	1	796	0.1	0.369	17.1	LOS B	13.9	97.2	0.60	0.53	0.60	68.2
6	R2	56	0	59	0.0	0.229	62.7	LOS E	3.4	23.6	0.93	0.76	0.93	33.7
Approach		820	1	863	0.1	0.369	20.2	LOS C	13.9	97.2	0.62	0.55	0.62	63.8
North: Berrimah Road														
7	L2	225	19	237	8.4	0.379	24.9	LOS C	8.5	63.9	0.67	0.77	0.67	48.4
8	T1	136	11	143	8.1	0.628	68.5	LOS E	4.7	35.5	1.00	0.79	1.07	31.5
9	R2	51	4	54	7.8	*0.661	78.5	LOS E	3.7	27.3	1.00	0.79	1.14	28.4
Approach		412	34	434	8.3	0.661	46.0	LOS D	8.5	63.9	0.82	0.78	0.86	38.3
West: Tiger Brennan Drive														
10	L2	52	0	55	0.0	0.036	9.7	LOS A	0.5	3.3	0.19	0.67	0.19	65.6
11	T1	1597	2	1681	0.1	*0.857	28.1	LOS C	49.3	345.5	0.86	0.82	0.90	56.7
12	R2	208	0	219	0.0	*0.851	75.7	LOS E	15.1	105.4	1.00	0.90	1.24	30.7
Approach		1857	2	1955	0.1	0.857	32.9	LOS C	49.3	345.5	0.86	0.82	0.92	52.0
All Vehicles		3375	60	3553	1.8	0.857	34.4	LOS C	49.3	345.5	0.80	0.75	0.86	49.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Berrimah Road												
P1	Full	5	5	59.2	LOS E	0.0	0.0	0.95	0.95	233.4	226.5	0.97
West: Tiger Brennan Drive												
P4	Full	5	5	59.2	LOS E	0.0	0.0	0.95	0.95	231.8	224.5	0.97
All		10	11	59.2	LOS E	0.0	0.0	0.95	0.95	232.6	225.5	0.97

Pedestrians

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: Without Project 2024 - PM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, D, E, F, G
Output Phase Sequence: A, D, E, F, G

Phase Timing Summary

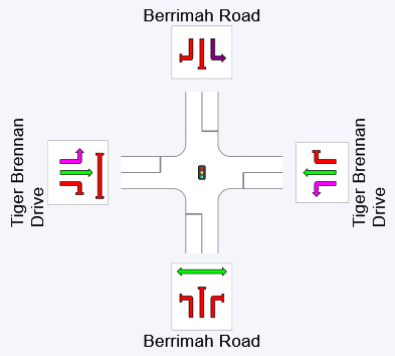
Phase	A	D	E	F	G
Phase Change Time (sec)	0	78	91	93	106
Green Time (sec)	72	6	***	6	18
Phase Time (sec)	79	13	2	12	24
Phase Split	61%	10%	2%	9%	18%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

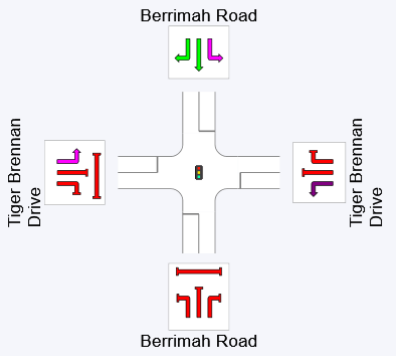
*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified. If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.

Output Phase Sequence

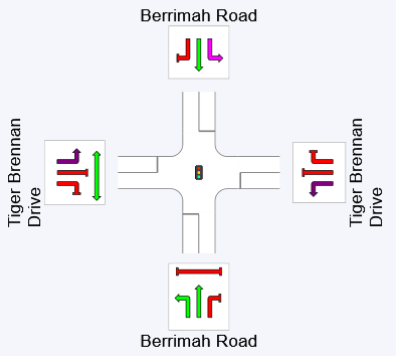
Phase A **REF**



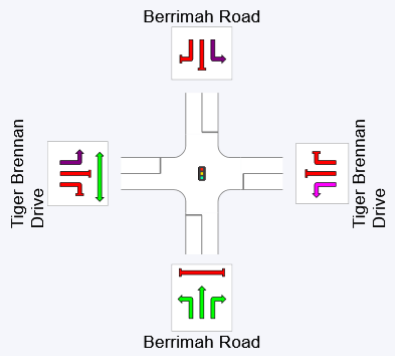
Phase D



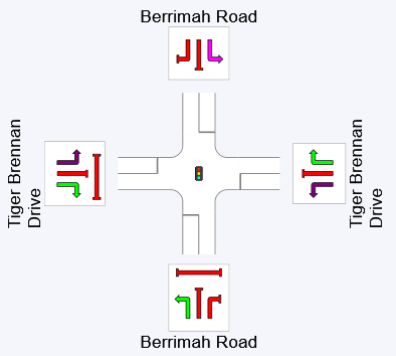
Phase E



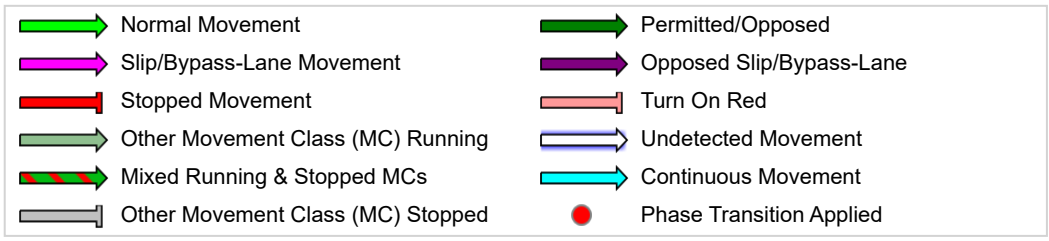
Phase F



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: Without Project 2024 - PM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Wishart Road														
1	L2	153	15	161	9.8	0.159	14.3	LOS B	2.8	21.0	0.48	0.72	0.48	57.4
2	T1	116	12	122	10.3	0.414	55.8	LOS E	7.1	53.9	0.94	0.77	0.94	31.7
3	R2	96	10	101	10.4	* 0.760	76.7	LOS E	6.8	52.1	1.00	0.85	1.19	27.5
Approach		365	37	384	10.1	0.760	43.9	LOS D	7.1	53.9	0.77	0.77	0.82	37.2
East: Tiger Brennan Drive														
4	L2	26	3	27	11.5	0.034	21.4	LOS C	0.7	5.7	0.50	0.70	0.50	52.5
5	T1	300	30	316	10.0	0.561	55.9	LOS E	9.5	71.9	0.98	0.79	0.98	39.6
6	R2	44	4	46	9.1	0.288	69.6	LOS E	2.8	21.4	0.97	0.75	0.97	30.6
Approach		370	37	389	10.0	0.561	55.1	LOS E	9.5	71.9	0.94	0.78	0.94	38.8
North: Tivendale Road														
7	L2	72	7	76	9.7	0.473	68.5	LOS E	4.8	36.1	0.99	0.77	0.99	29.6
8	T1	216	22	227	10.2	* 0.770	60.1	LOS E	14.6	111.2	1.00	0.90	1.10	30.0
9	R2	8	1	8	12.5	0.064	67.4	LOS E	0.5	4.0	0.95	0.67	0.95	29.6
Approach		296	30	312	10.1	0.770	62.3	LOS E	14.6	111.2	1.00	0.86	1.07	29.9
West: Tiger Brennan Drive														
10	L2	14	1	15	7.1	0.010	9.8	LOS A	0.1	0.9	0.18	0.66	0.18	61.6
11	T1	1348	135	1419	10.0	* 0.801	30.1	LOS C	37.6	286.0	0.91	0.83	0.91	54.9
12	R2	491	49	517	10.0	* 0.791	39.0	LOS D	19.9	151.3	0.95	0.92	0.98	40.9
Approach		1853	185	1951	10.0	0.801	32.3	LOS C	37.6	286.0	0.92	0.85	0.92	50.7
All Vehicles		2884	289	3036	10.0	0.801	39.8	LOS D	37.6	286.0	0.91	0.83	0.93	44.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: Without Project 2024 - PM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, C, D, E, G
Output Phase Sequence: A, C, D, E, G

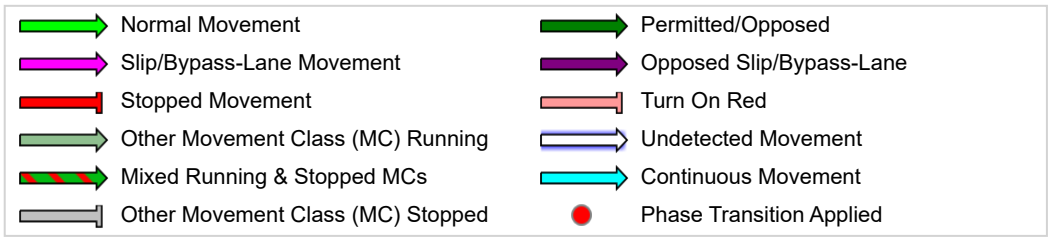
Phase Timing Summary

Phase	A	C	D	E	G
Phase Change Time (sec)	0	26	69	85	112
Green Time (sec)	20	37	10	21	12
Phase Time (sec)	26	43	16	27	18
Phase Split	20%	33%	12%	21%	14%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence

REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: Without Project 2024 - PM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
2	T1	389	107	409	27.5	0.171	5.4	LOS A	3.7	31.8	0.33	0.29	0.33	71.5
3	R2	322	88	339	27.3	* 0.374	21.7	LOS C	10.4	90.2	0.57	0.77	0.57	47.0
Approach		711	195	748	27.4	0.374	12.8	LOS B	10.4	90.2	0.44	0.50	0.44	57.8
East: Wishart Road														
4	L2	1	0	1	0.0	0.001	7.7	LOS A	0.0	0.0	0.11	0.61	0.11	65.1
6	R2	191	52	201	27.2	* 0.369	55.6	LOS E	5.3	45.8	0.93	0.78	0.93	32.7
Approach		192	52	202	27.1	0.369	55.4	LOS E	5.3	45.8	0.92	0.78	0.92	32.8
North: Berrimah Road														
7	L2	322	88	339	27.3	0.379	10.3	LOS B	4.6	39.5	0.32	0.69	0.32	55.5
8	T1	54	15	57	27.8	* 0.188	56.3	LOS E	1.6	13.9	0.96	0.70	0.96	35.9
Approach		376	103	396	27.4	0.379	16.9	LOS B	4.6	39.5	0.41	0.69	0.41	51.4
All Vehicles		1279	350	1346	27.4	0.379	20.4	LOS C	10.4	90.2	0.50	0.60	0.50	50.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: Without Project 2024 - PM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 120 seconds (Site User-Given Cycle Time)

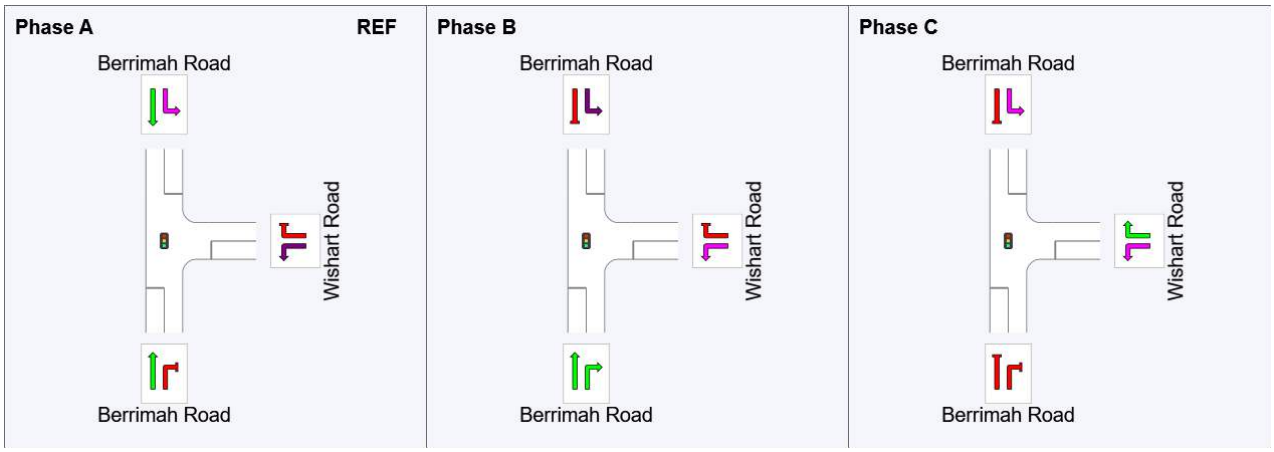
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

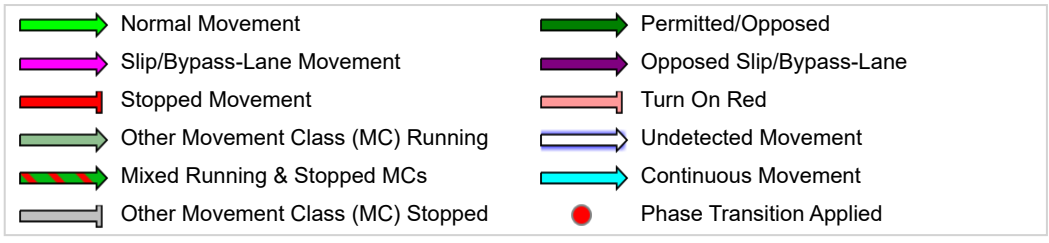
Phase	A	B	C
Phase Change Time (sec)	0	17	93
Green Time (sec)	11	70	21
Phase Time (sec)	17	76	27
Phase Split	14%	63%	23%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: With Project 2024 - AM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 140 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
1	L2	294	28	309	9.5	0.673	57.2	LOS E	19.0	143.7	0.95	0.85	0.95	35.0
2	T1	232	19	244	8.2	* 0.839	78.3	LOS E	9.1	68.0	1.00	0.90	1.29	28.9
3	R2	12	2	13	16.7	0.178	81.7	LOS F	0.9	7.1	0.99	0.68	0.99	28.0
Approach		538	49	566	9.1	0.839	66.8	LOS E	19.0	143.7	0.97	0.87	1.10	31.9
East: Tiger Brennan Drive														
4	L2	25	1	26	4.0	0.020	12.1	LOS B	0.4	2.8	0.27	0.67	0.27	64.4
5	T1	1687	2	1776	0.1	* 0.868	31.1	LOS C	55.5	389.1	0.90	0.86	0.93	54.2
6	R2	223	0	235	0.0	* 0.885	83.6	LOS F	17.8	124.9	1.00	0.92	1.28	28.3
Approach		1935	3	2037	0.2	0.885	36.9	LOS D	55.5	389.1	0.90	0.86	0.97	49.1
North: Berrimah Road														
7	L2	105	8	111	7.6	0.107	8.4	LOS A	1.1	8.2	0.21	0.64	0.21	62.0
8	T1	225	17	237	7.6	0.811	75.6	LOS E	8.7	64.7	1.00	0.89	1.24	29.7
9	R2	67	5	71	7.5	* 0.933	97.4	LOS F	5.7	42.6	1.00	0.96	1.61	24.8
Approach		397	30	418	7.6	0.933	61.5	LOS E	8.7	64.7	0.79	0.84	1.03	33.1
West: Tiger Brennan Drive														
10	L2	115	0	121	0.0	0.090	13.1	LOS B	2.2	15.2	0.31	0.69	0.31	61.8
11	T1	552	1	581	0.2	0.271	17.5	LOS B	10.3	71.9	0.57	0.49	0.57	67.8
12	R2	192	4	202	2.1	0.773	74.7	LOS E	14.1	100.3	1.00	0.86	1.11	30.8
Approach		859	5	904	0.6	0.773	29.7	LOS C	14.1	100.3	0.63	0.60	0.65	52.9
All Vehicles		3729	87	3925	2.3	0.933	42.2	LOS D	55.5	389.1	0.84	0.80	0.92	44.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Berrimah Road												
P1	Full	5	5	64.1	LOS F	0.0	0.0	0.96	0.96	238.4	226.5	0.95
West: Tiger Brennan Drive												
P4	Full	5	5	64.1	LOS F	0.0	0.0	0.96	0.96	236.8	224.5	0.95
All		10	11	64.1	LOS F	0.0	0.0	0.96	0.96	237.6	225.5	0.95

Pedestrians

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: With Project 2024 - PM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
1	L2	80	10	84	12.5	0.201	49.3	LOS D	4.2	32.8	0.83	0.76	0.83	37.6
2	T1	182	15	192	8.2	* 0.841	75.2	LOS E	6.7	50.3	1.00	0.89	1.35	29.6
3	R2	29	3	31	10.3	0.382	77.1	LOS E	2.0	15.4	1.00	0.72	1.00	29.4
Approach		291	28	306	9.6	0.841	68.3	LOS E	6.7	50.3	0.95	0.84	1.17	31.4
East: Tiger Brennan Drive														
4	L2	9	1	9	11.1	0.007	11.8	LOS B	0.1	1.0	0.26	0.66	0.26	62.7
5	T1	756	1	796	0.1	0.369	17.1	LOS B	13.9	97.2	0.60	0.53	0.60	68.2
6	R2	56	0	59	0.0	0.229	62.7	LOS E	3.4	23.6	0.93	0.76	0.93	33.7
Approach		821	2	864	0.2	0.369	20.2	LOS C	13.9	97.2	0.62	0.55	0.62	63.7
North: Berrimah Road														
7	L2	225	19	237	8.4	0.380	24.9	LOS C	8.5	64.0	0.67	0.77	0.67	48.4
8	T1	136	11	143	8.1	0.628	68.5	LOS E	4.7	35.5	1.00	0.79	1.07	31.5
9	R2	51	4	54	7.8	* 0.661	78.5	LOS E	3.7	27.3	1.00	0.79	1.14	28.4
Approach		412	34	434	8.3	0.661	46.0	LOS D	8.5	64.0	0.82	0.78	0.86	38.3
West: Tiger Brennan Drive														
10	L2	52	0	55	0.0	0.036	9.7	LOS A	0.5	3.3	0.19	0.67	0.19	65.6
11	T1	1597	2	1681	0.1	* 0.859	28.4	LOS C	49.7	348.3	0.86	0.82	0.90	56.5
12	R2	212	4	223	1.9	* 0.880	78.8	LOS E	15.8	112.4	1.00	0.92	1.30	29.8
Approach		1861	6	1959	0.3	0.880	33.6	LOS C	49.7	348.3	0.86	0.83	0.93	51.4
All Vehicles		3385	70	3563	2.1	0.880	34.9	LOS C	49.7	348.3	0.80	0.75	0.87	49.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

Pedestrian Movement Performance

Mov ID	Crossing	Input Vol. ped/h	Dem. Flow ped/h	Aver. Delay sec	Level of Service	AVERAGE BACK OF QUEUE [Ped ped	Dist] m	Prop. Que	Effective Stop Rate	Travel Time sec	Travel Dist. m	Aver. Speed m/sec
South: Berrimah Road												
P1	Full	5	5	59.2	LOS E	0.0	0.0	0.95	0.95	233.4	226.5	0.97
West: Tiger Brennan Drive												
P4	Full	5	5	59.2	LOS E	0.0	0.0	0.95	0.95	231.8	224.5	0.97
All		10	11	59.2	LOS E	0.0	0.0	0.95	0.95	232.6	225.5	0.97

Pedestrians

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

PHASING SUMMARY

Site: [Tiger Brennan Drive / Berrimah Road (Site Folder: With Project 2024 - PM Peak)]

Tiger Brennan Drive / Berrimah Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, D, E, F, G
Output Phase Sequence: A, D, E, F, G

Phase Timing Summary

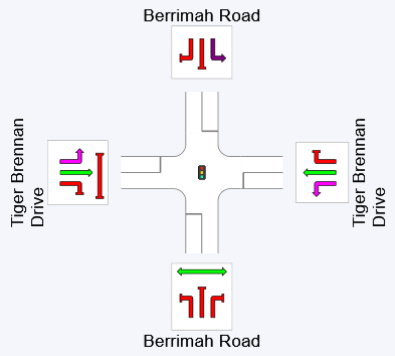
Phase	A	D	E	F	G
Phase Change Time (sec)	0	78	91	93	106
Green Time (sec)	72	6	***	6	18
Phase Time (sec)	79	13	2	12	24
Phase Split	61%	10%	2%	9%	18%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

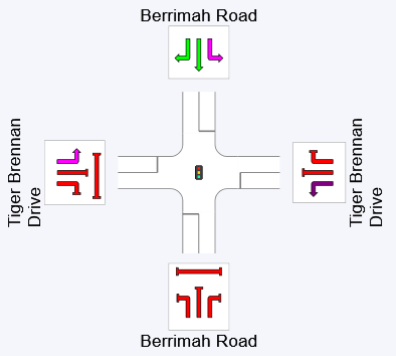
*** No green time has been calculated for this phase because the next phase starts during its intergreen time. This occurs with overlap phasing where there is no single movement connecting this phase to the next, or where the only such movement is a dummy movement with zero minimum green time specified. If a green time is required for this phase, specify a dummy movement with a non-zero minimum green time.

Output Phase Sequence

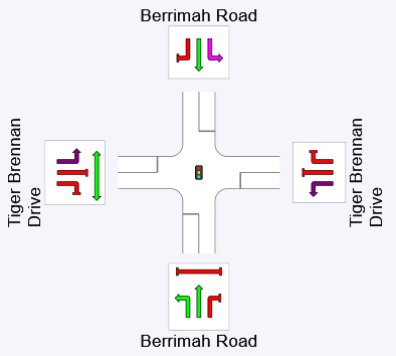
Phase A **REF**



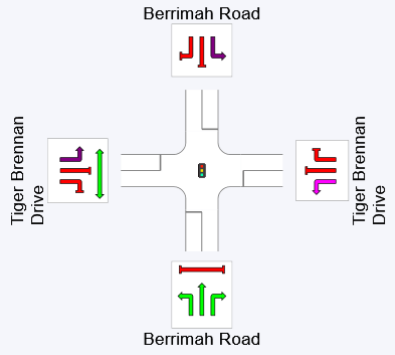
Phase D



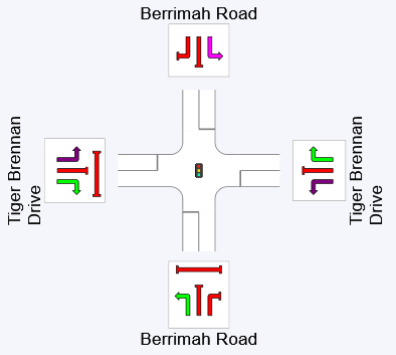
Phase E



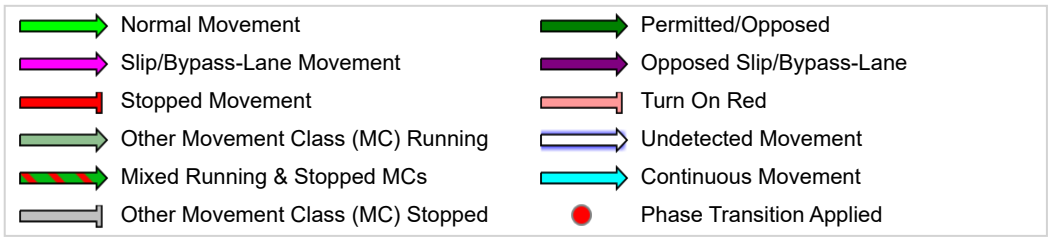
Phase F



Phase G



REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: With Project 2024 - PM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Wishart Road														
1	L2	153	15	161	9.8	0.161	14.8	LOS B	3.0	22.4	0.49	0.72	0.49	57.0
2	T1	116	12	122	10.3	0.434	56.9	LOS E	7.1	54.5	0.95	0.78	0.95	31.4
3	R2	96	10	101	10.4	* 0.844	81.3	LOS F	7.1	54.2	1.00	0.90	1.35	26.5
Approach		365	37	384	10.1	0.844	45.7	LOS D	7.1	54.5	0.77	0.79	0.86	36.5
East: Tiger Brennan Drive														
4	L2	26	3	27	11.5	0.034	21.8	LOS C	0.8	5.8	0.51	0.70	0.51	52.1
5	T1	301	31	317	10.3	0.512	53.7	LOS D	9.3	70.8	0.96	0.78	0.96	40.5
6	R2	44	4	46	9.1	0.203	63.6	LOS E	2.7	20.2	0.93	0.75	0.93	32.2
Approach		371	38	391	10.2	0.512	52.7	LOS D	9.3	70.8	0.92	0.77	0.92	39.9
North: Tivendale Road														
7	L2	72	7	76	9.7	0.334	62.3	LOS E	4.5	33.9	0.95	0.77	0.95	31.2
8	T1	216	22	227	10.2	* 0.808	62.9	LOS E	15.0	114.5	1.00	0.93	1.16	29.3
9	R2	8	1	8	12.5	0.071	68.8	LOS E	0.5	4.0	0.96	0.67	0.96	29.3
Approach		296	30	312	10.1	0.808	62.9	LOS E	15.0	114.5	0.99	0.88	1.10	29.8
West: Tiger Brennan Drive														
10	L2	14	1	15	7.1	0.010	9.7	LOS A	0.1	0.9	0.18	0.66	0.18	61.8
11	T1	1349	136	1420	10.1	* 0.843	36.6	LOS D	41.7	317.4	0.95	0.90	1.00	50.0
12	R2	491	49	517	10.0	* 0.791	33.4	LOS C	17.7	134.3	0.95	0.89	0.98	44.0
Approach		1854	186	1952	10.0	0.843	35.5	LOS D	41.7	317.4	0.95	0.89	0.99	48.5
All Vehicles		2886	291	3038	10.1	0.844	41.8	LOS D	41.7	317.4	0.92	0.86	0.98	42.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Tiger Brennan Drive / Wishart Drive / Tivendale Road (Site Folder: With Project 2024 - PM Peak)]

Tiger Brennan Drive / Wishart Road / Tivendale Road
Site Category: Base Year
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 130 seconds (Site User-Given Cycle Time)

Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, C, D, E, G
Output Phase Sequence: A, C, D, E, G

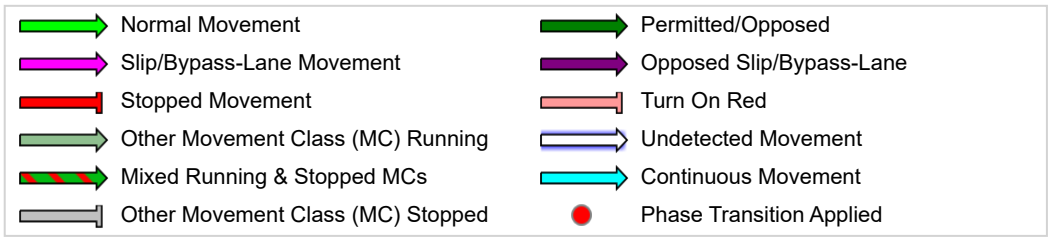
Phase Timing Summary

Phase	A	C	D	E	G
Phase Change Time (sec)	0	28	66	81	107
Green Time (sec)	22	32	9	20	17
Phase Time (sec)	28	38	15	26	23
Phase Split	22%	29%	12%	20%	18%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence

REF: Reference Phase
VAR: Variable Phase



MOVEMENT SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: With Project 2024 - PM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 50 seconds (Site User-Given Cycle Time)

Vehicle Movement Performance

Mov ID	Turn	INPUT VOLUMES [Total veh/h	HV] veh/h	DEMAND FLOWS [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% BACK OF QUEUE [Veh. veh	Dist] m	Prop. Que	Effective Stop Rate	Aver. No. Cycles	Aver. Speed km/h
South: Berrimah Road														
2	T1	394	112	415	28.4	0.197	4.0	LOS A	2.1	18.3	0.44	0.37	0.44	73.6
3	R2	343	92	361	26.8	* 0.579	20.6	LOS C	7.1	61.5	0.83	0.82	0.83	47.7
Approach		737	204	776	27.7	0.579	11.8	LOS B	7.1	61.5	0.62	0.58	0.62	58.8
East: Wishart Road														
4	L2	5	4	5	80.0	0.006	9.4	LOS A	0.0	0.2	0.25	0.61	0.25	46.2
6	R2	191	52	201	27.2	* 0.539	32.3	LOS C	2.6	22.1	0.98	0.79	1.03	41.4
Approach		196	56	206	28.6	0.539	31.7	LOS C	2.6	22.1	0.96	0.79	1.01	41.5
North: Berrimah Road														
7	L2	322	88	339	27.3	0.430	11.7	LOS B	3.5	30.1	0.59	0.76	0.59	54.2
8	T1	59	20	62	33.9	* 0.162	23.0	LOS C	0.7	6.6	0.93	0.67	0.93	53.3
Approach		381	108	401	28.3	0.430	13.5	LOS B	3.5	30.1	0.65	0.74	0.65	54.1
All Vehicles		1314	368	1383	28.0	0.579	15.2	LOS B	7.1	61.5	0.68	0.66	0.69	54.0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Delay Model: SIDRA Standard (Geometric Delay is included).
Queue Model: SIDRA Standard.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

* Critical Movement (Signal Timing)

PHASING SUMMARY

Site: [Berrimah Road / Wishart Road (Site Folder: With Project 2024 - PM Peak)]

Berrimah Road / Wishart Road
Site Category: (None)
Signals - EQUISAT (Fixed-Time/SCATS) Isolated Cycle Time = 50 seconds (Site User-Given Cycle Time)

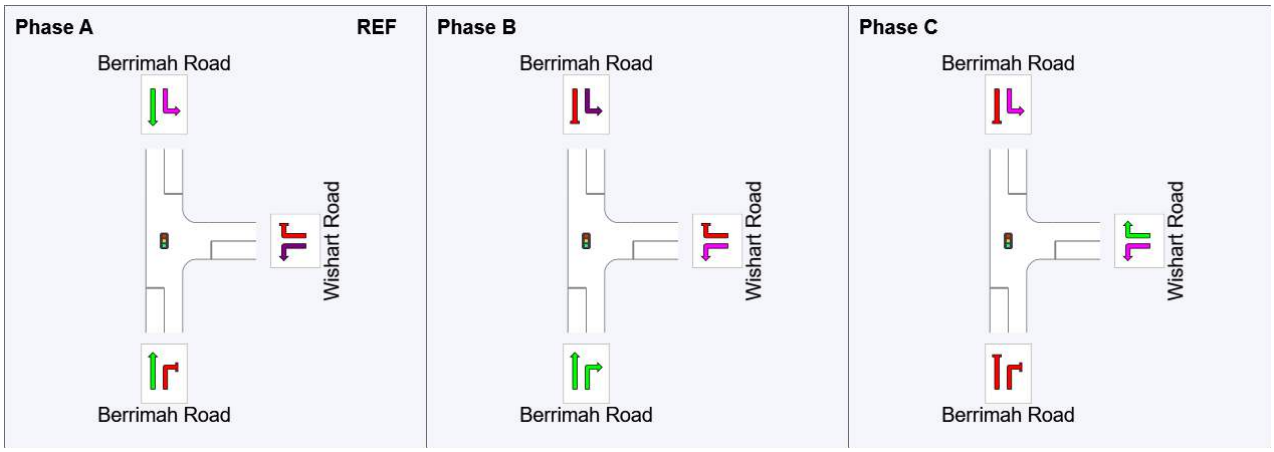
Timings based on settings in the Site Phasing & Timing dialog
Phase Times determined by the program
Phase Sequence: SCATS 2022
Reference Phase: Phase A
Input Phase Sequence: A, B, C
Output Phase Sequence: A, B, C

Phase Timing Summary

Phase	A	B	C
Phase Change Time (sec)	0	12	38
Green Time (sec)	6	20	6
Phase Time (sec)	12	26	12
Phase Split	24%	52%	24%

See the Timing Analysis report for more detailed information including input values of Yellow Time and All-Red Time, and information on any adjustments to Intergreen Time, Phase Time and Green Time values in cases of Pedestrian Actuation, Minor Phase Actuation and Phase Frequency values (user-specified or implied) less than 100%.

Output Phase Sequence



REF: Reference Phase
VAR: Variable Phase