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Report for **ARROW Energy Major Pipelines**

ABP Traffic Impact Assessment

ABP No: 08-GHD-02-0004

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1. Executive Summary

1.1 Overview

Arrow Energy Pty Ltd is proposing to develop a pipeline network in central eastern Queensland that will deliver coal seam gas from its gas fields in the Bowen and Surat Basins, to a future liquefied natural gas (LNG) plant located on Curtis Island near Gladstone.

The proposed pipeline network will be approximately 1,200 km long in total and will incorporate the Arrow Bowen Pipeline, the Arrow Surat Pipeline, laterals, scraper stations and intermediate mainline valves. The Arrow Surat Pipeline project (ASP) is 549 km long and is being assessed in a separate study. This study covers the Arrow Bowen Pipeline project (ABP).

The ABP will consist of:

- 600 km of pipeline length;
- 500 km of DN1050 (42”), Class 600 buried steel pipeline;
- 50 km each of DN500 (20”) and DN400 (16”), Class 600 buried steel pipeline;
- Mid-point scraper station and main line valves (locations to be determined); and
- Custody transfer metering station at LNGI.

The project site traverses areas within the Central Highlands Regional and Gladstone Regional Councils in the Department of Transport Main Roads (DTMR) Fitzroy Region and the Isaac Regional Council in the DTMR Mackay/Whitsunday Region of Queensland. The land uses adjoining the project site are predominantly rural, particularly grazing land and open fields, and associated rural residences.

The project area crosses several national, regional and district roads controlled by the DTMR. Aside from State-Controlled Roads (SCRs), local council roads will be utilised for access to the project site. As the pipeline is expected to generate a very low level of traffic during its operational phase, this impact assessment is mainly focussed on traffic impacts during the construction phase of the project. It is anticipated that the construction activity will occur over a duration of approximately 15 months within a 32 month calendar period.

Standard hours of construction for the duration of the construction program are anticipated to be between 6:00 am and 6:00 pm, seven days a week on a 28-day-on, 9-day-off cycle. It will be necessary to transport line pipe and heavy engineering machinery to site for construction of the pipeline.

1.2 Traffic Generation

The majority of traffic generated through the construction phase will be from equipment and material deliveries, including:

- *Line pipe supply delivery*
  - Line pipe deliveries into Australia will be via the ports of Mackay and Gladstone.
  - Transport of 433 km of pipes will be from the Port of Mackay to stockpile site in Nebo.
  - It is anticipated that a total of 32 truck trips per day per direction (64 movements for both directions) over 173 days will be required to move the first 333 km of line pipe followed by 6-8

trucks per day for a further 52 days (12-16 movements for both directions) for the remaining 100 km of line pipe deliveries from Mackay to Nebo.

  - Delivery of a further 167 km of pipes will be from the Port of Gladstone to Rockhampton and Gracemere via a stockpile site in Mount Larcom.
  - It is anticipated that a total of 32 truck trips per day per direction (64 movements for both directions) over 87 days will be associated with line pipe delivery from Gladstone to Rockhampton and Gracemere.

- *Construction plant and equipment* – Construction plant and equipment will be delivered to one end of the pipe route with intermediate travel being along the pipeline right-of-way (ROW) with the intent that they will be demobilised from the other end.
- *Construction Camps and Construction Workforce* – The construction workforce will comprise approximately 800 workers to be accommodated at any one construction camp located within close proximity to the pipeline. Workers will be transported from the camp site to the work area primarily along the project ROW. Given the number of staff to be transported, an indicative estimate of 21 buses, 56 station wagons and 100 utilities will be utilised. Camps will be adjacent to, or very near to, the ROW and thus daily transportation of the construction workforce will have very limited need to use public roads.
- *Minor construction materials and consumables* – It is anticipated that approximately 20 vehicles will be utilised to service the project for deliveries of fuel, water, materials and other consumables to locations along the pipeline ROW.
- *Supervisory personnel* – A further 20 vehicles are expected to use the local road network and the ROW to transport supervisory workforce and the principal's personnel.

1.3 Traffic Impacts

The traffic impact of the project is assessed on the following issues:

- *Impact of construction on access routes* - Light/medium vehicles will be used for staff movements from campsites to the pipeline ROW and movements by supervisory staff and principal's personnel. For light vehicles, it is likely that the transport of workers will occur before the AM peak hour and before the PM peak hour. It is important to note that staff workers will be accommodated at campsites located near the pipeline ROW thereby reducing travel distances and travel time. The impact of traffic movements associated with staff and workers on the surrounding road environment is considered to be minor.

  Heavy vehicle traffic will consist of line pipe supply deliveries, construction plant and equipment, and deliveries of construction materials, supplies and consumables. Since the main construction material is line pipe, the majority of the heavy vehicle movements are expected to be attributed to the delivery and distribution of line pipe. The vehicles expected to service the project for deliveries of fuel, water, materials and other consumables will use the local road network between the camp and the worksite and will generally traverse along the pipeline ROW.
- *Impact of construction on road crossings* – The pipeline will cross road corridors at certain points. The method of pipeline construction to be applied at each crossing is yet to be finalised but trenching is likely to be the preferred method of crossing unsealed roads as this is the most economical and time efficient method. If trenching is used, temporary road closures may be required and a traffic

management plan will be developed in consultation with the relevant road authority prior to construction. It is proposed that the open cut trenching method be employed on roads carrying low traffic flows. It is expected that minimal delays will be experienced and traffic will be regulated by appropriate traffic management measures.

- *Impact of construction on State Controlled Road Network* – Traffic movements on the SCR network will primarily be attributed to the movement of service vehicles and delivery or distribution of line pipe supply. In general, only heavy delivery vehicles which will use the SCR on a daily basis with approximately 52 vehicles expected to be involved in delivery of line pipe and supplies to the project site. The estimated maximum traffic generated on the SCR network will be approximately 249 vehicles per day in the worst-case scenario; however this will only occur when use of the SCR by light construction personnel traffic is unavoidable and will only occur over short distances and for short durations. It is assumed that traffic generated by staff movements and supervisory personnel will primarily access the project site through the local road network and along the ROW. It should be noted that any increase in traffic along the SCR network (i.e. 5% increase in Annual Average Daily Traffic – AADT) will be temporary and the number of days for which this volume will be exceeded will be a maximum of 184 days for any one road. It is recommended that mitigation measures such as general signposting, detours and awareness campaign be implemented for the duration of the period when traffic levels are likely to exceed the 5% increase in AADT threshold as stipulated in DTMR's Guidelines.
- *Traffic impact during pipeline operation* – When the pipeline is operational, occasional access into the pipeline ROW may be required to conduct inspections and maintenance throughout the life of the pipeline. Traffic volumes associated with these activities are expected to be negligible and confined during periodic times.
- *Impact of construction on pavement conditions of haulage routes* – It is noted that a key road impact due to the additional traffic would relate to the potential deterioration of the road pavements due to the additional vehicle loads. An on-site inventory of road conditions along the haulage routes and key road links to access the ROW, will be carried out in consultation with relevant authorities, prior to construction commencing. Where necessary, reinstatement and repair of the road will be immediately undertaken to ensure safe passage of vehicles and prevent further deterioration. It is anticipated that this short term duration would have minimal effect on the full life of the existing bitumen surfaced road pavements.

1.4 Summary

In summary, the generation of construction traffic will create short-term increases in traffic volumes on the road network within acceptable threshold levels. Based on the nominal capacity of the road network, the additional construction traffic generated by the project can be adequately accommodated at acceptable levels of service. The delivery of materials and equipment will be spread over the construction period of 15 months and the movement of these vehicles can be arranged to minimise impacts on the local community. Most of the construction activity will be confined within the pipeline ROW, and these traffic movements will be managed by appropriate traffic control plans for work sites.

Traffic management issues will be addressed through the preparation of an appropriate comprehensive Traffic Management Plan (TMP) in the detailed design phase. This TMP will be developed in consultation with the relevant District and local authorities of the relevant Councils. Initiatives that need to be undertaken as part of the TMP include:

- In consultation with the DTMR, identification of mitigation measures to address the relative increase in traffic levels (>5% or a percentage to be nominated by Main Roads) on affected road sections of the SCR network;
- Review of speed restrictions along SCR network and where necessary, additional signposting of speed limitations;
- Installation of specific warning sign at local access roads to the construction ROW to warn existing road users of entering and exiting traffic;
- Advanced notice of road/lane closures and advice on alternative routes;
- Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist;
- Management of the transportation of construction materials to maximise vehicle loads to therefore minimise vehicle movements;
- Whenever practical, vehicles associated with the construction works should use internal and haulage access roads instead of public roads; and
- Induction of truck and vehicle operators on the requirements of the TMP.

2. Introduction

2.1 Background

GHD has been commissioned by Arrow Energy Pty Ltd to prepare the preliminary design for the proposed Arrow Bowen Pipeline project (ABP). The project consists of a high pressure steel pipeline which will deliver coal seam gas from the Bowen Basin to a future liquefied natural gas (LNG) plant to be located at Curtis Island in Gladstone. This report examines the traffic and road impacts of the construction of the 600 kilometre (km) long ABP.

Based on the preliminary design, the ABP will be comprised of:

- 600 km of total pipeline length, broken down into:
  - 500 km of DN1050 (42”), Class 600 buried steel pipeline;
  - 50 km of DN500 (20”), Class 600 buried steel pipeline;
  - 50 km of DN400 (16”), Class 600 buried steel pipeline;
  - Mid-point scraper station and main line valves (locations to be determined); and
  - Custody transfer metering station at LNG.

The line pipe will be manufactured and coated offshore and delivered to Australia in 20,000 DWT vessels via the port of Mackay and Gladstone.

2.2 Scope and Context of this Report

This Traffic Impact Assessment report has been prepared to address traffic implications on roadway traffic and closures brought about by the construction of the pipeline. Although located across open country for most of its length, the pipeline will cross roadways and consequently, temporary lane closures at these locations may be necessary during construction. The construction of the pipeline is expected to generate additional traffic, mainly associated with the delivery of line pipe. Once the construction is complete, the pipeline will not generate additional traffic except for inspection and maintenance vehicles, the incidence of which will be negligible.

The report provides a broad assessment of traffic impacts during the construction stage and identifies mitigation measures to address these impacts. This report identifies the number of vehicles required to transport construction plant and materials, cam and workforce trips, and pipeline materials. It assesses whether this will significantly impact on the State Controlled Road (SCR) network.

2.3 Methodology

The methodology employed in this report mainly consists of desktop studies to establish baseline conditions in the study area. This entailed a review of aerial photography and other mapping information provided by the Client to identify the access roads and other transport infrastructure in the study area.

Existing traffic count data for SCRs was obtained from the Department of Transport and Main Roads (DTMR). Historical data, where available, was used to inform the study of the potential future growth in traffic along the main corridors. As the majority of the main roads had recent 2009 traffic volume data, no new traffic counts were undertaken for the purpose of this study.

The traffic impact assessment has been undertaken with reference to DTMR's Guidelines for Assessment of Road Impacts of Development (April 2006). The traffic operation assessment process outlined in the guidelines stipulates that the operating characteristics need to be compared with performance criteria. The main performance criteria adopted for the assessment are detailed in Table 1

Table 1 Performance Criteria

Performance Measure	Criteria Adopted
Level of Service (LOS)	LOS C can be considered the minimum standard in a rural context, although LOS D is considered satisfactory in circumstances involving event[1] traffic.
Percentage Increase in existing AADT on the SCR network	Increases within 5% are generally considered acceptable
Percentage Increase on pavements (ESA's)	Increases within 5% are generally considered acceptable

[1] Event traffic would be traffic associated with a unique event for example a sports event or a local festival.

2.4 Assumption and Limitations

As is normal in such studies, the scope of this work entails a number of limitations on the latitude of this assessment. The main limitations include:

- Inability to obtain detailed information on road environment and pavement conditions for key routes;
- Assessment based on series of assumptions to determine the likely traffic generation and distribution of traffic activity; and
- Visual inspection of key construction and haulage routes was not undertaken as part of this assessment.

2.5 Report Structure

The report structure is set out as follows:

- Section 2 – Project Site: provides an overview of the proposed pipeline alignment;
- Section 3 – Existing Conditions: examines existing roadway and traffic conditions in the vicinity of the proposed pipeline alignment;
- Section 4 – Traffic Generation and Distribution: estimates traffic generation associated with the proposal and determines the distribution on the surrounding road network;
- Section 5 – Traffic Impact Assessment: assesses the traffic implications from the construction and operation of the proposed development on the surrounding road network; and
- Section 6 – provides a summary of the Findings and Recommendations of the assessment.

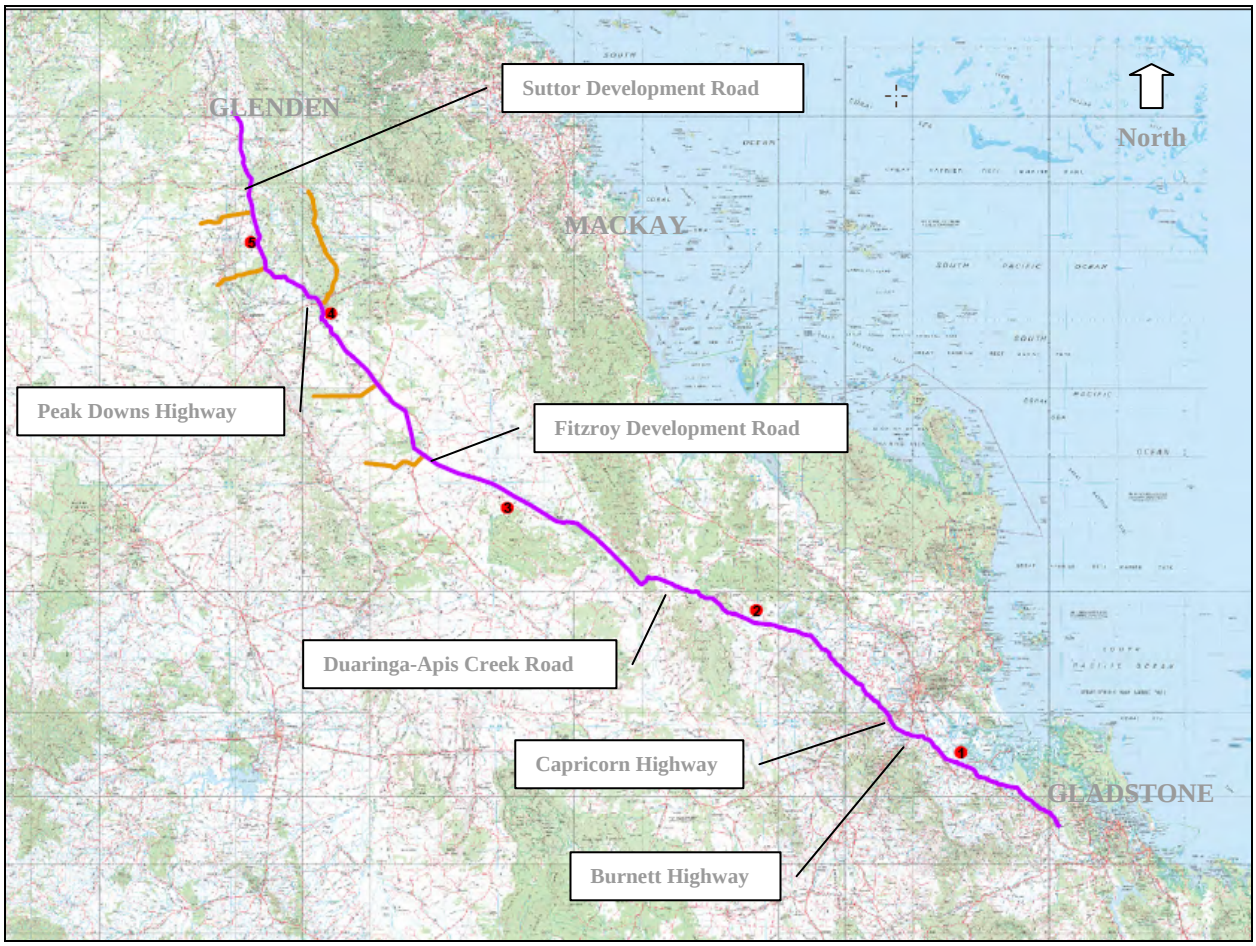
3. Project Site

This section provides an overview of the site location for the proposed pipeline alignment and the existing land uses in the vicinity of the site.

3.1 Location and Alignment of the Project Site

The project site traverses areas within the Central Highlands Regional Council in the Fitzroy Region and the Isaac Regional Council in the Mackay/Whitsunday Region of Queensland. (Refer to Figure 1). The land uses adjoining the project site are predominantly mining, rural, particularly grazing land and open fields and associated rural residences. The pipeline starts in the vicinity of the Glenden Township, then heads in a southerly direction crossing the Suttor Development Road, Peak Downs Highway and the Dysart-Middlemount Road within the Isaac Region. The pipeline continues on a south-easterly path from the KP 467 and crosses the administrative boundaries of the Isaac and Fitzroy Regions. Within the Fitzroy Region, the pipeline crosses the Capricorn Highway and Burnett Highway then terminates at the Gas Gathering Station at Gladstone.

Figure 1 Proposed ABP Alignment



3.2 Existing Land Uses in the Vicinity of the Project Site

The land uses adjoining the project site are predominantly mining and rural, particularly grazing land and open fields and associated rural residences. The land use of the area around pipeline alignment near Gladstone is designated as industrial area (either existing or future), with an isolated section near Yarwun being a residential area.

4. Existing Conditions

This section reviews the existing road and transport conditions that will influence the proposed development and its operations. For the purpose of this assessment, it is essential to understand the operation of the existing road and transport network serving the project site within the context of the study.

4.1 Existing Road Classification

The classification of roads along the existing road network can be used as an indication of the functional role each road plays with respect to the volume of traffic they should appropriately carry. The DTMR has developed a set of road hierarchy classifications detailed in Table 2. The table provides typical nominal volumes expressed in terms of average annual daily traffic (AADT) serviced by various classes of roads.

Table 2 Functional Classification of Roads

Type of Road		Traffic Volume (vmpd)[1]	Peak Hour Volume (vmph)[2]
Arterial Road	Highway	Volumes not restricted	>2,000
	Arterial	Volumes not restricted	
	Arterial Main	< 20,000	
Sub-Arterial Road	Traffic Distributor	Volumes not restricted	800 – 1,000
	Controlled Distributor	< 10,000	
	Sub Arterial Main	< 10,000	
Collector Road	Major Collector	< 6,000	300 – 600
	Minor Collector	< 3,000	
Local Road	Access Street	< 750	0 – 200
	Access Place	< 100	

1 vmpd = vehicle movements per day

2 vmph = vehicle movements per hour

The DTMR has jurisdiction over roads of State significance and has four administrative classifications in its hierarchy of roads. These are:

- National Highway (NH);
- State Strategic Road (SSR);
- Regional Road (RR); and
- District Road (DR).

The project area crosses several national, regional and district roads controlled by the DTMR. These roads are listed in Table 3.

Table 3 Key Roads to be crossed by the Pipeline Route

Road ID	Road Name	Classification
10E	Bruce Highway (Benaraby-Rockhampton)	National Highway
41E	Burnett Highway (Biloela-Mount Morgan)	State Strategic Road
16A	Capricorn Highway (Rockhampton-Duaringa)	State Strategic Road
5101	Duaringa-Apis Creek Road	District Road
85C	Fitzroy Development Road (Dingo-Mt Flora)	Regional Road
33A	Peak Downs Road (Nebo-Mackay)	State Strategic Road
82A	Suttor Development Road (Nebo-Mt Coolan)	Regional Road

Aside from the pipeline crossing points with the key roads, access to the pipeline corridor will also be through the above key roads with the addition of the following:

Table 4 Additional Key Road Sections to be used for Access

Road ID	Road Name	Classification
5307	Collinsville-Elphinstone Road	District Road
512	Marlborough-Sarina Road	District Road

4.2 Existing Traffic Volumes on State-Controlled Roads

Existing traffic count data was obtained from the regional offices of the DTMR. These counts were mostly 2009 counts and presented movements in annual average daily traffic (AADT). Data on the percentage of heavy vehicles were available for some road sections. It should be noted that for the road sections with multiple count sites, the highest AADT volume is presented in Table 5 below so as to represent the worst-case volumes along the road section.

Table 5 Existing AADT Volumes on State-Controlled Roads

Road ID	Road Name	AADT	% HV
41E	Burnett Highway (Biloela-Mount Morgan)	2,367	17.5%
16A	Capricorn Highway (Rockhampton-Duaringa)	NDA	-
5101	Duaringa-Apis Creek Road	NDA	-
85C	Fitzroy Development Road (Dingo-Mt Flora)	921	22.3%
33A	Peak Downs Road (Nebo-Mackay)	4,460	16.3%
33A	Peak Downs Road (Clermont to Nebo)	3,379	17.8%
82A	Suttor Development Road (Nebo-Mt Coolan)	876	19.2%
5307	Collinsville-Elphinstone Road	1,012	12.9%

Road ID	Road Name	AADT	% HV
512	Marlborough-Sarina Road	515	9.7%
10E	Bruce Highway (Benaraby-Rockhampton)	3,811	29.8%

NDA - no data available

4.3 Existing Traffic Volumes on Local Council Roads

Traffic count data for the local roads were also requested from local Councils. Limited information was provided regarding recent traffic count data on local roads. A review of the data showed that the volumes recorded from the previous counts indicate very low traffic levels, mostly under 50 vehicles per day with a small number of count sites registering up to 120 vehicles per day. It is assumed that the majority of the local roads exhibit low traffic levels and can be used for access to the pipeline right-of-way (ROW).

4.4 Roadway Capacity for Two-Lane Two-Way Rural Roads

It is noted that the majority of the access routes to the project site are two-lane, two-way rural roads (one lane per direction), with the exception of the road sections on the state highways that lead into the major urban centres. The AUSTROADS *Guide to Traffic Engineering Practice - Part 2: Roadway Capacity* defines level of service as a qualitative measure describing operational conditions within a traffic stream. The term Level of Service (LOS) and its characteristics for rural roads is defined in Table 6.

Table 6 Level of Service (LOS) for Rural Roads

LOS	Description	AADT	Description
A	Free, unrestricted flow	1,100	Very good
B	Mostly free flow, few disruptions	2,800	Very good
C	Stable flow	5,200	Good
D	Mostly stable flow, some delays	8,000	Acceptable
E	Congested flow, delays common	14,800	Bad
F	Forced flow	n/a	Bad

Source: AUSTROADS Guide to Traffic Engineering Practice Part 2: Roadway Capacity

The volume and composition of traffic on a given road determines the level of interaction between vehicles and is measured as its LOS. For a particular roadway capacity, LOS deteriorates with increasing traffic volumes. LOS A, LOS B and LOS C in a rural context are considered satisfactory. LOS D can be considered satisfactory within the rural context under some circumstances as well.

The AUSTROADS Guide further indicates that two-lane rural highways have a capacity of 2,800 passenger cars per hour total for both directions of flow (1,400 passenger cars per hour per direction), under ideal conditions where there are no restrictive roadway, terrain or traffic conditions.

In cases where traffic, terrain or geometric data may not be precisely known, the AUSTROADS Guide provides planning guidance on maximum AADT values that two-lane, two-way rural roads can accommodate under various terrain conditions.

Table 7 shows the values for various Levels of Service for a rural road in level terrain, with varying ratios of design hour volume to AADT.

Table 7 Maximum AADTs for Various Levels of Service on Two-Lane Two-Way Rural Roads on Level Terrain, vehicles per day

Design Hour Volume to AADT Ratio	Level of Service (LOS)				
	A	B	C	D	E
0.10	2,400	4,800	7,900	13,500	22,900
0.11	2,200	4,400	7,200	12,200	20,800
0.12	2,000	4,000	6,600	11,200	19,000
0.13	1,900	3,700	6,100	10,400	17,600
0.14	1,700	3,400	5,700	9,600	16,300
0.15	1,600	3,200	5,300	9,000	15,200

Source: AUSTROADS Guide to Traffic Engineering Practice, Part 2: Roadway Capacity, Table 3.9, from TRB Highway Capacity Manual (1985) Table 8.10.

Based on a design hour volume to AADT ratio of 10%, the information given in Table 7 indicates that the capacity of the main roads in the vicinity of the project site study area can theoretically achieve an AADT level of 4,800 vehicles per day (vpd) at LOS B, or 7,900 vpd at LOS C, and 13,500 vpd at LOS D[1].

In general, the acceptable LOS for rural roads is set at LOS C or a threshold value of 7,900 vehicles per day (vpd). From Table 5, the existing AADT on the key state roads all fall below the threshold value of for a LOS C and hence, indicating that the key roadways have sufficient and spare capacity and are currently operating at acceptable levels of service.

[1] See Appendix A for a discussion on Level of Service as used in traffic studies.

5. Traffic Generation and Distribution

This section provides an understanding of the traffic generation associated with the proposed construction of the pipeline and the expected future traffic conditions on the key roads of the SCR network.

5.1 Construction Activities

It is anticipated that the construction activity will occur over a 15 month duration spread over a period of approximately 32 months, with no construction activities scheduled to occur over the 'wet' season from October to April. Traffic volumes generated by construction personnel and by materials delivery will vary depending on the construction timetable. The sequence of activities is as follows:

- Route Alignment survey;
- Clearing and Grading;
- Trenching and Stringing;
- Welding;
- Laying of pipes;
- Backfilling;
- Reinstatement; and
- Hydrostatic testing and commissioning.

5.2 Construction Hours

Standard hours of construction for the duration of the construction program are anticipated to be between 6:00 am and 6:00 pm, seven days a week on a 28-day-on, 9-day-off cycle. Haulage of materials and plant will be on a seven-day-per-week operation. Line pipe deliveries will be coming from the ports of Mackay and Gladstone and there may be some night-time haulage to the stockpile site close to the port. The unloading of line pipe materials at site is likely to be limited to daylight hours and therefore the timing of the round trip for pipeline materials will depend on when the materials can be unloaded.

5.3 Construction Vehicles and Equipment

Various machinery will be necessary for construction of the pipeline. Heavy vehicles that will most likely be required at the construction site are as follows:

- Standard semi-trailers (if the line pipe is supplied in 12m lengths) or extendable tri-axle trailers (in the unlikely event that the line pipe is supplied in 18m lengths) and where permissible, road trains, to transport line pipes to the site;
- Tipper trucks, to transport bedding sand on-site and excavated burden off-site;
- Craneage to lift the pipe sections into position;
- Excavation machinery;
- Pipe-laying bulldozer (side-boom); and

- Equipment for directional drilling and horizontal boring.

The tipper trucks and the line pipe supply trucks are expected to be travelling along the SCR network. The crane, excavation equipment, pipe-laying bulldozer, drilling and boring machinery will be brought to site but may be stationary in areas where work is being undertaken and transferred between sites along the ROW during construction.

5.4 Construction Traffic

Most of the traffic generated through the construction phase will be from personnel transportation, equipment and material deliveries, such as:

- Movement of construction personnel and specialist supervisory personnel;
- Minor construction materials and consumables;
- Line pipe supply distribution; and
- Construction plant and equipment.

Each of these components of construction traffic generation is discussed in detail below.

5.4.1 Construction Camps and Construction Workforce

The construction workforce will be comprised of approximately 800 workers, to be accommodated at construction camps located within close proximity to the pipeline. The workers will travel to and from the pipeline ROW via the local road network. The approximate locations of the construction work camps are:

- Bajool;
- Foresthorne (Marlborough);
- Hillcrest (Middlemount);
- Daunia; and
- Redhill (Moranbah).

The workforce is expected to leave the camp between the hours of 5:30 and 6:30 a.m. and return between 5:00 and 6:00 p.m.

Workers will be transported from the camp site to the work area. Given the number of personnel to be transported, an indicative estimate of 21 buses, 56 station wagons, 100 utilities and 14 twin cabs will be utilised. Camps would be adjacent to, or very near, the pipeline ROW and transportation of personnel will thus have very limited impact on public roads. Movements from the campsites to the pipeline ROW are expected to be short distances only and then only at the start and end of the work shift. In between hours, movements will be confined within the ROW. As construction progresses, the crew progressively move to the next camp.

Access to the camps will be via the local roads.

It should be noted that since workers will be accommodated at campsites located near the pipeline ROW, travel distances and travel time on the SCR network will be minimal.

5.4.2 Minor Construction Materials and Consumables

It is anticipated that approximately 20 vehicles will be utilised to service the project for deliveries of fuel, water, materials and other consumables to locations along the pipeline ROW. These vehicles will also use the local road network between the camp and the ROW.

5.4.3 Line Pipe Supply Delivery

Line pipe deliveries into Australia will be via the ports of Mackay and Gladstone. It is estimated that a total of approximately 192,800 tonnes of line pipe will be required, comprising 185,000 tonnes of DN1050, 4,500 tonnes of DN500 and 3300 tonnes of DN400. Transport of 333 kilometres (km) of DN1050 line pipe, 50 km of DN500 and 50 km of DN400 line pipe will be from the Port of Mackay to a stockpile site in Nebo. The remaining 167 km of DN1050 line pipes will be from the Port of Gladstone to Rockhampton and Gracemere. The pipeline construction productivity target will be 1,920 m/day. To service the construction program, 32 truck loads per day will be required to transport the DN1050 line pipes, 8 truck loads per day for the DN500 line pipes and 6 truck loads per day for the DN400 line pipes, in order to produce 1920 metres of line pipe per day for each line pipe type respectively. Transportation of the pipe line sections will generate an average of 3 trucks per hour per direction. It is anticipated that a total of 225 days will be required for line pipe delivery from Mackay and a total of 87 days will be required for line pipe delivery from Gladstone.

Rail networks from the Port of Gladstone are not considered feasible options to distribute line pipe. Since detailed cost modelling is yet to be undertaken, it has been assumed for the purpose of this assessment, that the road network will be utilised for transport representing a ‘worst case’ scenario.

Based on the worst-case scenario, the heavy vehicle traffic generation during the weekday and weekend is in the order of 64 trucks per day, comprising 32 trucks in each direction. Distribution routes and the duration of road usage have been identified.

5.4.4 Construction Plant and Equipment

Construction plant and equipment will be delivered to the start point for construction with intermediate travel being along the pipeline ROW with the intent that they will be demobilised from the other end. There will be a minor amount of movement along roads in the change of locations.

5.5 Line Pipe Distribution Route

The delivery of line pipe will be a major component of traffic generation associated with the construction of the pipeline and will impact on roads far distant from the construction site itself. This section details the quantum of delivery traffic and the roads that it will impact upon.

5.5.1 From Port of Mackay

Upon arrival of line pipes at Mackay, delivery will be to a stockpile site, to be located at near Nebo for later supply for pipe stringing. It is intended that line pipe will be distributed to the ROW at identified locations from the stockpile site, although some deliveries to the ROW may potentially be undertaken directly from the port.

5.5.2 Stockpile Site at Nebo

Nebo has been identified as a suitable staging point for providing line pipe to the northern section of the pipeline route. The stockpile site in Nebo will be utilised to store approximately 131,000 tonnes, comprised mainly DN1050 line pipe, but incorporating 4,800 tonnes of DN500 and 3,300 tonnes of DN400 line pipe for the laterals. This stockpile site is intended to ensure no delays in the pipeline construction since this arrangement provides the project with guaranteed line pipe availability in the event of a severe weather incident in the northern section, which could interrupt the supply chain.

It is anticipated that to deliver this quantity of line pipe to Nebo, it will take a period of approximately 225 days at a delivery rate of 32 truck loads per day for 173 days to deliver the DN1050 line pipe, followed by 8 truck loads per day for 26 days to deliver the DN500 and 6 truck loads per day for 26 days to deliver the DN400 line pipe. Table 8 gives a breakdown of the anticipated truckloads and shipment details between Mackay and Nebo via Peak Downs Highway.

Table 8 Mackay to Nebo Line Pipe Delivery Details

Type	Mass (tonnes)	Delivery Period (days)	Trucks / Day	Mass / m (kg/m)	Truck Loads
DN1050	123,200	173	32	370	5536
DN500	4,500	26	8	90	208
DN400	3,300	26	6	66	106

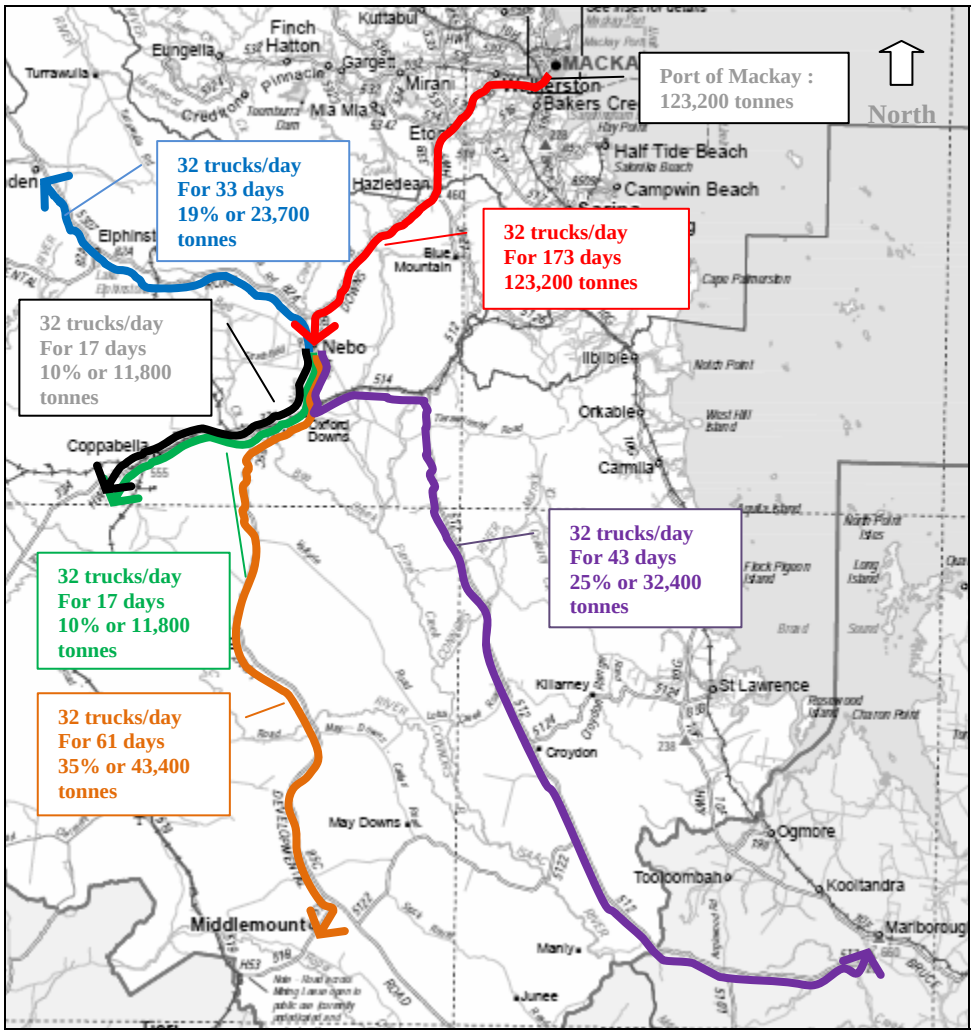
5.5.3 Line Pipe Delivery and Distribution Routes from Port of Mackay

Based on the above assumptions, it is anticipated that a total of 32 truck loads per day per direction (64 movements in both directions) can be associated with delivery of the DN1050 line pipe. Distribution routes for the 42” diameter line pipe on the road network have been identified for both the main feeder roads and the local network. The number of delivery days will vary by road section utilised in the distribution route. The routes and number of delivery days are shown in Table 9 and Figure 2.

Table 9 Distribution Routes and Delivery Period for DN1050 Line Pipe from Port of Mackay

Code	Route	Delivery Period (days)	Remarks
	Port of Mackay to Nebo	173	All line pipe (123,200 tonnes) to be transported to stockpile site in Nebo
	Nebo to Glenden	33	23,700 tonnes
	Nebo to Moranbah	17	11,800 tonnes
	Nebo to Coppabella	17	11,800 tonnes
	Nebo to Middlemount	61	43,400 tonnes
	Nebo to Marlborough-Sarina Road	43	32,400 tonnes

Figure 2 Line Pipe Distribution Routes for DN1050 Line Pipe from Port of Mackay



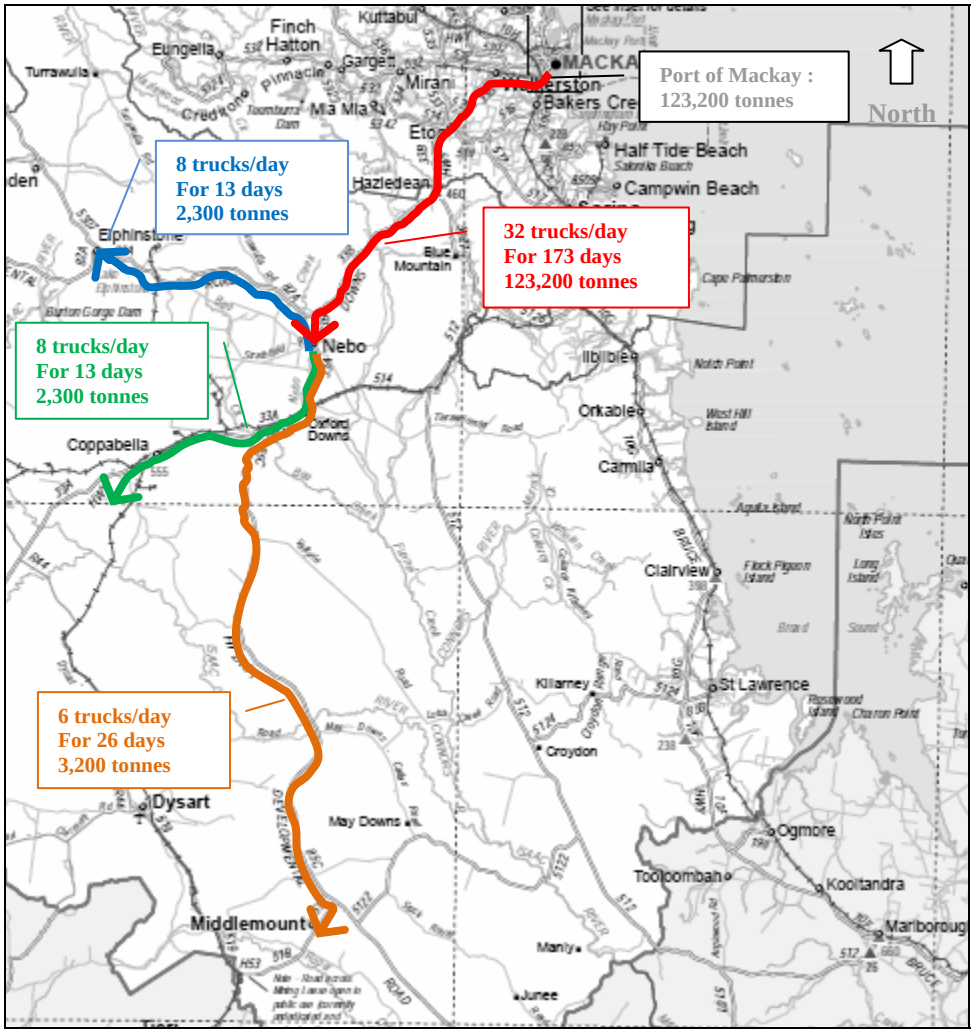
It is anticipated that a total of 8 vehicles per day per direction (16 movements for both directions) will be associated with delivery of the DN500 line pipe and 6 vehicles per day per direction (12 movements for both directions) will be associated with delivery of the DN400 line pipe. Distribution routes on the road network, for the DN500 and DN400 line pipe, have been identified for both the main feeder roads and the local network. The number of delivery days will vary per road section utilised in the distribution route. The routes and number of delivery days for each are shown in Table 10 and Figure 3.

Table 10 Distribution Routes and Delivery Period for DN500 and DN400 Line Pipe from Port of Mackay

Code	Route	Delivery Period (days)	Remarks
———	Port of Mackay to Nebo	52	4,500 tonnes of DN500 and 3,300 tonnes of DN400 line pipe to be transported to stockpile site in Nebo

Code	Route	Delivery Period (days)	Remarks
	Nebo to Lake Elphinstone	13	2,300 tonnes
	Nebo to Coppabella	13	2,300 tonnes
	Nebo to Middlemount	26	3,200 tonnes

Figure 3 Line Pipe Distribution Routes for DN500 and DN400 Line Pipe from Port of Mackay



5.5.4 Line Pipe Delivery and Distribution from the Port of Gladstone

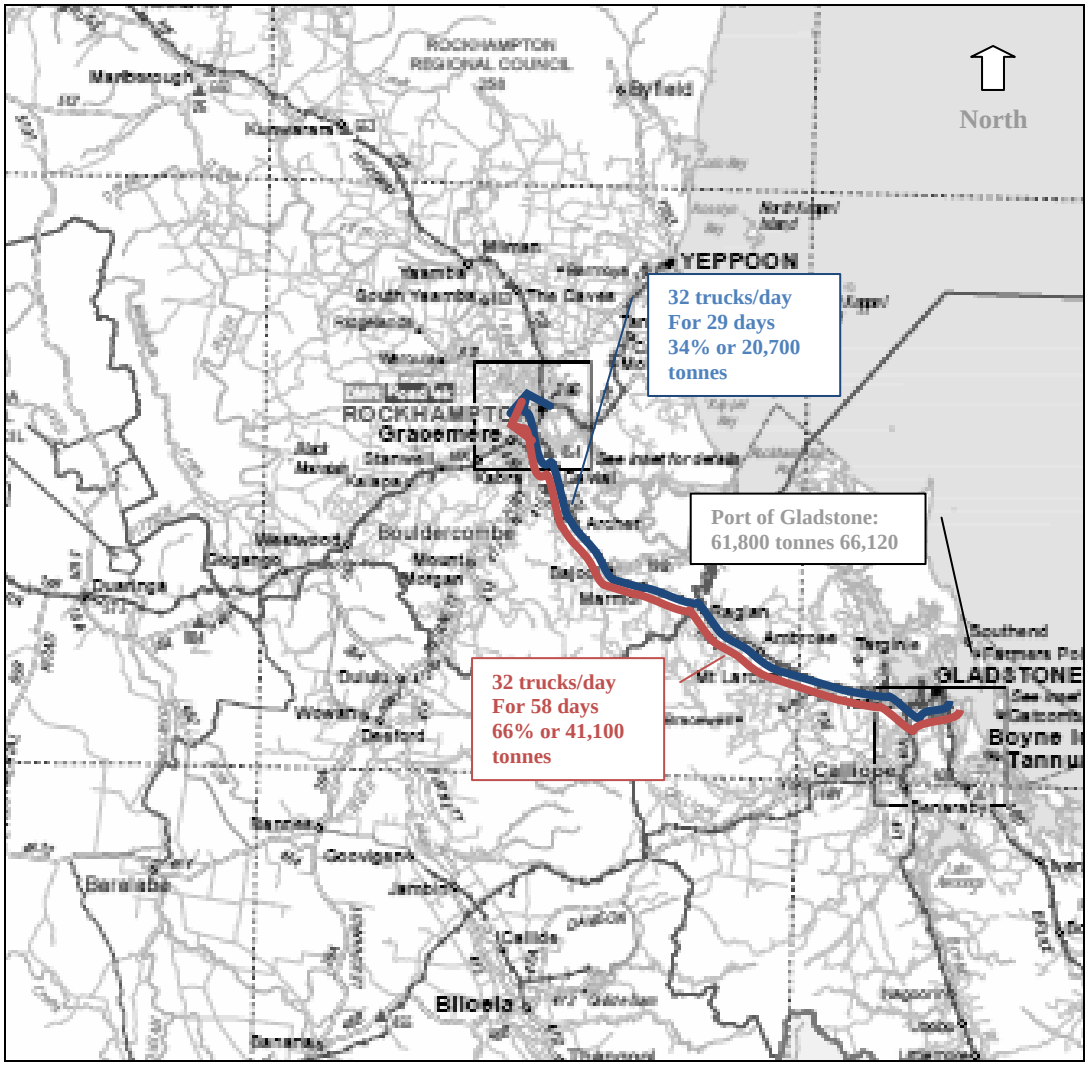
The remaining 167 km (61,800 tonnes) of line pipe will arrive at the Port of Gladstone. Upon arrival of line pipes at Gladstone, delivery will be direct to the pipeline ROW for pipe stringing at the designated location.

To service the construction program, 32 truck loads per day will be required, producing 1920 metres per day and averaging 3 trucks per hour per direction or 6 trucks (both directions). The routes and number of delivery days are shown in Table 11 and Figure 4

Table 11 Distribution Routes and Delivery Period from Port of Gladstone

Code	Route	Delivery Period (days)	Remarks
	Port of Gladstone to Rockhampton	29	20,700 tonnes
	Port of Gladstone to Gracemere	58	41,100 tonnes

Figure 4 Line Pipe Distribution Routes from Port of Gladstone



5.5.5 Road Sectional Usage on the SCR Due to Line Pipe Delivery

The road sections along the above routes will be utilised for varying periods. Table 12 indicates the approximate number of days that each section will be utilised for line pipe distribution. All sections will carry an average of 32 truck loads per day per direction or a total of 64 truck movements per day.

Table 12 Road Sectional Usages

Road ID	Road Name	Road Section	Usage (days)
33A	Peak Downs Road	(Nebo-Mackay)	225
33A	Peak Downs Road	(Nebo-Clermont)	184
5307	Collinsville-Elphinstone Road	Collinsville-Elphinstone	46
512	Marlborough-Sarina Road	Marlborough-Sarina Road	43
85C	Fitzroy Development Road	(Dingo-Mt Flora)	87
10E	Bruce Highway	(Benaraby-Rockhampton)	87

From the main feeder roads, the line pipe will then be delivered to the pipeline ROW via the local road network. Consequently, an average of 32 truck loads per day will also be traversing the local roads adjoining the pipeline route.

6. Traffic Impact Assessment

This section examines the broad traffic impacts of the proposed construction of the pipeline. It estimates the increase in traffic volumes on key SCR network as a result of the construction of the project. The section briefly describes the impacts on road crossings, public transport and pavement impacts.

6.1 Impact of Construction on Access Routes

Construction traffic on access routes will consist of light/medium and heavy vehicles. Light and medium vehicles will consist of personnel transport from the campsites and supervisory vehicles. Heavy vehicle traffic will consist of buses for transport of workers, line pipe supply deliveries, construction plant and equipment, and deliveries of construction materials, supplies and consumables.

The initial delivery of construction equipment to the site will occur in the early stages of the project. It is expected that intermediate travel will occur along the pipeline ROW and on occasional circumstances, on the local road network. These traffic movements are not expected to impact on the local road network since such movements can be confined to off-peak times.

In general, the movement of construction personnel traffic will be confined to the ROW and will not impact on the SCR network. It is anticipated that in some instances the use of state roads will be unavoidable and in these cases 100% of construction personnel traffic will be required to use the SCR network. However, when the use of the SCR network is required, this will be restricted to short distances and for short times.

In the worst case scenario, when construction personnel traffic is required to use the SCR network, the additional daily traffic on the SCR will include 177 light vehicles and 21 buses transporting construction personnel, 32 trucks for line pipe delivery and an additional 20 trucks for deliveries of construction supplies.

It should be noted that the locations of work camps are only approximate, and the final placement of the camps will determine the exact impact on the road network. It is possible that work camps may be located such that no construction personnel traffic is required to travel on the SCR network in the course of routine construction activities.

6.1.1 Total Traffic Generated During Construction

In summary, the estimated total vehicle movements for the worst-case scenario are shown in Table 13.

Table 13 Estimated Total Vehicle Trips on the SCRs (Worst-case Scenario)

Vehicle Movements		Daily (vehicles per day)
Heavy Delivery Traffic	Heavy vehicles for line pipe delivery	32
	Heavy vehicles for deliveries of fuel, water, materials and other consumables.	20
Construction Personnel Traffic	Light vehicles for construction personnel	156
	Buses for construction personnel	21
	Light vehicles for supervisory personnel	20
Total		249

Table 14 presents the impact of the additional traffic movements on the key roads and the anticipated level of service assuming the worst likely scenario for each individual road, and what traffic will be present in that scenario. In total, this additional volume is unlikely to impact on the existing road network operations as the network is expected to have sufficient spare capacity and will operate at acceptable levels of service (i.e. Level of Service C or better).

Table 14 Impact of Additional Traffic Movements on the State-Controlled Roads

Road ID	Road Name	Existing AADT	Existing LOS	Future AADT	Future LOS	Worst-case Traffic
33A	Peak Downs Road (Nebo-Mackay)	4,460	B	4,564[2]	B	Pipeline Delivery
33A	Peak Downs Road (Clermont-Nebo)	3,379	B	3,877[1]	B	Pipeline Delivery and Construction Personnel Traffic
82A	Suttor Development Road (Nebo-Mt Coolan)	876	A	1,270[3]	A	Construction Personnel Traffic
5307	Collinsville-Elphinstone Road	1,012	A	1,116[2]	A	Pipeline Delivery
512	Marlborough-Sarina Road	515	A	619[2]	A	Pipeline Delivery
85C	Fitzroy Development Road	921	A	1,025[2]	A	Pipeline Delivery
10E	Bruce Highway	3,811	B	4,309[1]	B	Pipeline Delivery and Construction Personnel Traffic
41E	Burnett Highway	2367	B	2,761[3]	B	Construction Personnel Traffic

[1] Existing AADT plus all vehicles listed in Table 13, multiplied by 2 for two-way movements.

[2] Existing AADT plus all Heavy Delivery Traffic listed in Table 13, multiplied by 2 for two-way movements.

[3] Existing AADT plus all Construction Personnel Traffic listed in Table 13, multiplied by 2 for two-way movements.

6.2 Impact of Construction on State Controlled Road (SCR) Network

The DTMR's Guidelines for Assessment of Road Impacts for Development (April 2006) stipulates that the extent of impact of the project on the SCR network can be assessed on the basis of percentage increase in existing Annual Average Daily Traffic (AADT). Where the construction or operational traffic generated by the development equals or exceeds 5% of the existing AADT on the road section, traffic operation impacts need to be considered.

Since the bulk of the traffic movements on the SCR network are attributed to the delivery and distribution of line pipe and supplies, the additional traffic to be generated on the SCR network will be approximately 52 vehicles per day (refer to Table 13 'Heavy Delivery Traffic'). It is assumed that traffic generated by personnel movements and supervisory personnel will mainly be accessing the construction site through the local road network. The use of the SCR network will not be regular and the additional traffic volumes will be within acceptable threshold levels.

Table 15 Construction Traffic Impact on State Controlled Roads

Road ID	Road Name	AADT	Future AADT[1]	% Increase
33A	Peak Downs Road (Nebo-Mackay)	4,460	4,564[2]	2.33%
33A	Peak Downs Road (Clermont-Nebo)	3,379	3,877[1]	14.74%
82A	Suttor Development Road (Nebo-Mt Coolan)	876	1,270[3]	44.98%
5307	Collinsville-Elphinstone Road	1,012	1,116[2]	10.28%
512	Marlborough-Sarina Road	515	619[2]	20.19%
85C	Fitzroy Development Road	921	1,025[2]	11.29%
10E	Bruce Highway	3,811	4,309[1]	13.07%
41E	Burnett Highway	2367	2,761[3]	16.65%

[1] Existing AADT plus all vehicles listed in Table 13, multiplied by 2 for two-way movements.

[2] Existing AADT plus all Heavy Delivery Traffic listed in Table 13, multiplied by 2 for two-way movements.

[3] Existing AADT plus all Construction Personnel Traffic listed in Table 13, multiplied by 2 for two-way movements.

As shown in Table 15 above, the additional traffic volume associated with the daily movement of service vehicles and the delivery of line pipe and supplies will exceed the threshold 5% increase in AADT. It is planned that those vehicles associated with personnel movements and service vehicles will not be travelling on the SCR network due to the proximity of the camp site to the pipeline ROW. However, in some instances it has been identified that vehicles associated with personnel movements and service vehicles travelling short distances on the SCR will be unavoidable. In these instances 100% of construction personnel traffic has been allocated to the SCR network. When use of the SCR by construction personnel traffic is required it is only expected to be for a short duration.

It is expected that suitable traffic management measures such as general signposting can be put in place for the duration of the period when these traffic levels are expected.

In addition, at some times during the construction of the project it will be require that construction personnel traffic travelling within the ROW will be required to cross the SCR and local road networks. This will be addressed in the Traffic Management Plan (TMP).

6.3 Impact of Construction on Road Crossings

The pipeline will cross road corridors at certain points. The locations of the crossings have been identified and discussed in Section 4.1 of this report.

Whilst the method of pipeline construction to be applied at each crossing has not yet been determined, it is expected that most bitumen roads will be bored and that most gravel roads will be open cut. However, this has not yet been clarified with either DTMR or the Local Government Authorities (LGAs). Generally, though, trenching is the preferred method of crossing as this is the most economical and time efficient method. As such, temporary road closures may be required and a traffic management plan will be developed in consultation with the relevant road authority prior to construction. In these instances, traffic will be restricted to one lane or via a temporary diversion. It is proposed that trenching be only employed on roads carrying low traffic flows. It is expected that minimal delays will be experienced.

However, where traffic volumes are anticipated to be high and road closures may cause unacceptable delays to traffic, other construction methods (such as thrust boring or another trenchless method) may be employed which cause no disruption to traffic. Boring is a low impact technique involving drilling short distances from below ground within an enlarged trench area (borepit) either side of the road within the pipeline ROW. The feasibility of using a bore is limited by site conditions including depth required, width of crossing, geology, landform, soil type and service / infrastructure.

6.4 Traffic Impact During Pipeline Operation

When the pipeline is operational, occasional access into the pipeline corridor will be required to conduct inspections and maintenance throughout the life of the pipeline. Traffic volumes associated with these activities are expected to be negligible. Consequently, the day-to-day impact of traffic generated by the pipeline operation is likely to be insignificant.

However, where maintenance works coincide with road sections and safety requirements require the closure of road lanes to road traffic, a special traffic management plan should be prepared in consultation with the local authorities.

6.5 Impact on School Bus Routes

Access routes for the project will overlap school bus routes. However, given the relatively low number of school bus services and the relatively short time of operation within the day, it is expected that there would be a negligible impact on the operation of the school bus routes. Any potential impacts will be addressed in detail when traffic management plans for construction are prepared to minimise any impacts on school bus operations.

6.6 Impact on Public Transport Routes

The potential impact of the construction traffic on public transport operations will be addressed in detail when traffic management plans for construction are prepared. It is anticipated that construction access

routes that coincide with public transport routes will be identified and special traffic management plans will be prepared to mitigate any potential impact on the public transport operation.

6.7 Impact on Pavement

It is noted that a key road impact due to the additional traffic would relate to the potential deterioration of the road pavements due to the additional vehicle loads. It is recommended that an on-site inventory of road conditions along the haulage routes and key road links to access the ROW, be carried out in consultation with relevant authorities, prior to construction commencing. A mitigation measure to be incorporated in the construction contract plan is to ensure that the vehicle loads for delivery scheduling adhere to existing load limits on the access routes to be used. Where necessary, reinstatement and repair of the road be immediately undertaken to ensure safe passage of vehicles and prevent further deterioration. It is anticipated that this short term duration would have minimal effect on the full life of the existing bitumen surfaced road pavements.

7. Findings and Recommendations

7.1 Overview

This Traffic Impact Assessment has examined the traffic implications brought about by the construction of the Arrow Bowen Pipeline on roadway traffic and identifies mitigating measures to address the impacts.

The assessment has sought to address the following key issues:

- Use of identified road segments on the SCR network for access by heavy vehicles for delivery of line pipe, materials, equipment and machinery;
- Disruption to traffic due to road/lane closures brought about by construction activities at road crossings;
- Ability of the roads to handle the volume of construction traffic particularly in regard to over-size and over-mass vehicles; and
- Traffic management measures.

7.2 Key Findings

The investigations of the implications of the construction of the ABP in terms of traffic and transport issues have confirmed the following key issues:

- Construction traffic will create short-term increases in traffic volumes on the road network during the construction period of 15 months.
- The expected increase in traffic on key SCRs from the construction of the pipeline is considered moderate in terms of congestion and roadway capacity.
- The key SCRs have sufficient spare roadway capacity to accommodate the expected traffic increases during the construction period and will operate at acceptable levels of service (i,e LOS C or better). Although
- The delivery of materials and equipment will be spread over the construction period of 15 months and the movement of these vehicles can be arranged to minimise impacts on the local community.
- Construction activity will primarily be confined within the pipeline ROW, and traffic movements will be managed by appropriate traffic control plans for work sites.
- The pipeline will not generate additional traffic except for inspection and maintenance vehicles, the incidence of which will be negligible.
- Current road network has been identified to be suitable for proposed trucking operations without the need for major improvements to pavement condition, carriageway alignment and road width based on this desktop assessment.

7.3 Key Recommendations

Based on the type of vehicles that would require access to the site during the construction period, it is recommended that a Traffic Management Plan is developed and implemented. Some of the initiatives that are likely to form part of the TMP include:

- Locate work camps so that access to the ROW can be gained without the need for construction personnel traffic to travel along the SCR;
- Consultation with the DTMR to identify mitigation measures to address the relative increase in traffic levels (>5% or a percentage to be nominated by Main Roads) on affected road sections of the SCR network;
- General signposting of access roads with appropriate heavy vehicle and construction warning signs;
- Installation of specific warning signs at local access roads to the construction ROW to warn existing road users of entering and exiting traffic;
- Advance notice of road/lane closures and advice on alternative routes;
- Installation of appropriate traffic control and warning signs for areas identified where potential safety risk issues exist;
- Manage the transportation of construction materials to maximise vehicle loads to therefore minimise vehicle movements;
- Whenever practical, vehicles associated with the construction works should use internal and haulage access roads instead of public roads;
- Induction of truck and vehicle operators on the requirements of the TMP; and
- Implementation of a community information and awareness program to be initiated prior to construction commencing and continue throughout the entire construction period to ensure that local residents are fully aware of the construction activities, with particular regard to construction traffic issues.

8. Disclaimer

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The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

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Appendix A

Level of Service

A discussion of the term “Level of Service” as used in traffic studies, as presented in the *Highway Capacity Manual* of the Transportation Research Board and the *Guide to Traffic Engineering Practice* by AUSTROADS.

Level of Service[2]

A multilane highway is characterized by three performance measures:

- Density, in terms of passenger cars per kilometre per lane;
- Speed, in terms of mean passenger car speed; and
- Volume to capacity ratio.

Each of these measures indicates how well the highway accommodates traffic flow.

Density is the assigned primary performance measure for estimating Level of Service (LOS). The three measures of speed, density, and flow or volume are interrelated. If the values of two of these measures are known, the remaining measure can be computed.

LOS A describes completely free-flow conditions. The operation of vehicles is virtually unaffected by the presence of other vehicles, and operations are constrained only by the geometric features of the highway and by driver preferences. Manoeuvrability within the traffic stream is good. Minor disruptions to flow are easily absorbed without a change in travel speed.

LOS B also indicates free flow, although the presence of other vehicles becomes noticeable. Average travel speeds are the same as in LOS A, but drivers have slightly less freedom to manoeuvre. Minor disruptions are still easily absorbed, although local deterioration in LOS will be more obvious.

In **LOS C**, the influence of traffic density on operations becomes marked. The ability to manoeuvre within the traffic stream is clearly affected by other vehicles. On multilane highways with a Free Flow Speed (FFS) above 80 km/h, the travel speeds reduce somewhat. Minor disruptions can cause serious local deterioration in service, and queues will form behind any significant traffic disruption.

At **LOS D**, the ability to manoeuvre is severely restricted due to traffic congestion. Travel speed is reduced by the increasing volume. Only minor disruptions can be absorbed without extensive queues forming and the service deteriorating.

LOS E represents operations at or near capacity, an unstable level. The densities vary, depending on the FFS. Vehicles are operating with the minimum spacing for maintaining uniform flow. Disruptions cannot be dissipated readily, often causing queues to form and service to deteriorate to LOS F. For the majority of multilane highways with FFS between 70 and 100 km/h, passenger-car mean speeds at capacity range from 68 to 88 km/h but are highly variable and unpredictable.

LOS F represents forced or breakdown flow. It occurs either when vehicles arrive at a rate greater than the rate at which they are discharged or when the forecast demand exceeds the computed capacity of a planned facility. Although operations at these points—and on sections immediately downstream—appear to be at capacity, queues form behind these breakdowns. Operations within queues are highly unstable, with vehicles experiencing brief periods of movement followed by stoppages. Travel speeds within queues are generally less than 48 km/h. Note that the term LOS F may be used to characterize both the point of the breakdown and the operating condition within the queue.

Although the point of breakdown causes the queue to form, operations within the queue generally are not related to deficiencies along the highway segment.

[2] Highway Capacity Manual 2000. Transportation Research Board, 2000.

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