Transport

8. TRANSPORT

8.1. Introduction

The proposed Port Bonython Bulk Commodities Export Facility (BCEF) is expected to generate additional movements on the surrounding transport networks during both the construction and operational phases of the Project.

There will be new rail movements associated with the proposed Project that will use existing and new rail lines. These movements may produce the following impacts:

- Increased risk of road / rail accidents at existing and new road / rail crossings
- Increased delay to existing rail movements.

The traffic generated by the proposed construction and operation of the BCEF and new rail line could also lead to impacts, including:

- Increased risk of road accidents due to a higher level of traffic on the roads
- Increased delay caused by insufficient capacity at intersections and along road links.

The following sections consider the baseline traffic conditions in the Port Bonython area, as well as the impact of the BCEF on the surrounding road network.

8.2. Methodology and Assumptions

8.2.1. Methodology

The assessment of the traffic impact of the construction and operation was completed using an eight step process:

- The critical design years for analysis were determined (refer to **Section 8.2.4**)
- The existing traffic environment was established to perform the assessment. This included an assessment of existing link capacity using the Highway Capacity Manual and intersection capacity using SIDRA Intersections software (refer to **Section 8.3.4.1**)
- The level of background traffic in the study area in the design years was determined (refer to **Section 8.4.1**)
- The likely volume and distribution of traffic generated by the construction and operation in the design years (refer to **Section 8.4.2**) was estimated
- The impact of the construction and operation of the Project on the surrounding environment was assessed (refer to **Section 8.5**)
- The operation of the road links and intersections within the study area were assessed to determine whether they can accommodate the additional traffic generated by construction and operation. This involved a review of the predicted road link and intersection operation parameters to determine whether the impact is significant (refer to **Sections 8.5** and **8.6**)
- The available rail capacity was determined for the proposed rail movements to and from the BCEF (refer to **Section 8.6.4**)
- The potential impact of the Project on the transport network for elements within the study area was assessed, with reference to the Significance Criteria defined in **Section 8.2.5**. If necessary, mitigation measures for both construction and operation were nominated (refer to **Section 8.7**).

8.2.2. Assumptions and Technical Limitations

During the transport assessment process, the following assumptions have been made:

- Existing developments in the region will continue to operate
- Construction of the BCEF will begin in the first half of 2015
- The rail track owner (Australian Rail Track Corporation) have (or will make available) sufficient capacity on the existing rail network to accommodate increased rail movements generated by the Project.

8.2.3. Policy Context and Legislative Framework

The development of this traffic assessment includes reference to the current policy and legislative framework. The relevant policy and legislation used in the preparation of this report are summarised below in **Table 8.2a**.

Table 8.2a: Documents used in the development of this report

Policy / Legislation	Relevance
ARTC Level Crossing Design ESD-03-01	The Project proposes new level crossings. This document was used to determine the requirements for rail crossings affected by the BCEF.
AS1742.7	Provide guidance and standards for treatments at rail level crossings. This document was used to determine the requirements for rail crossings affected by the BCEF.
AS2890	Provide guidance and standards for access, parking and servicing. This was used to identify the design requirements for parking spaces on site.
Austroads Guide to Road Design (2012)	Provide guidance and standards for any new or upgrade road works. This document was used to determine the requirement for turning treatment improvements.
Austroads Guide to Traffic Management (2009)	Provide guidance and standards for the assessment of traffic impacts. This document was used to determine the geographical scope of traffic assessment.
Highway Capacity Manual (2010)	Provide guidance on the measurement of highway capacity in order to determine the level of impact generated by a development. This document was used to determine the capacity of roads in the region.
Land Not Within a Council Area (Coastal Waters) Development Plan	Outlines the principles of transport network operation in non LGA areas. Impact on beach access.
Railways (Operations and Access) Act 1997	The Project proposes the use of rail.
South Australia Strategic Infrastructure Plan (2005)	The Project proposes the use of rail, which will minimise impact on the road network. The Project includes a new section of rail, a significant piece of infrastructure.
Whyalla (City) Development Plan (2012)	Outlines the principles of transport network operation in the Whyalla area, access, servicing and parking specification. This document was used to determine the on-site car parking provision for the Project.

8.2.4. Design Year

The traffic impact of developments is conducted at certain design years in order that assessments are carried out for peak conditions where impacts may be their greatest. Developments, such as the BCEF, involving a relatively high level of traffic generation during the construction stage and then a moderate level of traffic generation during the operational stage are assessed in two design years:

Design year during the construction phase: The year of peak traffic generation during construction. If the level of traffic movement during the construction phase is assumed constant, the design year is the expected final year of construction.

Design year during the operational phase: This is taken as the first year of operation of the Project assuming the level of operational traffic movement is constant.

An assessment of future traffic movement has also been undertaken. This is dependent on other likely development affecting the study year and is described in **Chapter 18, Cumulative Impacts**.

The construction programme is approximately 30 months long. Based on an assumed construction start date in early 2015, construction of the BCEF is expected to be complete by the end of 2017. As the exact period of peak construction and operation traffic generation is currently unknown, the design year during the construction phase used for this traffic assessment is 2017, as it is when background traffic is expected to be highest.

It is expected that the BCEF will open immediately following the construction phase. As such, the design year during the operational phase was assumed to be 2017. Initially, the BCEF will operate at a capacity of 25Mtpa, which will increase over time to 50Mtpa as demand grows. The traffic impact at the commencement of operation (2017) was assessed, in addition to a future 50Mtpa scenario (refer to **Section 8.4**).

8.2.5. Description of Significance Criteria

Based on the assessment documented above, significance criteria that the proposed BCEF will be assessed against were developed. These are shown in **Table 8.2b.**

Table 8.2b: Traffic-related Significance Criteria

Criteria	Significance	Measure	Significance of impact	Likelihood of impact	Risk rating
Traffic Capacity					
Link capacity	Proposed Project intensifies traffic during construction and operational phases. A reasonable level of service should be maintained on all links.	Level of service of 'C' or better as determined using the Highway Capacity Manual.	Moderate	Unlikely	Medium
Intersection capacity	Proposed Project intensifies traffic during construction and operational phases. A reasonable level of service should be maintained at all intersections.	Degree of saturation of 80 per cent for priority and 90 per cent for signalised intersections or better as determined using the SIDRA intersection assessment software.	Moderate	Unlikely	Medium
Safety					
Road design	Road safety is affected by design. All existing roads and proposed upgrades should be assessed for compliance.	Compliance against Austroads Guide to Road Design (2012).	Moderate	Possible	Medium
Level crossing design	Safety of road and rail users is affected by the design of level crossings. All existing and proposed crossings should be assessed for compliance.	Compliance against ARTC ESD-03-01 and AS1742.7.	Moderate	Possible	Medium
Rail					
Rail capacity	Proposed Project intensifies use of existing rail line. Capacity should be assessed.	Consultation with rail track owner.	Moderate	Possible	Medium

8.3. Existing Conditions

This section presents a summary of the existing traffic conditions in the vicinity of the proposed BCEF, in order to provide a benchmark to assess the traffic impact of the Project.

8.3.1. Local Road Network Overview

The initial study area was defined based on a high-level desktop assessment of the Project and surrounding road network. It identified three key roads that are likely to be impacted by the construction and operation:

- Lincoln Highway
- Port Bonython Road
- Norrie Avenue Extension.

These roads are illustrated below in **Figure 8.3a**, and the characteristics of each road are discussed below in **Sections 8.3.1.1** to **8.3.1.3.**

The study area has been defined based on the likely extent of impact. It was anticipated that the traffic impact of the proposed development will be negligible (less than five percent of existing volumes) on roads not included above. The five percent threshold is based on guidance in the Austroads Guide to Traffic Management Part 12 (Austroads, 2009).

An assessment of whether this assumption and whether the extent of the assessment was appropriate, considering the five per cent threshold, is presented in **Section 8.6**.

8.3.1.1. Lincoln Highway

The Lincoln Highway is a two-lane, undivided highway linking Port Lincoln to the south of Whyalla and the Eyre Highway to the north of Whyalla. The Lincoln Highway is controlled by the Department of Planning, Transport and Infrastructure (DPTI). The posted speed limit is 110km/h, reducing to 80km/h on the approach to Norrie Avenue Extension. The speed limit further reduces to 60km/h on the approaches to the built up area of Whyalla.

The width of the through traffic lanes are generally 4m wide, narrowing to between 3.5m and 3.9m wide near intersections. The sealed shoulder width varies between 0.5m and 1m. The condition of the pavement appears to be quite good, with little evidence of potholes or tyre rutting.

8.3.1.2. Port Bonython Road

Port Bonython Road is a two-lane, undivided road linking the Lincoln Highway to Point Lowly. Port Bonython Road is controlled by DPTI. Port Bonython Road is classified by Whyalla City Council as a “Secondary Arterial Road”. The posted speed limit is 110km/h from the Lincoln Highway to the proposed site access. The speed limit reduces to 80km/h near the access to the Santos facility, and reduces further to 50km/h near Point Lowly.

The lanes are approximately 4m wide, with a sealed shoulder width of approximately 0.5m. The condition of the pavement appears to be quite good, with little evidence of potholes or tyre rutting.

The Lincoln Highway / Port Bonython Road intersection is a priority controlled channelised intersection, with vehicles on Port Bonython Road giving way to those on the Lincoln Highway. Left turn slip lanes are provided on both the northern (Lincoln Highway) and eastern (Port Bonython Road) approaches. A short right turn lane is provided on the southern approach. The layout of the right turn appears to be a Channelised Right Turn (CHR) layout as described in the Austroads Guide to Road Design (2012). Site measurements indicate that the length of the left turn storage bay from the north is approximately 188m, while the length of the right turn storage bay from the south is approximately 88m (including a length for deceleration).

Site observations noted that visibility from Port Bonython Road to oncoming traffic from both directions on Lincoln Highway is good (over 250m). The layout of this intersection is illustrated below in **Figure 8.3b**.

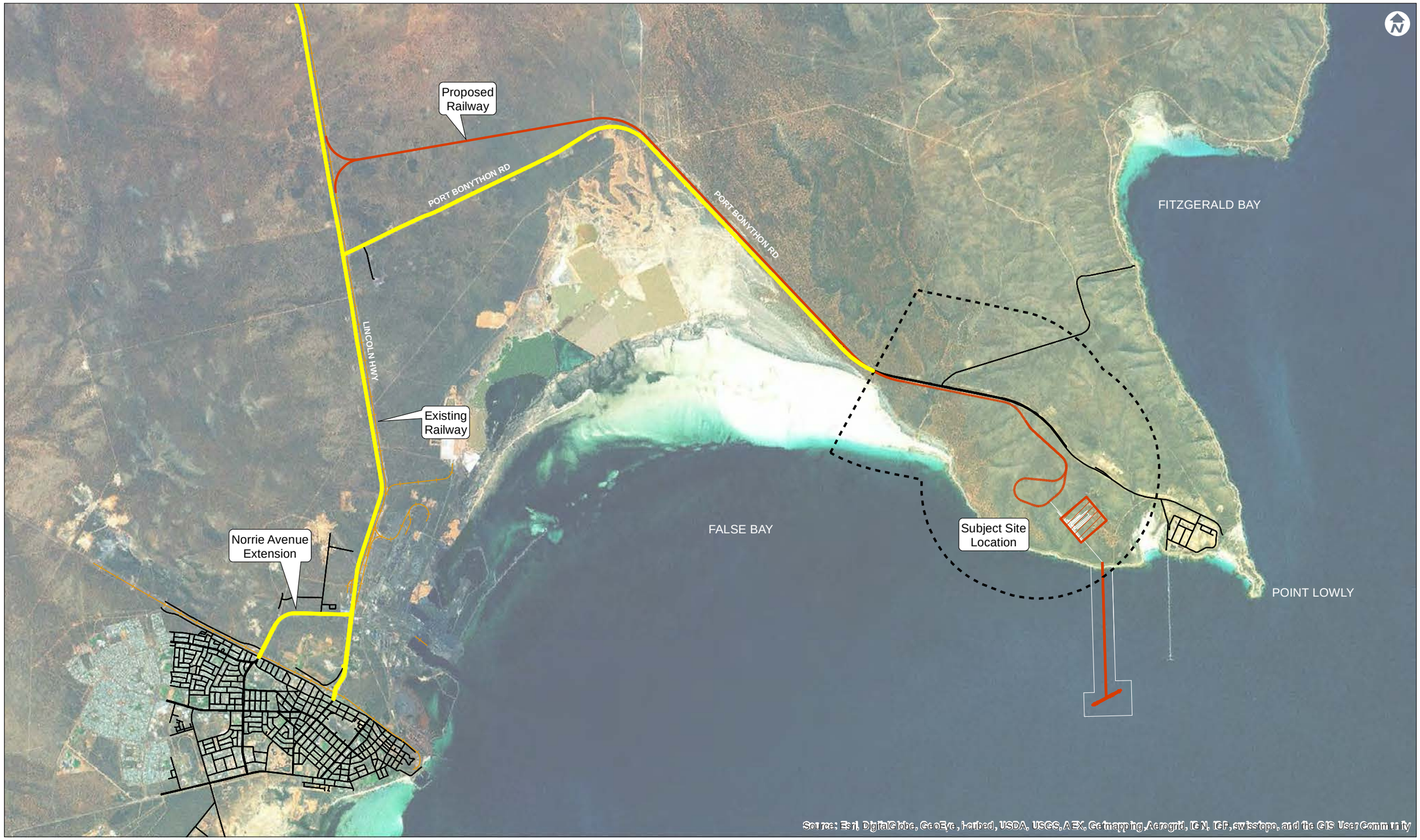
In addition to the intersection with the Lincoln Highway, there are other intersections along Port Bonython Road. These include unsealed property accesses, beach access and access to the Fitzgerald Bay and False Bay communities.

8.3.1.3. Norrie Avenue Extension

The Norrie Avenue Extension is a four lane, two–way undivided road linking Norrie Avenue near its intersection with Iron Knob Whyalla Road in the north of Whyalla to the Lincoln Highway. The Norrie Avenue Extension is classified by Whyalla City Council as a “Secondary Arterial Road”. It has a posted speed of 100km/h, although the speed limit drops to 80km/h near the intersections with Iron Knob Whyalla Road and the Lincoln Highway.

The Lincoln Highway / Norrie Avenue Extension / Arrium access intersection is signalised. Left turn slip lanes are provided on all approaches, and short (65m long) right turn lanes are provided on the northern and southern approaches. The layout of this intersection is illustrated below in **Figure 8.3c**.

Figure 8.3a: Roads within study area



Port Bonython EIS
Spencer Gulf Port Link

Figure 8.3a -
Roads within the Study Area

Legend

- Roads
- Roads within the study area

ARUP

Spencer Gulf Port Link

1:75,000 (at A3)

0 1 2 4
Kilometers

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 8.3a: Roads within study area

Figure 8.3b: Layout of Lincoln Highway / Port Bonython Road intersection

Port Bonython EIS
Spencer Gulf Port Link

Figure 8.3b -
Lincoln Highway and Port Bonython Road Intersection

ARUP

Spencer Gulf Port Link

1:1,000 (at A3)

0 10 20 40
Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 8.3b: Layout of Lincoln Highway / Port Bonython Road intersection

Figure 8.3c: Layout of Lincoln Highway / Norrie Avenue Extension intersection

Port Bonython EIS
Spencer Gulf Port Link

Figure 8.3c -
Lincoln Highway and Norrie Avenue
Intersection

ARUP

Spencer Gulf Port Link

1:1,000 (at A3)

0 10 20 40
Meters

Map Projection: Transverse Mercator
Horizontal Datum: Geographic Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

Figure 8.3c: Layout of Lincoln Highway / Norrie Avenue Extension intersection

8.3.2. Traffic Volumes

Traffic volume data for each of the three routes was obtained from DPTI. A summary of the volumes, detailing the survey date, Annual Average Daily Traffic (AADT measured as vehicles) and Commercial Vehicle (CV) percentage is provided below in **Table 8.3a**.

Table 8.3a: Existing traffic volumes near Port Bonython (data provided by DPTI, 2013)

Route	Data Year	AADT	CV%
Port Bonython Road	2011	450	18%
Lincoln Highway	2011	2,000	15%
Norrie Avenue Extension	2006	3,400	11%

8.3.3. Restricted Vehicle Approved Routes

Port Bonython Road, the Lincoln Highway and the Norrie Avenue Extension are all B-Double routes gazetted by DPTI. Furthermore, these routes are designated by DPTI as routes for vehicles up to a 36.5m Road Train (including the 35m B-Triple).

8.3.4. Link and Intersection Capacity

The capacity of the links and intersections identified in **Section 8.3.1** were assessed using volumes obtained from a traffic survey conducted by Austraffic on 28 February 2013 at the following intersections:

- Lincoln Highway / Port Bonython Road
- Lincoln Highway / Norrie Avenue Extension.

The raw survey data is attached in **Appendix H.1**.

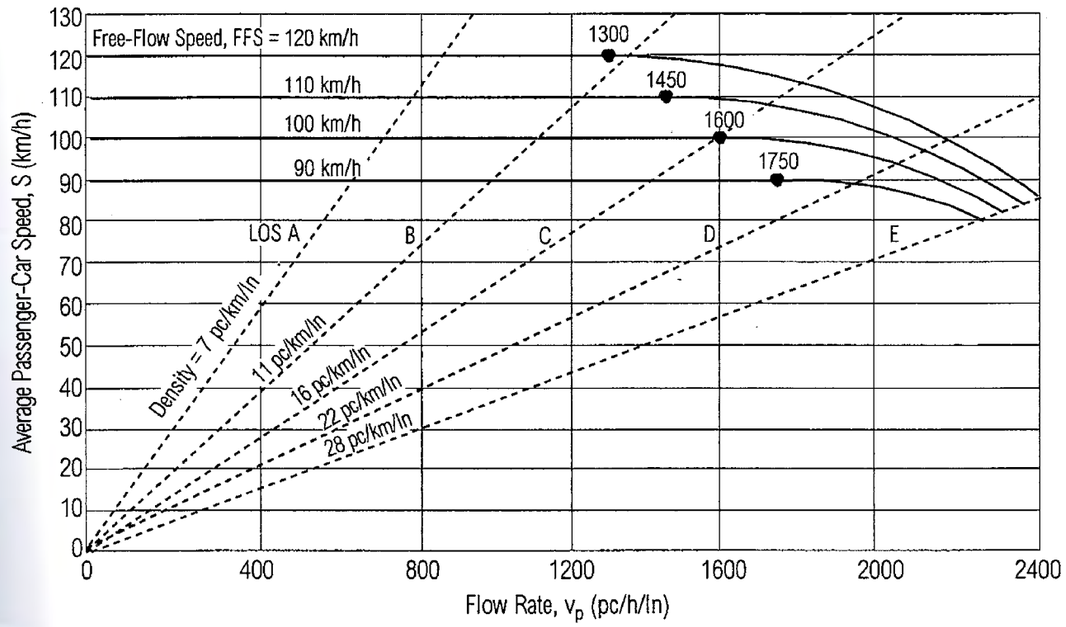
8.3.4.1. Link Capacity

Two methods of assessing the link capacity of existing roads were utilised. The first method includes calculation of the capacity of basic freeway segments based on guidance in the Austroads Guide to Traffic Management (2009). The second method involves consideration of the reduced capacity of two-lane highways due to reduced opportunities for passing slow vehicles. This was conducted using guidance from the Highway Capacity Manual, referred to in following sections as the HCM2010 (Transportation Research Board, 2010).

Port Bonython Road and Lincoln Highway

A high level assessment of the link (road) capacity was conducted using guidance for basic freeway segments in the Austroads Guide to Traffic Management Part Three (Austroads, 2009). An excerpt is provided in **Figure 8.3d**.

Figure 8.3d: Link capacity (Transportation Research Board via Austroads, 2009)



This indicates that the maximum flow rate per lane to achieve a Level of Service (LOS) of C or better is approximately 1700 passenger cars per hour per lane for a free flow speed of 110km/h. LOS is measured in this case as a range of vehicle densities with LOS A being best and LOS F being worst. LOS C was selected, as it the highest level of service that provides some tolerance for small increases in traffic flow. LOS C is generally used as a benchmark for traffic operations in regional areas. The recorded traffic volumes on both Port Bonython Road and the Lincoln Highway were less than 400 vehicles per hour (vph) per lane in each direction during both peak hours. As such, it is considered that the traffic volumes on both roads are currently lower than their capacity.

Both Port Bonython Road and the Lincoln Highway are two-lane highways, as they are high speed, limited access roads. As there is only one lane in each direction, the link capacity is affected by the number of passing opportunities available. This is a function of:

- The free flow speed of the road
- The volume of traffic in the opposing direction
- The design of the road (including lane width, shoulder width)
- The alignment of the road and the terrain in the region
- The link capacities were determined using guidance from the HCM2010 for two-lane highways.

A summary of the parameters used in the link capacity assessments are provided in **Table 8.3b**. It shows that both road links operate with LOS A, which indicates that they currently have free flow conditions with drivers virtually unaffected by the presence of others in the traffic stream.

Table 8.3b: Link Capacity Assessment

Parameter	Lincoln Highway	Port Bonython Road
Class	Class I (National highway)	Class II (Secondary route)
Lane width	3.7m	4.2m
Shoulder width	1.8m	1.8m
Number of access points	Minimal (1/km assumed)	Minimal (1/km assumed)
Peak hour factor	0.85	0.8
Grade	0 (Flat)	0 (Flat)
Heavy vehicle percentage	15%	18%
Percent No-Passing Zones	20%	20%
Link Level of Service	A (both directions)	A (both directions)

Norrie Avenue Extension

The link capacity of Norrie Avenue Extension was estimated using the Austroads method for basic freeway segments described above. A link capacity assessment based on the HCM2010 two-lane highway methodology has not been conducted because this road has two lanes in both directions. The survey results indicated that the peak traffic volume is approximately 400vph. Based on **Figure 8.3d**, the maximum flow rate to achieve an LOS C for a 100km/h road is 1,600veh/hr/lane. Given that Norrie Avenue Extension has two lanes in each direction, it can be concluded that it currently operates within capacity.

8.3.4.2. Intersection Capacity

As shown in **Figure 8.3a**, there are two intersections that are predicted to be affected by the traffic generated by the construction or operation of the development:

- Lincoln Highway / Port Bonython Road
- Lincoln Highway / Norrie Avenue Extension / Arrium access.

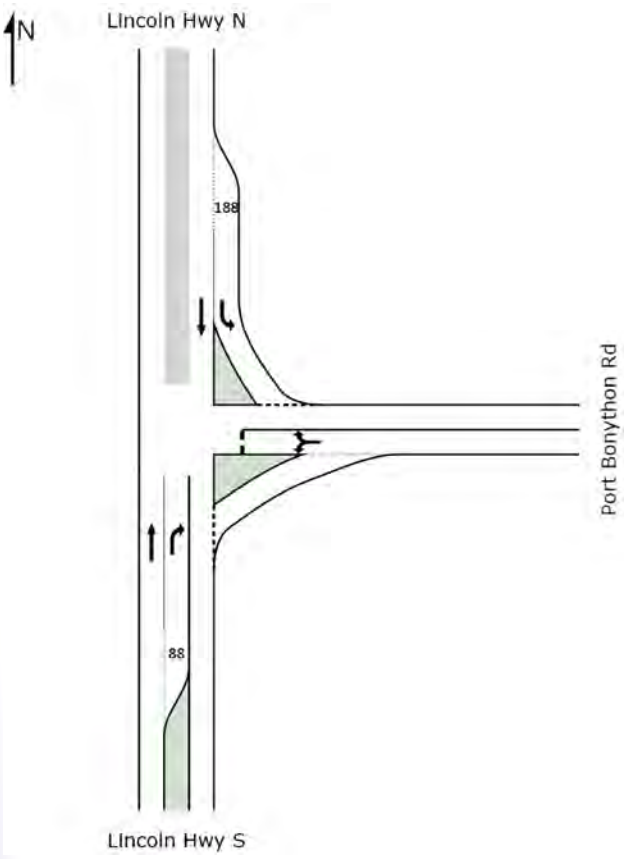
The current operation of these intersections was assessed using SIDRA Intersection software, which assesses intersection operation based on factors such as intersection layout and traffic volumes. Three key performance parameters were assessed:

- Degree of Saturation (%) -This is the ratio of demand flow to capacity. For priority controlled intersections, the acceptable limit of operation is reached when the degree of saturation exceeds 80 per cent. For signalised intersections, the acceptable limit of operation is reached when the degree of saturation exceeds 90 per cent
- Average Delay (sec) – The average delay per vehicle in seconds incurred by vehicles over the modelled time period
- 95th Percentile Queue – A queue length measured in metres of which only five percent of queues are equal to or greater than.

Lincoln Highway / Port Bonython Road

The Lincoln Highway / Port Bonython Road intersection is currently priority controlled, with segregated turn lanes. Site observations indicate that visibility from Port Bonython Road to oncoming traffic from both directions on Lincoln Highway is compliant with requirements presented in Austroads Guide to Road Design Part 4A (over 250m) (2012). An indicative layout of the intersection is shown in **Figure 8.3e**.

Figure 8.3e: Lincoln Highway / Port Bonython Road intersection layout



The results of the SIDRA assessment are presented in **Table 8.3c**.

The results show that the intersection currently operates with an acceptable level of service. It is noted that the queue on Port Bonython Road (no more than one vehicle in both peak periods) is unlikely to obstruct the operation of the level crossing, which is located approximately 70m away.

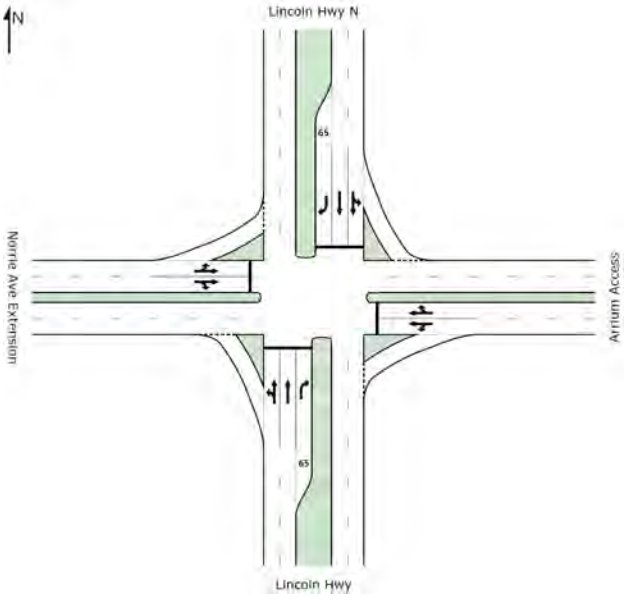
An assessment of the existing turn treatment at Port Bonython Road was completed based on guidelines presented in the Austroads Guide to Road Design Part 4A. Due to the low volume of turning traffic, a basic right turn (BAR) treatment without a segregated right turn lane will be considered acceptable. It is considered that the current arrangement with a separate right turn lane is in excess of the minimum requirement. However, it was noted from site measurements that the existing channelised right turn treatment from Lincoln Highway south approach does not fully meet the design requirements presented in the Austroads Guide to Road Design Part 4A (2012).

The current length of the right turn lane (including taper) is approximately 84m. The minimum length of a CHR(S) treatment according to Austroads is 85m to allow for sufficient deceleration distance, plus the length of one design vehicle. It is considered that the most appropriate design vehicle is the 36.5m road train. Therefore, the minimum right turn lane length should be 121.5m (or approximately 37.5m longer than the current arrangement).

Lincoln Highway / Norrie Avenue Extension / Arrium access

The Lincoln Highway / Norrie Avenue Extension / Arrium access intersection is currently signalised with left turn slip lanes provided on every approach, and a short right turn lane provided on the northern and southern approaches. An indicative diagram of the current layout is provided in **Figure 8.3f**.

Figure 8.3f: Lincoln Highway / Port Bonython Road intersection layout



The results of the SIDRA assessment are presented in **Table 8.3d**.

The results indicate that the intersection has sufficient capacity to accommodate the existing traffic volumes. However, site observations have noted that a security boom gate located within the Arrium facility occasionally causes queues that extend into the intersection, affecting traffic flows. It should be noted that the logistical issues observed at the Arrium entrance are unrelated to background traffic movement and / or the BCEF Project.

Table 8.3c: Lincoln Highway / Port Bonython Road intersection assessment results

Approach	Movement	Degree of Saturation		Average Delay (seconds)		95th Percentile Queue (metres)	
		AM	PM	AM	PM	AM	PM
Lincoln Highway (south)	Through	5%	5%	0	0	0	0
	Right	1%	1%	9	9	0.1	0.2
Port Bonython Road	Left	2%	1%	9	8	0.6	0.3
	Right	2%	1%	11	9	0.6	0.3
Lincoln Highway (north)	Left	1%	1%	8	8	0	0
	Through	3%	6%	0	0	0	0
Overall		5%	6%	2	1	0.6	0.3

Table 8.3d: Lincoln Highway / Port Bonython Road intersection assessment results

Approach	Movement	Degree of Saturation		Average Delay (seconds)		95th Percentile Queue (metres)	
		AM	PM	AM	PM	AM	PM
Lincoln Highway (south)	Left	8%	20%	20	28	6	8
	Through	8%	20%	16	24	6	8
	Right	56%	20%	31	37	46	7
Arrium Access	Left	16%	26%	14	10	8	15
	Through	16%	26%	14	11	8	24
	Right	16%	26%	36	28	6	24
Lincoln Highway (north)	Left	5%	16%	17	30	2	6
	Through	5%	16%	18	24	2	7
	Right	11%	28%	36	36	4	12
Norrie Avenue Extension	Left	52%	9%	23	13	41	7
	Through	52%	9%	20	12	41	7
	Right	52%	9%	36	38	33	4
Overall		56%	28%	22	17	46	24

8.3.5. Crash Analysis

Crash analysis has been undertaken for the key roads in the study area. Road safety is usually treated as part of a risk management process. According to the Austroads Guide to Road Safety Part Seven (2006), this involves determining:

- The relevant risk factors in a given situation
- Which factors can be effectively manipulated
- Which countermeasures will produce the desired outcomes.

This Chapter considers the first element of the risk management process. It is important to recognise that the road safety risk factors include those from the road environment, road user (human) factors as well as vehicle factors.

The purpose of this assessment is to understand the current risk factors along the route that is most likely to carry construction workers and equipment during the construction phase and materials and operational staff during the operational phase.

An assessment of the crash history for the route between Whyalla and the proposed development site at Port Bonython was undertaken. This included the Lincoln Highway between the intersection with the Norrie Avenue Extension and the intersection with Port Bonython Road, and along Port Bonython Road.

8.3.5.1. Survey Data

Raw crash data for the subject roads was obtained from the DPTI. This data is attached in **Appendix H.2**, with details of each crash including location, crash severity and crash type. A review of the most recent five years of available crash data (2008-2012) was completed.

A map showing the location of recorded crashes in the area is presented in **Figure 8.3f**. The crashes recorded and the reference numbers are summarised in **Table 8.3e**.

Table 8.3e: Crashes in the Port Bonython Area

Reference Number	Crash Type
1	Hit Animal
2	Roll Over
3	Left Road – Out of Control
4	Head On (animal)
5	Hit Fixed Object
6	Side Swipe
7	Roll Over
8	Hit Animal
9	Right Angle
10	Hit Fixed Object

8.3.5.2. Crash Assessment

There were ten crashes recorded in the most recent five years, which consisted of:

- Three collisions with animals (vehicle hit animal)
- Two rollovers
- Two collisions with fixed objects (vehicle hit fixed object)
- One loss of control (vehicle left road – out of control)
- One right angle collision
- One side swipe.

The crash data indicates that relatively few crashes have occurred within the study area. Of the recorded crashes, a large proportion appears to be due to animals on the roadway.

Of the other crashes, the majority appear to be caused by road user issues. This is indicated by the number of rollovers, collisions with fixed objects (of which one was caused by reversing without due care), and the side swipe.

The crash data above does not show any discernible patterns, as there are few accidents overall and the type and location of accidents are randomly distributed with no evidence of re-occurrence. In summary, the assessment suggests that there are no accident black spot locations, as each crash recorded was unrelated to all others in crash type and / or location. In addition, there is little evidence to suggest that any of the crashes were caused by road design or poor maintenance of the road.

Figure 8.3f: Five year crash history in the study area

Figure 8.3f: Five year crash history in the study area

8.3.6. Rail Overview

There is currently a single standard gauge railway track running from Port Augusta to Whyalla, with an alignment roughly parallel to the Lincoln Highway. The southern end of this line is located at the Arrium facility in Whyalla. The northern end of this line connects to the main east-west rail corridor from New South Wales and Victoria to Western Australia (refer to **Figure 1.6a** in **Chapter 1, Project Introduction**). The main east-west rail corridor is owned by the Australian Rail Track Corporation (ARTC).

8.3.7. Road / Rail Crossing Condition Analysis

There is currently one active rail level crossing within the study area of relevance to the Project, located on Port Bonython Road near the intersection with the Lincoln Highway. There is a second level crossing on the Lincoln Highway near the Ausmelt access, however, this is currently disused. Signage and line marking relating to the railway crossing are still present; however, secondary signs advising of the disuse of the crossing have been erected. It is noted from Australian Standard (AS) 1742.7 that this treatment indicates that operational rail traffic is no longer carried on this line, but maintenance and inspection traffic may still be present.

The condition analysis below focuses on the level crossing located on Port Bonython Road. An assessment of the condition of the existing level crossing was completed on 14 March 2013, with a focus on the following elements:

- Warning signals
- Signage
- Line marking
- Sight distance.

The current crossing is actively controlled by flashing lights and bells only. This is consistent with the minimum requirements from the ARTC standard for Level Crossing Design for a single line railway intersected by a public road. The positioning and type of signal assembly used appears to be compliant with AS1742.7, with no vegetation or other signage obstructing the sign or lights. It is considered that the current safety treatment is appropriate due to the low traffic volumes on Port Bonython Road. It was noted, however, that one of the signal lamps is currently malfunctioning. This should be replaced as part of ARTC's maintenance program.

Advisory signs advising of a rail crossing on the side road are present on both approaches to the intersection from Lincoln Highway (north and south). While AS1742.7 does require the use of these signs, they are currently located in excess of 200m away from the intersection. The AS recommends that the sign is located approximately 50m away from the intersection to ensure that drivers turning into Port Bonython Road are aware that the sign refers to their direction of travel. An advisory sign is also present on Port Bonython Road on the eastern approach, warning drivers of the rail crossing. This sign is located approximately 230m from the crossing, which is compliant with AS1742.7.

In addition to signage, line marking warning of the rail crossing is provided. Site observations indicated that the type and positioning of the line marking is consistent with the requirements in AS1742.7. Site observations indicated that the condition of these line markings is generally good, with only minor obscuring due to tyre marks.

Sight distance from the stop line along the tracks in each direction appears to be greater than 200m towards Port Augusta, but dense vegetation obstructs sight distance towards Whyalla. However, the crossing is still considered compliant with AS1742.7.

8.4. Potential Traffic Impacts

In assessing the traffic impact of the construction and operation phases of the Project, it is important to separate the effects of background traffic and construction and operation traffic to assess the relative impact of each. Background traffic refers to traffic which will be present in the absence of the construction and operation of the Project.

8.4.1. Future Background Traffic

The level of background traffic at a given design year was calculated as the sum of the following:

- Surveyed traffic volumes (as reported in **Section 8.3**)
- An allowance for traffic growth to account for gradual development in the area.

This sub-section summarises the process of determining the background traffic volumes within the study area:

Section 8.4.1.1 presents the relevant surveyed traffic volumes

Section 8.4.1.2 summarises the results of the traffic growth rate calculation

Section 8.4.1.3 presents the predicted background traffic volumes in the design year.

8.4.1.1. Surveyed Traffic Volumes

As discussed in **Section 8.3.4**, traffic volume surveys were conducted at relevant intersections to determine the existing traffic conditions in the area.

In addition to those traffic volumes, historical traffic volumes on Norrie Avenue Extension were also obtained from the DPTI for comparison.

The data from these surveys is attached in **Appendix H.1**.

Further traffic survey data was obtained from the DPTI relating to the following intersections:

- Norrie Avenue Extension / Iron Knob Whyalla Road
- Lincoln Highway / McBryde Terrace
- Lincoln Highway / Eyre Highway.

These additional data sets were obtained to confirm the appropriate study area extent, and are also provided in **Appendix H.1**.

8.4.1.2. Determination of Traffic Growth

As discussed in **Section 8.2**, the future level of background traffic was predicted by applying a growth factor to the surveyed traffic volumes. For the purposes of this traffic assessment, the growth rate of traffic within the study area was obtained from the historical traffic growth rate on several roads in the study area. The average rate of growth was calculated using intersection counts at Lincoln Highway/Norrie Avenue Extension and AADT volumes on Port Bonython Road.

The average growth rate was calculated to be three per cent per annum. This was agreed as being reasonable through discussions with DPTI. This was based on providing a conservative estimate considering that historical traffic growth in the area is at least two per cent per annum.

The calculation of the average growth rate is shown in **Appendix H.3**.

8.4.1.3. Estimation of Future Background Traffic Volumes

The background traffic volumes at the design years (2017, the final year of construction of the initial stage, and 2020, the estimated first year of operation of the expanded BCEF) were estimated using the surveyed traffic volumes described in **Section 8.4.1.1** and the growth rates presented in **Section 8.4.1.2**. These volumes are summarised below in **Figures 8.4a** to **8.4d.**

Figure 8.4a: Estimated background traffic volumes, 2017 morning peak hour

Figure 8.4b: Estimated background traffic volumes, 2017 evening peak hour

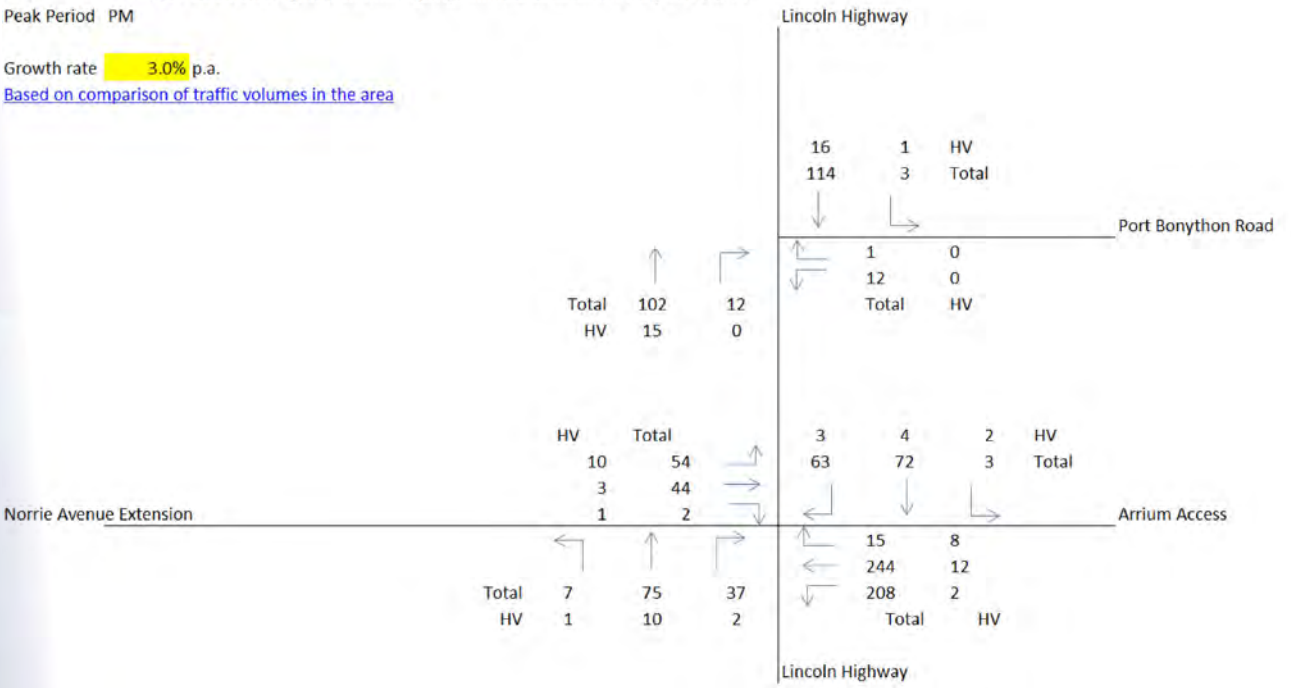


Figure 8.4c: Estimated background traffic volumes, 2020 morning peak hour

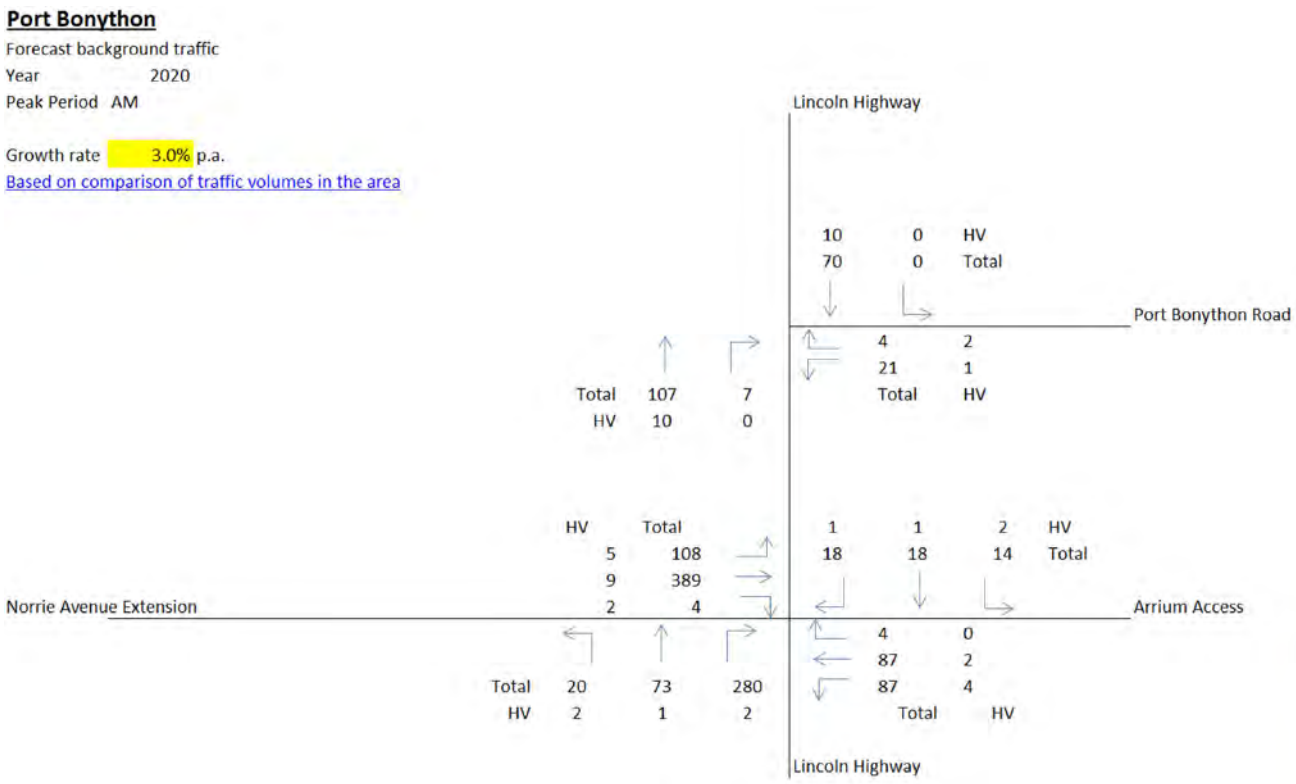
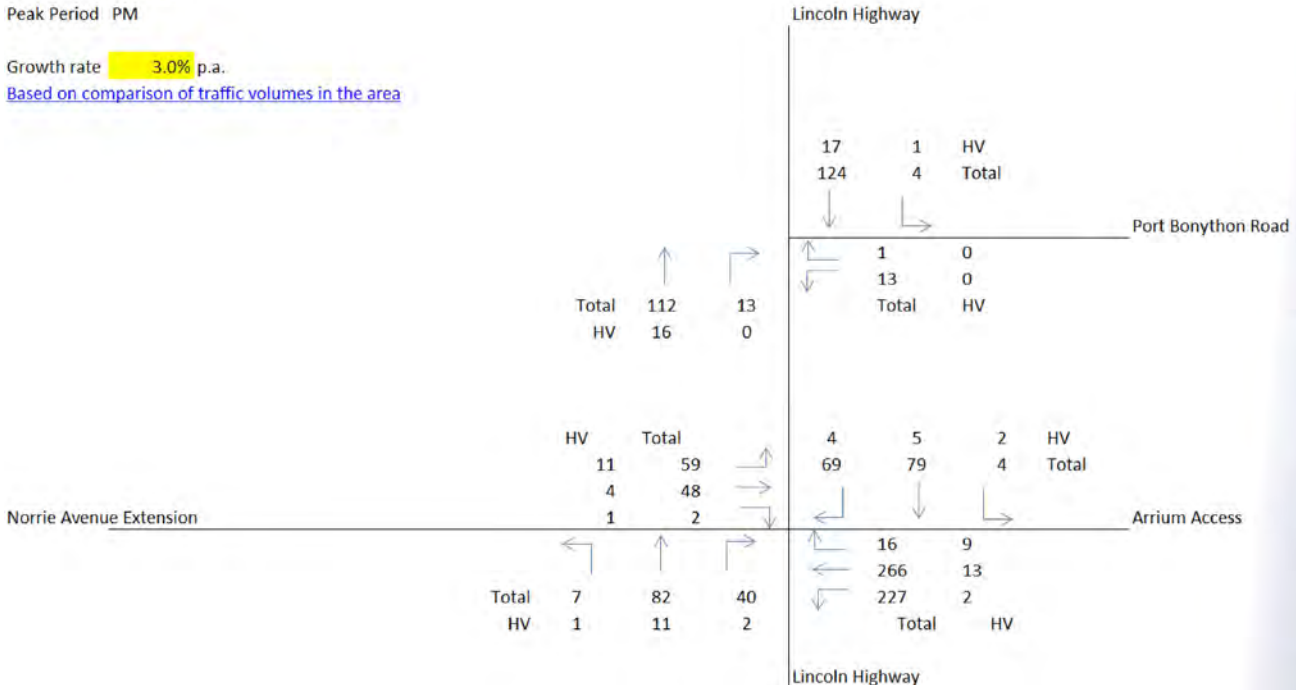


Figure 8.4d: Estimated background traffic volumes, 2020 evening peak hour



It is noted that there is loss and gain of traffic flows on the Lincoln Highway between Port Bonython Road and Norrie Avenue Extension. This is likely to be due to vehicles from Whyalla entering properties along the Lincoln Highway, including the Arrium facility and the Whyalla Solar Storage site.

8.4.2. Traffic Generation

The traffic generated by the construction and operational phases were estimated using predicted staff numbers and traffic as outlined in **Chapter 2, Project Description** for the construction phase and operational phases. These are summarised in **Section 8.4.2.1**.

8.4.2.1. Staffing and Traffic Operations Data and Assumptions

Construction Phase (Stage One, 25Mtpa)

The following staffing and traffic operations data relating to the construction phase of the proposed BCEF was provided by LCPL for the initial stage of construction (to provide 25Mtpa of capacity):

- Construction will occur on six days of the week, Monday to Saturday, and shifts are expected to be from 6am to 6pm
- The peak construction workforce in the study area is 200 persons, with an additional 30 to 50 persons in the ancillary workforce supporting the workshop, office support, cleaning, food services etc.
- All construction personnel will be accommodated in Whyalla
- There are an additional 20 to 40 persons employed in the pre-assembly facilities, but piles will be manufactured overseas and transported to the worksite directly or via the load-out facility. Therefore, it is assumed that these workers are not accommodated within the region
- 25 per cent of construction personnel will drive private vehicles to the worksite, with the remainder carpooling or bussing
- 30 to 50 vehicles per week will deliver prefabricated components for jetty construction, as well as other materials and supplies
- The delivery route is along the Lincoln Highway approaching from the north of Port Bonython
- Approximately 15 light vehicles per day will travel along the route between the BCEF and Port Augusta/Port Pirie.

Operation Phase (Stage One, 25Mtpa)

The following staffing and traffic operations data relating to the operations of Stage One of the proposed BCEF is detailed in full in **Chapter 2, Project Description**, and is summarised below:

- Landside operations will have a peak workforce of 30-35 persons
- An additional ten percent of vehicle numbers has been assumed to account for maintenance heavy vehicles
- Marine side operations staff numbers may be generally ignored for the traffic volumes, as they will be transported via boat to site
- Landside operations will work in four shifts of eight persons, with an additional four persons working permanent days.

Construction Phase (Stage Two, 50Mtpa)

The following staffing and traffic operations data relate to the expansion of the proposed BCEF:

- The majority of materials and component deliveries will be undertaken via sea rather than via the site road
- The expansion will involve the construction of an additional berth together with a wharf and jetty conveyor
- Construction for the expansion will occur while the BCEF is in operation.

Operation Phase (Stage Two, 50Mtpa)

The following staffing and traffic operations assumptions have been made for the operations of Stage Two of the proposed BCEF:

- The staff levels will be higher by approximately 50 percent than that required for operation of the first stage of the Project.

General Assumptions

In addition to the above data, some further assumptions were made in order to complete the traffic assessment:

- The 25 per cent of construction staff that will drive private vehicles to work will not carry any carpooling passengers
- Of the 75 per cent of construction staff that will carpool or catch a bus to the worksite, 25 per cent will carpool (one driver and one passenger per vehicle assumed) and 50 per cent will catch a bus (23 passengers per bus assumed)
- For the operations phase it has been assumed that 50 percent of the operations staff will drive private vehicles and 50 percent will carpool (one driver and one passenger per vehicle assumed)
- South of the Lincoln Highway / Norrie Avenue Extension intersection, workers are evenly split between Norrie Avenue Extension and Lincoln Highway

- 50 per cent of construction workers will travel during each road network peak hour (morning between 8am-9am and evening between 3pm-4pm at the Lincoln Highway / Norrie Avenue Extension intersection). While most employees are expected to travel prior to the start of the 6am shift and after the end of the 6pm shift, this assumption allows the Contractor to retain some operational flexibility
- During operations it has been assumed that workers beginning and ending a shift will both travel within the peak hour
- Delivery vehicles are spread evenly between days of the week (i.e. 50 trucks per week equates to approximately eight per day)
- Construction vehicles will be spread linearly through the day. Ten percent of the trucks servicing the site each day will travel during the morning peak hour, and ten percent will travel during the evening peak hour
- Construction of the second stage to upgrade the BCEF to 50Mtpa will occur over two years. This assumption is based on the time to construct the wharf and jetty conveyor for the first stage
- The peak construction staff requirement is assumed to be 60 percent of the peak during Stage One, accounting for the fact that Stage Two has a smaller scope (and does not require railway construction). Therefore, the peak construction workforce is estimated to be 120 people, with an ancillary workforce of 20-30 people (workshop, office support, cleaning, food services etc.)
- Accommodation and mode share for Stage Two construction workers is the same as that for Stage One
- As delivery vehicles do not travel along Lincoln Highway during Stage Two construction, no other workforce vehicles are assumed to travel on Lincoln Highway north of Port Bonython Road
- The hourly time of peak traffic generation on a typical day for construction of Stage Two will coincide with the time of peak traffic generation for operation of Stage One
- The number of staff required for the ultimate BCEF (after the expansion) will be 50 percent greater than the requirement for the interim BCEF.

8.4.2.2. Traffic Generation Summary

Peak Traffic Scenario Testing

Based on the data and assumptions presented in **Section 8.4.2.1**, the volume of traffic generated by the Project in the construction and operations phases of both stages of development (Interim – 25Mtpa and Ultimate – 50Mtpa) was calculated. These are presented in **Table 8.4a**.

Table 8.4a: Traffic generated by the BCEF

Phase	Traffic Generation (vehicles per day)
Construction (Stage One)	200vpd
Operations (Stage One)	60vpd
Construction (Stage Two)	120vpd
Operations (Stage Two)	90vpd

Four scenarios were tested using the above data. These scenarios represent the four likely stages of construction and operation of the BCEF:

- Construction of the first stage (25Mtpa) of the Project
- Operation of the first stage (25Mtpa) of the Project
- Construction of the second stage (50Mtpa) of the Project, while the first stage (25Mtpa) is operational
- Operation of the second stage (50Mtpa) of the Project.

These scenarios and the corresponding traffic generation are presented in **Table 8.4b**.

Table 8.4b: Traffic generated by the BCEF

Phase	Traffic Generation (vehicles per day)
Construction (Stage One) only	200vpd
Operations (Stage One) only	60vpd
Construction (Stage Two), occurring simultaneously with Operations (Stage One)	180vpd
Operations (Stage Two) only	90vpd

Based on the data in **Table 8.4b**, it can be seen that the scenario with the greatest level of traffic generation is construction of the first stage of the Project. As such, it is considered that an assessment of traffic impact is only required for that phase. This is presented in **Section Construction Phase (Stage One, 25Mtpa**).

Further to the above, an assessment of the traffic impact of the BCEF during the operation of the ultimate (50Mtpa) stage was completed, which showed that the traffic impact on the surrounding road was significantly less. This analysis is **presented in Section Operation Phase (Stage Two, 50Mtpa)**.

Based on this analysis, it was considered that the maximum traffic impact will occur during the construction of Stage 1, and the traffic impact caused by construction or operation of Stage Two is not as significant.

Construction Phase (Stage One, 25Mtpa)

The traffic generated by the construction of the rail line and the initial stage of the BCEF in the morning and evening peak hours is presented in **Figures 8.4e** to **8.4j**.

Port Bonython

Traffic generated by staff
Year 2017
Peak Period AM

Peak Workforce within Study Area

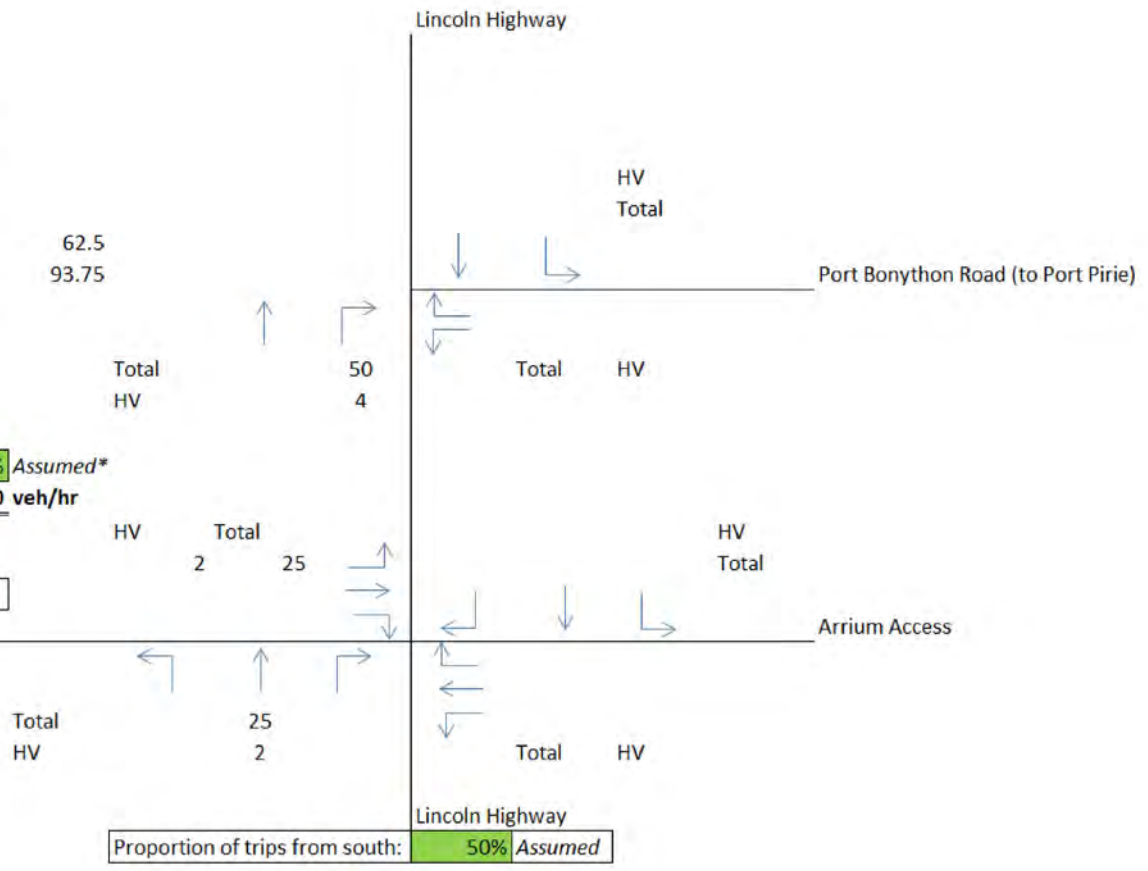
Construction	200	persons	*Source:Leighton*
Ancillary	50	persons	*Source:Leighton*
Prefabrication staff are located outside study area			
Total	**250**	**persons**	

Mode Share:

Car (single passenger)	25%	*Source:Leighton*
Car (car pool - 2 pax)	25%	*Assumed*
Bus (bus - 23pax)	50%	*Assumed*
Total	**100%**	

% of Staff Travelling During Peak Hour	50%	*Assumed**
Total number of vehicle trips generated	**50**	**veh/hr**

Proportion of trips from west:	50%	*Assumed*



*Leighton suggests that shifts begin at 6am, which is prior to the commencement of the morning peak hour (6:30am-7:30am at Port Bonython Road, 8am-9am at Norrie Avenue extension). Although most workers would travel prior to shifts starting, this traffic assessment has conservatively assumed that 50% of workers travel during peak hour.

Figure 8.4e: Traffic generated by construction staff (morning peak)

Port Bonython

Traffic generated by staff

Year 2017

Peak Period PM

Peak Workforce:

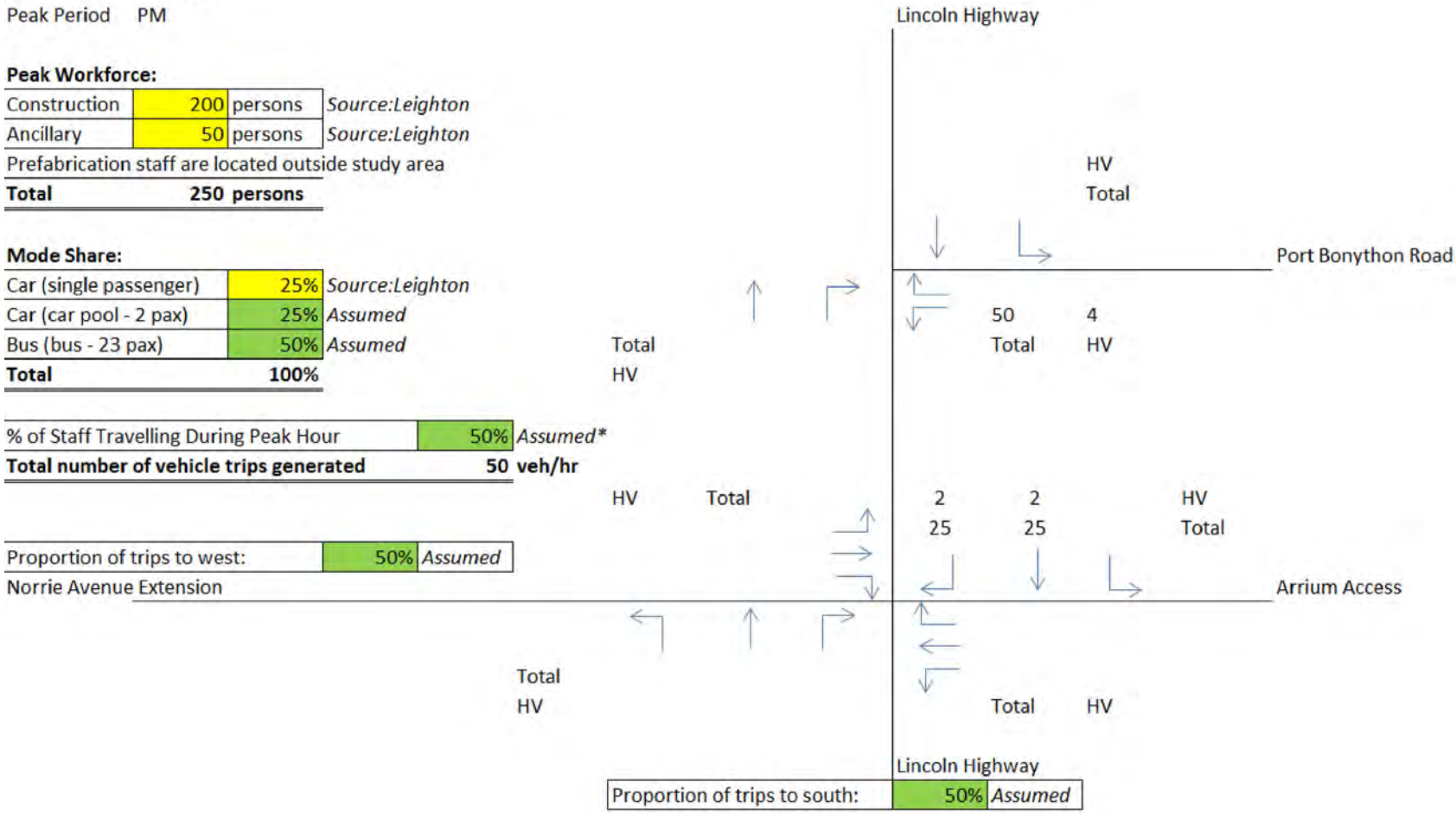
Construction	200	persons	*Source:Leighton*
Ancillary	50	persons	*Source:Leighton*
Prefabrication staff are located outside study area			
Total	**250**	**persons**	

Mode Share:

Car (single passenger)	25%	*Source:Leighton*
Car (car pool - 2 pax)	25%	*Assumed*
Bus (bus - 23 pax)	50%	*Assumed*
Total	**100%**	

% of Staff Travelling During Peak Hour	50%	*Assumed**
Total number of vehicle trips generated	**50**	**veh/hr**

Proportion of trips to west:	50%	*Assumed*
Proportion of trips to south:	50%	*Assumed*



*Leighton suggests that shifts end at 6pm, which is prior to the commencement of the morning peak hour (3pm-4pm at Port Bonython Road, 4pm-5pm at Norrie Avenue extension). Although most workers would travel prior to shifts starting, this traffic assessment has conservatively assumed that 50% of workers travel during peak hour.

Figure 8.4f: Traffic generated by construction staff (evening peak)

Port Bonython

Construction traffic (trucks)

Year 2017

Peak Period AM

Trucks servicing the site:

Delivery	50	per week	*Source:Leighton*
Working days	6	days/wk	*Source:Leighton*
Total trucks	**9**	**per day**	
Peak Hr %	10%		*Assumption*
Trucks in peak	**1**	**per hour**	

All heavy vehicles are to/from the north *(Source: Leighton)*

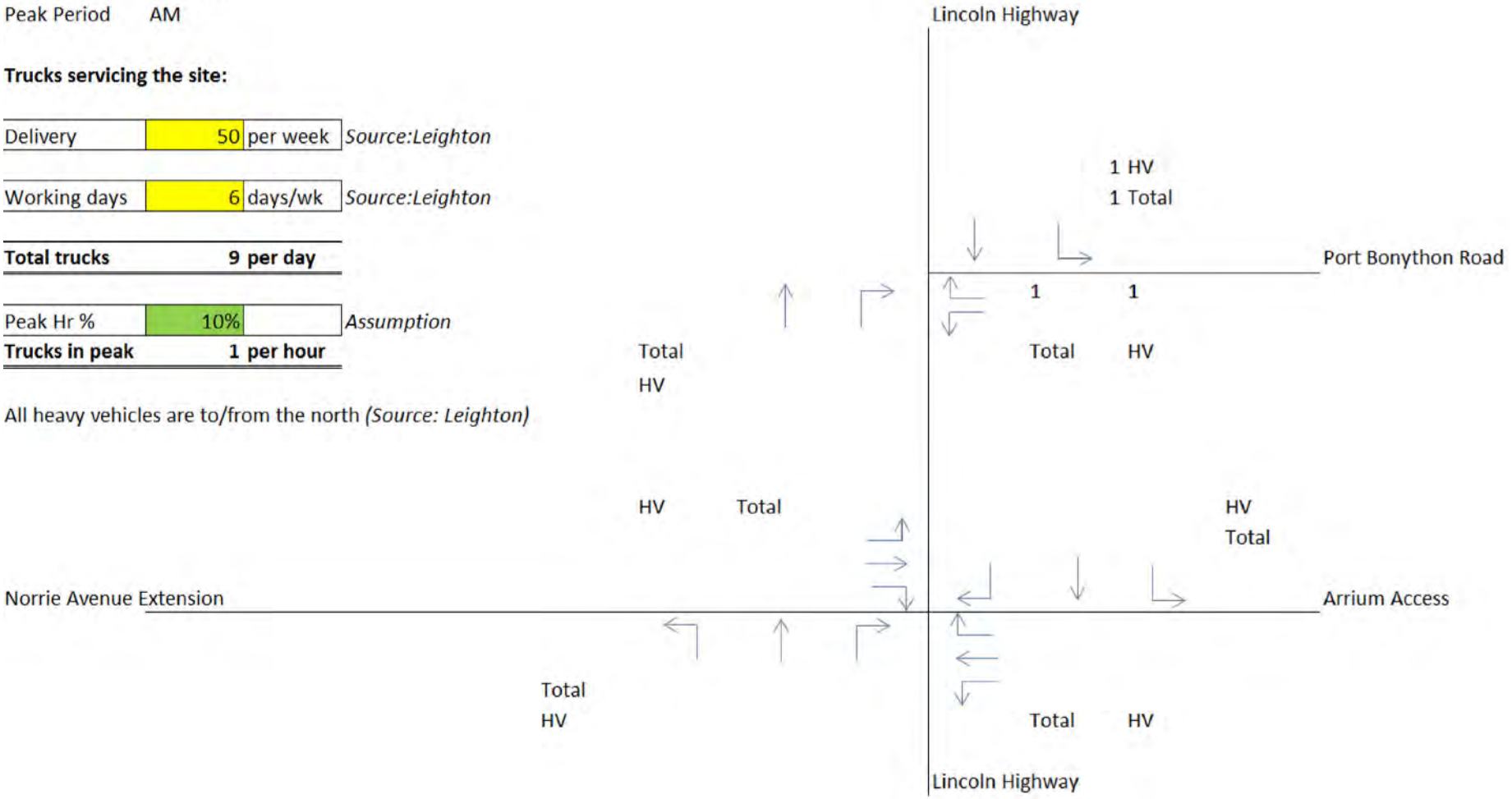


Figure 8.4g: Traffic generated by construction trucks on materials delivery route (morning peak)

Port Bonython

Construction traffic (trucks)

Year 2017

Peak Period PM

Trucks servicing the site:

Delivery	50	per week	*Source:Leighton*
Working days	6	days/wk	*Source:Leighton*
Total trucks	**9 per day**		
Peak Hr %	10%		*Assumption*
Trucks in peak	**1 per hour**		

All heavy vehicles are to/from the north *(Source: Leighton)*

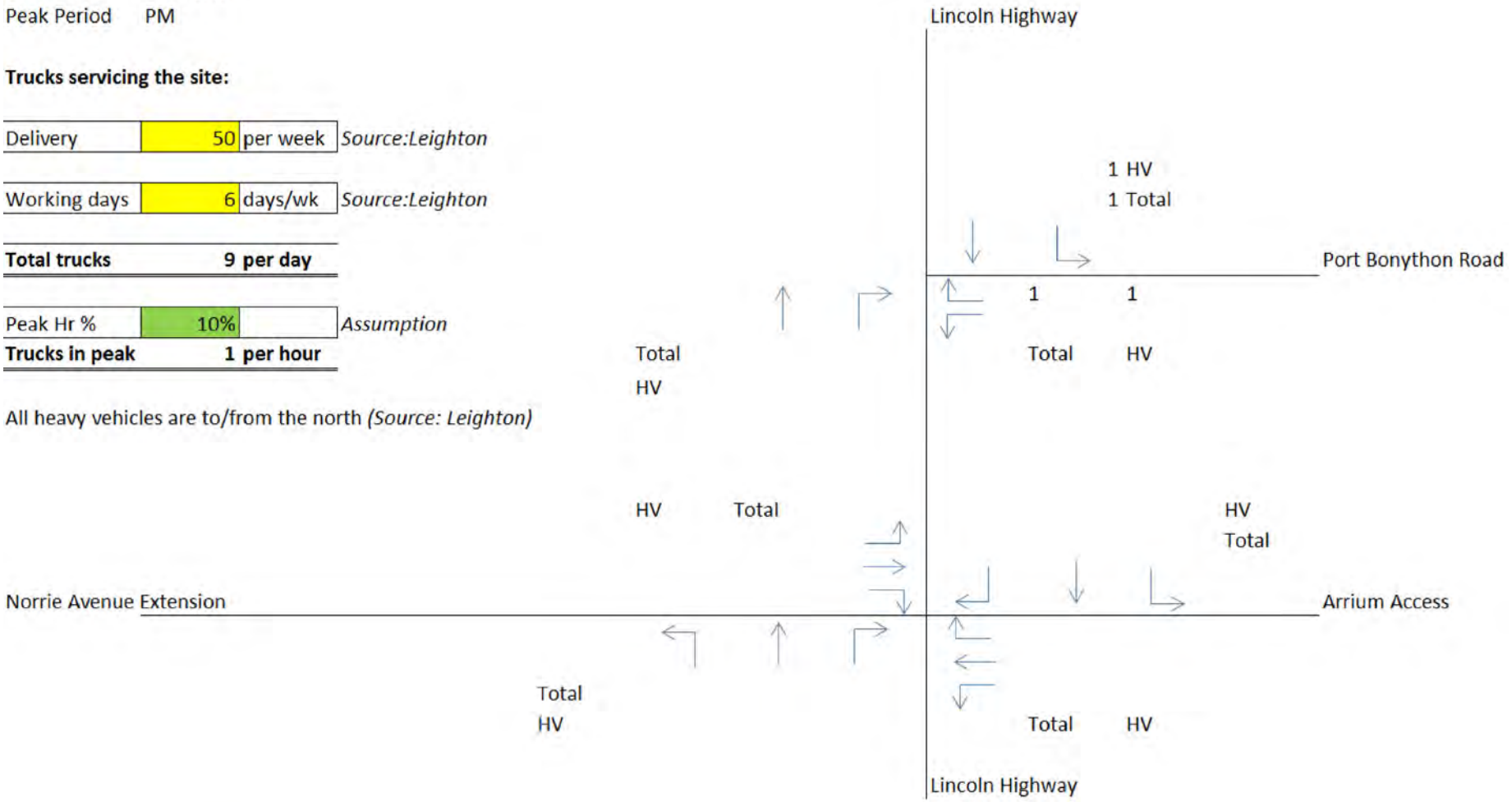


Figure 8.4h: Traffic generated by construction trucks on materials delivery route (evening peak)

Port Bonython

Construction traffic (cars)

Year 2017

Peak Period AM

Cars along haul route:	15	veh/day	*Source:Leighton*
Peak Hr %	10%		*Assumption*
Cars in peak	**2 per hour**		

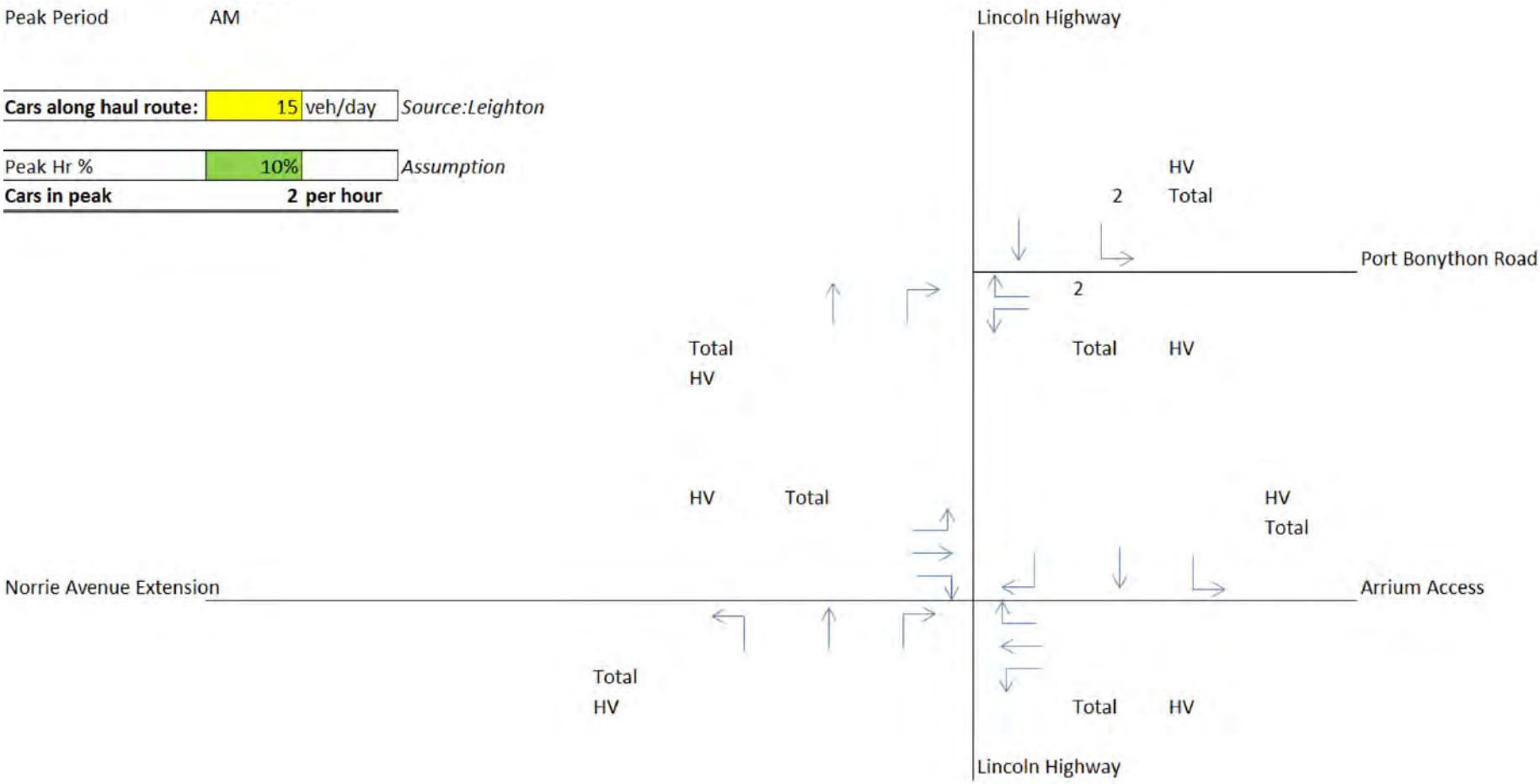
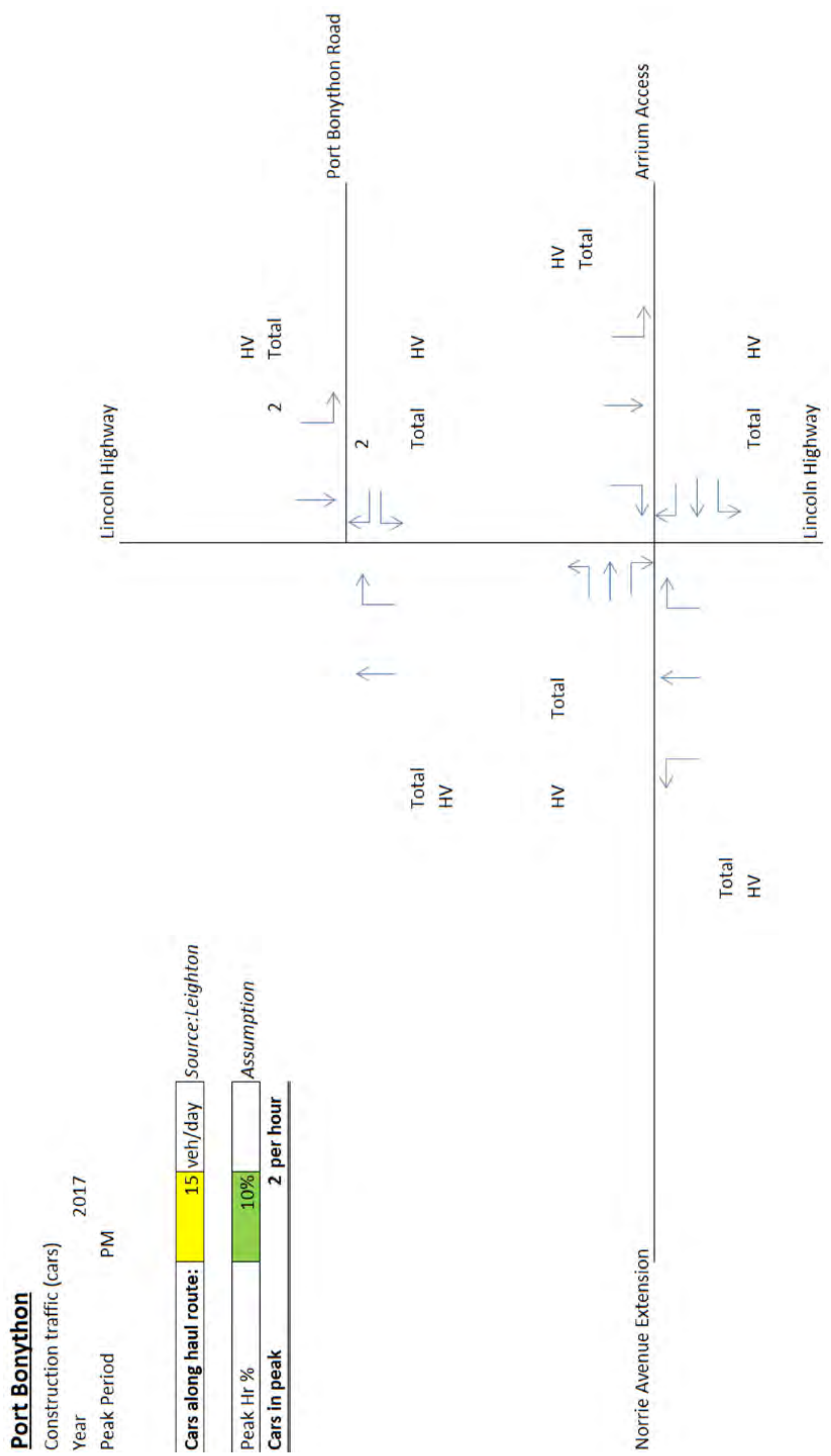


Figure 8.4i: Traffic generated by construction cars on materials delivery route (morning peak)

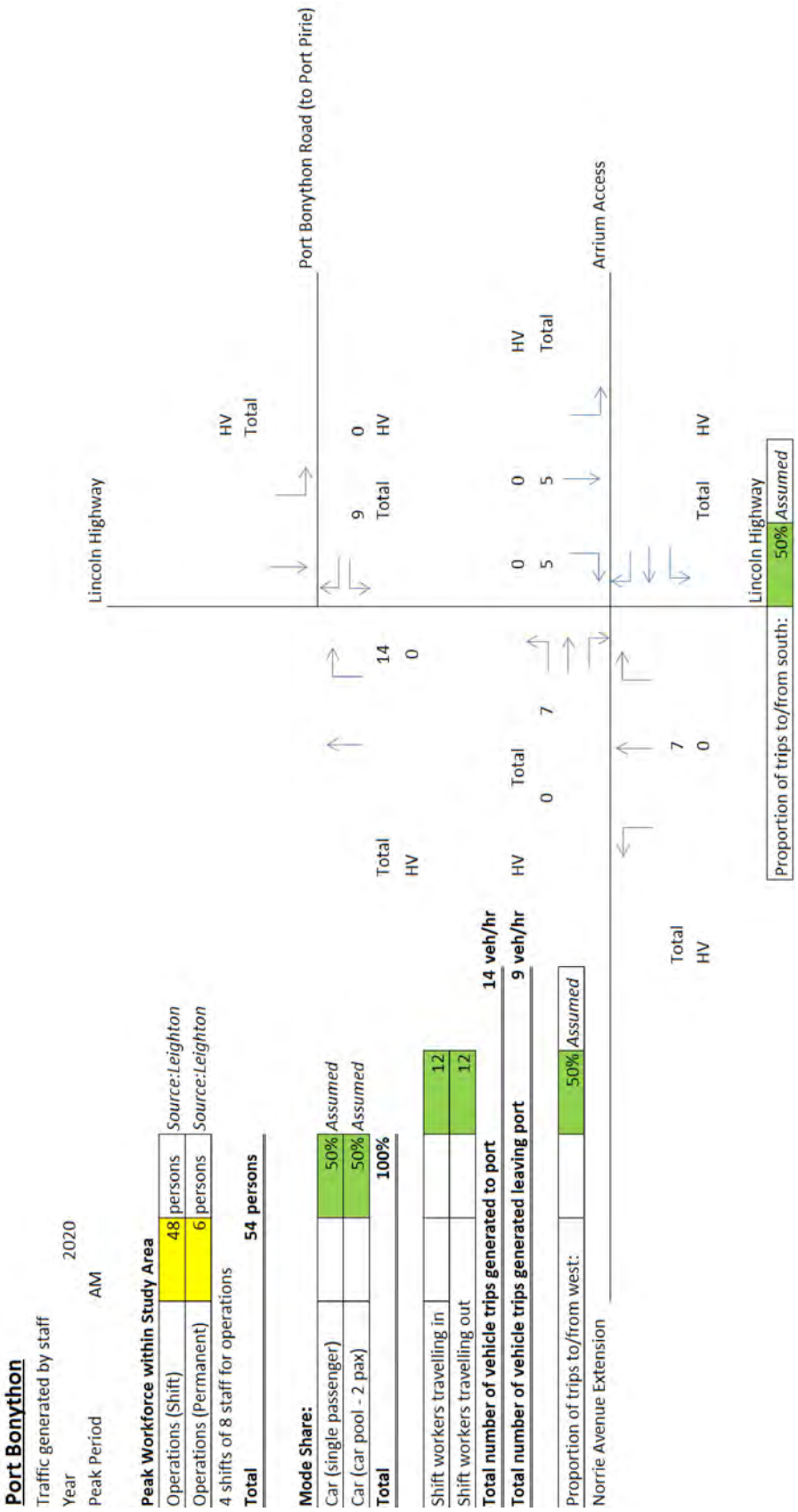
Figure 8.4j: Traffic generated by construction cars on materials delivery route (evening peak)



Operation Phase (Stage Two, 50Mtpa)

The traffic predicted to be generated by the operation of the BCEF in the morning and evening peak hours is presented below in **Figures 8.4k** to **8.4n**.

Figure 8.4k: Traffic generated by operations staff (morning peak)



Port Bonython

Traffic generated by staff

Year 2020

Peak Period PM

Peak Workforce within Study Area

Operations (Shift)	48	persons	*Source:Leighton*
Operations (Permanent)	6	persons	*Source:Leighton*

4 shifts of 8 staff for operations

Total 54 persons

Mode Share:

Car (single passenger)	50%	*Assumed*
Car (car pool - 2 pax)	50%	*Assumed*
Total	**100%**	

Shift workers travelling in		12
Shift workers travelling out		12

Total number of vehicle trips generated to port 9 veh/hr

Total number of vehicle trips generated leaving port 14 veh/hr

Proportion of trips to/from west:	50%	*Assumed*

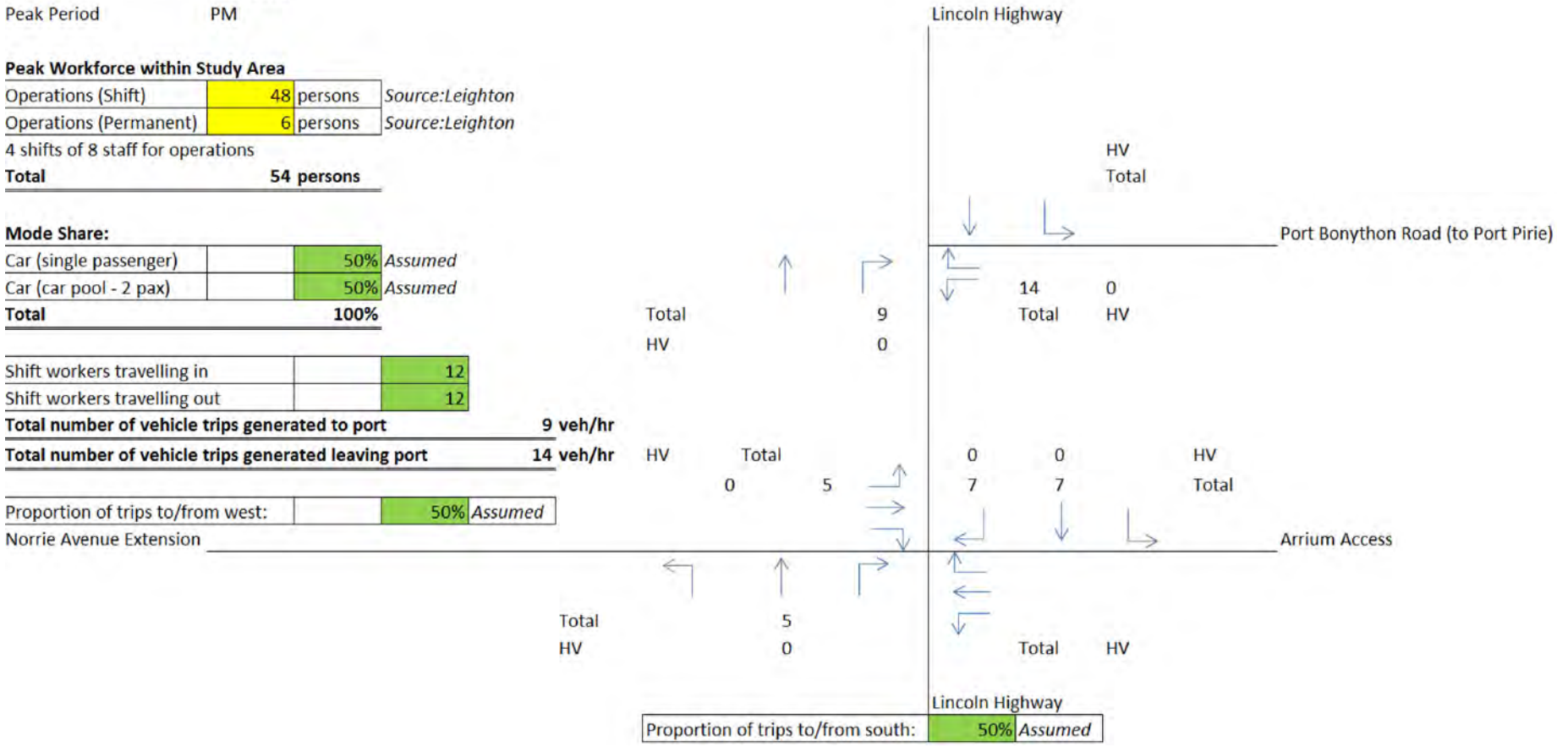


Figure 8.4l: Traffic generated by operations staff (evening peak)

Figure 8.4m: Traffic generated by operations trucks (morning peak)

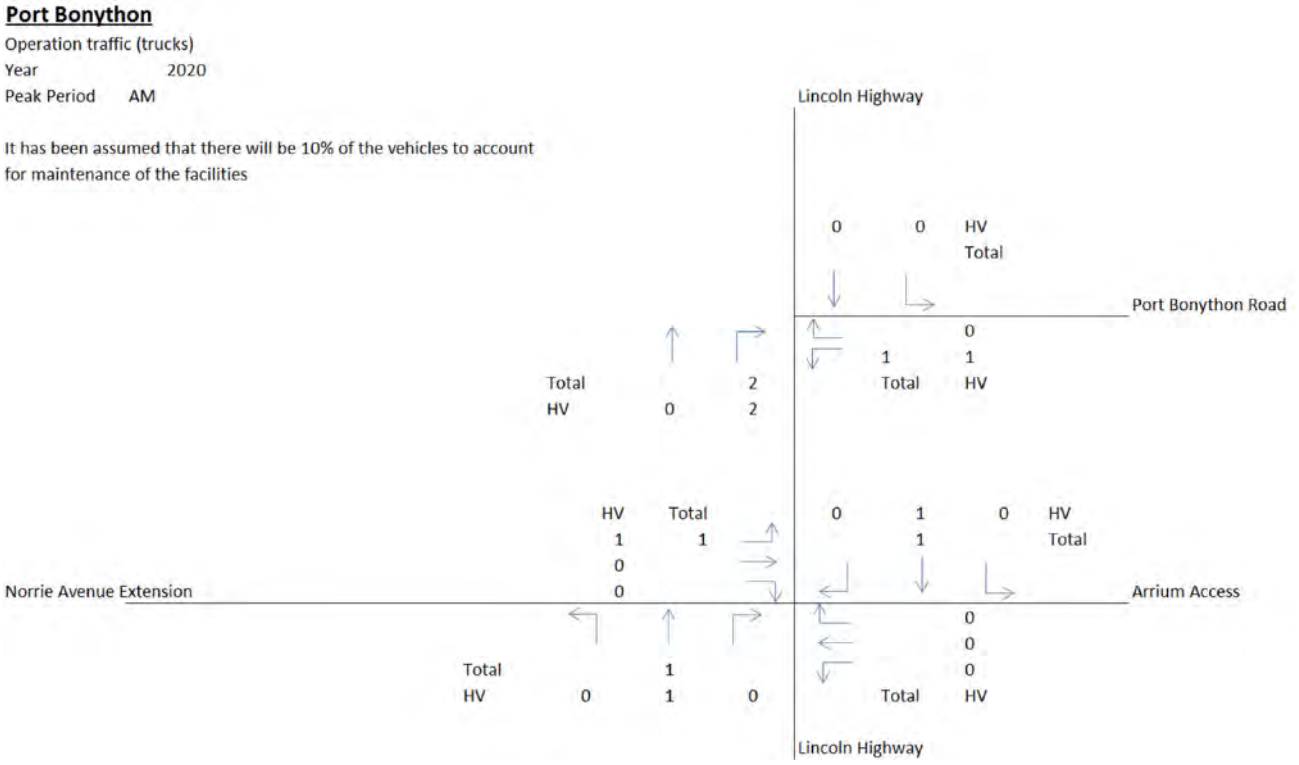
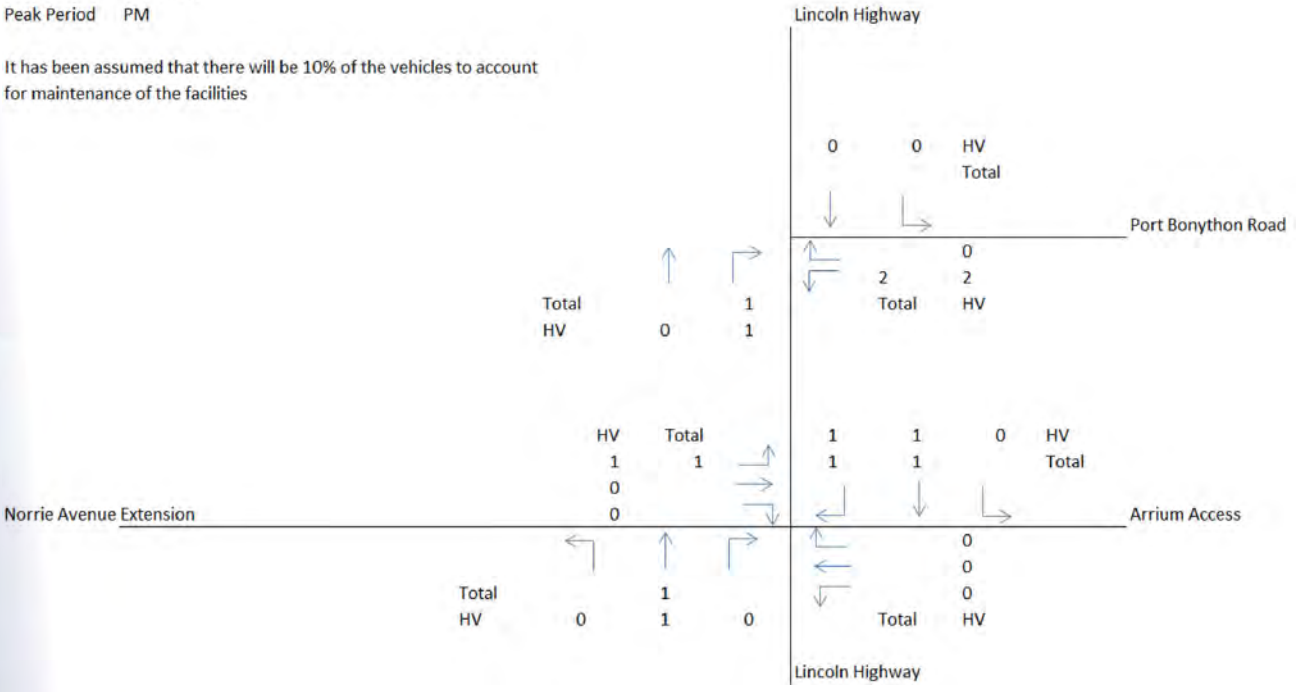


Figure 8.4n: Traffic generated by operations trucks (evening peak)



8.4.2.3. Daily Traffic Volumes

The daily traffic volumes on the key links in the study area were calculated for the years of interest. The AADT, 15 Hour volumes and the nine hour volumes were calculated. These calculations were based on traffic counts undertaken in 2013 and a factor for the ratio between the historic peak period volumes and AADT, 15 hour and nine hour volumes. The assumptions outlined in **Section 8.4.2.1** above were then used to determine the daily traffic volumes during construction and the first year of operation of Stage One of the Project.

A summary of the daily traffic volumes is presented in **Table 8.4c** to **8.4e**. Detailed calculations are provided in **Appendix H.4**.

Table 8.4c: Summary of AADT on key roads

AADT (veh/day)	Lincoln Hwy	Port Bonython Rd	Norrie Ave Extension
2013	2174	330	3223
2017 Do Nothing	2447	371	3628
2020 Do Nothing	2674	406	3964
2017 Construction	2647	595	3728
2020 Operations	2734	466	3994

Table 8.4d: Summary of 15 hour traffic volumes on key roads

15 Hour (veh/15 hr)	Lincoln Hwy	Port Bonython Rd	Norrie Ave Extension
2013	1990	276	2951
2017 Do Nothing	2240	311	3322
2020 Do Nothing	2448	340	3630
2017 Construction	2390	485	3397
2020 Operations	2496	388	3654

Table 8.4e: Summary of nine hour traffic volumes on key roads

9 Hour (veh/9 hr)	Lincoln Hwy	Port Bonython Rd	Norrie Ave Extension
2013	405	36	601
2017 Do Nothing	456	41	677
2020 Do Nothing	499	45	739
2017 Construction	506	91	702
2020 Operations	513	59	747

8.4.2.4. Heavy Vehicle Percentage

The percentage of heavy vehicles was calculated on the three roads for the four scenarios. Percentages from traffic counts were used for the 2013 and 2016 Do Nothing scenarios. For the construction and operations scenarios the additional heavy vehicles such as haulage vehicles were taken into consideration.

A summary of the heavy vehicle percentages is presented in **Table 8.4f** to **8.4h**. Detailed calculations are provided in **Appendix H.4**.

Table 8.4f: Summary of heavy vehicle percentages on Port Bonython Road

Assessment	Time Period	HV%
2013	AADT, 15hr, 9hr	17.0%
2017 Do Nothing		17.0%
2020 Do Nothing		17.0%
2017 Construction	AADT	14.6%
	15hr	15.8%
	9hr	7.7%
2020 Operations	AADT	14.2%
	15hr	14.3%
	9hr	13.0%

Table 8.4g: Summary of heavy vehicle percentages on Lincoln Highway

Assessment	Time Period	HV%
2013	AADT, 15hr, 9hr	9.9%
2017 Do Nothing		9.9%
2020 Do Nothing		9.9%
2017 Construction	AADT	9.2%
	15hr	9.3%
	9hr	8.9%
2020 Operations	AADT	9.0%
	15hr	9.0%
	9hr	9.0%

Table 8.4h: Summary of heavy vehicle percentages on Norrie Avenue Extension

Assessment	Time Period	HV%
2013	AADT, 15hr, 9hr	17.0%
2017 Do Nothing		17.0%
2020 Do Nothing		17.0%
2017 Construction	AADT	16.5%
	15hr	16.6%
	9hr	16.4%
2020 Operations	AADT	15.5%
	15hr	15.5%
	9hr	15.4%

8.5. Assessment of Study Area Extents

An assessment of the impact of the construction and operation at the boundary of the study area was completed. Guidance from Austroads Guide to Traffic Management Part 12: Traffic Impacts of Development (2009) suggests that a traffic assessment should be completed where the amount of additional traffic generated by a development exceeds five percent of existing volumes.

A comparison of additional traffic generated by the construction and operation to the background traffic at each intersection was made to determine whether the development generated traffic is greater than five percent of the background traffic. A summary of this assessment is presented in **Table 8.5a** and **Table 8.5b** for the two scenarios selected in **Section 8.4.2.2** (the final year of construction of the 25Mtpa BCEF, and the first year of operation of the 50Mtpa BCEF).

Table 8.5a: Summary of intersection traffic increases due to construction of Stage One

Intersection	Percentage increase in traffic caused by construction	
	Morning peak hour	Evening peak hour
Lincoln Highway / Eyre Highway	4%	4%
Lincoln Highway / Port Bonython Road	31%	24%
Lincoln Highway / Norrie Avenue Extension	5%	6%
Norrie Avenue Extension / Iron Knob Whyalla Road	3%	3%
Lincoln Highway / McBryde Terrace	3%	3%

Table 8.5b: Summary of intersection traffic increases due to operation of Stage Two

Intersection	Percentage increase in traffic caused by operations	
	Morning peak hour	Evening peak hour
Lincoln Highway / Eyre Highway	0%	0%
Lincoln Highway / Port Bonython Road	12%	9%
Lincoln Highway / Norrie Avenue Extension	2%	2%
Norrie Avenue Extension / Iron Knob Whyalla Road	3%	3%
Lincoln Highway / McBryde Terrace	3%	3%

The results above indicate that the study area extents described in **Section 3.1** are appropriate, as the intersections at the boundary of the study area have less than five percent impact from the construction and operation.

8.6. Assessment of Potential Impact

The design traffic volumes used in the traffic assessment were calculated by combining the data presented in **Section 8.3** (existing traffic) and **Section 8.4** (predicted traffic volumes, including Project traffic). The resulting volumes are summarised below in **Figures 8.6a** to **8.6d**.

Figure 8.6a: Forecast traffic volumes with the construction in 2017 (morning peak)

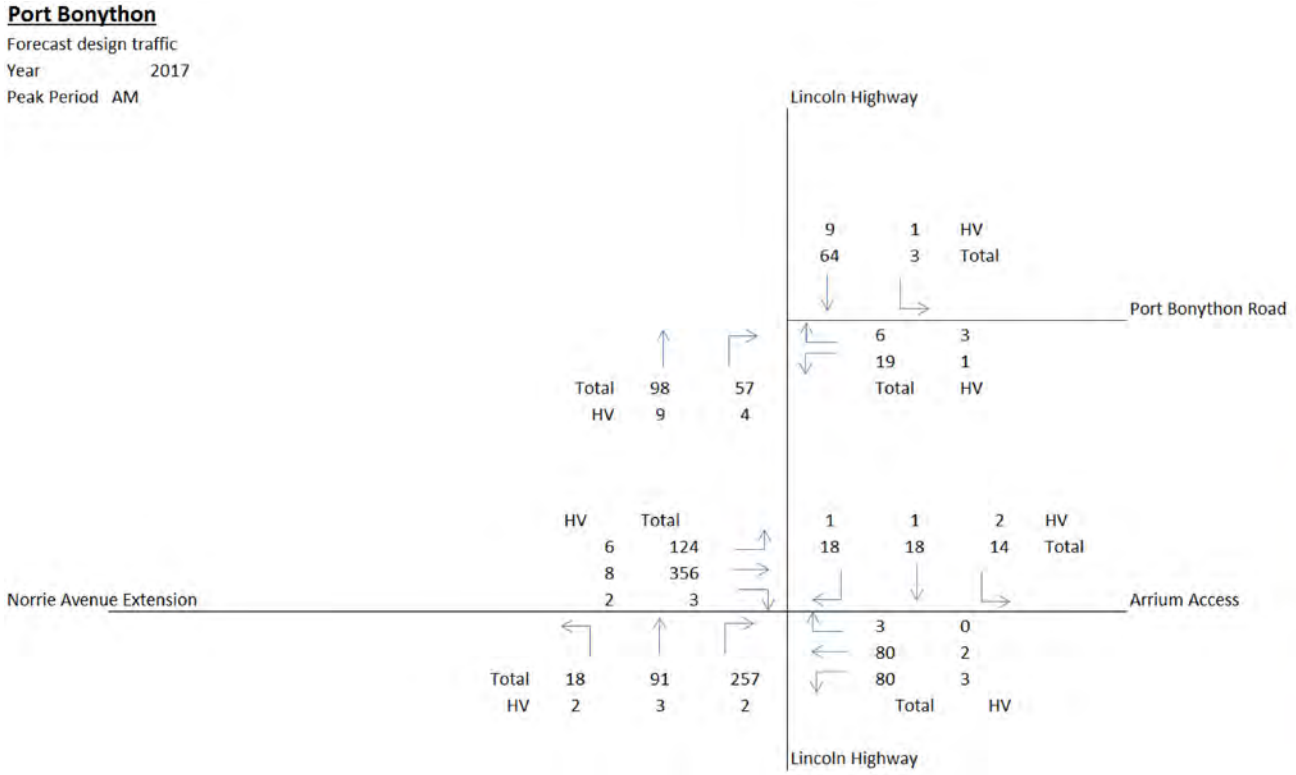


Figure 8.6b: Forecast traffic volumes with the construction in 2017 (evening peak)

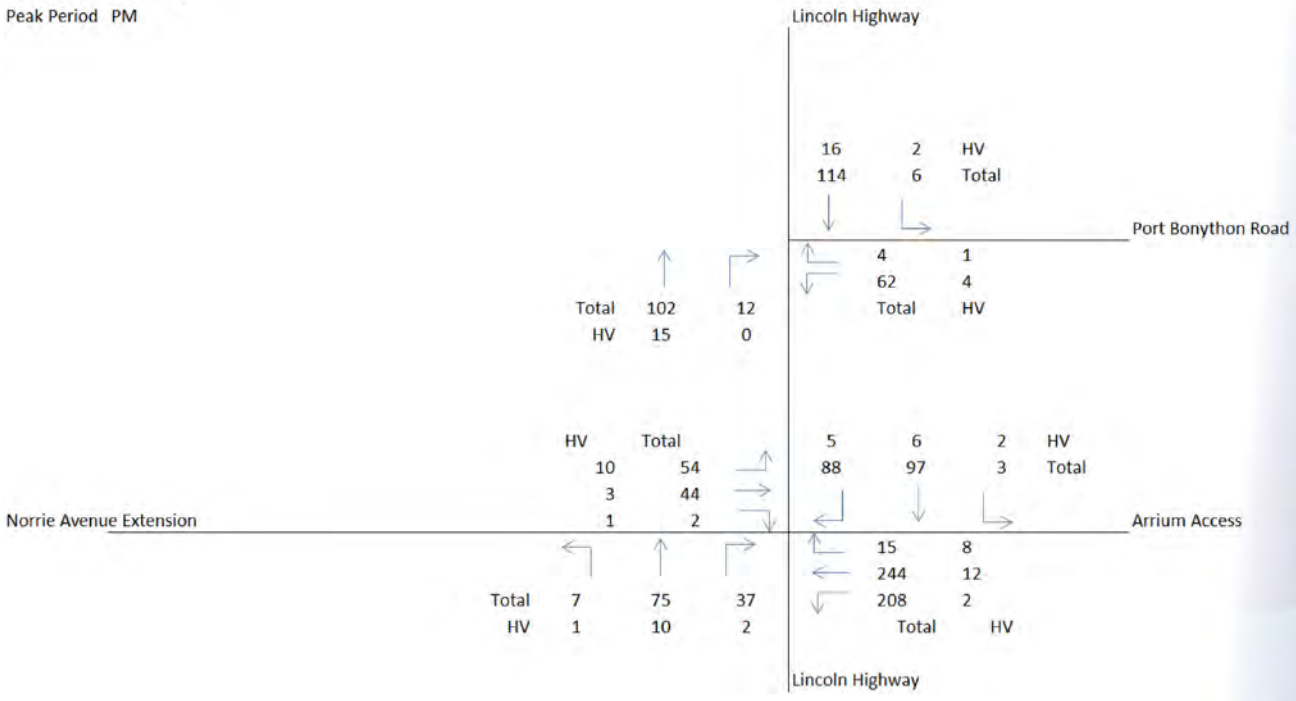


Figure 8.6c: Forecast traffic volumes for operation in 2020 (morning peak)

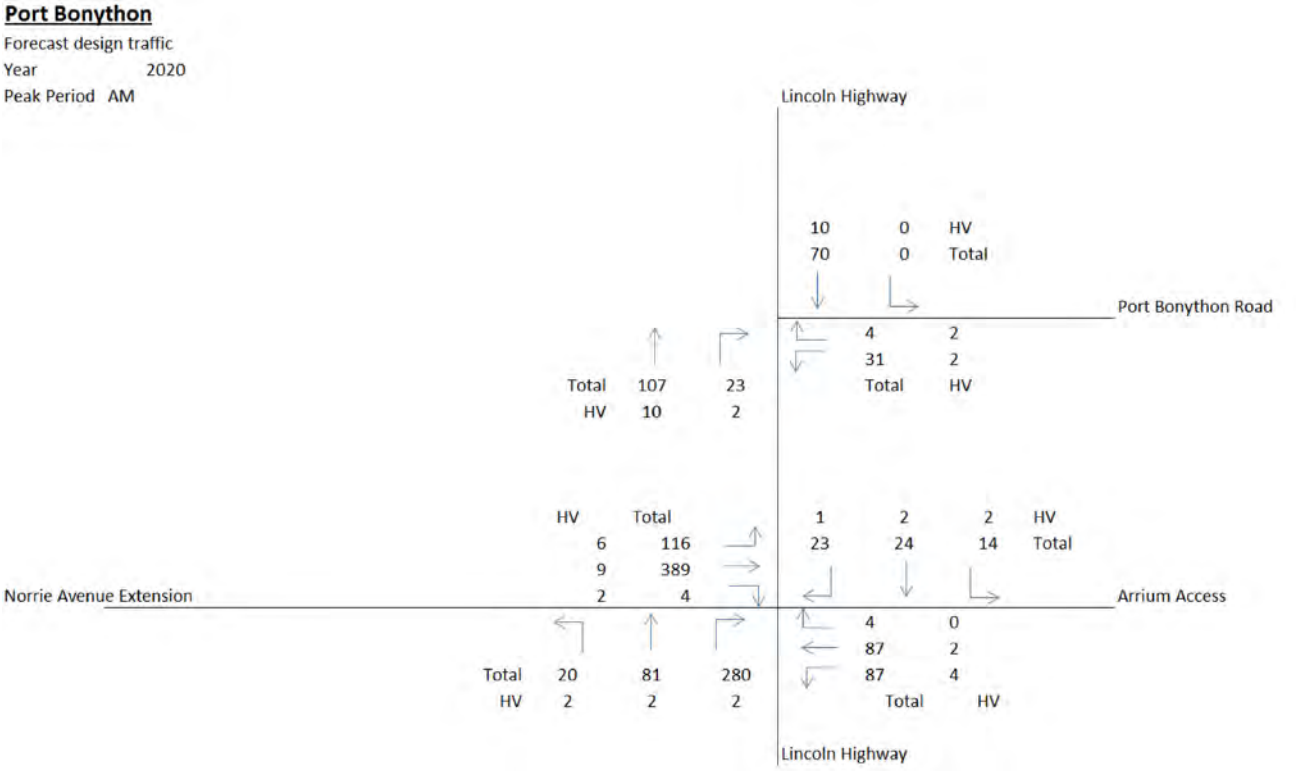
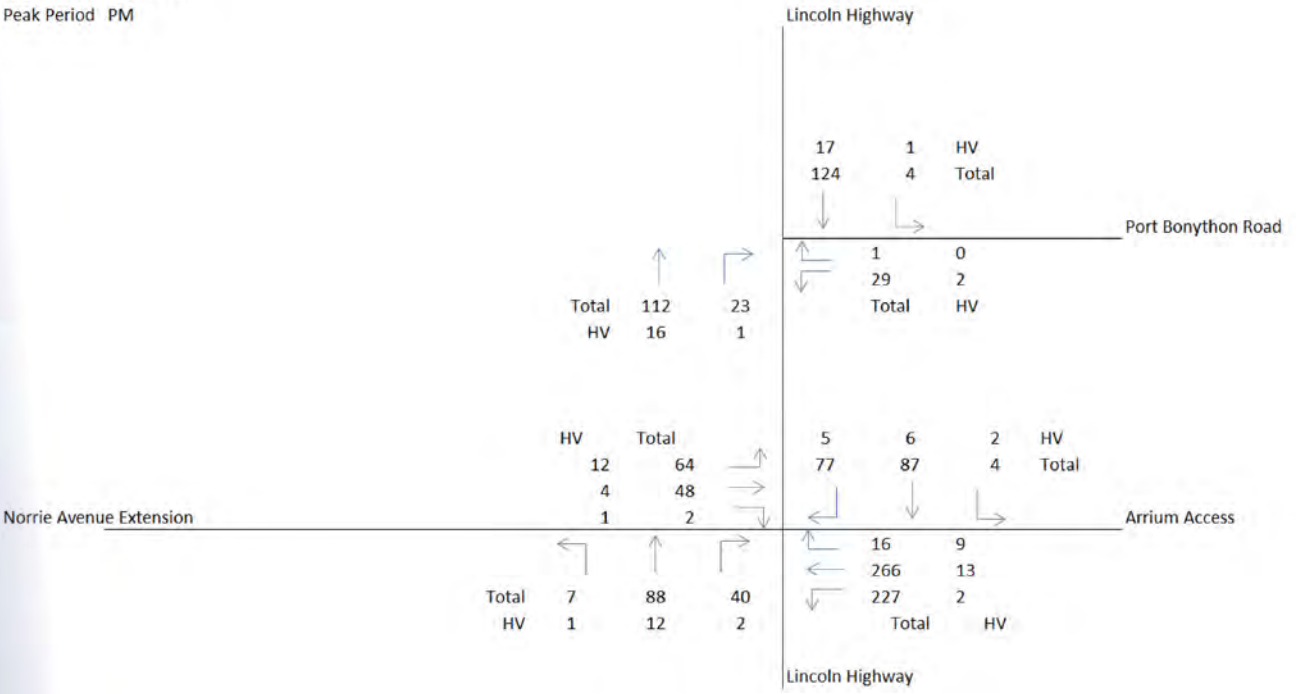


Figure 8.6d: Forecast traffic volumes for operation in 2020 (evening peak)



Three aspects of the impact of the development generated traffic were assessed:

- The impact on the intersections. This was assessed using SIDRA Intersection software (refer to **Section 8.6.1**), as well as turn treatment warrants based on Austroads guidelines
- The impact on the road links. This was assessed using guidance from the HCM2010 (refer to **Section 8.6.2**)
- The impact on rail crossings that are currently in use.

8.6.1. Intersection Assessment

Two key intersections within the study area were assessed using SIDRA Intersection software:

- Lincoln Highway / Port Bonython Road
- Lincoln Highway / Norrie Avenue Extension / Arrium access.

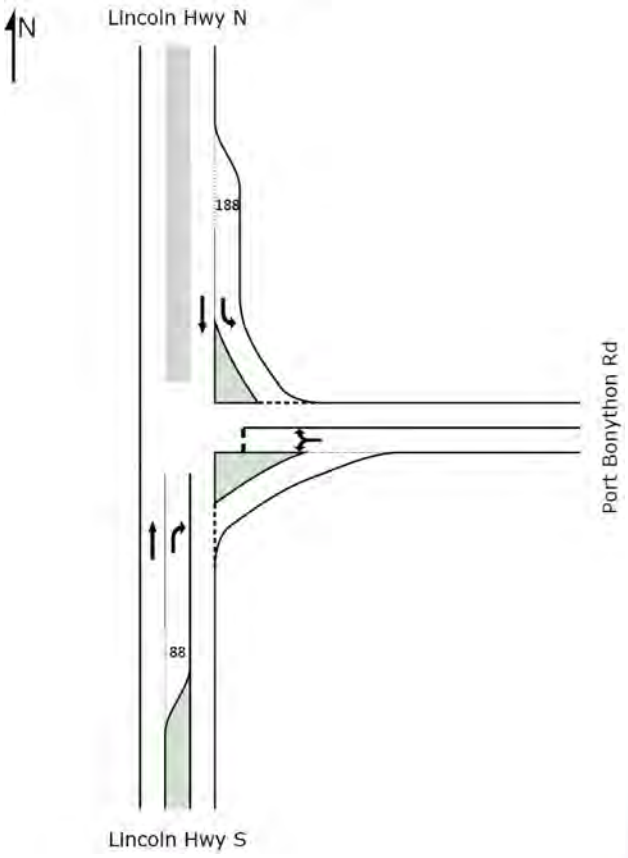
The current operation of these intersections was assessed using SIDRA Intersection software based on the existing intersection layouts. Similarly to the baseline intersection capacity calculation, three key performance parameters were assessed:

- Degree of Saturation (%) -This is the ratio of demand flow to capacity. For priority controlled intersections, the acceptable limit of operation is reached when the degree of saturation exceeds 80 per cent. For signalised intersections, the acceptable limit of operation is reached when the degree of saturation exceeds 90 per cent
- Average Delay (sec) – The average delay per vehicle in seconds incurred by vehicles over the modelled time period
- 95th Percentile Queue – A queue length measured in metres of which only five per cent of queues are equal to or greater than.

8.6.1.1. Lincoln Highway / Port Bonython Road

The Lincoln Highway / Port Bonython Road intersection is currently priority controlled, with segregated turn lanes. An indicative layout of the existing intersection is shown in **Figure 8.6e.**

Figure 8.6e: Lincoln Highway / Port Bonython Road intersection layout



Construction Phase

The results of the SIDRA assessment for the construction phase are presented in **Table 8.6a**.

Table 8.6a: Lincoln Highway / Port Bonython Road intersection assessment results during construction (Stage One)

		Degree of Saturation		Average Delay (s)		95th Percentile Queue (m)	
Approach	Movement	AM	PM	AM	PM	AM	PM
Lincoln Highway (south)	Through	6%	6%	0	0	0	0
	Right	4%	1%	9	9	1	0
Port Bonython Road	Left	3%	7%	9	9	1	2
	Right	3%	7%	11	10	1	2
Lincoln Highway (north)	Left	0%	1%	9	9	0	0
	Through	4%	7%	0	0	0	0
Overall		6%	7%	3	3	1	2

The above results show that the intersection will operate with an acceptable level of service during the peak construction period. It is noted that the queue on Port Bonython Road (less than 3m in both peak periods) is unlikely to obstruct the operation of the level crossing, which is located approximately 70m away.

Operation Phase

The results of the SIDRA assessment for the operation phase are presented in **Table 8.6b**.

Table 8.6b: Lincoln Highway / Port Bonython Road intersection assessment results during operation (Stage One)

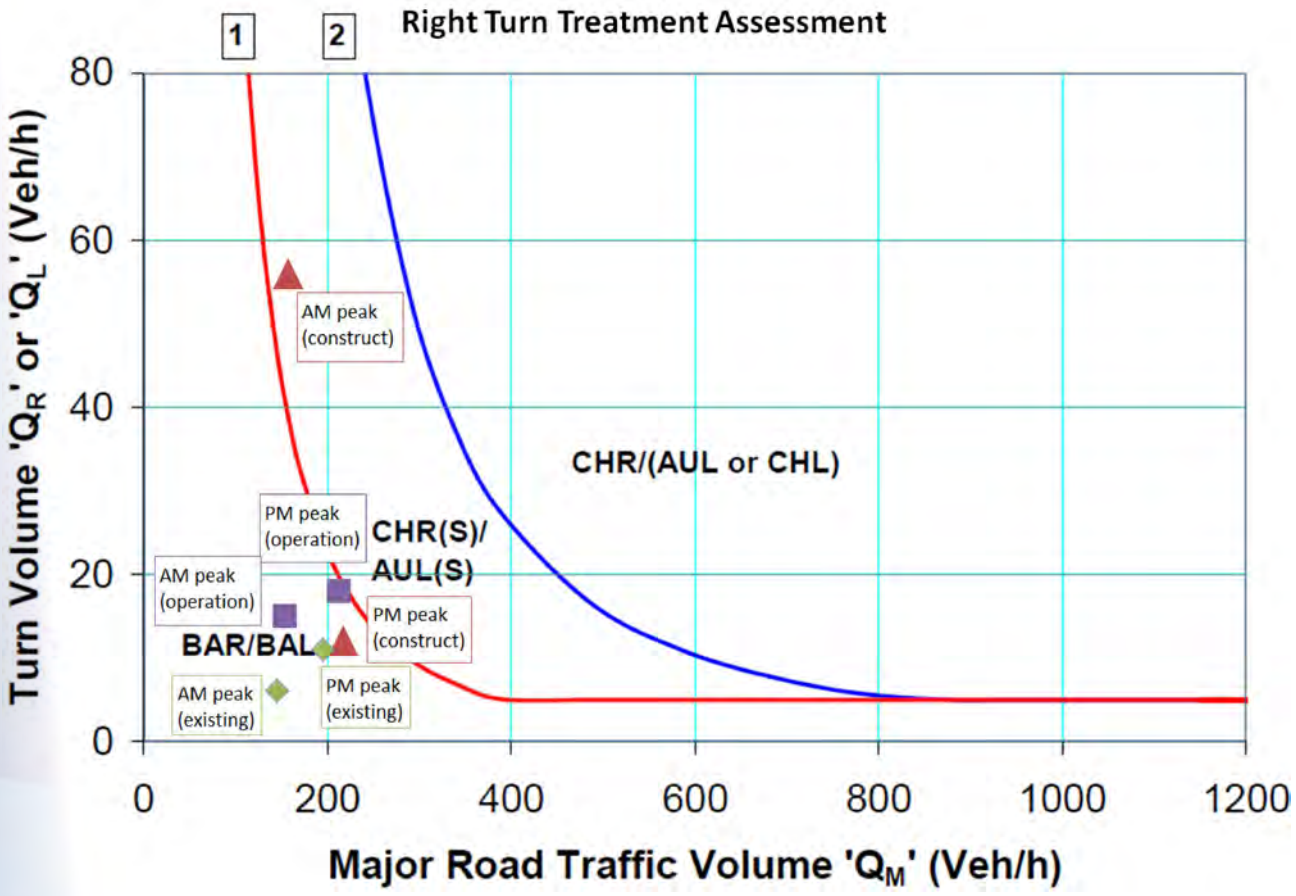
		Degree of Saturation		Average Delay (s)		95th Percentile Queue (m)	
Approach	Movement	AM	PM	AM	PM	AM	PM
Lincoln Highway (south)	Through	6%	7%	0	0	0	0
	Right	2%	2%	9	9	1	1
Port Bonython Road	Left	4%	3%	9	9	1	1
	Right	4%	3%	11	9	1	1
Lincoln Highway (north)	Left	0%	0%	8	8	0	0
	Through	4%	7%	0	0	0	0
Overall		6%	7%	2	2	1	1

The above results show that the intersection will operate with an acceptable level of service during the first year of operation. It is noted that the queue on Port Bonython Road (less than 1m in both peak periods) is unlikely to obstruct the operation of the level crossing.

Intersection Geometry

In addition to the capacity assessment, an assessment of the existing right turn treatment from Lincoln Highway south approach to Port Bonython Road was completed based on guidelines presented in the Austroads Guide to Road Design Part 4A (2012). A summary of the assessment results is presented in **Figure 8.6f**.

Figure 8.6f: Right Turn Treatment Assessment (Austroads, 2012)



The assessment showed that while a BAR treatment is suitable for existing and operational volumes, a shortened channelised right turn (CHR(S)) treatment will be required to accommodate the expected traffic volumes in 2017. It should be noted that the CHR(S) will only be required in the construction phase. However, given that the construction phase will be 30 months it may be considered necessary due to the long construction period.

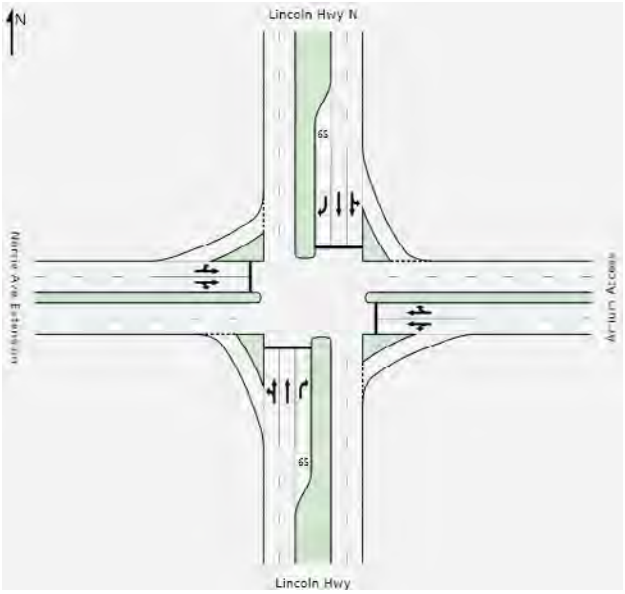
It was noted from site measurements that the existing channelised right turn treatment from Lincoln Highway south approach does not fully meet the design requirements presented in the Austroads Guide to Road Design Part 4A (2012). It is considered that a turn lane that is not long enough will increase the likelihood of nose-to-tail accidents, as turning vehicles decelerate more prior to entering the turn lane.

As discussed in **Section 8.3.4.2**, the minimum right turn lane length to achieve a CHR(S) treatment should be 121.5m (or approximately 37.5m longer than the current arrangement).

8.6.1.2. Lincoln Highway / Norrie Avenue Extension / Arrium access

The Lincoln Highway / Norrie Avenue Extension / Arrium access intersection is currently signalised with left turn slip lanes provided on every approach, and a short right turn lane provided on the northern and southern approaches. An indicative diagram of the current layout is provided in **Figure 8.6g**.

Figure 8.6g: Lincoln Highway / Norrie Avenue Extension / Arrium Access intersection layout



Construction Phase (Stage One)

The results of the SIDRA assessment for the construction phase are presented in **Table 8.6c**.

The results indicate that the intersection has sufficient capacity to accommodate the traffic volumes in the peak construction year.

Table 8.6c: Lincoln Highway / Norrie Avenue Extension / Arrium Access intersection assessment results

		Degree of Saturation		Average Delay (s)		95th Percentile Queue (m)	
Approach	Movement	AM	PM	AM	PM	AM	PM
Lincoln Highway (south)	Left	12%	22%	21	27	8	8
	Through	12%	22%	17	24	9	9
	Right	63%	22%	32	37	53	8
Arrium Access	Left	18%	33%	14	11	9	21
	Through	18%	33%	14	12	9	28
	Right	18%	33%	36	30	7	28
Lincoln Highway (north)	Left	5%	19%	16	29	2	9
	Through	5%	19%	18	22	2	10
	Right	11%	35%	36	34	4	19
Norrie Avenue Extension	Left	58%	10%	21	13	49	7
	Through	58%	10%	20	13	49	7
	Right	58%	10%	36	38	38	4
Overall		63%	35%	22	18	53	28

Operations Phase (Stage One)

An intersection assessment of the Lincoln Highway / Norrie Avenue Extension / Arrium access intersection was not necessary for the operations phase as the increase in traffic volume is two percent of the total intersection volume. This is much less than the industry convention of five percent increase that will warrant an assessment.

8.6.2. Road Link Assessment

The capacity of the road links within the study area was assessed using guidelines from the HCM2010. The three key road links within the study area are:

- Lincoln Highway
- Port Bonython Road
- Norrie Avenue Extension.

The Lincoln Highway and Port Bonython Road were assessed as two lane highways in accordance with guidelines in Chapter 15 of the HCM2010. Norrie Avenue Extension was assessed as a multi-lane highway using the methodology in Chapter 14 of the HCM2010.

8.6.2.1. Lincoln Highway

The capacity of the Lincoln Highway between the Lincoln Highway / Port Bonython Road and Lincoln Highway / Norrie Avenue Extension intersections was assessed using the methodology specified in Chapter 15 of the HCM2010. The assessment showed that the road link has sufficient capacity to accommodate the expected future traffic volumes during the peak construction year and first year of operation, and is expected to operate with a Level of Service (LOS) of A.

8.6.2.2. Port Bonython Road

The capacity of Port Bonython Road was assessed using the methodology specified in Chapter 15 of the HCM2010. The assessment showed that the road link has sufficient capacity to accommodate the expected future traffic volumes during the peak construction year and first year of operation, and is expected to operate with a Level of Service (LOS) of A.

8.6.2.3. Norrie Avenue Extension

The capacity of Norrie Avenue Extension was assessed using guidance from Chapter 14 of the HCM2010. As the maximum predicted traffic flow rate on Norrie Avenue Extension (approximately 450 vehicles per hour eastbound in the morning peak) is less than the service flow rate for a single lane (550 vehicles per hour for a Level of Service of A), it was concluded that Norrie Avenue Extension has sufficient capacity to accommodate the future predicted traffic flows during the peak construction year and first year of operation.

8.6.3. Rail Level Crossing

There is currently one active rail level crossing within the study area. This crossing is located on Port Bonython Road, approximately 60-70m from the Lincoln Highway / Port Bonython Road intersection. The crossing is currently controlled by lights only, which is appropriate for public roads crossing a single rail line according to the Australian Rail Track Corporation Standard ESD-03-01. The standard does, however, note that boom gates may be installed on single line crossings following a risk assessment.

While boom gates assist in preventing vehicles from entering a level crossing while a train is approaching or crossing, it is considered that a boom gate treatment is unnecessary at this location for the following reasons:

- The peak predicted traffic volume crossing the tracks is approximately 67 vehicles/hour, or approximately one vehicle per minute. This is considered to be a very low traffic volume
- Other crossings in the region with similar or higher traffic volumes do not utilise boom gates (for example, Port Augusta-Quorn Road at Stirling North, Flinders Highway at Coomunga near Port Lincoln)
- As such, this introduces a risk that spare parts are not readily available to repair any boom gate malfunction at Port Bonython Road.

8.6.4. Rail Capacity

Advice from the ARTC indicates that there will be sufficient capacity on the railway network to support the expected rail traffic generated by the BCEF. This advice is attached in **Appendix H.5**.

8.6.5. Temporary Construction Impacts

In addition to the impact on traffic capacity caused by additional traffic volumes explored in **Sections 8.6.1** and **8.6.2**, there are expected to be additional temporary impacts during construction. These include:

- Impact on the Whyalla rail spur during the construction of the connection with the line to Port Bonython
- Obstruction to property accesses along Port Bonython Road during the construction of the line to Port Bonython
- Disruption to general traffic during the movement of oversized loads along the delivery path.

It is anticipated that the construction of the rail connection to Port Bonython can be completed during a brief closure of the Whyalla line. The exact methodology will be required to be agreed with ARTC during the detailed design phase of the Project.

It is recognised that the construction of the Port Bonython rail line is likely to affect the operation of property accesses along Port Bonython Road, including access to properties at Fitzgerald Bay. These will be required to be managed through the development of a Traffic Management Plan during the detailed design phase, in consultation with local property owners. The permanent impact of the rail line crossing these accesses will be minimised by tailoring the location of the rail line / Port Bonython Road grade separated crossing to avoid an at-grade crossing of the property accesses at Fitzgerald Bay Road and Cuttlefish Drive.

There may also be some temporary disruption to normal traffic flow due to over-sized vehicles travelling along the delivery route. As is usual with vehicles of this type, the contractor will be required to prepare a Traffic Management Plan for these vehicles, in consultation with DPTI.

8.6.6. Parking Arrangements

Sufficient off-road car parking spaces shall be provided to minimise the occurrence of on-road or uncontrolled off-road parking, which will tend to affect road safety. The number of parking spaces provided should be sufficient to allow for staff and visitor car parking. The peak parking demand on site will coincide with the peak traffic generation from the site, or during the construction of the first phase of the Project.

Based on the mode share information and assumptions presented in **Sections 8.4.2.1**, it is anticipated that staff will drive a total of 94 vehicles to the BCEF during the period of highest staff activity. A further 15 car parking spaces should be provided for visitors, based on the number of private vehicles anticipated to drive along the delivery route during construction. Based on this, a total of at least 109 car parking spaces should be provided on site. However, the Whyalla Development Code suggests a minimum car parking space provision of one space per two employees, corresponding to a requirement of 125 spaces. Therefore, it is proposed that at least 125 spaces be provided. Based on the National Construction Code, three of these car parking spaces should be provided for people with disabilities.

The parking demand from the facility will be significantly lower during the operational phase due to the lower staff numbers on site. Based on the operational staff numbers and assumptions provided in **Sections 8.4.2.1**, approximately 23 staff parking spaces would be required (accounting for overlap of parking demand during shift changeover). It is considered that approximately four visitor car parking spaces would be appropriate, based on the proportion of visitor car parking provided during the construction phase. The Whyalla Development Code recommends at least one space per two employees be provided, or 27 spaces. It is noted that these methods result in the same requirement, and as such, 27 car parking spaces should be provided. Based on the National Construction Code, one of these car parking spaces should be provided for people with disabilities.

The car parking spaces provided on site shall be sized in accordance with the requirements in AS2890.1, the Australian Standard for off-street car parking.

8.7. Significance Criteria Assessment Summary

8.7.1. Initial Assessment

Based on the assessment summarised in **Section 8.6.2**, the additional traffic generated by the construction is not expected to cause a significant impact on the surrounding road network. The only impact that will require further mitigation is the safety impact on the right turn from Lincoln Highway south approach to Port Bonython Road. A summary of the impact assessment completed is provided in **Table 8.7a.**

Table 8.7a: Transport Impacts (no mitigation)

Traffic Impacts		Initial assessment with no mitigation			
Primary impacting processes	**Relevant Significance Criterion**	**Statutory mitigation measures required**	**Significance of impact**	**Likelihood of impact**	**Risk rating**
Reduced safety for turning traffic at the Lincoln Highway / Port Bonython Road intersection	Safety (road)	Turn treatment improvements as required, as per Austroads	Moderate	Likely	High
Operational failure (insufficient capacity) of the Lincoln Highway / Port Bonython Road intersection	Traffic capacity (Intersection capacity)	NA	Moderate	Highly Unlikely	Low
Operational failure (insufficient capacity) of the Lincoln Highway / Norrie Avenue Extension intersection	Traffic capacity (Intersection capacity)	NA	Moderate	Highly Unlikely	Low
Over-utilisation of Lincoln Highway traffic capacity (north)	Traffic capacity (Link capacity)	NA	Moderate	Highly Unlikely	Low
Over-utilisation of Lincoln Highway traffic capacity (south)	Traffic capacity (Link capacity)	NA	Moderate	Highly Unlikely	Low
Reduced safety at rail level crossings	Safety (rail)	NA	Moderate	Unlikely	Medium
Disruption of traffic due to over-sized loads	Traffic capacity (Intersection capacity)	Traffic management plan to be developed during detailed design stage	Minor	Unlikely	Low
Disruption of property accesses along Port Bonython Road due to construction of rail line	Traffic capacity (Intersection capacity), Safety (rail)	Traffic management plan to be developed during detailed design stage	Minor	Likely	Medium
Disruption of property accesses along Port Bonython Road due to operation of rail line	Safety (rail)	NA	Moderate	Unlikely	Medium
Insufficient on-site parking leading to parking occurring at inappropriate locations	Safety (road)	Car park to provide sufficient on-site parking spaces	Minor	Unlikely	Low

8.7.2. Mitigation Measures

Several mitigation measures are proposed as part of the Project works:

- Improvement of the right turn treatment at the Lincoln Highway / Port Bonython Road intersection
- Grade separation of the new rail crossing of Port Bonython Road
- Development of a construction traffic management plan
- Provision of sufficient off-road car parking spaces.

The first mitigation measure required involves the lengthening of the existing right turn lane from Lincoln Highway south approach to Port Bonython Road to comply with Austroads guidelines, as specified in **Section 8.6.1.1**. Lengthening the turning lane will reduce the need for turning vehicles to decelerate prior to entering the turn lane, which will be effective at reducing the risk of accidents. Although the existing right turn treatment does not conform to the CHR(S) treatment described in Austroads (2012), it is in excess of the BAR treatment currently required. The requirement for a CHR(S) treatment is due to the increased turning traffic generated by the construction of the Project. It is considered that the cost of lengthening the turn lane will largely consist of three components:

- Additional pavement
- Additional line marking
- Traffic management during the extension.

As the Lincoln Highway is a State Controlled Road, the method of implementing these works will need to be agreed with DPTI. These works are not likely to require significant time to complete.

The second mitigation measure required relates to the risk of accidents at new crossings along the proposed rail line to Port Bonython. This mitigation measure involves the provision of a grade separated crossing with Port Bonython Road, with the location of the crossing to be co-ordinated to minimise the number of level crossings with property accesses. This mitigation measure will reduce the likelihood of accidents.

The third mitigation measure required involves the preparation of a construction Traffic Management Plan during the detailed design stage. This plan will identify temporary detours and / or access points during construction of the rail line, and also identify any temporary road closures and / or detours required during the movement of over-sized loads. This mitigation measure will reduce the significance and likelihood of delays and / or accidents to the general public.

The fourth mitigation measure identified is the provision of sufficient on-site (off-road) parking spaces. This mitigation measure will reduce the likelihood of accidents by relocating any parking that may occur at the roadside. As discussed in **Section 8.6.6**, this car park will be required to accommodate 125 vehicles during the construction period and 48 vehicles during the operation period.

8.7.3. Residual Impact Assessment

The residual impact assessment summary is presented in **Table 8.7b**. It should be noted that while the mitigation measures will reduce the significance and / or likelihood of impacts, the effect may not be sufficient to reduce the risk categories from the initial assessment.

Table 8.7b: Residual Transport Impacts

Traffic Impacts	Residual assessment with mitigation			
Primary impacting processes	**Mitigation measures adopted**	**Significance of impact**	**Likelihood of impact**	**Risk rating**
Reduced safety for turning traffic at the Lincoln Highway / Port Bonython Road intersection	Extend turn lanes as per requirements in Austroads	Moderate	Unlikely	Medium
Operational failure (insufficient capacity) of the Lincoln Highway / Port Bonython Road intersection	NA	Moderate	Highly Unlikely	Low
Operational failure (insufficient capacity) of the Lincoln Highway / Norrie Avenue Extension intersection	NA	Moderate	Highly Unlikely	Low
Over-utilisation of Lincoln Highway traffic capacity (north)	NA	Moderate	Highly Unlikely	Low
Over-utilisation of Lincoln Highway traffic capacity (south)	NA	Moderate	Highly Unlikely	Low
Reduced safety at rail level crossings	Grade separation of new rail crossing over Port Bonython Road	Moderate	Unlikely	Medium
Disruption of traffic due to over-sized loads	Traffic management plan to be developed during detailed design stage	Minor	Unlikely	Low
Disruption of property accesses along Port Bonython Road due to construction of rail line	Traffic management plan to be developed during detailed design stage	Negligible	Likely	Low
Disruption of property accesses along Port Bonython Road due to operation of rail line	Design to consider co-ordinating grade separation of rail at property access	Moderate	Unlikely (where not grade separated)	Medium
			Highly Unlikely (where grade separated)	Low
Insufficient on-site parking leading to parking occurring at inappropriate locations	Car park to provide sufficient on-site parking spaces	Minor	Unlikely	Low

8.8. Conclusion

The proposed BCEF development in Port Bonython is expected to generate additional traffic on the surrounding road network. The key potential impacts of this traffic were identified as:

- Reduced safety due to increased chance of conflict between vehicles
- Increased delays due to insufficient capacity at intersections or on road or rail links.

An assessment of the predicted traffic impact of the construction and operations phases was undertaken, which considered the contribution of both background traffic volumes and design generated traffic volumes in both the peak construction year and at the first year of operation.

The results of the traffic assessment showed that the surrounding road network generally has sufficient capacity to accommodate the future traffic volumes, and no upgrades to road links or intersections are required to increase traffic capacity. The analysis showed that the increase in traffic volumes was greatest in the construction phase of Stage One of the BCEF, compared to the traffic generated during operation of Stage One, or construction or operation of Stage Two of the Project.

It was found that the right turn from Lincoln Highway south approach to Port Bonython Road eastbound will require lengthening during the construction phase to meet Austroads guidelines. The traffic assessment indicated that the additional traffic generated by the development will be sufficient to warrant a CHR(S) treatment for the right turn. Such a treatment will allow turning vehicles to perform most of their deceleration manoeuvre outside the through traffic lane, improving safety. Based on a B-Double design vehicle and a 110km/h speed limit, it was considered that the existing turn lane will need to be lengthened by 37.5m to 121.5m long.

Advice from the ARTC indicates that there will be sufficient capacity on the railway network to support the expected rail traffic generated by the BCEF.

The mitigation measures required as part of this Project are:

- Improvement to the right turn treatment at the Lincoln Highway / Port Bonython Road intersection
- Provision of a grade separated crossing between the new rail line and Port Bonython Road, and co-ordination of this grade separation to minimise the number of level crossings at property accesses
- Development of a traffic management plan during the detailed design phase
- Provision of sufficient on-site (off-road) car parking spaces.