# Utah Point Bulk Commodities Berth Stage B - Port Hedland

TRANSPORT ASSESSMENT

- Updated Report (Rev 5.1)
- 14 May 2008

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Sinclair Knight Merz
ABN 37 001 024 095
7th Floor, Durack Centre
263 Adelaide Terrace
PO Box H615
Perth WA 6001 Australia
Tel: +61 8 9268 4400
Fax: +61 8 9268 4488
Web: www.skmconsulting.com

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| 5.1 (Final) | PDF | 1 | Justin.Mckirdy@mainroads.wa.gov.au (MRWA Pilbara) |
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| **Project manager:** | David Wilkins |
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# Contents

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# Executive Summary

This updated Transport Assessment report has been prepared in accordance with the Western Australian Planning Commission's Guidelines and represents a detailed assessment of the transport aspects of the Utah Point Bulk Commodities Berth Stage B development. The assessment is based on the facility opening in late 2009 and attracting its full allocation of road based transport of 9 Mtpa within the first year of operation.

The majority of the proposed haul route is on the Great Northern Highway, with the remainder being on Pinga St, Cajarina Rd and a new access road running parallel to the existing Finucane Road. All of these roads currently provide the only route to Utah Point and are approved for road train use by MRWA.

There are two identified peak hours for traffic in Port Hedland, from 6 AM to 7 AM and from 4 PM to 5 PM. Annual traffic growth is expected to be 5%.

The current haul route is considered to have a number of deficiencies and impediments, with Great Northern Highway not having priority at the intersections of Port Hedland Road, Wallwork Road or Pinga Street, despite it forming the National Highway No 1 route through Port Hedland. Furthermore, there is no dedicated industrial distributor type road connecting the Great Northern Highway to Wedgefield Industrial Area and Finucane Island, the latter the location for the Utah Point development as well as the FMG Anderson Point development and BHPBIO operations.

There are currently three railway level crossings on the proposed haul route, with another planned for construction this year (2007). MRWA has indicated that the movement of trains is regulated through the State Agreements which are agreed with the State and specific rail operators. Movements are regulated by the level of protection and administered via MRWA.

A review of the crash record for the road network within Port Hedland as well as key intersections, has not revealed an over representation of heavy vehicles in crash numbers or crashes resulting in deaths or injury. Three intersections on the proposed haul route to and from the Utah Point development have a previous five-year crash record that warrants further investigation under state and/ or national blackspot programs. Main Roads WA has assessed these intersections in the past and has indicated that this is an important consideration with the proposed redesign of the road network and key intersections.

There are not expected to be any adverse safety concerns provided that all intersections used by the generated road trains have a degree of saturation less than 1 and contain no adverse crossfalls.

There is not expected to be any significant impact on pedestrian, cycling or public transport, primarily because the proposed haul route is on an established route for road trains.

The Utah Point generated traffic (whether triples or quads) is not expected to have a major impact on the operation of current intersections and sections of roads along the haul route during the AM peak hour and off-peak times. There will be noticeable increases in the degree of saturation for some turning movements at intersections during these times, however they remain below 0.8, the level at which increases in delay and queuing are considered to result in operational problems.

Bases on maximum haulage rates, the generated traffic is expected to have a major impact on the Great Northern Hwy/ Port Hedland Rd, Great Northern Hwy/ Wallwork Rd and Cajarina Rd/ Pinga St intersections during the PM peak period. The proposal is not expected to have a significant impact on the level of service of any section of road between intersections.

**It is recommended that:**

1) PHPA, DPI and the Town of Port Hedland continue to work with MRWA on the proposed changes to the road network that will address the issues raised in this TA;
2) Quad road trains be used instead of triple road trains;
3) Dependent on the timing for the proposed changes to the road network, interim consideration is given to:
    1) minor widening and/ or channelisation of intersections on the haul route (e.g. widening of Cajarina Road at Pinga Street would allow left turners to turn left without being held up by right turners); and
    2) Operational restrictions for road trains accessing the Utah Point facility are discussed with ToPH and MRWA to ensure that a suitable regime is successfully implemented to avoid using the haul route during the PM peak periods where the degree of saturation of intersections exceeds 0.8.

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# 1. Introduction and background

## 1.1 Purpose of report

This report has been prepared by Sinclair Knight Merz (SKM) on behalf of Port Hedland Port Authority (PHPA) in support of a Public Environmental Review (PER) process. SKM has been commissioned to undertake a Transport Assessment (TA) to determine the transport infrastructure required to support the Utah Point Bulk Commodities Berth Stage B development and the potential impacts on the surrounding transport network. Whilst this Transport Assessment can be read as a standalone document, it was prepared as a section of a PER report and therefore contains some references to the PER report.

## 1.2 Transport Assessment

This Transport Assessment has been undertaken in accordance with the WAPC Guidelines[1] and represents a detailed assessment of the transport aspects of the Utah Point Bulk Commodities Berth Stage B development.

The intent of this TA is to clearly demonstrate that the development:

- provides safe and efficient access for all modes of transport;
- is well integrated with the surrounding land uses;
- does not adversely impact on the surrounding land uses; and
- does not adversely impact on the surrounding transport networks and the users of those networks.

This TA also aims to demonstrate that the proposed development is consistent with the transportation aspects of the structure and subdivision planning for the area.

## 1.3 Consultation

Section 6 of Volume 1 of the WAPC Guidelines indicates that a TA should clearly identify who has been consulted (agencies and officers' names) during the course of preparing the assessment so that copies can be referred to the most appropriate officers and agencies. It should also clearly identify who should be contacted if the assessing officers need to discuss details of the assessment. Table 1 on the following page provides details regarding this.

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[1] *Transport Assessment Guidelines For Developments*, Western Australian Planning Commission, Version for Trial & Evaluation, August 2007

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**Table 1 Relevant agencies and contact details**

| Agency | Officer | Contact details |
|---|---|---|
| Main Roads WA (Pilbara) | Justin McKirdy | Maxine McGilvray Centre<br>Brand Street<br>PO Box 2256<br>South Hedland WA 6722<br>Telephone: +61 8 9172 8877<br>Facsimile: +61 8 9140 1076<br>pilreg@mainroads.wa.gov.au |
| Town of Port Hedland | Terry Dodds (1)<br>Jenella Voitkevich (2)<br>(Previously Grant Logie) | Civic Centre<br>McGregor Street<br>PO Box 41<br>PORT HEDLAND WA 6721<br>Telephone: +61 (08) 91589320<br>Facsimile: +61 (08) 91731766<br>directoreng@porthedland.wa.gov.au |
| Department for Planning & Infrastructure (Karratha) | John Kaucz | 3 - 5 Welcome Road<br>PO Box 429<br>Karratha WA 6714<br>Telephone: +61 (08) 91596910<br>Facsimile: +61 (08) 91431288<br>john.kaucz@dpi.wa.gov.au |
| Department for Planning & Infrastructure (Perth) | Imre Szito | Albert Facey House<br>469 Wellington Street<br>Perth WA 6000<br>Telephone: +61 (08) 92647725<br>Facsimile: +61 (08) 92647566<br>imre.szito@dpi.wa.gov.au |
| Port Hedland Port Authority | Craig Wilson | PO Box 2<br>Port Hedland WA 6721<br>Telephone: +61 (08) 91730021<br>Facsimile: +61 (08) 91730060<br>craig.wilson@phpa.com.au |

### 1.3.1 Consultation process

SKM identified Main Roads WA and the Town of Port Hedland as the key stakeholders with respect to the roads that were proposed to be used for the haul route. These agencies were contacted for assistance in the development of the TA and provided SKM with relevant background data including traffic survey and crash data, land use and asset management information. Both these agencies were invited to, and attended, a Public Environmental Review (PER) workshop in Port Hedland. Further details regarding the PER consultation process and other agencies involved are provided in Section 2 (Stakeholder Engagement) of the PER report.

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The first 'formal' issue of this TA was as part of the Draft PER that, under direction from the EPA, was sent to the Department for Planning and Infrastructure (DPI). The DPI had not been identified as a key stakeholder during the preparation of the TA and had not been invited, or attended, the PER workshops. As a result of this it was necessary to convene a meeting of representatives from the Town of Port Hedland, Main Roads WA (Pilbara) and the DPI (Karratha and Perth) to obtain consensus of content and level of detail to be provided in the final version of the report. This meeting was held in Port Hedland in April 2008. During this meeting Main Roads WA provided details of proposals that they had prepared that would significantly change the road network on the haul route between Port Hedland Road and the Finucane Island/ FMG Access Road. Main Roads WA indicated that funding and construction was likely to take place prior to a revised Public Berth opening date of early 2010 and that it would address all of the capacity issues raised in this Transport Assessment report. Further detail regarding this is provided in Section 7: Proposed road network changes.

## 1.4 Updated Transport Assessment

A TA report was issued as a "Final Report (Rev 4)" in October 2007 and included in the Draft PER that was subsequently issued to the Environmental Protection Authority (EPA) for review prior to public release. The EPA subsequently sought comment from relevant State Government Agencies on various elements of the Draft PER. Background traffic data used in the Paramics and aaSIDRA models was based on historical traffic data collected over a number of years that was then annually adjusted to obtain existing 2007 traffic models. Main Roads WA undertook extensive traffic surveys on key intersections and roads in Port Hedland that form part of the haul route for the Utah Point development in October 2007. PHPA commissioned SKM to update the Paramics model using the newly available data. Comments received during the community consultation and PER stakeholder comment processes indicated that the TA should also be updated to reflect the updated model and PHPA agreed to this request. This Updated report uses the actual data collected in October 2007. It also contains additional information regarding the consultation process and road safety in response to comments received on the "Rev 4" version as well as details of the road network changes proposed by Mains Roads WA and how this relates to this TA.

## 1.5 Background

Port Hedland is located about 1,660 kilometres north of Perth, in the coastal plain of the Pilbara. The southern boundary of the town extends some 180 kilometres inland.  The six districts of Port Hedland - West End, Cooke Point, Pretty Pool, Redbank, Wedgefield and South Hedland - together represent some 5,500 hectares of development.

Port Hedland is Australia's largest tonnage port, with the annual cargo throughput in 2007 in excess of 110 million tonnes. When combined, the throughput of the Pilbara Ports of Port Hedland, Dampier and Cape Lambert is the fourth largest in the world by tonnage[2].

Currently there are nine ship berths in Port Hedland:

- Two BHP Billiton Iron Ore (BHPBIO) berths on Finucane Island
- Three PHPA public berths near Tug Harbour on West End
- Two BHPBIO berths at Nelson Point (West End)
- Two Fortescue Metals Group (FMG) berths at Anderson point

A new public bulk commodities berth has been proposed at Utah Point by Port Hedland Port Authority. Utah Point is situated on the western shore of the port in Port Hedland (Figure 1). The Utah Point development will provide public access berth facilities to cater for an anticipated increase in smaller-scale mining developments in the Pilbara.

- **Figure 1 Location plan**


Background mapping source: Department of Land Information. July 2004

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2 Town of Port Hedland Land Use Master Plan. Discussion Paper No. 1. 2007

## 1.6 Layout of the report

This report is structured as follows:

- Section 2 – Development proposal. This section describes the proposed development, including land uses, access arrangements, parking provision and end of trip facilities.
- Section 3 – Assessment methodology. This section describes the methodology that has been used to assess future impacts on the transport network.
- Section 4 – Existing situation (2007). This section reviews the existing transport conditions in the local and wider area, including road and intersection operation, public transport services and crash statistics.
- Section 5 – Traffic generation (2007 – 2009). This section reviews the traffic likely to be generated on the Port Hedland road network by the Utah Point Public Berth development.
- Section 6 – Analysis of transport networks. This section assesses the impact of the development on the transport network.
- Section 7 – Proposed road network changes. This section provides details of Main Roads WA's proposed changes to the road network following the preparation and issue of this TA.
- Section 8 – Findings and recommendations. This section summarises the conclusions based on assessment findings and makes recommendations to address any identified deficiencies.

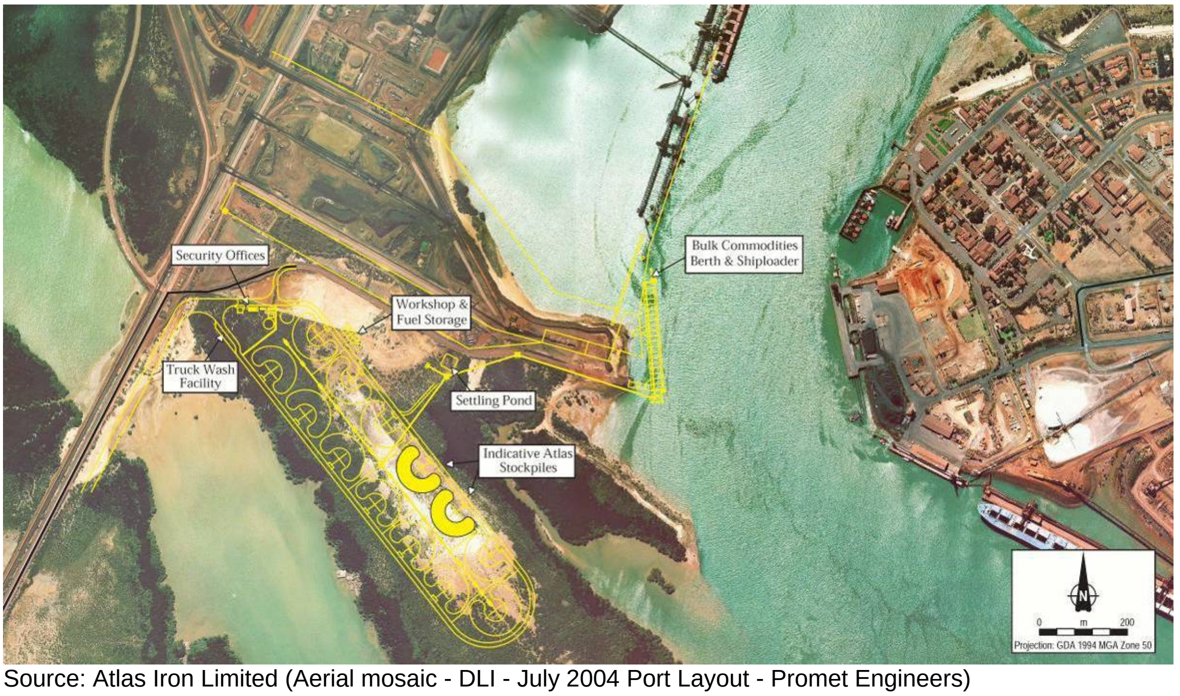
# 2. Development proposal

Demand on the existing three PHPA berths is such that utilisation has reached capacity. The increased demand for capacity, combined with existing berth capacity problems has led to PHPA's decision to fast track the development and approvals of a new bulk commodities berth at Utah Point.

The proposed Utah Point Bulk Commodities Berth is shown in Figure 2 and will include the following facilities:

- access road to the berth site;
- truck dump facility, stockpile and material handling area;
- reclaim and conveyor system;
- berth and ship loader designed to cater for Capesize ships[3].

- **Figure 2 Conceptual Utah Point Bulk Commodities Berth**




Source: Atlas Iron Limited (Aerial mosaic - DLI - July 2004 Port Layout - Promet Engineers)

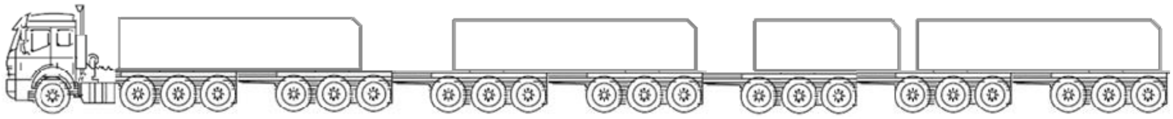
[3] Capesize ships are cargo ships too large to traverse either the Suez Canal or Panama Canal (i.e., larger than both Panamax and Suezmax vessels). To travel between oceans, such vessels must traverse either the Cape of Good Hope or Cape Horn. Capesize vessels are typically above 150,000 deadweight tons (DWT), and ships in this class include VLCC and ULCC supertankers and bulk carriers transporting coal, ore, and other commodity raw materials. The term "capesize" is most commonly used to describe bulk carriers rather than tankers. A standard capesize bulker is around 175,000 DWT, although larger ships (normally dedicated to ore transportation) have been built, up to 400,000 DWT. The large dimensions and deep drafts of such vessels mean that only the largest deep water terminals can accommodate them.

# 3. Assessment methodology

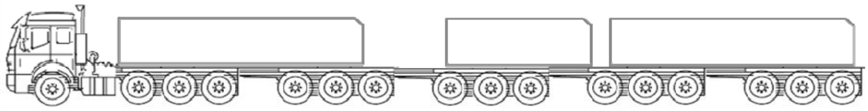
## 3.1 Scenarios

Utah Point is expected to open for operation in late 2009 and is expected to attract its full allocation of 9 Mtpa by road transport during the first year of operation. All of the existing traffic data used is dated 2007. It was therefore deemed appropriate to model the existing traffic situation as '2007' and the full operation of Utah Point as '2009'. This allowed for incremental annual increases in background traffic to be included in the assessment. The '2009' scenario was further split into two scenarios: one using quad road trains to transport material to the facility, the other using triple road trains.

- **Figure 3 Quad road train**



- **Figure 4 Triple road train**



## 3.2 Quality of traffic service at intersections

Quality of traffic service is used to describe operational conditions within a traffic stream and their perception by road users, in terms of factors such as speed, travel time, delay, freedom to manoeuvre, interruption to traffic flow, comfort, convenience and safety. Robin T. Underwood [4] recommends that the *degree of saturation* measure should be used to determine the quality of traffic service at intersections. The degree of saturation is defined as the ratio of demand flow to *capacity*. When the degree of saturation increases to 1 or more, there are too few gaps of suitable size to allow traffic on the minor road to safely cross through traffic on the opposing major road. As a result the minor road will typically experience long delays and significant queuing. The method is based on a constant critical gap size. Sometimes drivers on the minor road will select smaller than usual gaps. In such cases, safety may be a problem, and some disruption to the major traffic stream may result.

[4] Underwood, R.T. (Robin T.) Monash University, Australia: Road engineering practice 1995 p184: Quality of Traffic Service.

It should be noted that although theoretical *capacity* is reached when the degree of saturation is 1, a practical operational *capacity* occurs between 0.80 and 0.85. It is at this stage that approach arms will begin to experience increased queuing and delay.

To complete this study two different forms of assessment have been used. Initially, Paramics micro-simulation software was used to model the local highway network, followed by detailed individual intersection modelling using aaSIDRA software.

### 3.3 Micro-simulation modelling (Paramics)

The computer modelling software Paramics has been used within this study to allow key road sections and intersections within the study area to be analysed using a co-ordinated approach and not in isolation.

Paramics was used within this study for several reasons:

- It provides a real-time visual display that allows different scenarios to be modelled and the effects to be observed in real-time, over the whole modelled road network;
- It allowed information to be gathered on the interaction of all intersections within the modelled road network;
- It provides input data for detailed individual intersection analysis using aaSIDRA (refer Section 3.4.1) to determine Degree of Saturation and Level of Service for existing and proposed traffic flows; and
- It provides input data for analysis of sections of road using a spreadsheet model (refer Section 3.4.2 to determine Level of Service for existing and proposed traffic flows).

### 3.4 Detailed intersection and road section modelling

To provide a detailed understanding of development impacts on key intersections and road sections two analysis techniques were used.

#### 3.4.1 Intersection assessment

To assess the impact of the proposed Utah Point development on the surrounding intersections, analysis has been undertaken using the industry standard computer modelling software aaSIDRA. Reporting using this type of modelling is in the form of the degree of saturation experienced by each traffic movement at the intersection. In addition a level of service is provided to the intersection as a whole.

There are a number of intersection analysis criteria that are assessed during the analysis process, descriptions of these are:

- *Demand Flow (Dem Flow)*

  The estimated or observed number of vehicles per hour for each movement through the intersection.

- *Percentage Heavy Vehicles (%HV)*

  The percentage of heavy vehicles such as trucks, buses, long vehicles and road trains.

- *Degree of Saturation (Deg of Satn)*

  The degree of saturation is defined as the ratio of demand Flow (Dem Flow) to *capacity (Cap).*

- *Capacity (Cap)*

  The maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time under the prevailing roadway, traffic and control conditions. As mentioned in Section 3.2, it should be noted that although theoretical *capacity* is reached when the *degree of saturation* is 1, a practical operational *capacity* occurs between 0.80 and 0.85.

- *Average Delay (Aver Delay)*

  The average length of time in seconds that a motorist may be delayed for when approaching the intersection due to their passage being hindered by another vehicle.

- *Back of Queue (95% of)*

  Maximum extent of the queue relative to the stop line or give way line during a signal cycle or gap-acceptance cycle. The last queued vehicle that joins the back of queue is the last vehicle that departs at the end of the saturated part of the green interval or the available gap interval.

### 3.4.2 Road section assessment

An assessment of the impact of the proposed Utah Point development on the road sections in the surrounding area has been undertaken using spreadsheet modelling techniques. A spreadsheet model was created which calculated the theoretical *capacity* of each road section (using *Austroads GTEP Part 2*[5]) and compared it to the corresponding existing and forecast traffic flows.

In accordance with *Austroads GTEP Part 2* a level of service concept was used to determine the quality of the highway operation on the surrounding network. There are six levels, designated A to

[5] Austroads GTEP Part 2: *Guide to Traffic Engineering Practice, Part 2 - Roadway Capacity*, Austroads Publication No AP-11.2/88, Sydney, 1988.

F, with level of service A (*LOS A*) representing the best operating condition (at or close to free flow), and level of service F (*LOS* F) the worst (forced flow). More specifically:

- *LOS A*
  Individual drivers are virtually unaffected by others in the traffic stream. Their freedom to select their own desired speed and to manoeuvre in the traffic stream is extremely high, and the general level of comfort and convenience is excellent.
- *LOS B*
  Individual drivers still have reasonable freedom to select their desired speed and to manoeuvre in the traffic stream, although the general level of comfort and convenience is less than at *LOS A*.
- *LOS C*
  Most drivers are restricted to some extent in their freedom to select their desired speed and to manoeuvre in the traffic stream. The general level of comfort and convenience declines noticeably at this level.
- *LOS D*
  All drivers are severely restricted in their freedom to select their desired speed and to manoeuvre in the traffic stream. Traffic is close to the upper limit of stable flow, the general level of comfort and convenience is poor, and small increases in traffic flow will usually cause operational problems.
- *LOS E*
  Traffic volumes are at, or close to *capacity*, and drivers have virtually no freedom to select their desired speed or to manoeuvre. Traffic flow is unstable and minor disturbances will result in stop-start conditions.
- *LOS F*
  Flow is forced and the amount of traffic approaching the point under consideration exceeds that which it can handle. Stop-start conditions apply and queuing and delays result.

Examples of different LOS's in a freeway situation are provided at Figure 5 on the following page.

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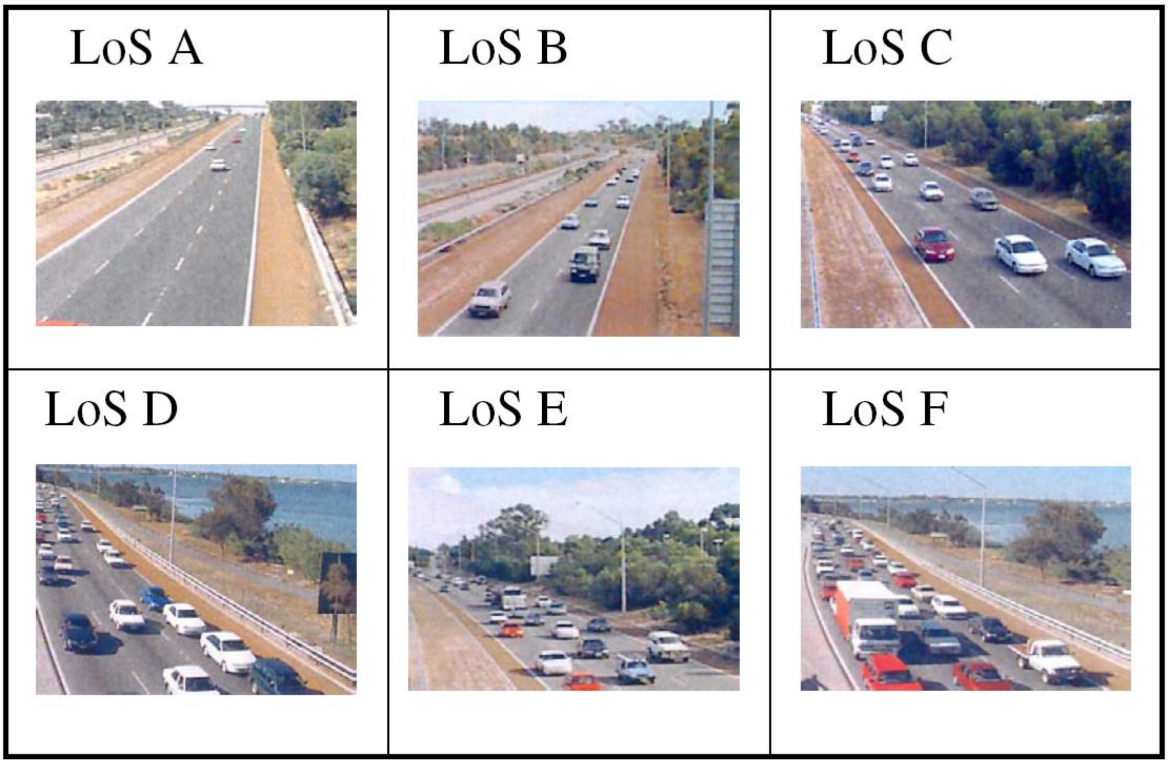
- **Figure 5 Examples of level of service traffic conditions on a freeway**



# 4. Existing situation (2007)

## 4.1 Existing land use in Port Hedland

The six districts of Port Hedland - West End, Cooke Point, Pretty Pool, Redbank, Wedgefield and South Hedland - together represent some 5,500 hectares of development, excluding road reserves. Over half (58 per cent) of this land is for industrial use, with another twenty per cent devoted to utilities and communications infrastructure[6]. Less than two per cent of the total area is for commercial use, including retail, offices, hotel and short-stay accommodation facilities. Public facilities, including schools, hospitals, churches and other community services occupy approximately 96 hectares. The remaining nineteen per cent of the developed area is made up of approximately equal parts of recreation and open space (366 hectares), residential development (349 hectares), and vacant property (314 hectares). Vacant sites are scattered throughout the town, with the majority of available land located in South Hedland.

## 4.2 Road Network

The proposed haulage route to and from Utah Point consists of two main roads (Great Northern Highway and Port Hedland Road/ Wilson Street) and three local roads (Pinga Street, Cajarina Road and Finucane Road). Each of these roads is shown in Figure 6 on page 15 and described in greater detail in Sections 4.2.1 to 4.2.5.

It should be noted that Port Hedland Road becomes Wilson Street on its approach to the West End of Port Hedland. Throughout the remainder of this report this road will be referred to as Port Hedland Road between the Great Northern Highway and McGregor Street, and then Wilson Street between McGregor Street and the existing public access berths.

[6] The industrial total does not include the Boodarie Industrial Estate or undeveloped sections of the Port or BHPBIO property.

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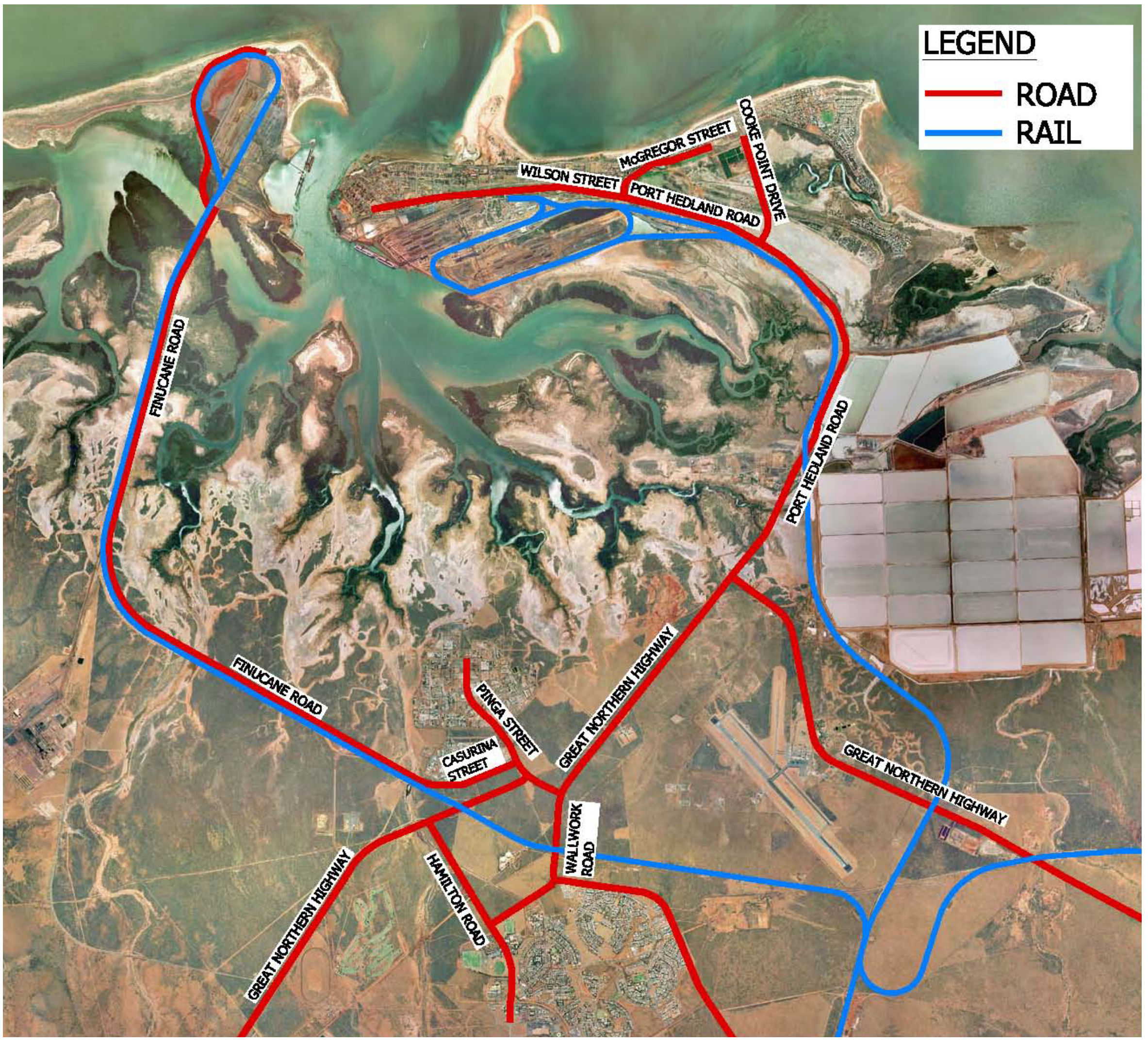
- **Figure 6 Existing road network in Port Hedland**




Background mapping source: Department of Land Information. July 2004

### 4.2.1 Great Northern Highway

Great Northern Highway comes under the care and control of Main Roads Western Australia (MRWA). It is described as a State and Regional Road in the current Town Planning Scheme No 5 and is designated for use by road trains, including quad trains under concessional permits for certain sections. An example of such a quad road train is shown on the cover of this report.

The Great Northern Highway is the main communication route between Perth and Darwin. It also forms part of the regional transport infrastructure that links the Murchison, Pilbara and Kimberley Regions to Perth. In addition to it being a dedicated National Highway No. 1, it also serves as the classified Heavy Haulage and High/ Wide Load Route to the north of the State. The regional context of this highway in the Port Hedland region is its function of transporting large amounts of material between various resource sites and Port Hedland. Despite its National Highway No 1 status, the Great Northern Highway does not have priority at Pinga Street (refer Photograph 1), at Wallwork Road (refer Photograph 2) or at Port Hedland Road (refer Photograph 4). In addition to this, there are three rail level crossings associated with BHPBIO operations on Great Northern Highway and one for Fortescue Metals Group (FMG) that was constructed in 2008. Further detail regarding these rail crossings is provided in Section 6.6.

The majority of the Great Northern Highway is undivided two lane highway, with the exception of the section immediately south of the Port Hedland Road intersection where there are two lanes in each direction. Further south, the southbound carriageway reduces from two lanes to one lane in the vicinity of the cemetery entrance.

Photograph 1: Looking north-east on Great Northern Highway towards Pinga Street (GNH terminates then continues right)

Photograph 2: Looking east on Great Northern Highway towards Wallwork Road (GNH continues left)

Photograph 3: Looking north-east on Great Northern Highway between Dalton Road and Pinga Street

Photograph 4: Looking north-west on Great Northern Highway towards Port Hedland Road (GNH continues left)

### 4.2.2 Port Hedland Road/ Wilson Street

Port Hedland Road and Wilson Street come under the care and control of MRWA. This road is described as a State and Regional Road in the current Town Planning Scheme No 5 and is designated for use by road trains.

Port Hedland Road/ Wilson Street is currently the only route in and out of the West End Port. It is currently an undivided two lane road with the exception of some median separation at key intersections and the provision of two westbound lanes from Redbank Bridge to the 6 mile turn-off. For safety reasons this route or sections of it are expected to be duplicated at some point in the future.

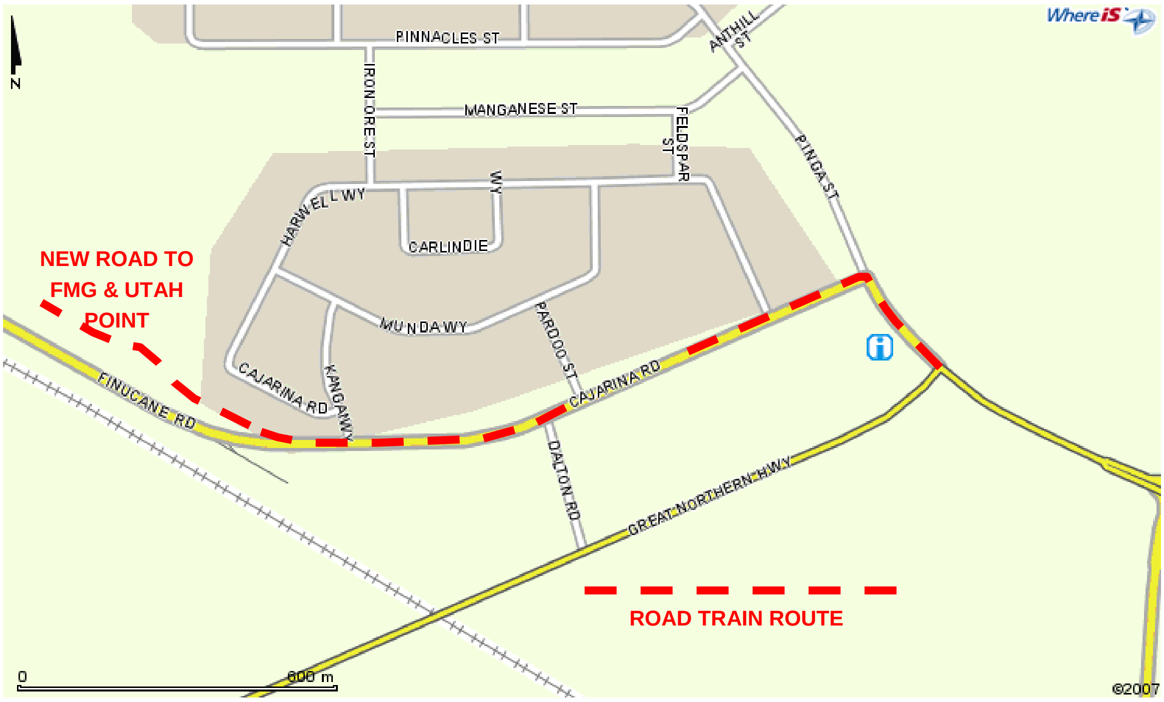
Photograph 5: Looking east on Wilson Street leaving Port Hedland

Photograph 6: Looking south on Wedge St towards Port Entrance

### 4.2.3 Pinga Street

Pinga Street comes under the care and control of the Town of Port Hedland (ToPH). It is described as a District Road in the current Town Planning Scheme No 5 and is designated by MRWA for use by road trains. It is a district road in the Wedgefield Industrial Area and serves as one of two links between this industrial area and the Great Northern Highway, the other being Dalton Road, a local access road. The ToPH and MRWA have both indicated that they do not support the use of Dalton Road by road trains and therefore Pinga Street forms the only link between the Great Northern Highway and Finucane Island for road trains. The road train route is shown in Figure 7.

Figure 7 Proposed haulage route on local roads from Great Northern Highway to Finucane Island




Map reproduced with permission of UBD. Copyright Universal Publishers Pty. Ltd. DG 07/04

Photograph 7: Looking north on Pinga St between Great Northern Hwy and Cajarina Rd

Photograph 8: Looking south on Pinga St between Cajarina Rd (on right) and Great Northern Hwy

### 4.2.4 Cajarina Road

Cajarina Road comes under the care and control of the Town of Port Hedland (ToPH). It is described as a Local Road in the current Town Planning Scheme No 5 and is designated by MRWA for use by road trains. It is a local road in the Wedgefield Industrial Area and serves as the only link between Pinga Street (and hence the Great Northern Highway) and Finucane Road, by way of being an extension of that road.

Photograph 9: Looking west at Cajarina Rd from Pinga St


Photograph 10: Looking west on Cajarina Rd west of Pinga St

### 4.2.5 Finucane Road/ New FMG & Berth Access Road

Finucane Road is not identified as a public road in the current Town Planning Scheme No 5. It runs parallel to the BHPBIO Goldsworthy railway and is signed as a Private Access Road under the control of and leading to BHPBIO's facilities on Finucane Island and the location of the proposed Utah Point Bulk Commodities Berth. Finucane Road is an undivided sealed road (six to seven metres wide) providing the only access between the Great Northern Highway (via Cajarina Rd and Pinga St) and Finucane Island.

Despite its classification as a private road and a railway maintenance access, it is understood that BHPBIO is required to maintain general public access along this road to recreational areas on Finucane Island. Due to the close proximity of the road to the railway, the road is regarded as providing a less than desirable access for the public and a new dual purpose road (suited to road trains, trucks and public light vehicles) is proposed to be constructed as part of the Utah Point Development. The new road will connect onto the northern end of the current FMG access road and follow an alignment offset approximately 50 metres to the east of the existing Finucane Road.

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| Photograph 11: Looking west on Finucane Road with BHPBIO sign stating “Private Plant Access Road” | Photograph 12: Looking east on Finucane Road – showing typical arrangement between rail on right and port area land on left |
|---|---|
|   |  |

## 4.3 Operation of existing road network

Surveys and analysis show that there is a deficiency in terms of existing *capacity* on the Great Northern Highway and Port Hedland Roads at the intersection of Great Northern Highway and Port Hedland Road during the afternoon peak hour. This is discussed further in Section 6: Analysis of transport networks.

There are other deficiencies that will adversely affect the safety, efficiency, productivity, reliability and amenity of the road network within Port Hedland. The Perth-Darwin AusLink corridor strategy[7] identified the following deficiencies:

- Congestion exists between local urban traffic and heavy vehicles in Port Hedland where the corridor and the port access road both allow triple road train access and are also major collector roads for freight transport to the ports and other industrial areas. Current operational problems are exacerbated by the configuration of the corridor where it intersects with the access roads for the South Hedland residential area, Wedgefield industrial zones, the port and by the number of rail level crossings in Port Hedland.
- The alignment of the Wedgefield-South Hedland-Port Hedland section of the AusLink corridor exacerbates the conflict between heavy vehicles, ore trains and local traffic.
- Insufficient overtaking opportunities given the mix of heavy vehicles, passenger vehicles and tourist traffic.
- Quantity and quality of rest areas along the corridor and lack of parking opportunities for road trains is not conducive to improving fatigue management outcomes.

[7] Perth – Darwin Corridor Strategy. AusLink: Building our National Transport Future. 2007

- Some parts of the corridor in the study area require reconstruction in the longer term, due to the poor pavement quality.

In addition to the above, Section 4.2 of this TA report has identified the following additional deficiency with the existing road network:

- The only link to Finucane Island, the proposed Utah Point berth and the existing FMG berth is via a combination of local and private roads.

Section 4.2 of this TA report has identified the following impediment to using the Great Northern Highway as a major haul route:

- Priority is not provided to the Great Northern Highway at three intersections in Port Hedland.

## 4.4 Operation of existing rail network

The existing rail network is owned and operated by BHPBIO, including the Goldsworthy line which runs east-west to Finucane Island and the Mount Newman line which runs north-south to Nelson Point. Traffic on both these lines is expected to increase in the near future.

Up until the end of July 2007, BHPBIO operated two railway lines in the Pilbara, one from Nelson Point (Port Hedland) past Yandi Junction (Yandi 1, 2 + MAC mines), to Jimblebar Junction Marshalling Yard, which branches out to Jimblebar (with Ore body 18 spur) and Whaleback (Newman) and Ore Body 23/25 mine sites. BHPBIO is currently running 14 trains a day departing Nelson Point. Train lengths are either 104, 208 or 312 cars with the last two configurations requiring mid train helpers, give or take an ore car or two. It is expected that with the upgrade facilities, BHPBIO are able to run 336 car trains to and from Jimblebar Junction Marshalling Yard. The other line runs from Finucane Island to the Yarrie and Nimingarra Mines via Boodarie Yard, with train lengths of up to 90 cars and one Dash 8 locomotive. Currently four trains depart daily from Boodarie Yard (resource: www.railways.pilbara.net.au).

MRWA advised that individual trains are estimated at approximately 600 metres in length on the Goldsworthy line and 1.8 kilometres on the Newman line. MRWA estimated that the operating speed for the trains is 40 km/h. PHPA has expressed a view that trains are travelling at approximately 20km/h over the crossing. MRWA has indicated that the movement of trains is regulated through the State Agreements which are agreed with the State and specific rail operators. Movements are regulated by the level of protection and administered via MRWA.

The frequencies of BHPBIO rail operations have not been made available at this stage. For the purpose of this study, the following frequencies have been assumed:

- 20 trains (each way) run daily on the Port Hedland-Newman railway from Nelson Point (Note: currently 14 each way on average)
- 8 trains (each way) run daily on the Goldsworthy railway (GNH east crossing) (Note: currently 1-2 each way on average)
- 14 trains (each way) run daily on Goldsworthy railway (GNH west crossing)

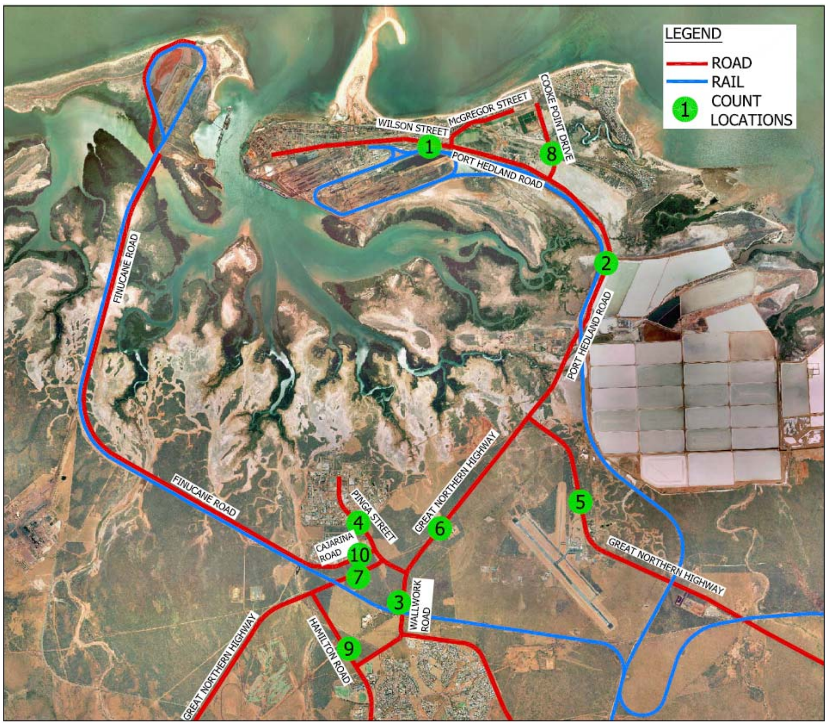
FMG has recently constructed a 310 kilometre rail line linking mining operations at Cloud Break to two new berths at Anderson Point. Hope Downs and Rio Tinto are currently conducting feasibility studies for additional rail lines or sharing the FMG line. Delays associated with the proposed FMG crossing have not been modelled due to lack of information regarding likely train movements. They can be assessed as being similar to the Goldsworthy railway (GNH west crossing) if movements are similar. MRWA has advised that no traffic statement or assessment was required for the FMG crossing and on this basis, it is assumed that delays will be negligible.

## 4.5 Existing traffic profile

### 4.5.1 Traffic volumes

Traffic counts on Port Hedland Road, Great Northern Highway, Wallwork Road and Pinga Street have been provided by MRWA. The counts were undertaken in October 2007. Figure 8 illustrates the locations of the traffic counts.

- **Figure 8 Traffic count locations**




Background mapping source: Department of Land Information. July 2004

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▪ **Table 2 Average weekday traffic volumes (AWT)**

| Ref. | Location | Date of survey | Volumes (vehicles per day) | Source |
|---|---|---|---|---|
| 1 | Wilson Street (E of BHP) | Oct 2007 | 8,000 | MRWA |
| 2 | Port Hedland Road (N of GNH) | Oct 2007 | 11,400 | MRWA |
| 3 | Wallwork Road | Oct 2007 | 10,000 | MRWA |
| 4 | Pinga Street (N of Cajarina Rd) | Oct 2007 | 5,900 | MRWA |
| 5 | Great Northern Highway (E of Port Hedland Road) | Oct 2007 | 3,600 | MRWA |
| 6 | Great Northern Highway (mid Port Hedland Rd & Wallwork Rd) | Oct 2007 | 12,000 | MRWA |
| 7 | Great Northern Highway (S of Pinga St) | Oct 2007 | 2,400 | MRWA |
| 8 | Cooke Point Drive | Oct 2007 | 3,000 | MRWA |
| 9 | Hamilton Road (S of GNH) | Oct 2007 | 3,400 | MRWA |
| 10 | Cajarina Road (W of Dalton Rd) | Oct 2007 | 3,000 | MRWA |

Table 2 indicates that Port Hedland Road and Great Northern Highway are currently carrying approximately 12,000 vehicles per day (vpd) at the busiest sections. Detailed examination of the traffic count data shows that the peak hours at different locations occur between 06:00 – 08:00 in the morning and 16:00 – 18:00 in the afternoon (Appendix A). Further analysis of this revealed that the two most common peak hours for traffic in Port Hedland are 06:00 – 07:00 and 16:00 – 17:00. These are the peak hours used in this TA report.

### 4.5.2 Vehicle classification

Table 3 shows the percentage breakdown of vehicle types on Port Hedland Road and the Great Northern Highway, applying the Austroads vehicle classification system. Category 1 and 2 includes light vehicles, such as cars, vans and caravans. Heavy vehicles are classed under categories 3 to 9. These include buses, trucks and articulated vehicles with up to 3 axle groups. Categories 10 to 12 include long vehicles and road trains such as B doubles, double road trains, triple road trains, and quadruple road trains (not shown symbolically).

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### Table 3 Vehicle Classification (Austroads 94)

| VEHICLE CLASSIFICATION SYSTEM AUSTROADS | | Port Hedland Rd east of BHP Access | Gt Northern Hwy mid Wallwork Rd Port Hedland Rd |
|---|---|---|---|
| CLASS | LIGHT VEHICLES | 90.6 | 84.3 |
| 1 | SHORT<br>Car, Van, Wagon, 4WD, Utility, Bicycle, Motorcycle | 88.4 | 82.2 |
| 2 | SHORT - TOWING<br>Trailer, Caravan, Boat | 2.2 | 2.1 |
| | HEAVY VEHICLES | 6.3 | 13.3 |
| 3 | TWO AXLE TRUCK OR BUS<br>*2 axles | 3.6 | 9.6 |
| 4 | THREE AXLE TRUCK OR BUS<br>*3 axles 2 axle groups | 1.5 | 1.9 |
| 5 | FOUR (or FIVE) AXLE TRUCK<br>*4 (5) axles, 2 axle groups | 0.2 | 0.4 |
| 6 | THREE AXLE ARTICULATED<br>*3 axles 3 axle groups | 0.1 | 0.2 |
| 7 | FOUR AXLE ARTICULATED<br>*4 axles 3 or 4 axle groups | 0.2 | 0.4 |
| 8 | FIVE AXLE ARTICULATED<br>*5 axles 3+ axle groups | 0.1 | 0.1 |
| 9 | SIX AXLE ARTICULATED<br>*6 axles 3+ axle groups or 7+ axles, 3 axle groups | 0.6 | 0.7 |
| | LONG VEHICLES AND ROAD TRAINS | 3.1 | 2.5 |
| 10 | B DOUBLE or HEAVY TRUCK and TRAILER<br>*7+ axles, 4 axle groups | 0.1 | 0.1 |
| 11 | DOUBLE ROAD TRAIN<br>*7+ axles, 5 or 6 axle groups | 2.1 | 1.2 |
| 12 | TRIPLE ROAD TRAIN<br>*7+ axles, 7+ axle groups | 0.9 | 1.2 |

Table 3 indicates that approximately eighty-seven per cent of the vehicles on these roads are light vehicles. Approximately three percent of vehicles on Great Northern Highway and Port Hedland Road are long vehicles or road trains, such as double, triple and quadruple road trains.

## 4.6 Existing public transport services

Hedland Bus Lines operate three public bus routes in the Port Hedland/ South Hedland area.

Route descriptions and frequencies are summarised in Table 4.

**Table 4 Bus services and frequencies**

| Route | Route description | Frequency (services per hour) | |
|---|---|---|---|
| | | Weekdays | Saturday |
| 301 | South Hedland (clockwise) | every 2 to 3 hours (between 8.15am and 5.00pm) | every 3 to 4 hours (between 8.15am and 4.05pm) |
| 401 | South Hedland (anticlockwise) | every 2 to 3 hours (between 9.10am and 5.55pm) | 2 services (10.05am and 2.05pm) |
| 501 | South Hedland, Pretty Pool, Cooke Point, Port Hedland | every 1 to 3 hours (between 8.40am and 4.30pm) | every 2 hours (between 8.40am and 2.30pm) |
| 501 | Port Hedland, Cooke Point, Pretty Pool, South Hedland | every 1 to 3 hours (between 8.30am and 5.15pm) | every 2 hours (between 9.20am and 3.20pm) |

As a major employer in Port Hedland, BHPBIO provides their staff with several private bus services. Operated by Hedland Bus Lines, these services are:

- Finucane Island – Western Yard – South Hedland
- Nelson Point – South Hedland
- South Hedland – Cooke Point and Pretty Pool
- Nelson Point – Cooke Point and Pretty Pool

## 4.7 Crash data analysis using CRASHtool

CRASHtool is a MRWA owned software specifically designed to assist in the analysis of reported road crashes on the Western Australian public road network. CRASHtool provides evaluation of crash performance at any location, and the evaluation of any proposed countermeasures.

The crash data used in CRASHtool is extracted from a database known as IRIS, which is a MRWA repository for a wide variety of road network information, including crash data.

CRASHtool allows the user to:

- Diagnose performance problems at a location by comparing crash distribution with network average crash patterns;
- Prepare a collision diagram at intersections;

- Rank possible countermeasures in decreasing order of net present value (NPV) of crash costs, from which one can then simplify the search for practical, effective solutions to crash problems at a location;
- Use a crash factor matrix to look for trends in crashes at a location; and
- Model countermeasures at a location and prepare cost benefit calculations.

The following sections provide an analysis of MRWA CRASHtool data for the Pilbara Region in the five years from 1st January 2001 to 31st December 2005.

### 4.7.1 Pinga Street and Great Northern Highway intersection

The crash data indicates that four crashes were reported at the intersection from 2001 to 2005. One of these involved a truck and was reported as a car travelling from south to north on Great Northern Highway colliding with a truck travelling from the west (on Great Northern Hwy) turning right at the T intersection onto Pinga Street, resulting in property damage only.

### 4.7.2 Pinga Street and Cajarina Road intersection

The crash data indicates that two crashes were reported at the intersection from 2001 to 2005. None of these involved a truck and both resulted in property damage only.

### 4.7.3 Wallwork Road and Great Northern Highway intersection

The crash data indicates that twelve crashes were reported at the intersection from 2001 to 2005. None of these involved a truck. One crash resulted in hospitalisation; two resulted in people seeking medical attention; the rest resulted in property damage only.

The reported crash types, ranked from the highest percentage to the lowest are:

| | | |
|---|---|---|
| 1) | Right Angle | 58% |
| 2) | Right Turn Against | 25% |
| 3) | Rear End | 17% |

CRASHtool indicated that the Rear End and Right Angle type crashes are considered to be significantly over-represented for this type of intersection in this environment.

### 4.7.4 Port Hedland and Great Northern Highway intersection

The CRASHtool data could not be fully assessed as the orientation code for this intersection was not available corrupting the data. The corrupted data shows five reported crashes at the intersection from 2001 to 2005. One of these involved a truck. This was reported as being a prime mover and trailer that hit a power pole resulting in property damage only. One crash resulted in hospitalisation; one resulted in a person seeking medical attention; the rest resulted in property damage only.

### 4.7.5 Great Northern Highway (excluding intersections)

The crash data indicates that sixty crashes were reported on the Great Northern Highway (excluding intersections) within the Town of Port Hedland boundaries from 2001 to 2005. One of these involved a prime mover with a trailer swerving to avoid an animal and going off the carriageway resulting in property damage only. Another five crashes were reported as involving road trains, with one on a level crossing but only one involving another vehicle, a utility. One of these crashes resulted in hospitalisation (road train ran off road and hit culvert); the remainder resulted in property damage only.

### 4.7.6 Port Hedland Road/ Wilson Street (excluding intersections)

The crash data indicates that seventeen crashes were reported on the Port Hedland Road (excluding intersections) within the Town of Port Hedland boundaries from 2001 to 2005. Wilson Street is not listed as a road name in the crash database. Two of these involved a truck; one leaving a driveway and colliding with an unknown vehicle or object, the other leaving the carriageway but not colliding with anything. Both resulted in property damage only.

### 4.7.7 Truck/ Road Train Crashes in the district of Port Hedland

The crash data indicates that a total of 309 crashes were reported on all roads and intersections within the Town of Port Hedland boundaries from 2001 to 2005. Twenty three of these crashes (7%) involved prime movers, road trains, trucks and trailers as shown in Table 5.

- **Table 5 Reported Truck/ Road Train crashes in Port Hedland district (5 years)**

| Heavy Vehicle Description | Number | % of total reported crashes | Estimated % of traffic on road |
|---|---|---|---|
| Prime mover and trailer | 3 | 1.0% | 3% |
| Road train | 6 | 1.9% | |
| Truck | 13 | 4.2% | 6% |
| Truck and trailer | 1 | 0.3% | |
| TOTAL | 23 | 7.4% | 9%[8] |

Further analysis of the consequences of reported crashes was also carried out with respect to those that resulted in a death (Fatal), persons being conveyed from the crash scene to hospital (Hospital) and those that resulted in persons involved in the crash seeking medical attention themselves, e.g.: visiting their doctor (Medical). A summary of this analysis is shown in Table 6.

[8] 90% of traffic is classified light vehicles. The remainder are heavy vehicles, including buses (assumed at 1%).

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**Table 6 Comparison of personal injury or fatality crashes in Port Hedland District**

| Heavy Vehicle Description | Number of reported crashes | | | % of total reported crashes | | | Estimated % of traffic on road |
|---|---|---|---|---|---|---|---|
| | Hospital | Medical | Fatal | Hospital | Medical | Fatal | |
| All vehicle types | 74 | 72 | 13 | 100% | 100% | 100% | 100% |
| Prime mover and trailer | 1 | 1 | 0 | 1.3% | 1.4% | 0.0% | 3% |
| Road train | 2 | 0 | 0 | 2.7% | 0.0% | 0.0% | |
| Truck | 2 | 4 | 1 | 2.7% | 5.6% | 7.7% | 6% |
| Truck and trailer | 0 | 0 | 0 | 0.0% | 0.0% | 0.0% | |
| Total trucks, prime movers, road trains etc… | 5 | 5 | 1 | 6.7% | 7.0% | 7.7% | 9%[9] |

### 4.7.8 Articulated Truck Crashes Nationally

(Extract from *Road Safety Strategies and Solutions, Robin T Underwood, NSW 2006)*

*In Australia, in 2004, articulated trucks were involved in a total of 136 fatal crashes. 73% of these crashes were multiple vehicle crashes, 18 % were single vehicle crashes and the remaining 9 % involved a pedestrian and a truck. 64 % of the fatal crashes occurred on roads with a speed limit of 100 km/h or more. Earlier analyses had indicated that in the majority of multiple vehicle fatal crashes involving articulated trucks the truck was not considered responsible. For example, in 1997, in 79 % of the multiple vehicle fatal crashes the articulated truck was not responsible for the crash. The annual number of fatal crashes involving articulated trucks reached a peak of 260 in 1988. It then declined to 146 in 1997, increased to 165 in 2000, and dropped to 146 in 2001. It increased to 171 in 2002. Between 1989 and 1999, the total tonne kilometres of freight by truck increased by 60 %, while for the same period the number of fatal crashes declined by 35%.*

*The roll-over propensity of heavy vehicles, and particularly hazardous goods vehicles such as petroleum tankers, is a serious problem. On average, about one petroleum tanker rolls over each month in Australia, and of these about 50% ignite. These types of hazardous goods vehicles require special treatment, and it is most desirable that electronic stability control systems be mandated for them as soon as possible. In the longer term, electronic stability control systems should be required for all heavy articulated vehicles. In this respect, regardless of any training and enforcement, some drivers of heavy articulated vehicles will always be driven by deadlines, and the effects of fatigue and consequent run-off-road crashes, including roll-overs, will be a continuing problem.*

The roll-over propensity of heavy vehicles is a documented safety concern. It is for this reason that roads and intersections with adverse crossfalls (such as roundabouts) should be avoided. It is

[9] 90% of traffic is classified light vehicles. The remainder are heavy vehicles, including buses (assumed at 1%).

understood that there is an existing adverse crossfall for left turning vehicles travelling towards Port Hedland on Great Northern Highway at its intersection with Wallwork Road and that roll-overs at this location have been experienced with adverse effects on the road network due to blocking of the highway.

#### 4.7.9 Crash Assessment Summary

Analysis of the CRASHtool data supplied by MRWA does not indicate that trucks and road trains are over represented in the crash data or in crashes resulting in death or injury.

There appears to be an over representation of Rear End and Right Angle type crashes at some intersections. Three intersections have a crash record of three or more crashes in a five year period and hence meet the criteria for assessment under state and/ or national black spot programs. It is considered appropriate for the relevant road authority to undertake detailed crash analysis of these intersections to determine whether the safety performance could be improved by changing priorities to suit the function of the intersecting roads.

It is important to note, as stated in Section 3.2, that when the degree of saturation of an intersection increases to 1 or more, that there are too few gaps of suitable size to allow traffic on the minor road to safely cross through traffic on the opposing major road. In such cases drivers on the minor road will select smaller than usual gaps out of frustration resulting in an adverse affect on the predicted safety performance of the intersection. It is therefore recommended for safety as well as network performance reasons, that no intersections are proposed to be used by Utah Point generated road train traffic when the degree of saturation is 1 or above.

The roll-over propensity of heavy vehicles is a documented safety concern. It is for this reason that roads and intersections with adverse crossfalls (such as roundabouts) should be avoided.

Non-injury type crashes should not be discounted as they may still have an adverse effect on the performance of the road network, particularly when they result in a section of road being closed for a significant amount of time.

### 4.8 Existing situation summary

The six districts of Port Hedland - West End, Cooke Point, Pretty Pool, Redbank, Wedgefield and South Hedland - together represent approximately 5,500 hectares of development. This comprises 58 per cent industrial use, 20 per cent utilities and communications infrastructure, 19 per cent recreation and open space, residential development and vacant property and less than 2 per cent commercial use.

There are currently two main roads in the Port Hedland region, the Great Northern Highway (National Highway No.1) and Port Hedland Road/ Wilson Street.

Identified highway network deficiencies include:

- Congestion between local urban traffic and heavy vehicles where the corridor and the port access road both allow road train access.
- Priority not provided to the Great Northern Highway at several intersections.
- Only link to Finucane Island, the proposed Utah Point berth and the FMG berth is via a combination of local and private roads.

The existing rail network is owned and operated by BHPBIO, including the Goldsworthy line which runs east-west to Finucane Island and the Mount Newman line which runs north-south to Nelson Point.

FMG has recently constructed a 310 kilometre rail line linking mining operations at Cloud Break to two new berths at Anderson Point.  Hope Downs and Rio Tinto are currently conducting feasibility studies for additional rail lines or sharing the FMG line.

Approximately eighty-seven per cent of vehicles Port Hedland Road and the Great Northern Highway are light vehicles.  Approximately three percent of vehicles on Great Northern Highway and Port Hedland Road are long vehicles or road trains, such as double, triple and quadruple road trains.

Hedland Bus Lines operate three public bus routes and several private BHPBIO routes in the Port Hedland/ South Hedland area.

Analysis of the CRASHtool data supplied by MRWA indicates that trucks and road trains are involved in 7.4% of the total reported crashes and are not considered to be over represented on roads and intersections within the district of Port Hedland.

There appears to be an over representation of Rear End and Right Angle type crashes at some intersections. Three intersections have a crash record of three or more crashes in a five year period and hence meet the criteria for assessment under state and/ or national black spot programs. Main Roads WA has assessed these in the past and has indicated that this is an important consideration with the proposed redesign of the road network and key intersections.

The roll-over propensity of heavy vehicles is a documented safety concern. It is for this reason that roads and intersections with adverse crossfalls (such as roundabouts) should be avoided.

Non injury type crashes should not be discounted as they may still have an adverse effect on the performance of the road network, particularly when they result in a section of road being closed for a significant amount of time.

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# 5. Traffic generation (2007 – 2009)

## 5.1 Existing road transport at Port Hedland (2007)

Currently there are five main companies that operate at the Port Hedland public berth at West End: Dampier Salt, Consolidated Minerals, Process Minerals International, Telfer Gold Mine and Nifty Gold Mine. In addition, sulphuric acid and fuel is imported to supply BHPBIO and local copper mines. This totals approximately 5.3 million tonnes per annum (Mtpa) currently delivered by road trains as shown in Table 7.

▪ **Table 7 Existing Port generated road train tonnages (2007)**

| Operation | Exported (Mtpa) | Imported (Mtpa) |
|---|---|---|
| Consolidated Minerals | 1.0 | |
| Dampier Salt | 3.2 | |
| Process Minerals International | 0.2 | |
| Telfer Gold Mine | 0.13 | |
| Nifty Gold Mine | 0.13 | |
| Sulphuric acid to copper mines | | 0.15 |
| Fuel to BHPBIO and copper mines | | 0.5 |
| **TOTAL** | **4.66** | **0.65** |
| | **5.31** | |

Current material tonnage and vehicle trips generated by these imports and exports are shown in Table 8.

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**Table 8 Existing road transport demands at Port Hedland (2007)**

| Company | Truck type | Capacity (t) | Annual Mtpa | Road trains (pa) | Road trains per day[10] | Roads travelled | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Port Hedland Road + Wilson Street | Great Northern Highway (south) | Great Northern Highway (east) |
| Dampier Salt | Triples | 70 | 3.2 | 45,710 | 125 | T | | |
| Consolidated Minerals (chrome) | Triples | 70 | 0.2 | 2,860 | 8 | T | T | |
| Consolidated Minerals (mn) | Triples | 70 | 0.8 | 11,430 | 31 | T | | T |
| Process Minerals International | D'bles | 40 | 0.2 | 5,000 | 14 | T | | T |
| Telfer Gold Mine (gold + copper concentrate) | Triples/ quads | 90 | 0.13 | 1,440 | 4 | T | | T |
| Nifty Gold Mine (copper concentrate) | Triples/ quads | 90 | 0.13 | 1,440 | 4 | T | | T |
| Copper mines (sulphuric acid) | Triples | 70 | 0.15 | 2,140 | 6 | T | | T |
| BHPBIO + copper mines (fuel) | Triples | 70 | 0.5 | 7,140 | 20 | T | T | T |
| **Total** | | | **5.3** | **77,200** | **212** | | | |

[10] Assumes continuous transport, 24 hours per day, 7 days per week

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## 5.2 Future road transport prospect (2009)

In order to model predicted traffic it has been necessary to estimate shipments and quantities requiring road transport from mining operations in the vicinity that may use the public berth at Utah Point. These are summarised as:

- 6.725 Mtpa of bulk mineral products from east of the Great Northern Highway
- 0.255 Mtpa of bulk mineral products from south of the Great Northern Highway
- 2.000 Mtpa concentrate from south of the Great Northern Highway

It is understood that current bulk mineral exports from West End (i.e. PHPA Public Berths) would relocate their shipments to Utah Point and not export from both locations.

It is not clear at this stage whether triple road trains (triples) or quadruple road trains (quads) would be used as this is dependent on permits being issued by MRWA. On this basis, two scenarios have been considered in this Transport Assessment: a) 100% use triples and b) 100% use quads. The road transport demands for various products are shown in Table 9.

**Table 9 Road transport demands to Utah Point (2009)**

| Product / material [11] | Mtpa | Quads per year @105 ton/load | Triples per year @70 ton/load | Road Trains/ Day[12] | | Daily Operation hours |
|---|---|---|---|---|---|---|
| | | | | Quads | Triples | |
| Proponents approaching Port Hedland from the east | | | | | | |
| Bulk Mineral Product | 6.725 | 64,048 | 96,071 | 175 | 263 | 20 - 24 |
| Target | 7 | | | 182 | 274 | |
| Proponents approaching Port Hedland from the south | | | | | | |
| Concentrate | 2 | 19,048 | 28,571 | 52 | 78 | 24 |
| Bulk Mineral Products | 0.255 | 2,429 | 3,643 | 7 | 10 | 12 |
| **Total** | **2.255** | **21,476** | **32,214** | **59** | **88** | |
| **Target** | **2** | | | **52** | **78** | |
| | | | | | | |
| **Total from east and south** | **9** | | | **234** =7.6/ hr 24hrs =8.3/ hr 22hrs | **352** =3.2/ hr 24hrs =3.5/ hr 22hrs | |

[11] Products shown are used to model outcomes but final make-up of proponents and products are still to be finalised at the time of issuing this report.
[12] Assumes continuous transport, 365 days per year

Table 9 shows the turnover at Utah Point and the road-train movement modelled. For the purpose of traffic analysis it has been assumed (as a worst case scenario) that approximately 7 Mtpa would be transported to Port Hedland from the east on the Great Northern Highway and approximately 2 Mtpa from the south on the Great Northern Highway. This would result in approximately 274 triple road trains (or 182 quad road trains) per day operating between Utah Point and Great Northern Highway east and approximately 78 triple road trains (or 52 quad road trains) per day operating between Utah Point and Great Northern Highway south.

### 5.3 General vehicle demands

It is unclear at this stage how many workers will be working on the Utah Point, Finucane Island and FMG sites. It is very likely that traffic generated by vehicles other than export/ import material vehicles would result in traffic volumes on the access road (Finucane Road/ New FMG & Berth Access Road) less than 2,000 vehicles per day. 200 service/ employee vehicles were added to the identified peak hours.

### 5.4 Traffic generation summary

There are currently five main companies that operate at the Port Hedland public berth at West End: Dampier Salt, Consolidated Minerals, Process Minerals International, Telfer Gold Mine and Nifty Gold Mine. In addition to this, sulphuric acid and fuel is imported to supply BHPBIO and local copper mines.

Approximately 5.3 Mtpa of port export and import material is currently carried by road trains. Future imports and exports at Utah Point will result in an additional 9 Mtpa of material being transported by road train. All modelling has been based on the assumption that spare capacity at the public berth in West End (as a result of the redirection of existing exports and import traffic to Utah Point) will be taken up by other operators using road trains due to lack of rail infrastructure.

# 6. Analysis of transport networks

## 6.1 Road network assessment approach

For the purpose of this assessment report the operation of the road network has been analysed at two levels, intersection level and road section level.

### 6.1.1 Intersection assessment

To assess the impact of the proposed Utah Point development on the surrounding intersections, analysis has been undertaken using the computer modelling software Paramics and aaSIDRA. A detailed description of the intersection methodology and analysis criteria is provided in Section 3.

### 6.1.2 Road section assessment

Assessment of the impact of the proposed Utah Point development on the highway links in the surrounding area has been undertaken using spreadsheet modelling. A detailed description of the road section methodology and analysis criteria is provided in Section 3.

## 6.2 Traffic assumptions

### 6.2.1 Road train passenger car equivalence (PCE)

In order to accurately model the effects of road trains on the road network within aaSIDRA it is necessary to convert these larger vehicles into equivalent passenger cars. This is not necessary in Paramics as this software enables individual vehicle characteristics to be used.

In the absence of a general guideline of the passenger car equivalence (PCEs) for multi combination vehicles (MCVs), reference has been made to *EXAMINING THE IMPACT OF LARGE FREIGHT VEHICLES ON SIGNALISED INTERSECTION OPERATION*[13]. This paper documented field tests conducted to measure passenger car equivalences of three MCVs used in Queensland in the simulated environment of a signalised intersection. The tested vehicles and their PCEs are shown in Table 10.

[13] TRAVELATOR – Traffic and Transport "ON THE MOVE" AITPM National Conference – 2002

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- **Table 10 Passenger car equivalent values for large freight vehicles**[14]

| Test Vehicle | Tested Length (m) | Tested Mass (t) | Saturation Headway (s) | | PCE |
|---|---|---|---|---|---|
| | | | Mean | Standard Deviation | |
| Passenger Car | 4.96 | 1.53 | 2.01 | 0.49 | 1.00 |
| Unladen B-Double | 22.84 | 32.28 | 9.38 | 0.61 | 4.66 |
| Unladen Triple Road Train | 40.70 | 44.34 | 9.53 | 1.03 | 4.74 |
| Laden B-Double | 22.84 | 52.54 | 11.15 | 0.60 | 5.55 |
| Unladen B-Triple | 29.69 | 51.25 | 11.44 | 0.66 | 5.69 |
| Laden B-Triple | 29.69 | 71.86 | 13.61 | 0.65 | 6.77 |
| Laden Triple Road Train | 40.70 | 115.0 | 14.97 | 1.02 | 7.45 |

Table 10 indicates that at signalised intersections, the passenger car equivalent for a loaded triple road train is 7.45 and for an unloaded triple road train is 4.74. Due to the non-signalised nature of the local highway network of Port Hedland, the PCE of road trains operating on this network is likely to be more than less. On this basis, a PCE of 7 for all triple road trains (laden and unladen) and 9 for all quad road trains (laden and unladen) has been adopted. This is consistent with some practices in the industry that use the same PCE value for loaded and unloaded vehicles.[15]

Concerns with the use of PCE's were raised by Main Roads WA and DPI during the consultation process. These concerns relate to whether or not the characteristics of a PCE with respect to acceleration, deceleration and braking were taken into account and whether it would be better to use an equivalent heavy vehicle within the aaSIDRA model.

SKM decided against using an equivalent heavy vehicle for two reasons. The first was that it was unable to find any relevant studies regarding this and the second that the differences in vehicle characteristics were accounted for in the Paramics model and this model had been calibrated by adjusting inputs into the existing situation model in order to obtain consistency with observed behaviours from recent video surveys of the intersections provided by Main Roads WA. Main Roads WA has been provided with a copy of the Paramics model along with a calibration report.

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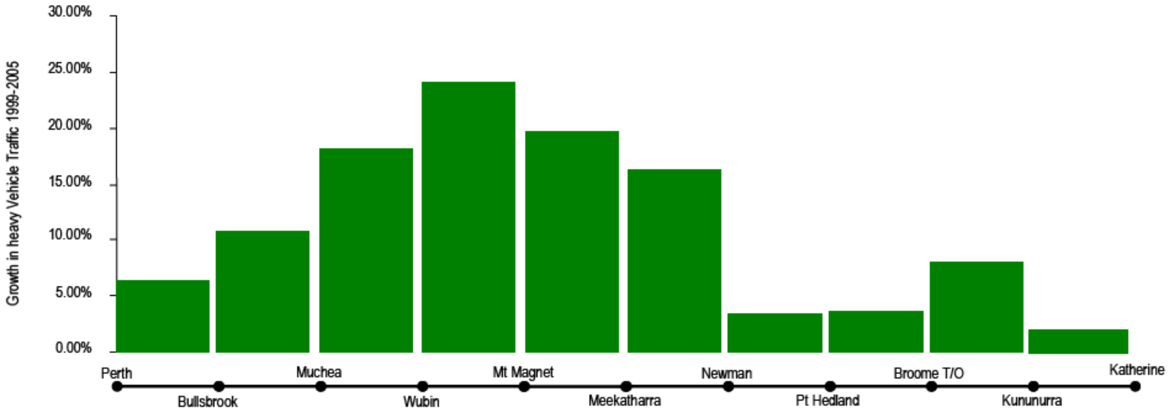
[14] TRAVELATOR – Traffic and Transport "ON THE MOVE" AITPM National Conference – 2002

[15] Austroads *Guide to Traffic Engineering Practice Part, 2 – Roadway Capacity* Sydney 1988.
National Transport Commission, Third Heavy Vehicle Road Pricing Determination Technical Report, Table 47, October 2005.

### 6.2.2 Traffic growth

Although traffic counts from 2004 to 2007 have been obtained and analysed, consistent historical growth at sites cannot be established, perhaps due to seasonal variation and/ or generated traffic from construction activity. Based on our understanding of the site and discussions with MRWA (Pilbara), it has been assumed that within the next ten years, general traffic in Port Hedland is unlikely to increase by more than five per cent per annum. This is consistent with Figure 6 from the Draft Perth – Darwin Corridor Strategy Report prepared by AusLink and reproduced as Figure 9 in this Transport Assessment report.

- **Figure 9 Annual Growth In Heavy Vehicle Traffic - AusLink Corridor 1999-2005**




### 6.2.3 Turning volumes

Current traffic turning movements at key intersections have been provided by Main Roads WA based on video surveys undertaken in November 2007. It is important to note that due to major construction currently occurring around Port Hedland (e.g. FMG and John Holland) traffic patterns are likely to change significantly from month to month and year to year. On this basis, existing turning patterns at some key intersections may not be indicative of future turning patterns.

Forecast traffic volumes have been based on the available information of road-train movements and the assumption of a 5 per cent per annum growth rate for general vehicles. The forecast traffic turning volumes at the key intersections are contained within Appendix C. These are based on the first year of operation as there is no forecast increase in road based tonnage after this year. Additional tonnage through Utah Point will only be permitted by rail or slurry pipeline. The provision of a rail option in the future is likely to result in a reduction of road based tonnage as product is switched from road to rail.

## 6.3 Impact on surrounding roads

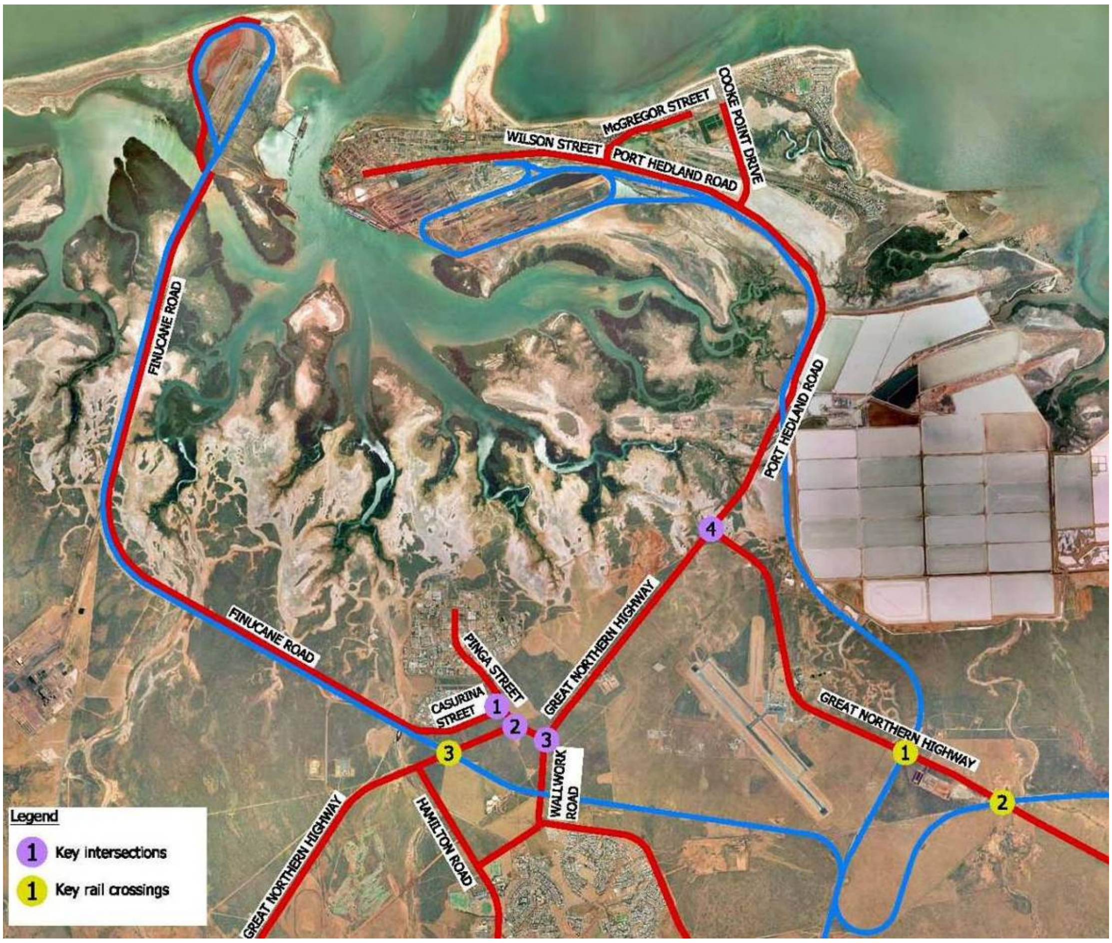
After the commencement of the operation of Utah Point (expected late 2009), it is anticipated that the existing road transported exports from public berth No. 1 will be shipped from the new Utah

Point Bulk Commodities Berth. As discussed in Section 5.2, it is estimated that there will be approximately 352 triple or 234 quadruple road train trips per day operating to and from Utah Point. This is equivalent to approximately 17 triple or 10 quadruple road train trips per hour based on 20 hour, 7 day a week operation. The traffic generated by vehicles other than road trains along the Utah Point access road is likely to be less than 2000 vehicles per day, which includes light vehicles to BHPBIO facilities at Finucane Island as well as public vehicles to recreational areas on Finucane Island.

## 6.4 Intersection *capacity* analysis

The key intersections and railway crossings that will be affected by the Utah Point operation are shown in Figure 10.

- **Figure 10 Key intersections and Railway crossings in the study area**




Background mapping source: Department of Land Information. July 2004

The *degrees of saturation* (as defined in Section 3) for all traffic movements at the key intersections, for existing and forecast scenarios are presented in Figure 11 to Figure 16.

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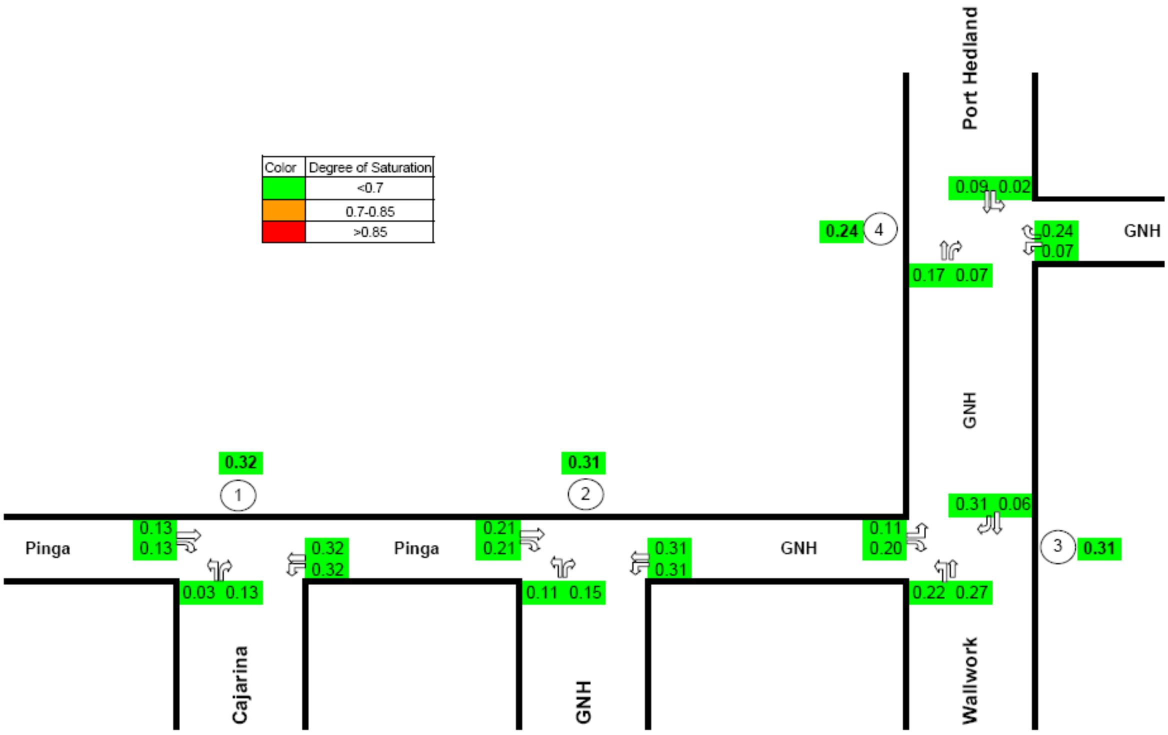
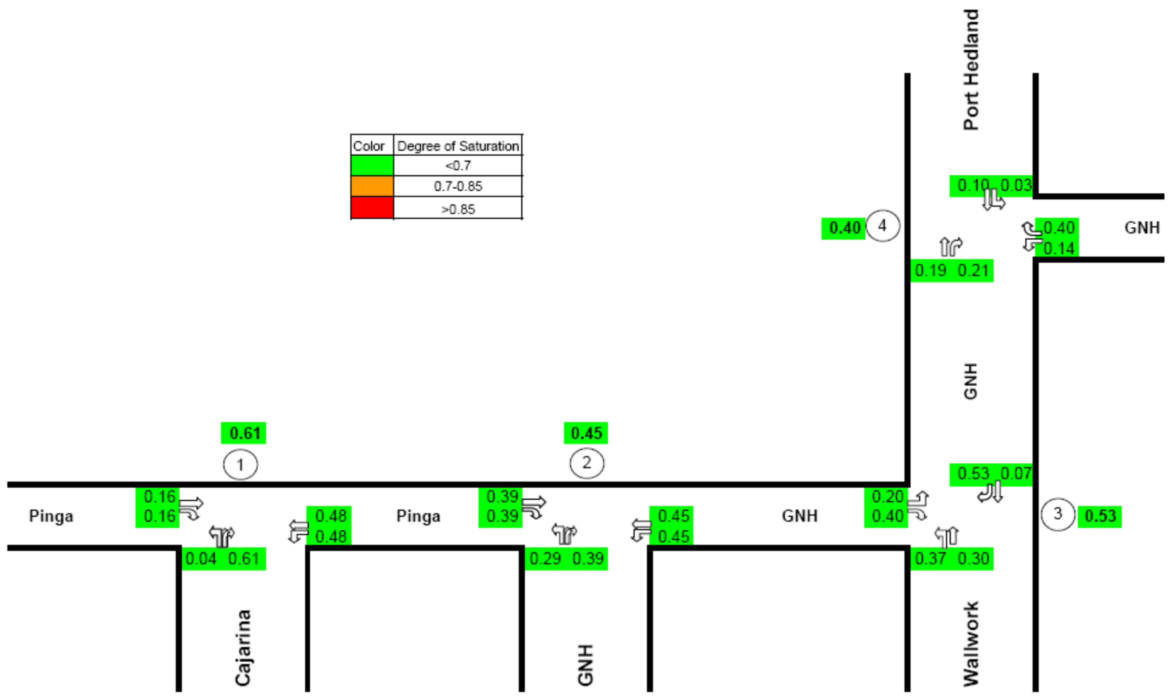
- **Figure 11 Existing degree of saturation for all movements AM peak 2007**




- **Figure 12 Forecast degree of saturation for all movements with triples AM peak 2009**



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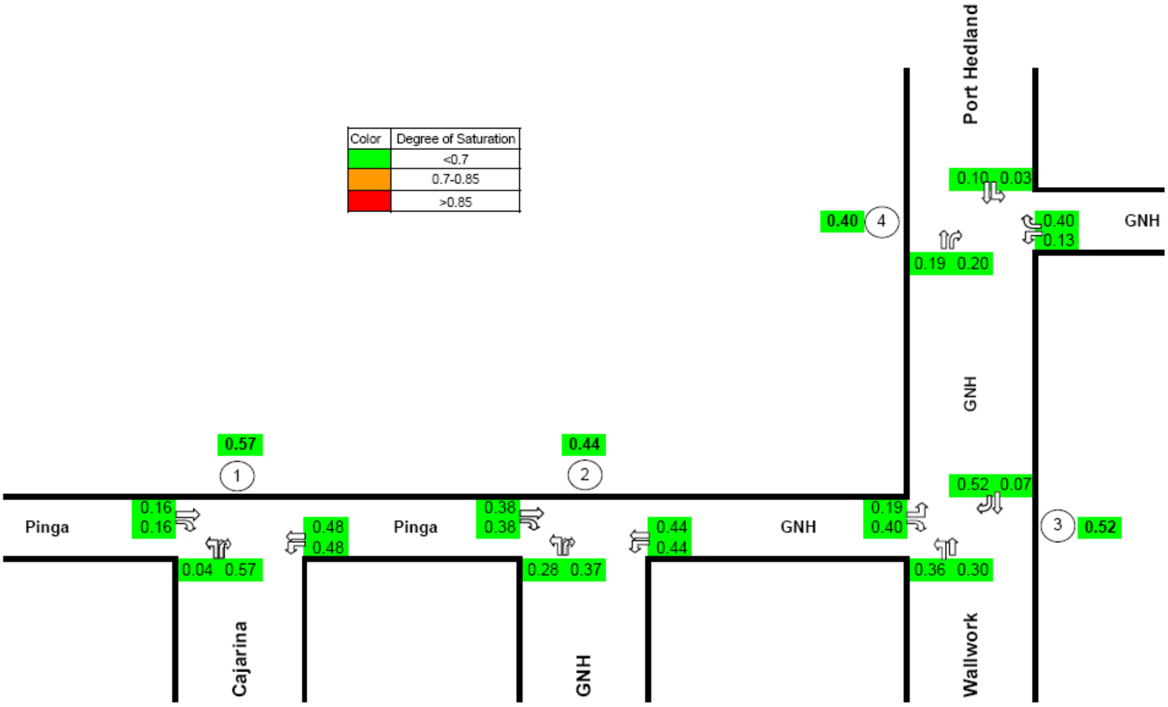
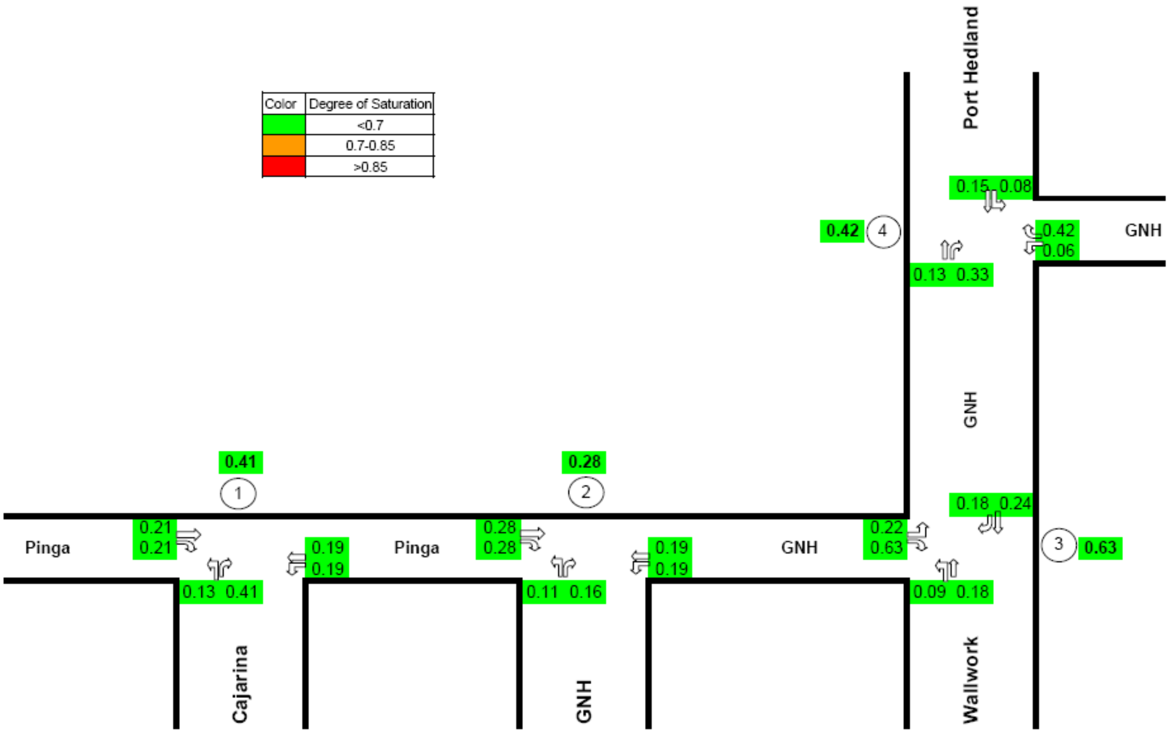
- **Figure 13 Forecast degree of saturation for all movements with quads AM peak 2009**




- **Figure 14 Existing degree of saturation for all movements PM peak 2007**



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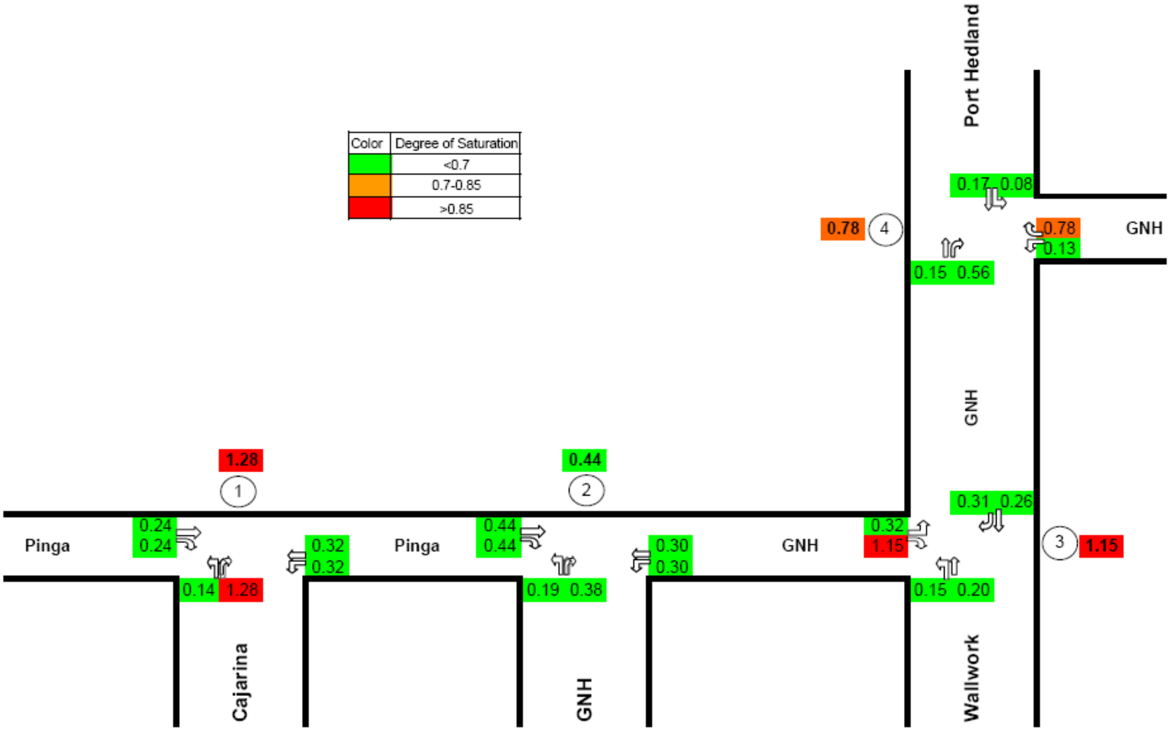
- **Figure 15 Forecast degree of saturation for all movements with triples PM peak 2009**




- **Figure 16 Forecast degree of saturation for all movements with quads PM peak 2009**

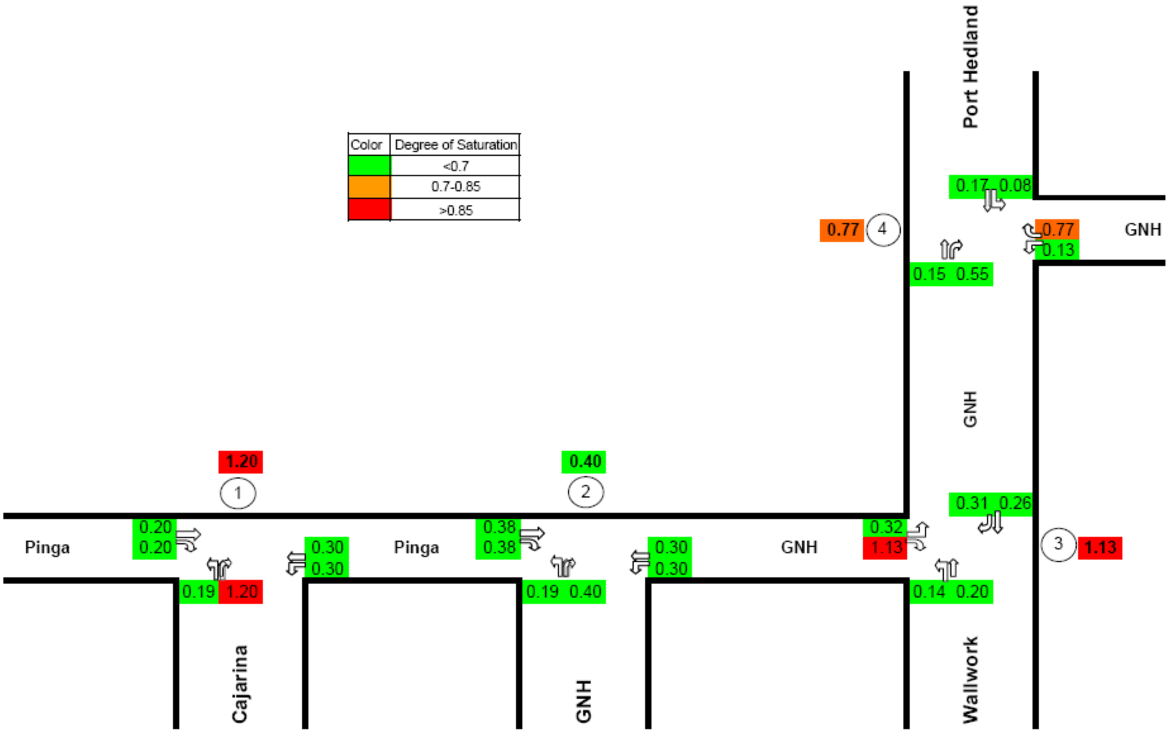


Table 11 to Table 18 compare the degree of saturation for the existing and forecast traffic demand for the key intersections during morning and evening peak hours. Separate analysis has been undertaken to reflect quadruple road train operation to allow comparison with triple road train results. Detailed intersection analysis using aaSIDRA is presented in Appendix C. **Highlighted** data is considered significant and comment is provided on this following the tables.

### Table 11 Cajarina Rd/ Pinga St - AM peak hour degree of saturation comparison

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| Cajarina, left | 0.03 | 0.04 | 0.04 | 0.01 | 0.01 |
| **Cajarina, right** | **0.13** | **0.61** | **0.57** | **0.48** | **0.44** |
| Pinga, right | 0.13 | 0.16 | 0.16 | 0.03 | 0.03 |
| Pinga, through to GNH | 0.13 | 0.16 | 0.16 | 0.03 | 0.03 |
| Pinga, left | 0.32 | 0.48 | 0.48 | 0.16 | 0.16 |
| Pinga, through to Wedgefield | 0.32 | 0.48 | 0.48 | 0.16 | 0.16 |

### Table 12 Cajarina Rd/ Pinga St - PM peak hour degree of saturation comparison

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| Cajarina, left | 0.13 | 0.14 | 0.14 | 0.01 | 0.01 |
| **Cajarina, right** | **0.41** | **1.28** | **1.21** | **0.87** | **0.80** |
| Pinga, right | 0.21 | 0.24 | 0.24 | 0.03 | 0.03 |
| Pinga, through to GNH | 0.21 | 0.24 | 0.24 | 0.02 | 0.03 |
| Pinga, left | 0.19 | 0.32 | 0.31 | 0.13 | 0.13 |
| Pinga, through to Wedgefield | 0.19 | 0.32 | 0.31 | 0.13 | 0.13 |

### Table 13 Great Northern Hwy/ Pinga St - AM peak hour degree of saturation comparison

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, right | 0.15 | 0.39 | 0.37 | 0.24 | 0.22 |
| GNH, left to Pinga | 0.11 | 0.29 | 0.28 | 0.18 | 0.17 |
| Pinga, through | 0.21 | 0.39 | 0.38 | 0.18 | 0.17 |
| Pinga, right | 0.21 | 0.39 | 0.38 | 0.18 | 0.17 |
| GNH, through | 0.31 | 0.45 | 0.44 | 0.14 | 0.13 |
| GNH, left | 0.31 | 0.45 | 0.44 | 0.14 | 0.13 |

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- **Table 14 Great Northern Hwy/ Pinga St - PM peak hour degree of saturation comparison**

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, right | 0.16 | 0.38 | 0.36 | 0.22 | 0.20 |
| GNH, left to Pinga | 0.11 | 0.19 | 0.18 | 0.08 | 0.07 |
| Pinga, through | 0.28 | 0.44 | 0.43 | 0.16 | 0.15 |
| Pinga, right | 0.28 | 0.44 | 0.43 | 0.16 | 0.15 |
| GNH, through | 0.19 | 0.30 | 0.30 | 0.11 | 0.11 |
| GNH, left | 0.19 | 0.30 | 0.30 | 0.11 | 0.11 |

- **Table 15 Great Northern Hwy/ Wallwork Rd - AM peak hour degree of saturation comparison**

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, left | 0.11 | 0.20 | 0.19 | 0.09 | 0.07 |
| GNH, right to Wallwork | 0.20 | 0.40 | 0.40 | 0.20 | 0.20 |
| Wallwork, left | 0.22 | 0.37 | 0.36 | 0.15 | 0.14 |
| Wallwork, through | 0.27 | 0.30 | 0.30 | 0.03 | 0.03 |
| GNH, through | 0.06 | 0.07 | 0.07 | 0.01 | 0.01 |
| GNH, right | 0.31 | 0.53 | 0.52 | 0.22 | 0.21 |

- **Table 16 Great Northern Hwy/ Wallwork Rd - PM peak hour degree of saturation comparison**

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, left | 0.22 | 0.32 | 0.32 | 0.10 | 0.10 |
| **GNH, right to Wallwork** | **0.63** | **1.15** | **1.13** | **0.52** | **0.50** |
| Wallwork, left | 0.09 | 0.15 | 0.14 | 0.06 | 0.05 |
| Wallwork, through | 0.18 | 0.20 | 0.20 | 0.02 | 0.02 |
| GNH, through | 0.24 | 0.26 | 0.26 | 0.02 | 0.02 |
| GNH, right | 0.18 | 0.31 | 0.31 | 0.13 | 0.13 |

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- **Table 17 Great Northern Hwy/ Port Hedland Rd - AM peak hour degree of saturation comparison**

| Movement from | 2007 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, through | 0.17 | 0.19 | 0.19 | 0.02 | 0.02 |
| GNH, right | 0.07 | 0.21 | 0.20 | 0.14 | 0.13 |
| Port Hedland, through | 0.09 | 0.10 | 0.10 | 0.01 | 0.01 |
| Port Hedland, left | 0.02 | 0.03 | 0.03 | 0.01 | 0.01 |
| GNH, left | 0.07 | 0.14 | 0.13 | 0.07 | 0.06 |
| GNH, right to Port Hedland | 0.24 | 0.40 | 0.40 | 0.16 | 0.16 |

- **Table 18 Great Northern Hwy/ Port Hedland Rd - PM peak hour degree of saturation comparison**

| Movement from | 2006 | 2009 (triples) | 2009 (quads) | Change (triples) | Change (quads) |
|---|---|---|---|---|---|
| GNH, through | 0.13 | 0.15 | 0.15 | 0.02 | 0.02 |
| GNH, right | 0.33 | 0.56 | 0.55 | 0.23 | 0.22 |
| Port Hedland, through | 0.15 | 0.17 | 0.17 | 0.02 | 0.02 |
| Port Hedland, left | 0.08 | 0.08 | 0.08 | 0.00 | 0.00 |
| GNH, left | 0.06 | 0.13 | 0.13 | 0.05 | 0.05 |
| GNH, right to Port Hedland | 0.42 | 0.78 | 0.77 | 0.36 | 0.35 |

The difference between the degree of saturation for triple and quad road trains averages out to 0.007 (0.7%). The greatest difference is 0.070 (7%) for movements out of Cajarina Rd turning either right into Pinga St. Although there are fewer quads than triples on the roads and intersections, the PCE (refer Section 6.2.1) factor for quads is higher than for triples. In overall terms, quads have a smaller effect on degree of saturation at the intersections.

As mentioned in Section 3.2, practical operational *capacity* of intersections occur between a *degree of saturation* of 0.80 and 0.85. Intersections where the *degree of saturation* is forecast to exceed 0.80 are Cajarina Rd/ Pinga St and Great Northern Hwy/ Wallwork Rd. This is forecast to occur during the afternoon peak hour and possibly during times immediately prior to and after this peak hour. The forecast *degree of saturation* during the morning peak hour never exceeds 0.7. Sections 6.4.1 to 6.4.3 provide comment on individual intersections where the impact is forecast to be significant.

### 6.4.1 Cajarina Rd/ Pinga St

The overall *degree of saturation* of this intersection during the PM peak hour is forecast to increase from 0.41 to 1.28 for triples and 1.20 for quads. The critical movement at this intersection is the right turn for road trains from Cajarina Road onto Pinga Street. The left turn out of Cajarina Rd could also be subject to delay when a right turning truck makes it difficult to pass or see past.

### 6.4.2 Great Northern Hwy/ Wallwork Rd

The overall *degree of saturation* for this intersection during the PM peak hour is forecast to increase from 0.63 to 1.15 for triples and 1.13 for quads. The critical movement at this intersection is the right turn from the Great Northern Highway onto Wallwork Road for general traffic due to the increase in right turn southbound traffic on the Great Northern Highway and associated reduction in gaps in this traffic. It should be noted that the model does not reflect a two stage crossing where right turning vehicles cross the westbound lane and wait in the median for a suitable gap in eastbound traffic. A two-stage crossing can only be undertaken by light vehicles. The likely degree of saturation is less than that forecast but is still considered too high to be acceptable.

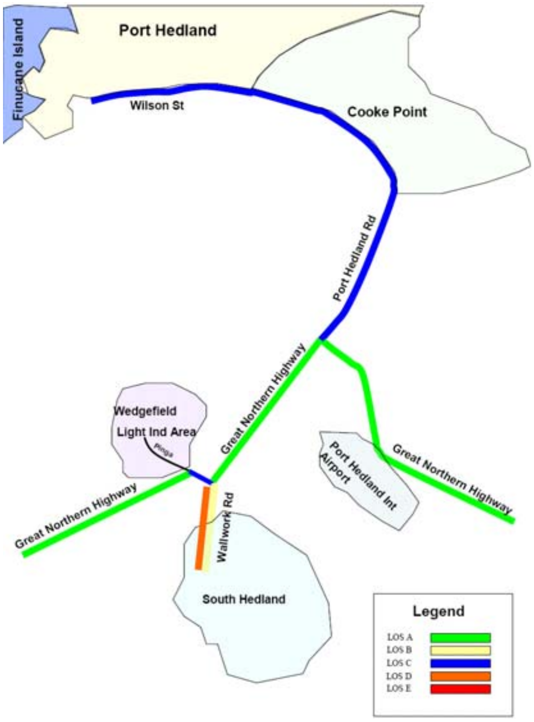
### 6.4.3 Great Northern Hwy/ Port Hedland Rd

The overall *degree of saturation* for this intersection during the PM peak hour is forecast to increase from 0.42 to 0.78 for triples and 0.77 for quads. The critical movement at this intersection is the right turn from the Great Northern Highway into Port Hedland Road for general traffic, due to the increase in right turn northbound traffic on the Great Northern Highway and associated reduction in gaps in this traffic. It should be noted that the model does not reflect a two stage crossing where right turning vehicles cross the eastbound lane and wait in the median for a suitable gap in westbound traffic. A two-stage crossing can only be undertaken by light vehicles. The likely degree of saturation is less than that forecast.

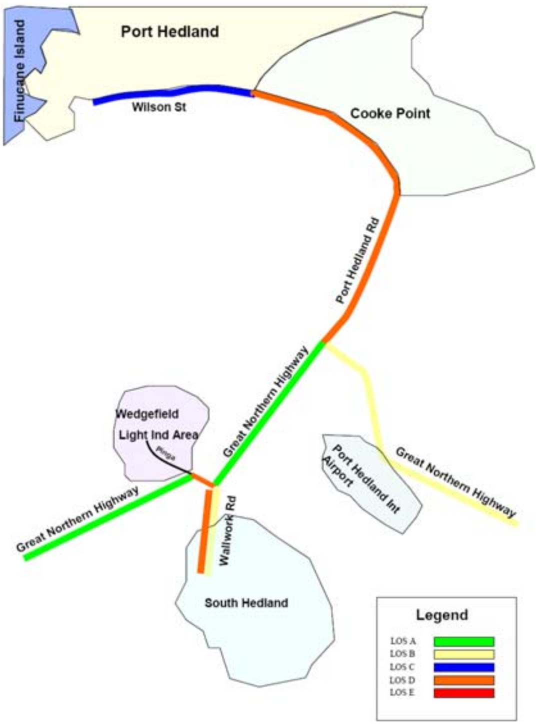
## 6.5 Road section level of service analysis

The *level of service* on road sections for existing and forecast scenarios are presented in Figure 17 to Figure 22.

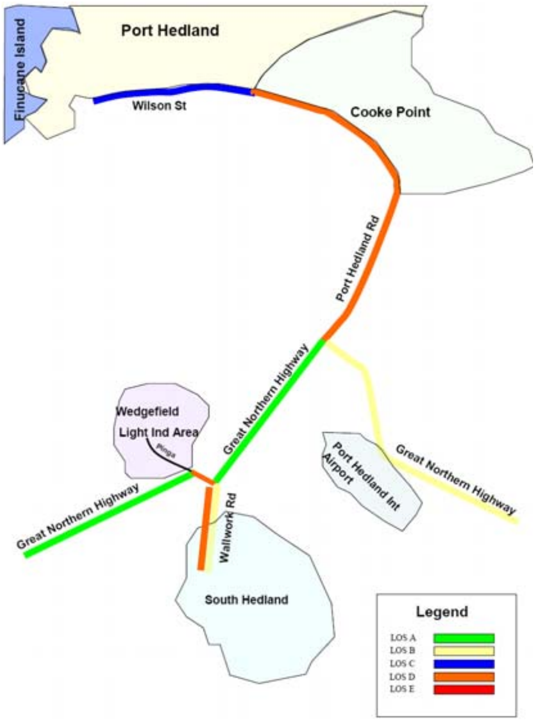
- **Figure 17 2007 *LOS*, AM peak**



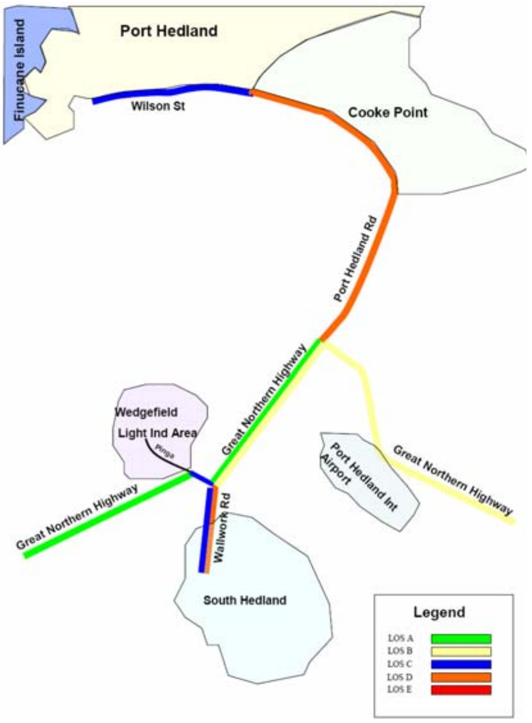

- **Figure 18 2009 *LOS* (triples), AM peak**



- **Figure 19 2009 *LOS* (quads), AM peak**




- **Figure 20 2007 *LOS*, PM peak**



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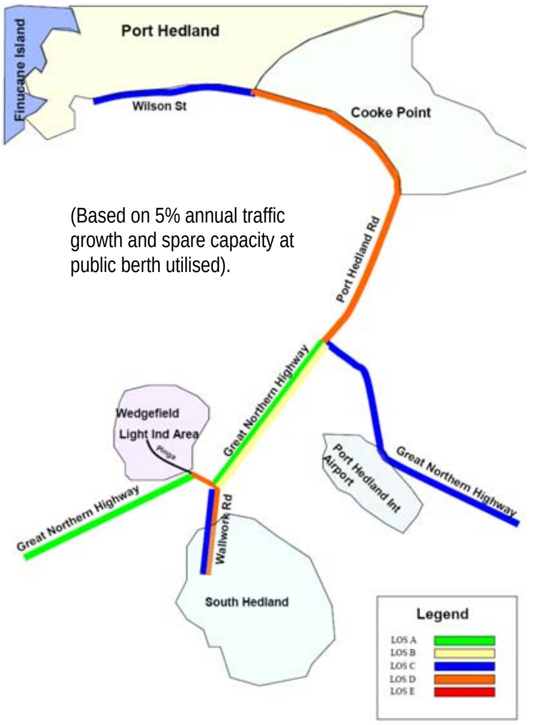
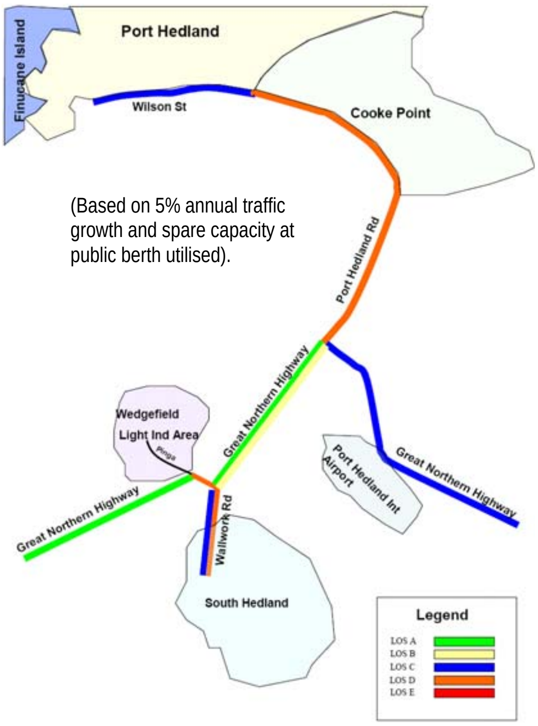
- **Figure 21 2009 *LOS* (triples), PM peak**




- **Figure 22 2009 *LOS* (quads), PM peak**



It is important to understand that each *level of service* (A to F) as defined in Section 3 of this report has a range. Where traffic volumes increase within the defined range, then the *level of service* will not be affected. For this reason it is important that all link assessments are read in conjunction with the corresponding intersection assessments.

The *level of service* analysis undertaken for the sections of roads illustrated in Figure 17 to Figure 22 indicates that there are two sections of road where the *level of service* is forecast to reduce. These sections of road are discussed in Sections 6.5.1 and 6.5.2.

### 6.5.1 Port Hedland Road (Great Northern Highway to Wilson Street)

The overall *level of service* for this section of road (excluding intersections) is forecast to reduce from C to D during the AM peak hour in 2009 despite no Utah Point generated traffic using this road as part of the haul route. The facility at Utah Point will initially result in a reduction in road train traffic due to the transfer to the new facility at Utah Point. However, this Transport Assessment has taken a pragmatic approach that the spare capacity at the existing public berth will be taken up by other road based export operations within the first year.

On this basis, the reduction in the *level of service* of this road is attributed to the increase in annual traffic of 5% per year as well as traffic generated by residential development in Cooke Point.

### 6.5.2 Great Northern Highway (north of Port Hedland Road)

The overall *level of service* for this section of road (excluding intersections) is forecast to reduce from A to C for triples and A to B for quads during the AM peak hour and from B to C for triples in the PM peak hour. It is important to remember that the 5% per annum annual growth and airport generated traffic plays a significant role in these changes in level of service. The use of quads over triples will assist in keeping this level of service during the peak hours to B.

## 6.6 Rail crossing

### 6.6.1 Existing operation (2007)

As indicated in Section 4.4, the frequencies of BHPBIO rail operations have not been made available at this stage. For the purpose of this study, the following MRWA advised frequencies have been used. Refer to Figure 10: Key intersections and Railway crossings in the study area on page 38 for location details.

- 20 trains each way run daily on the Port Hedland-Newman railway from Nelson Point;
- 8 trains each way run daily on the Goldsworthy railway @ GNH east crossing; and
- 14 trains[16] each way run daily on Goldsworthy railway @ GNH west crossing.

[16] It is assumed that there are movements back and forth over this crossing resulting in more movements than the Great Northern Hwy east crossing.

Traffic on the Great Northern Highway is interrupted by these rail crossings. Using the frequencies above, traffic is interrupted approximately:

- twice in an hour at the Great Northern Hwy/ Port Hedland - Newman Railway Level Crossing (No. 1);
- once in one and half hours at the Great Northern Hwy (East)/ Goldsworthy Railway Level Crossing (No. 2), and
- once in an hour at the Great Northern Hwy (West)/ Goldsworthy Railway Level Crossing (No. 3).

### 6.6.2 Forecast operation (2009)

In the absence of advice or data from rail operators or MRWA, existing operation data as outlined in Section 6.6.1 has been used. At each of the two Goldsworthy line rail crossings, the interruption time would be approximately five minutes each time (assuming 600 metre train running at 20 km/h). At the Port Hedland-Newman line crossing, traffic is likely to be interrupted for eight minutes each time (assuming 1.8 kilometre train running at 20 km/h speed). The 95$^{th}$ percentile queues[17] that would build up during these interruptions are shown in Table 19.

No information was available to forecast the future growth in rail movements at existing railway crossings. The future growth in frequency will only affect the number of times traffic is interrupted, not the queue length which is only affected by traffic volumes on the Great Northern Highway and train length and speed.

**Table 19 Queues (95 per cent) at railway crossings**

| Crossing | Interruption time (min) | 2007 | | | 2009 | | |
|---|---|---|---|---|---|---|---|
| | | Average volume (vph) | 95% queue (v) | No. road trains | Average volume (vph) | 95% queue (v) | No. road trains |
| 1 | 8 | 50 | 10 | 1 | 70 | 13 | 2 |
| 2 | 5 | 50 | 8 | 1 | 70 | 9 | 2 |
| 3 | 5 | 80 | 10 | 1 | 95 | 11 | 1 |

### 6.6.3 Crossing No 1

Great Northern Highway/ Port Hedland - Newman railway level crossing

Currently the peak hour traffic on the Great Northern Highway at this crossing occurs between 14:00 and 15:00, with approximately 50 vph in each direction. The 95$^{th}$ percentile queue resulting from the estimated 8 minute interruption time during this peak hour is approximately 10 vehicles (7 light vehicles, 2 trucks and 1 road train), which is equivalent to approximately 120 metres.

[17] Based on a normally distributed arrival profile. There is a 95 per cent chance the actual number of vehicles arriving during the interruption time is equal to or less than the 95 per cent queues shown in Table 19.

Once Utah Point is fully operational (late 2009), an additional 12 triple or 9 to 10 quad movements per hour in each direction at this location is forecast, in conjunction with general traffic growth. As a result, the 95th percentile queue length is forecast to increase from 10 to 13 vehicles (9 light vehicles, 2 trucks and 2 road trains). This is equivalent to approximately 170 metres, an increase of 50 metres. Delays associated with this have been incorporated into the Paramics model.

### 6.6.4 Crossing No.2

Great Northern Hwy (East)/ Goldsworthy Railway Level Crossing

The location of this rail crossing is close to crossing No 1 (1.5 kilometres to the south-east). The traffic volumes and profiles are similar, with the peak hour occurring between 14:00 and 15:00, with approximately 50 vph in each direction. The existing 95th percentile traffic queue estimated to occur from the 5 minute interruption at this crossing is approximately 8 vehicles (6 light vehicles, 1 truck and 1 road train), which is equivalent to approximately 100 metres.

Once Utah Point is fully operational (late 2009), an additional 12 triple or 9 to 10 quad movements per hour in each direction is forecast at this location, in conjunction with the general traffic growth. As a result, the 95th percentile queue length is forecast to increase slightly from 8 to 9 vehicles (7 light vehicles, 1 truck and 1 road train). This is equivalent to approximately 110 m, an increase of 10 metres. Delays associated with this have been incorporated into the Paramics model.

### 6.6.5 Crossing No. 3

Great Northern Highway (west)/ Goldsworthy railway level crossing

Currently the peak hour traffic on this crossing occurs between 16:00 and 17:00, with approximately 80 vph in each direction. The existing 95th percentile traffic queue estimated to occur from the 5 minute interruption at this crossing is approximately 10 vehicles (8 light vehicles, 1 truck and 1 road train), which is equivalent to approximately 110 metres.

Once Utah Point is fully operational (late 2009), an additional there 3 triple or 2 quad movements per hour in each direction is forecast at this location, in conjunction with the general traffic growth. As a result, the 95th percentile queue length is forecast to increase slightly from 10 to 11 vehicles (9 light vehicles, 1 truck and 1 road train). This is equivalent to approximately 120 m, an increase of 10 metres. Delays associated with this have been incorporated into the Paramics model.

### 6.6.6 FMG Rail

*All text in this section (unless marked otherwise) has been sourced from the following document "Public Environmental Review Pilbara Iron Ore and Infrastructure Project: Stage A Port and North-South Railway" and is not comment by SKM.*

FMG has developed its Pilbara Iron Ore and Infrastructure Project in the Pilbara region in the north of Western Australia. This Project has been developed in stages: Stage A involved the construction and operation of a Port and North-South Railway that FMG has indicated it will make accessible to third parties; Stage B comprises the development of iron ore mining operations that will utilise the Stage A infrastructure.

The Pilbara Iron Ore and Infrastructure Project Stage A incorporates port facilities at Anderson Point in Port Hedland and a railway stretching south-southeast some 345 km to resources in the East Pilbara at Mindy Mindy. It is proposed to initially transport 45 Mtpa but the railway has been designed to be capable of transporting 100 Mtpa, to ensure future railway duplication is not required. FMG has indicated that it will make available its railway and port facilities to other users, who also have mineral deposits in the Pilbara, but are currently unable to gain access to existing infrastructure for export of their ore at commercially competitive rates and timeslots.

The proposed railway has been located for much of its length in close proximity to the existing BHPBIO railway and the proposed corridor for the Hope Downs project, but does deviate on some occasions where there are significant environmental, heritage or engineering constraints. FMG has pursued the development of its own port and railway facilities as it has not yet been able to gain access to the existing BHPBIO infrastructure, and the proposed Hope Downs infrastructure may not be constructed and/ or not available to FMG to meet FMG's timing requirements. It is FMG's expectation that, due to inherent cost and inefficiency issues, only one of the proposed FMG or Hope Downs railways will be constructed. The FMG railway lines are shown in Figure 23.

SKM comment

Further operational information of train profile is not available at this stage. Based on the railway capacity of transporting 100 Mtpa, it is assumed that if 336 ore car trains are used, (each ore car with a load capacity of approximately 106 tonnes), there would be approximately 8 trains (each way) operating daily from various mine sites to Anderson Point. The interruption at the proposed Great Northern Highway crossing is forecast to be approximately once every hour and a half.

## ▪ Figure 23 FMG Iron Ore Infrastructure Project

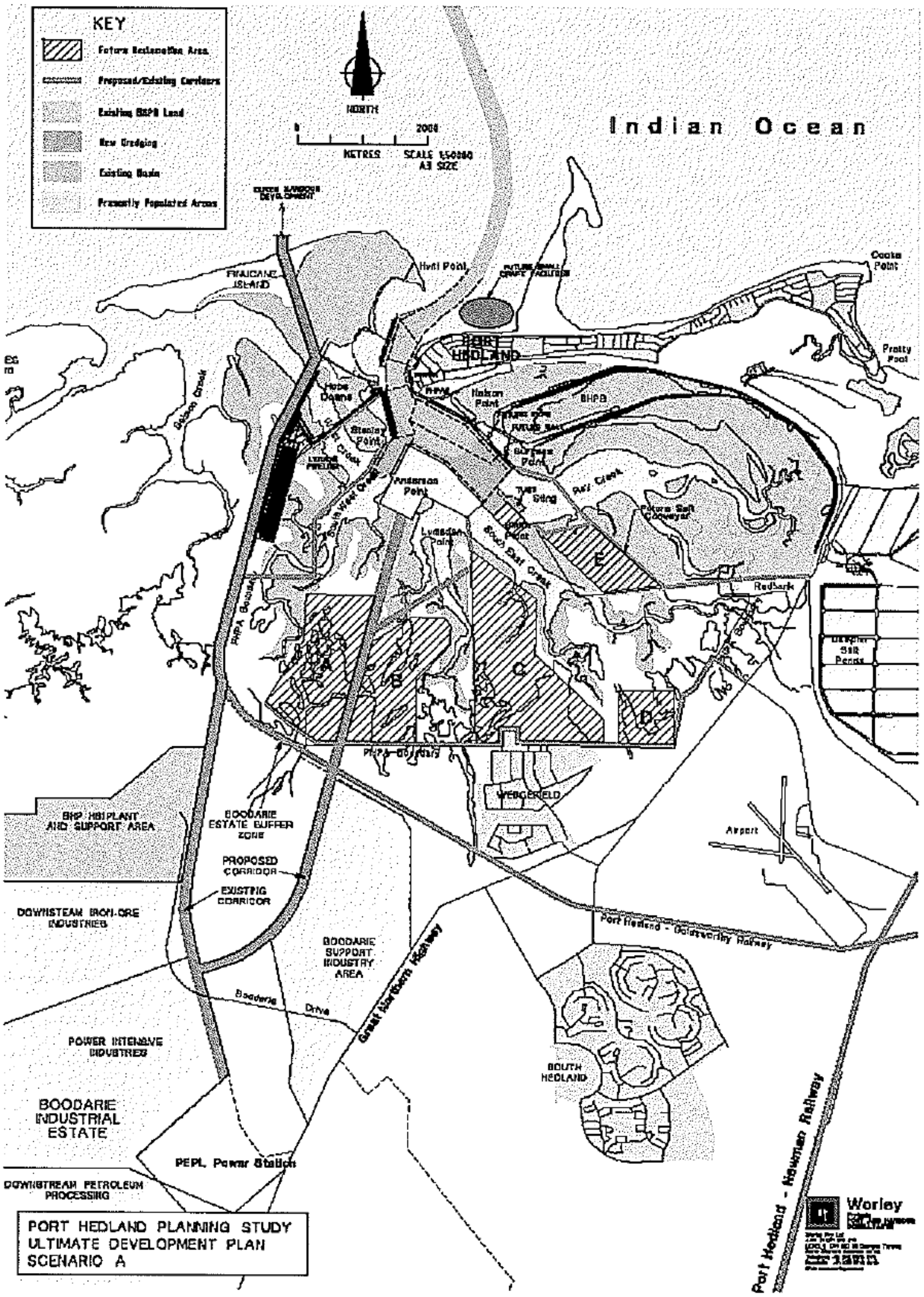



**Figure 6 Possible linkages and reclamation areas, according to PHPA (Figure 4-4 of Worley 2003)**

Source: Public Environmental Review Pilbara Iron Ore and Infrastructure Project: Stage A Port and North-South Railway

### 6.7 Analysis summary

The operation of the road network has been analysed at intersection and road section level for current traffic movements (2007) and forecast traffic movements (2009) with different assessments for 100% quad use and 100% triple road train use. An annual general traffic increase of 5% has been used.

By late 2009, it is estimated that there will be approximately 352 triple or 234 quadruple road train trips per day operating to and from Utah Point. This is equivalent to approximately 17 triple or 10 quadruple road train trips per hour based on 24 hour, 7 day a week operation. An allowance for 200 vehicles per peak hour has been included in the assessment to cover employee/ service and other vehicles associated with the Utah Point development and nearby developments such as FMG for which there was no data available.

There is not expected to be an unacceptable level of delay or congestion on any intersection or section of road during the AM peak hour with the forecast increased road train traffic, and therefore none is expected during off peak hours (except immediately prior to and after the PM peak hour). There will be noticeable increases in the degree of saturation for some turning movements at intersections during these times, however they remain below 0.8, the level at which increases in delay and queuing are considered to result in operational problems.

There are three key intersections that will be significantly impacted during the PM peak hour by the increased road haulage associated with the Utah Point development:

- Cajarina Rd/ Pinga St

  The overall degree of saturation of this intersection during the PM peak hour is forecast to increase from 0.41 to 1.28 for triples and 1.20 for quads. The critical movement at this intersection is the right turn for road trains from Cajarina Road onto Pinga Street. The left turn out of Cajarina Rd could also be subject to delay when a right turning truck makes it difficult to pass or see past.

- Great Northern Hwy/ Wallwork Rd

  The overall degree of saturation for this intersection during the PM peak hour is forecast to increase from 0.63 to 1.15 for triples and 1.13 for quads. The critical movement at this intersection is the right turn from the Great Northern Highway onto Wallwork Road for general traffic due to the increase in right turn southbound traffic on the Great Northern Highway and associated reduction in gaps in this traffic. It should be noted that the model does not reflect a two stage crossing where right turning vehicles cross the westbound lane and wait in the median for a suitable gap in eastbound traffic. A two-stage crossing can only be undertaken by light vehicles. The likely degree of saturation is less than that forecast but is still considered too high to be acceptable.

- Great Northern Hwy/ Port Hedland Rd

  The overall degree of saturation for this intersection during the PM peak hour is forecast to increase from 0.42 to 0.78 for triples and 0.77 for quads. The critical movement at this intersection is the right turn from the Great Northern Highway into Port Hedland Road for general traffic, due to the increase in right turn northbound traffic on the Great Northern Highway and associated reduction in gaps in this traffic. It should be noted that the model does not reflect a two stage crossing where right turning vehicles cross the eastbound lane and wait in the median for a suitable gap in westbound traffic. A two-stage crossing can only be undertaken by light vehicles. The likely degree of saturation is less than that forecast.

Road section analysis indicates that there are two sections of road where the *level of service* is forecast to reduce to a lower level, but this is only during the peak hours and is not considered significant if quads are used instead of triples.

Traffic at existing railway crossings are forecast to experience increased queuing, as follows:

- Great Northern Highway/ Port Hedland - Newman railway level crossing

  The 95$^{th}$ percentile queue length is forecast to increase from 10 to 13 vehicles (9 light vehicles, 2 trucks and 2 road trains). This is equivalent to approximately 170 metres, an increase of 50 metres.

- Great Northern Highway (east)/ Goldsworthy railway level crossing

  The 95$^{th}$ percentile queue length is forecast to increase slightly from 8 to 9 vehicles (7 light vehicles, 1 truck and 1 road train). This is equivalent to approximately 110 m, an increase of 10 metres.

- Great Northern Highway (west)/ Goldsworthy railway level crossing

  The 95$^{th}$ percentile queue length is forecast to increase slightly from 10 to 11 vehicles (9 light vehicles, 1 truck and 1 road train). This is equivalent to approximately 120 m, an increase of 10 metres.

- Great Northern Highway/ FMG railway level crossing

  There is insufficient data to forecast queue lengths. The interruption at this proposed crossing is forecast to be approximately once every hour and a half.

Delays associated with the railway crossings have been incorporated into the Paramics model.

SKM

# 7. Proposed road network changes

The first version of this TA report was issued in March 2007 and reflects no changes in the road network during the assessment period up to 2009.

In April 2008, MRWA (Pilbara) indicated that there was a strong possibility of funding being provided for major changes to the road network and for these changes to be implemented prior to, or in conjunction with, the construction phase of the Utah Point Public Berth project. MRWA provided SKM with a plan of these changes (refer Appendix D: Main Roads WA Drawing 0811-097) and indicated that all intersections had been designed to accommodate the increased truck movements indicated in this TA without the degree of saturation exceeding 0.8. It is important to note that the intersection of Port Hedland Road and Great Northern Highway near the airport is not included in the proposed scheme and remains an intersection that will be significantly impacted if used during the afternoon peak period.

The proposed changes were published in the West Australian newspaper on 30 April as follows:

**Pilbara's mining roads to get $240m injection**

*30th April 2008, 6:45 WST*

Roads supporting BHP Billiton and Rio Tinto's $18 billion Pilbara mining operations will get a $240 million upgrade under next month's Federal Budget, as part of a $900 million-plus injection into the State's roads.

Amid concerns that infrastructure bottlenecks could threaten an expected doubling of iron ore exports from the Pilbara in the next five years, the Rudd Government will announce a $160 million reconfiguration of the road and rail network at Port Hedland. As well as building a fourth lane on Great Northern Highway between Port Hedland and South Hedland, the works will include three intersection improvements and eliminate the need for heavy freight and haulage vehicles to make three rail crossings to reach the port.

Another $80 million will be committed for a six-stage duplication of Dampier Highway, improving road safety for Karratha residents and increasing freight access for oil, gas and chemical exporters.

Some of the WA roadworks will begin this year and some will start next year when the five-year $22.3 billion AusLink II program starts.

Infrastructure and Transport Minister Anthony Albanese said the Budget funding for WA roads would be targeted at "critical export supply chains". By 2014, an extra $1.76 billion would be spent on transport projects in WA, he said.

SKM

# 8. Findings and recommendations

## 8.1 Findings

This Transport Assessment report has looked at the impact that traffic generated by the Utah Point Bulk Commodities Berth stage B development will have on key intersections and sections of roads within Port Hedland. The assessment is based on the facility opening in late 2009 and attracting its full allocation of road based transport of 9 Mtpa within the first year of operation.

It is understood that the preference of operators using Utah Point is that the majority of road transport will be by quad road trains. These road trains require a Concessional permit to be issued by MRWA to use all of the roads on the haul route. This assessment has also assessed the transport of all material using triple road trains instead of quad road trains, and the difference that this has on the impact on the road network.

The majority of the proposed haul route is on the Great Northern Highway, with the remainder being on Pinga St, Cajarina Rd and a new access road running parallel to Finucane Road. All of these roads currently provide the only route to Utah Point and are approved for road train use by MRWA.

There are two peak hours for traffic in Port Hedland, from 6 AM to 7 AM and from 4 PM to 5 PM. Annual traffic growth is expected to be 5%.

The current haul route is considered to have a number of deficiencies and impediments, with Great Northern Highway not having priority at the intersections of Port Hedland Road, Wallwork Road or Pinga Street, despite it forming the National Highway No 1 route through Port Hedland. Furthermore, there is no dedicated industrial distributor type road connecting the Great Northern Highway to Wedgefield Industrial Area and Finucane Island, the latter the location for the Utah Point development as well as the FMG Anderson Point development and BHPBIO operations.

There are currently three railway level crossings on the proposed haul route, with another planned for construction this year (2007). MRWA has indicated that the movement of trains is regulated through the State Agreements which are agreed with the State and specific rail operators. Movements are regulated by the level of protection and administered via MRWA. All of these crossings impact on the road network as trains have priority over road traffic at all times.

A review of the crash record for the road network within Port Hedland as well as key intersections, has not revealed an over representation of heavy vehicles in crash numbers or crashes resulting in deaths or injury. It has however, identified a number of intersections with a crash record that warrant investigation under state and/ or national black spot funding programs. Main Roads WA has assessed these intersections in the past and has indicated that this is an important consideration with the proposed redesign of the road network and key intersections.

There are not expected to be any adverse safety concerns provided that all intersections used by the generated road trains have a degree of saturation not exceeding 1 and contain no adverse crossfalls.

There is not expected to be any significant impact on pedestrian, cycling or public transport, primarily because the proposed haul route is on an established route for road trains.

The Utah Point generated traffic (whether triples or quads) is not expected to have a major impact on the operation of intersections and sections of roads along the haul route **during the AM peak hour and off peak times** (except immediately prior to and after the PM peak hour). There will be noticeable increases in the degree of saturation for some turning movements at intersections during these times, however they remain below 0.8, the level at which increases in delay and queuing are considered to result in operational problems.

The generated traffic is expected to have a major impact on the following intersections during the PM peak period:

- Great Northern Hwy/ Port Hedland Rd
- Great Northern Hwy/ Wallwork Rd
- Cajarina Rd/ Pinga St

It should be noted that these intersections have been identified as having a current operating deficiency and therefore are sensitive to increases in traffic, particularly when that traffic has been assigned to the appropriate road according to its classification and function.

The *level of service* for Port Hedland Rd between Great Northern Highway and Wilson Street, excluding intersections, is forecast to reduce from C to D during the AM peak as a result of the assumed 5 per cent annual increase in traffic and new residential development in Cooke Point. Utah Point will initially reduce this annual growth by redirecting existing traffic to the new Utah Point Bulk Commodities Berth and away from the West End. It is expected however, that spare capacity at the public berths at West End will quickly be taken up by other import and export road based operators.

Based on current rail crossing data, there are not expected to be any significant increases in queues and delays at the rail level crossings with the increased Utah Point generated traffic. However, rail movements are likely to significantly increase in the future and there needs to be a process in place to assess the impact of this.

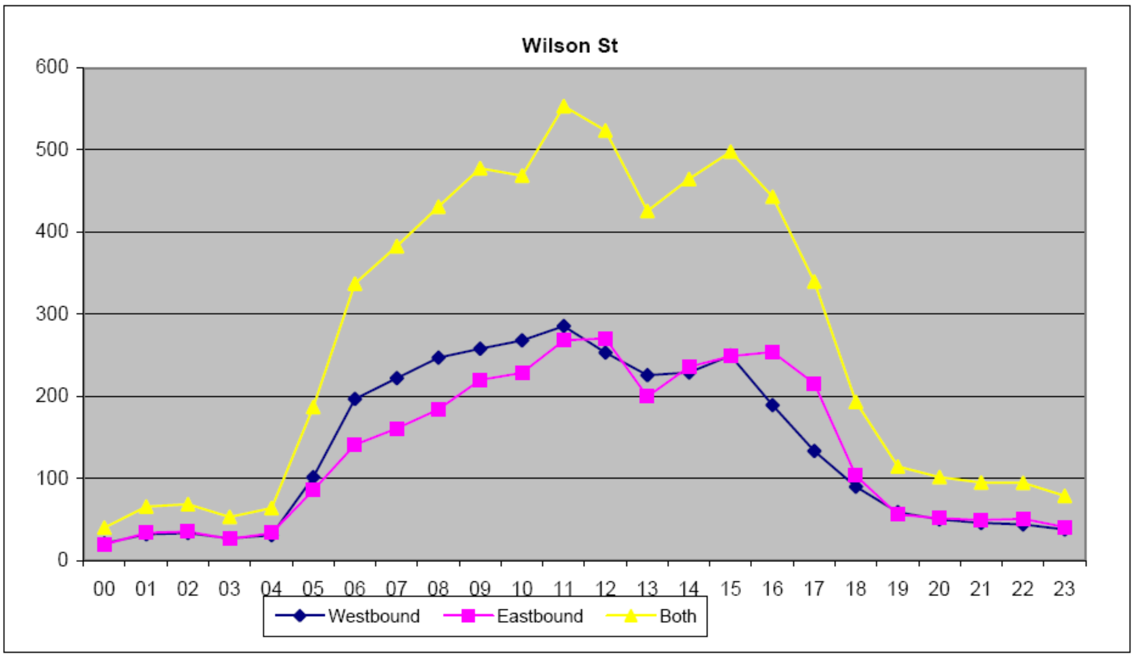
## 8.2 Recommendations

1) PHPA, DPI and the Town of Port Hedland continue to work with MRWA on the proposed changes to the road network (as outlined in Section 7) that will address the issues raised in this TA;
2) Quad road trains be used instead of triple road trains;
3) Dependent on the timing for the proposed changes to the road network, interim consideration is given to:
    1) minor widening and/ or channelisation of intersections on the haul route (e.g. widening of Cajarina Road at Pinga Street would allow left turners to turn left without being held up by right turners); and
    2) Operational restrictions for road trains accessing the Utah Point facility are discussed with ToPH and MRWA to ensure that a suitable regime is successfully implemented to avoid using the haul route during the PM peak periods where the degree of saturation of intersections exceeds 0.8.

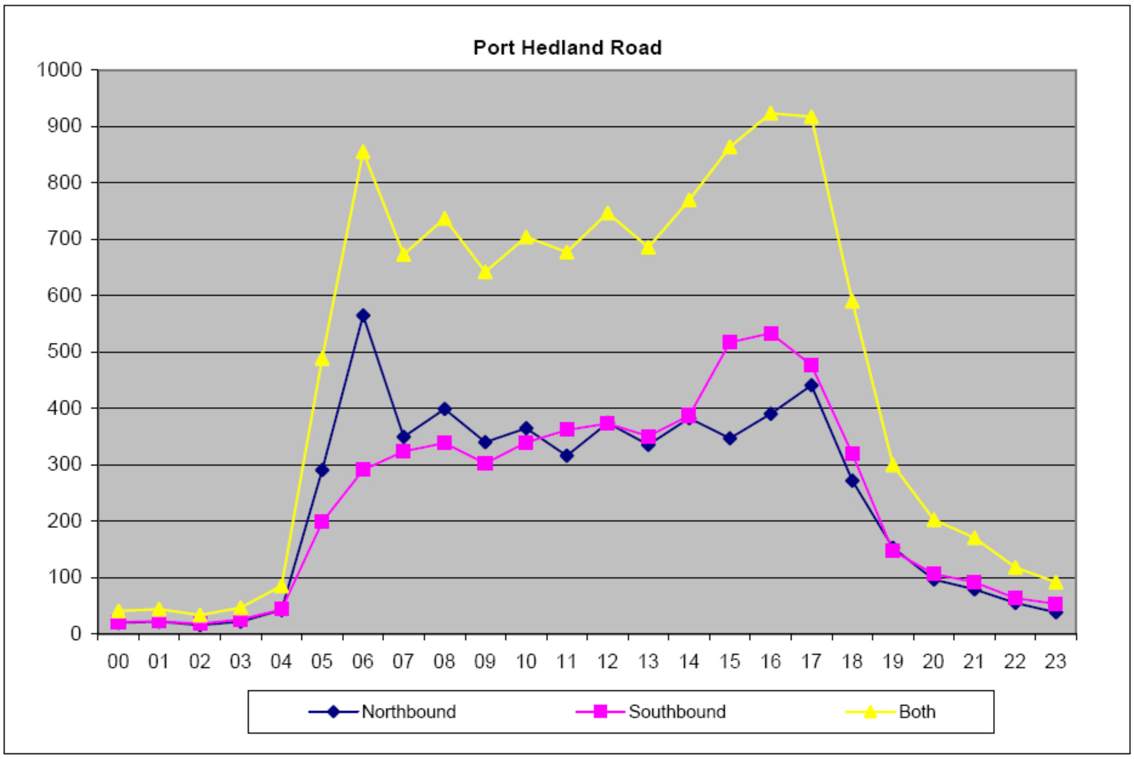
SKM

# Appendix A Existing traffic profiles and volumes

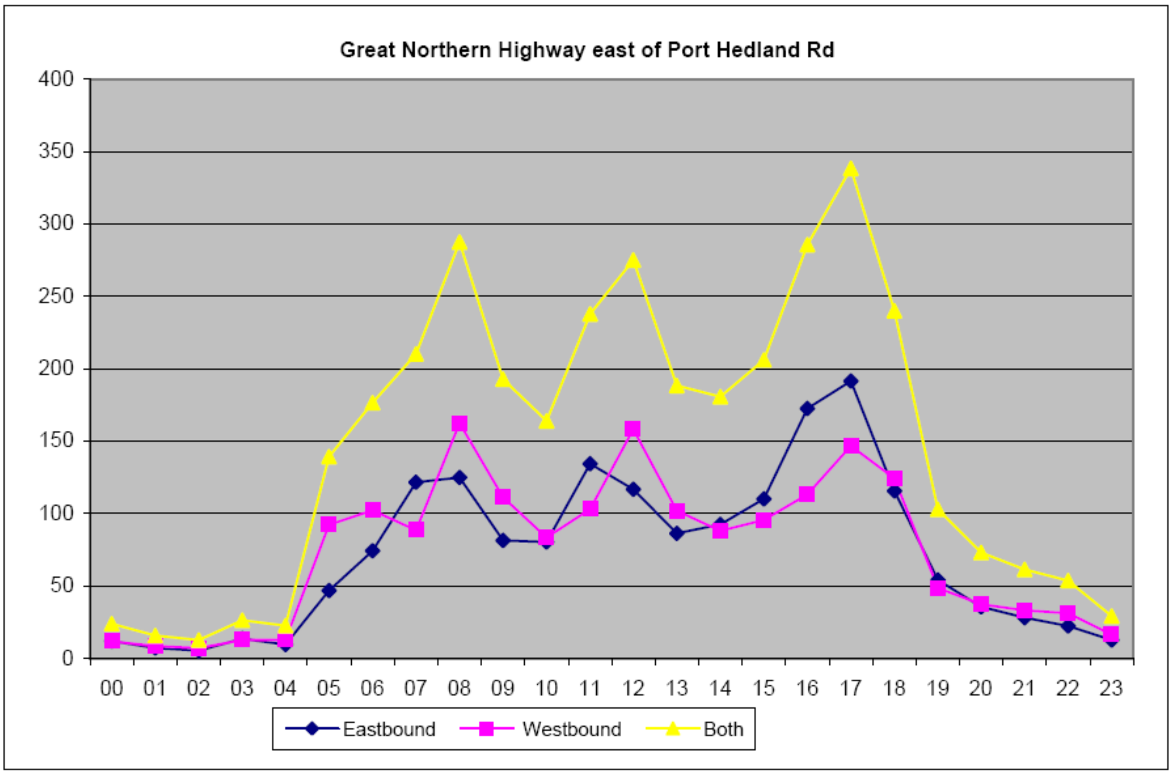
- **Figure 24 Existing (2007) traffic profile - Wilson St**



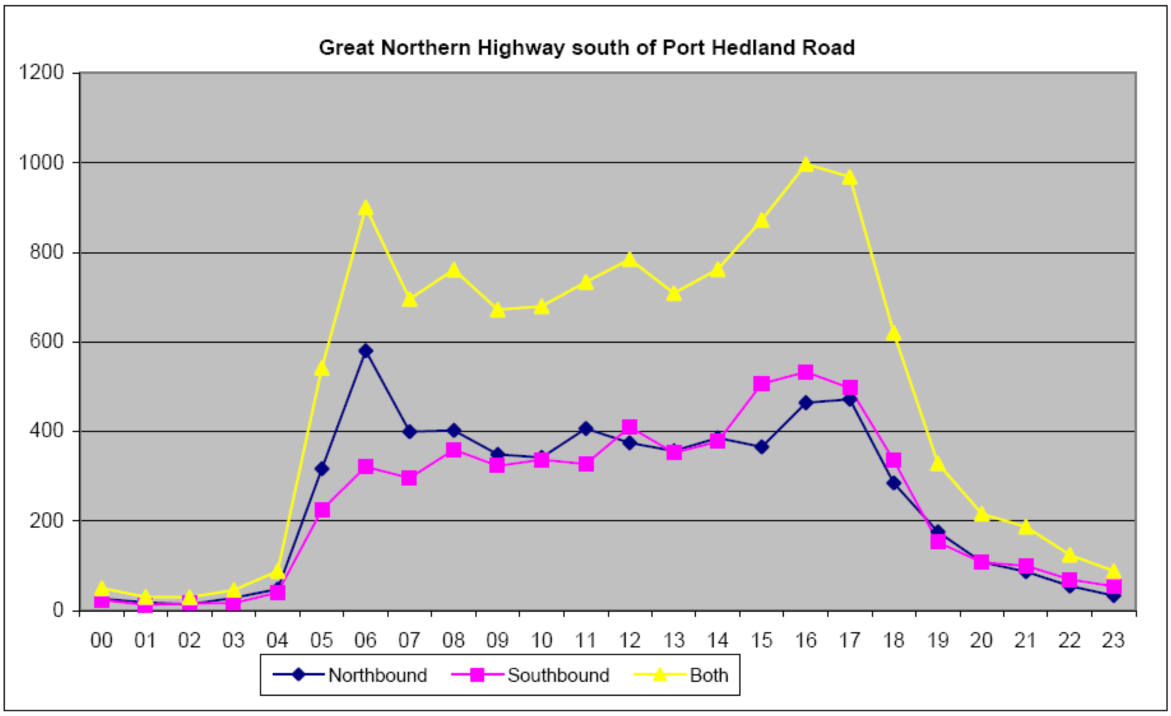

- **Figure 25 Existing (2007) traffic profile - Port Hedland Road**



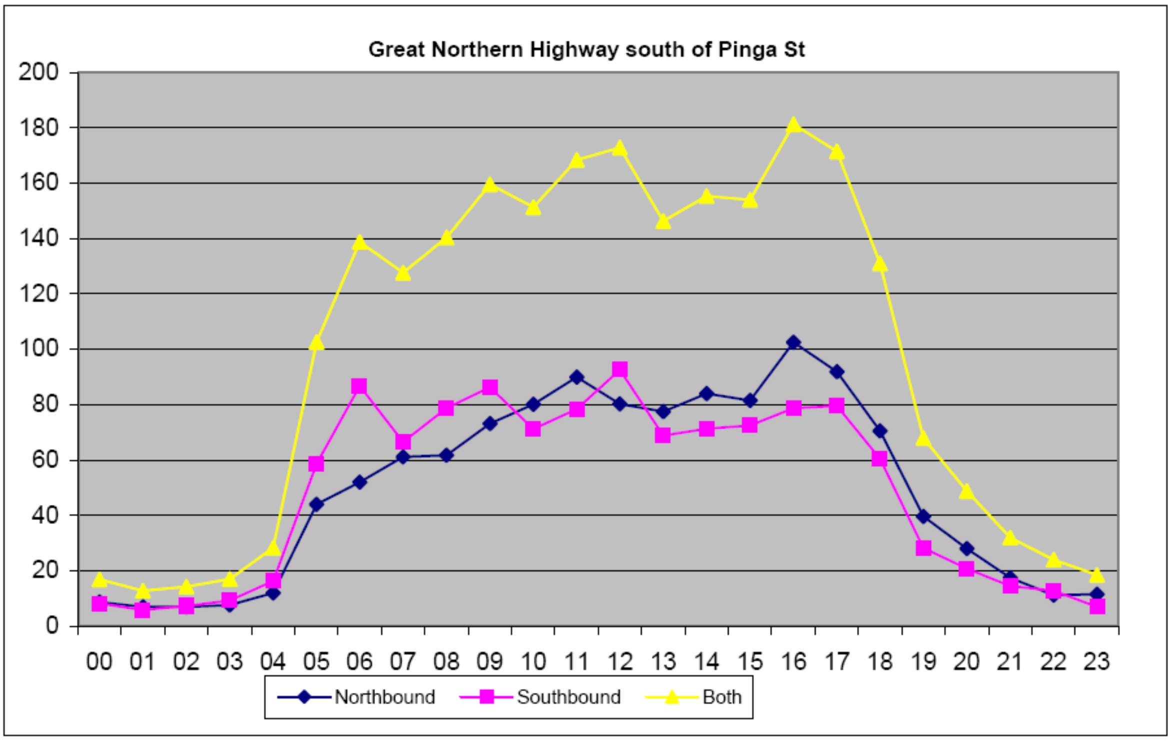
- **Figure 26 Existing (2007) traffic profile - Great Northern Hwy east of Port Hedland Rd**



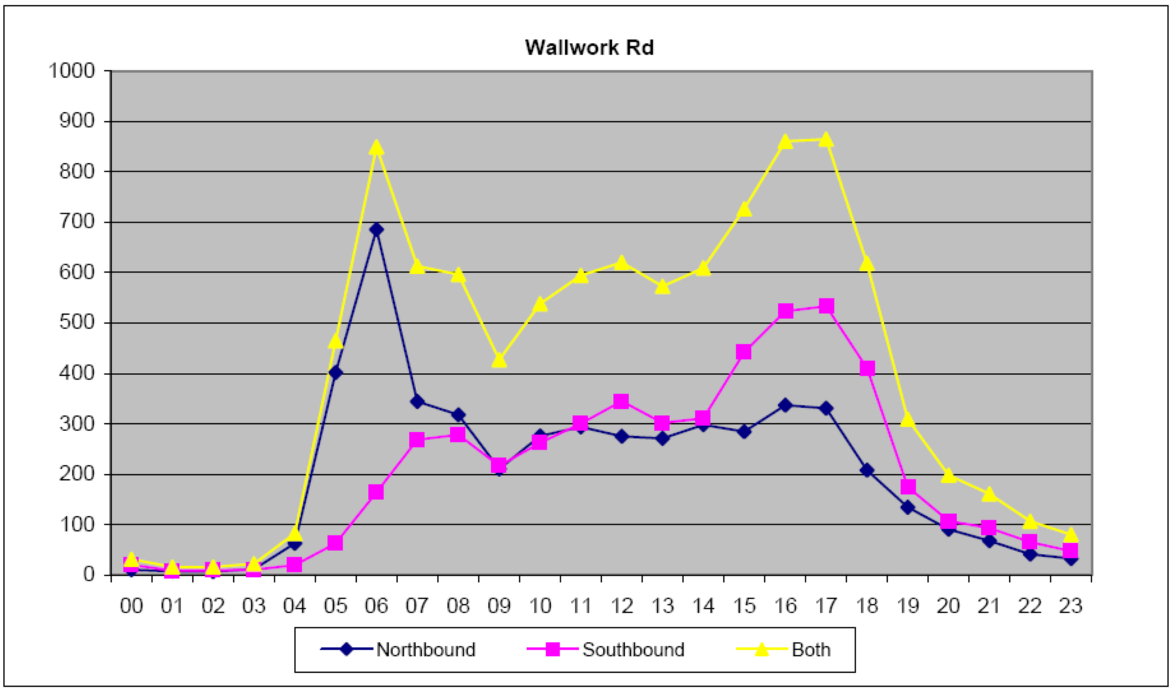

- **Figure 27 Existing (2007) traffic profile - Great Northern Hwy mid Port Hedland Rd & Wallwork Rd**



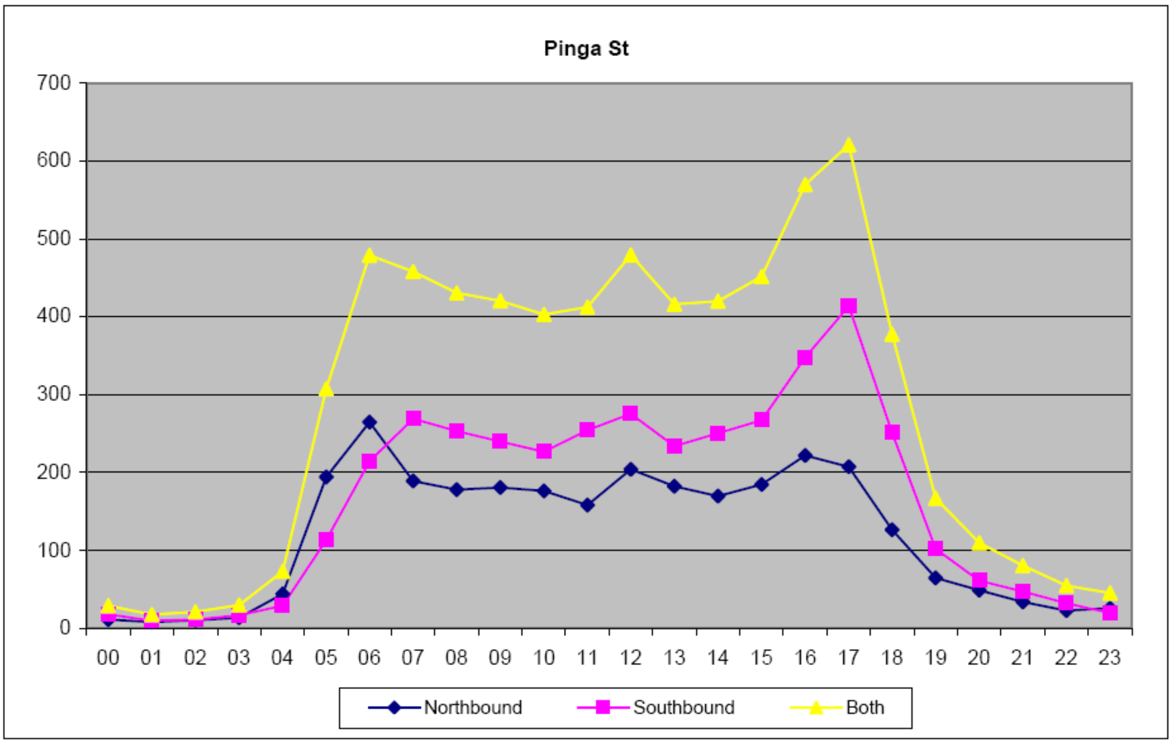
- **Figure 28 Existing (2007) traffic profile - Great Northern Hwy south of Pinga St**



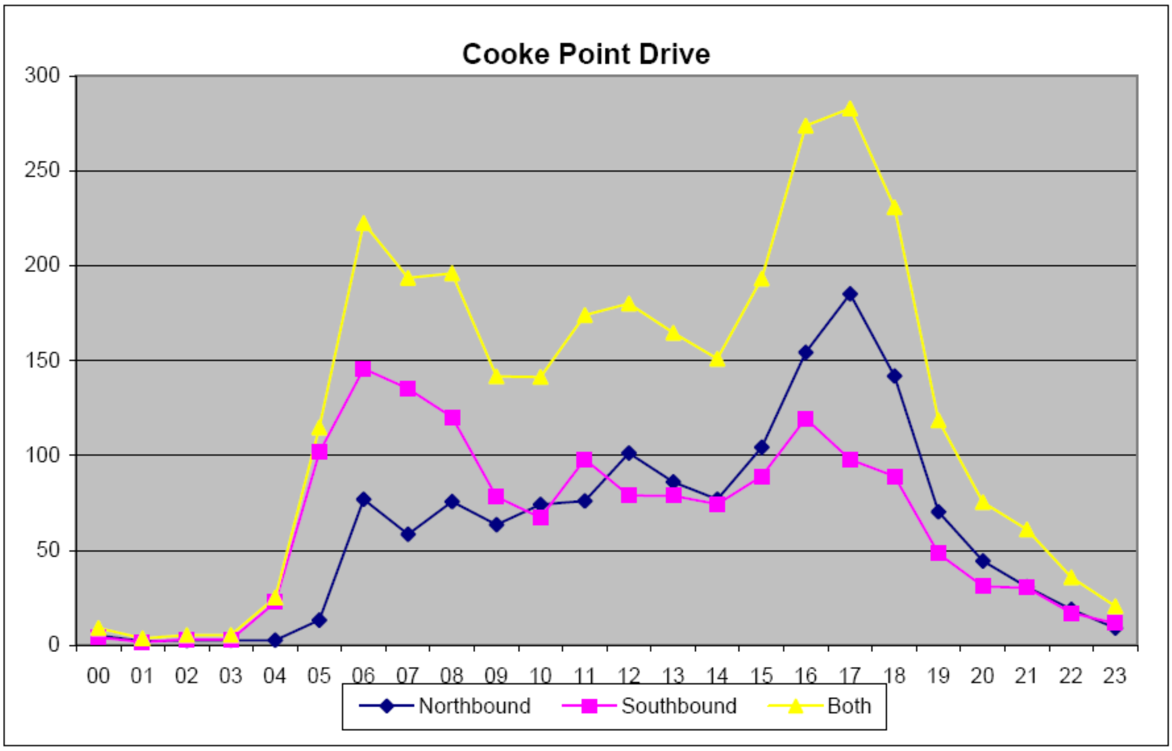

- **Figure 29 Existing (2007) traffic profile - Wallwork Rd**



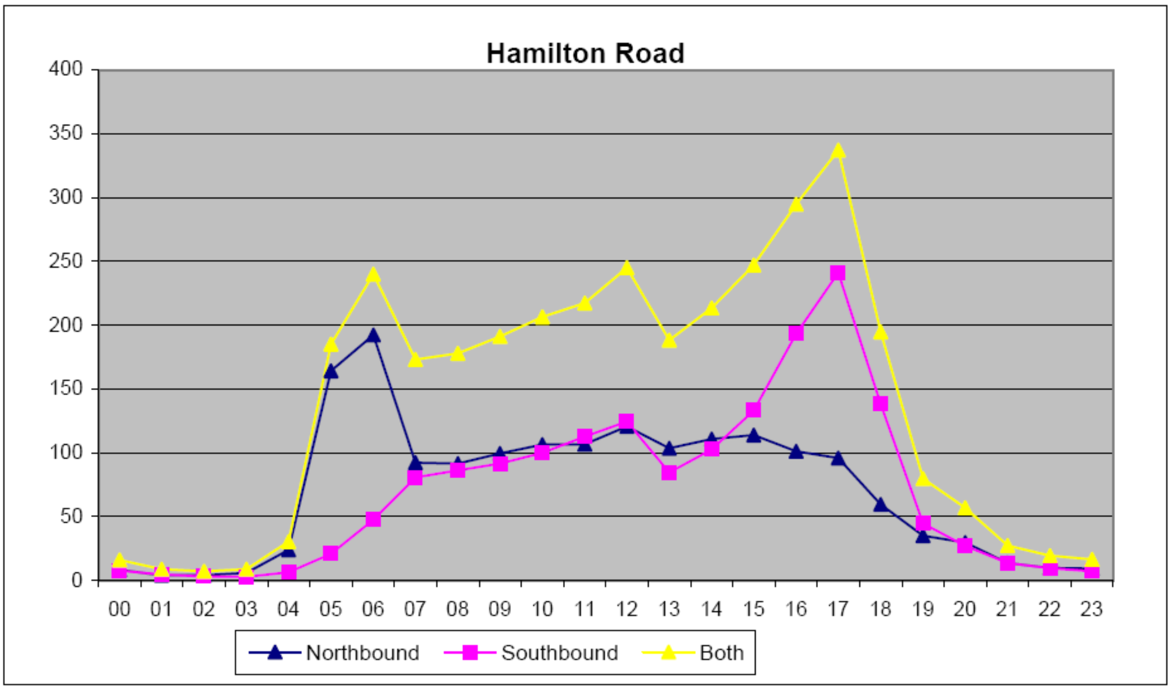
- **Figure 30 Existing (2007) traffic profile - Pinga St**




- **Figure 31 Existing (2007) traffic profile - Cooke Point Dr**



▪ **Figure 32 Existing (2007) traffic profile - Hamilton Rd**



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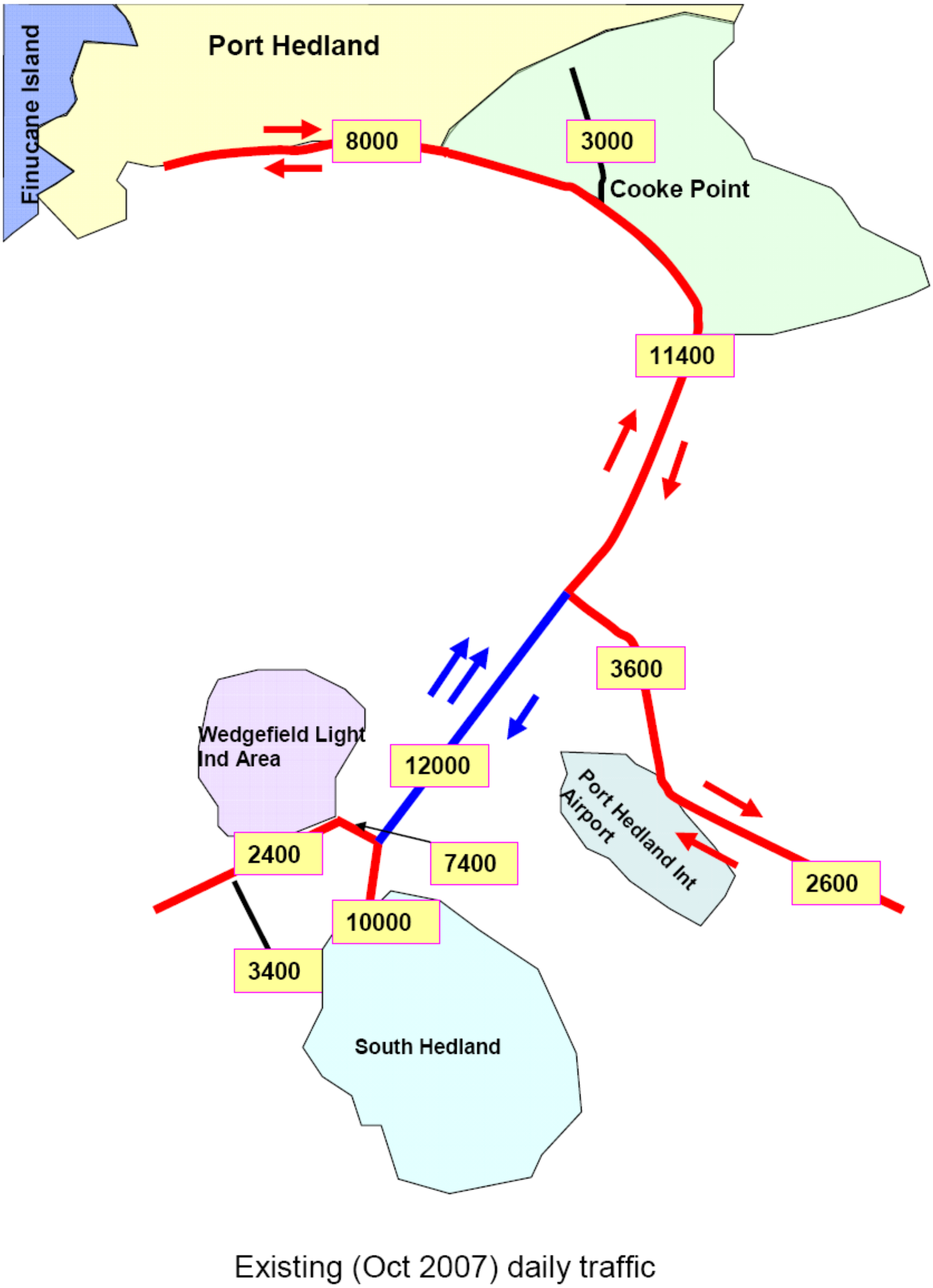
- **Figure 33 Existing daily traffic on product haul routes**



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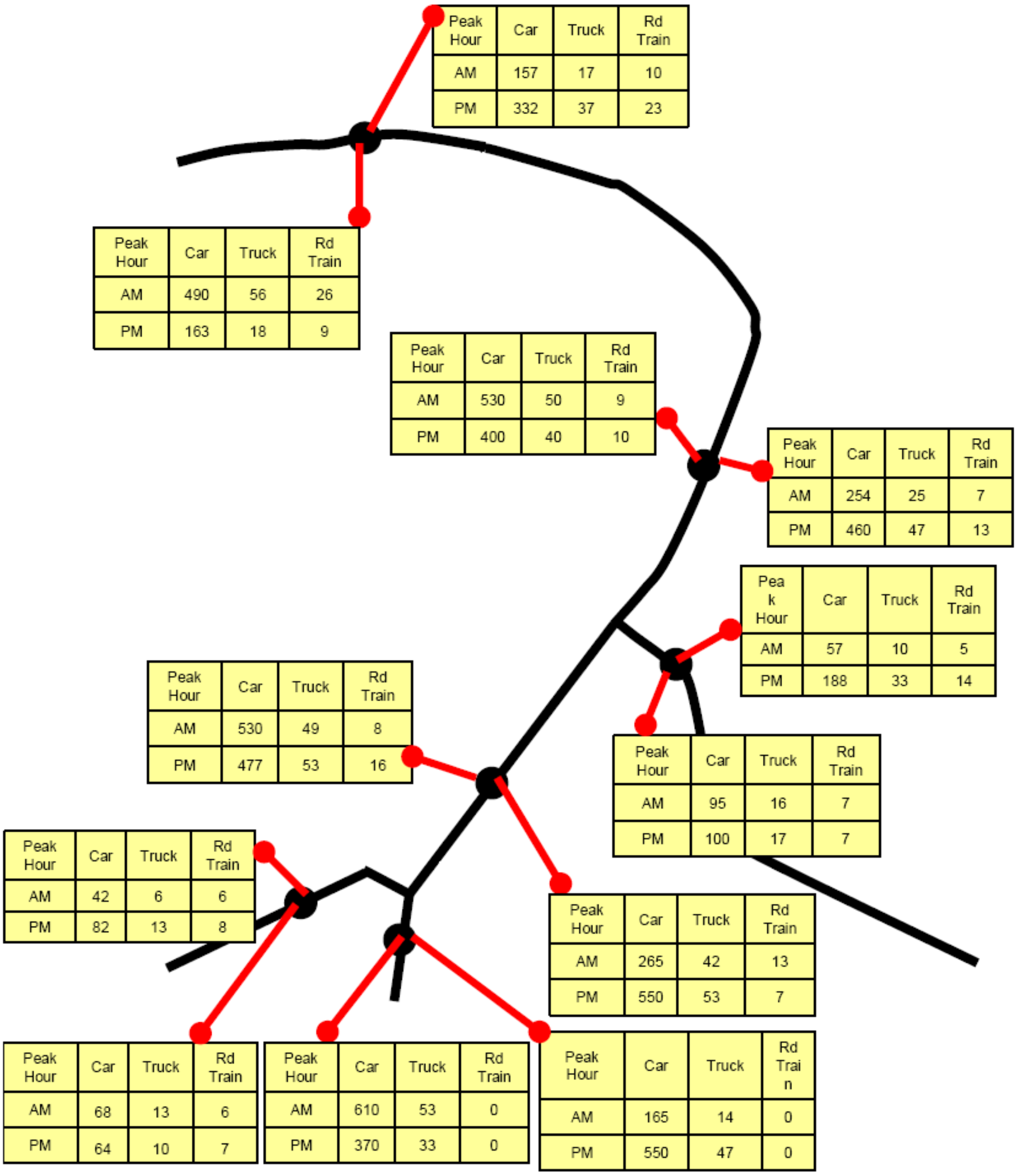
- **Figure 34 Existing AM and PM peak hour traffic on product haul routes**




**Existing (2007) peak hour traffic**

**(Vehicle breakdown based on daily class split)**

# Appendix B Existing 2007 turning movements

The following turning movements are based on data collected in November 2007 and supplied to SKM by Main Roads WA in the form of turning movement diagrams and video surveys. This data was used as the base data for the aaSIDRA and Paramics models.

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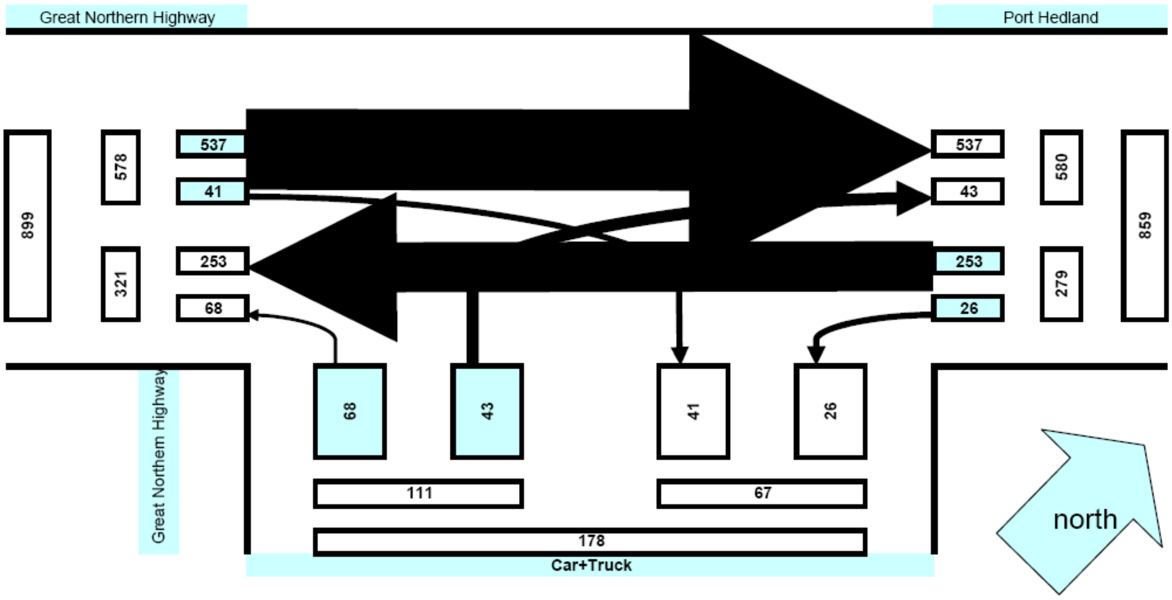
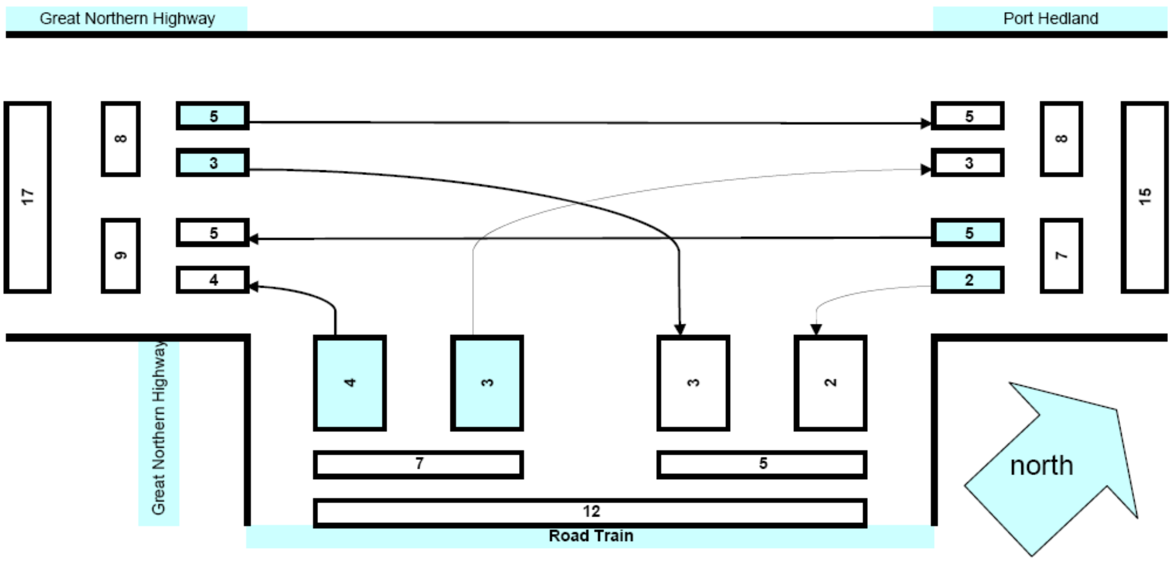
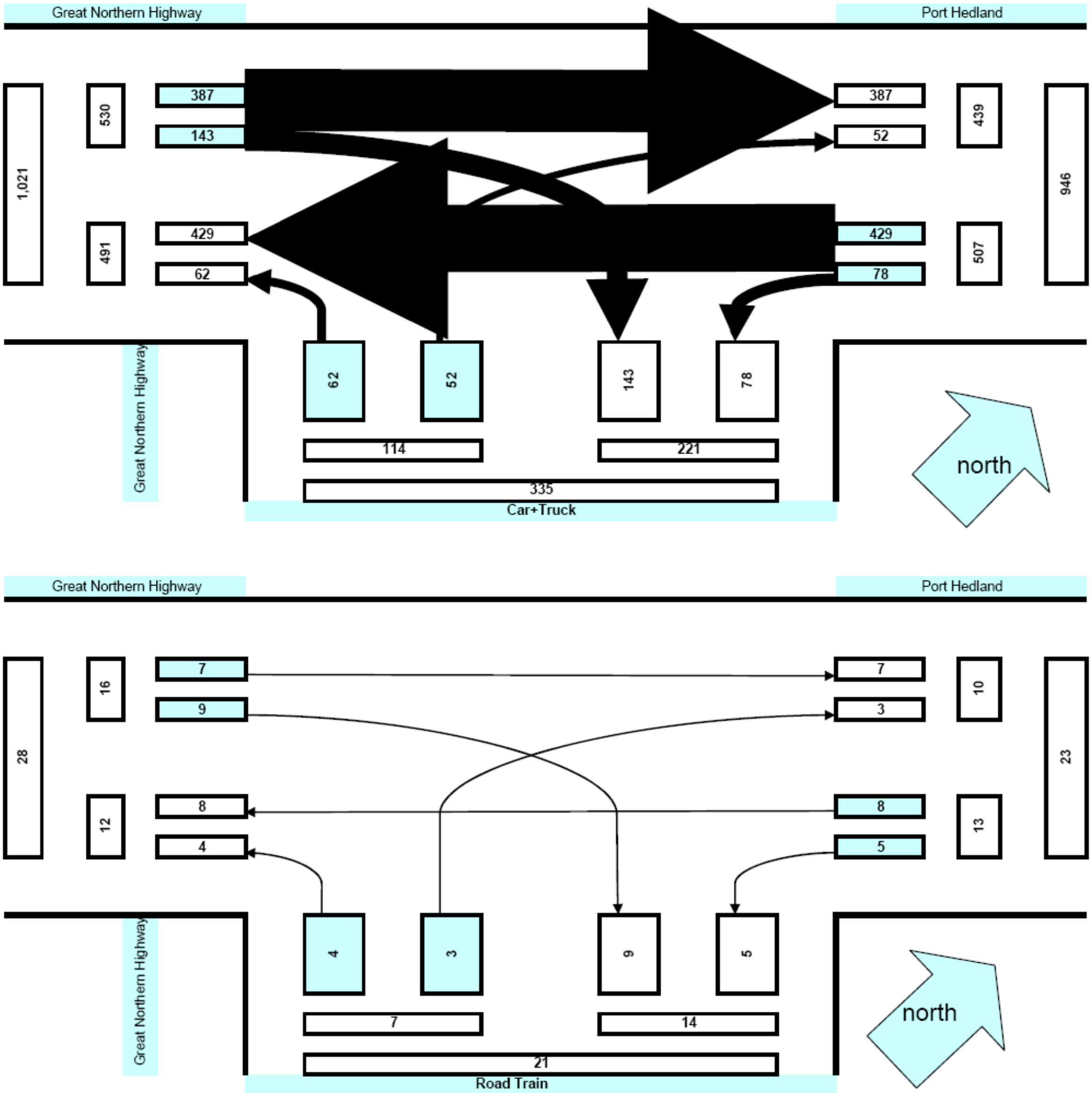
- **Figure 35 Existing 2007 AM peak hour traffic volumes for Great Northern Highway/ Port Hedland Road**

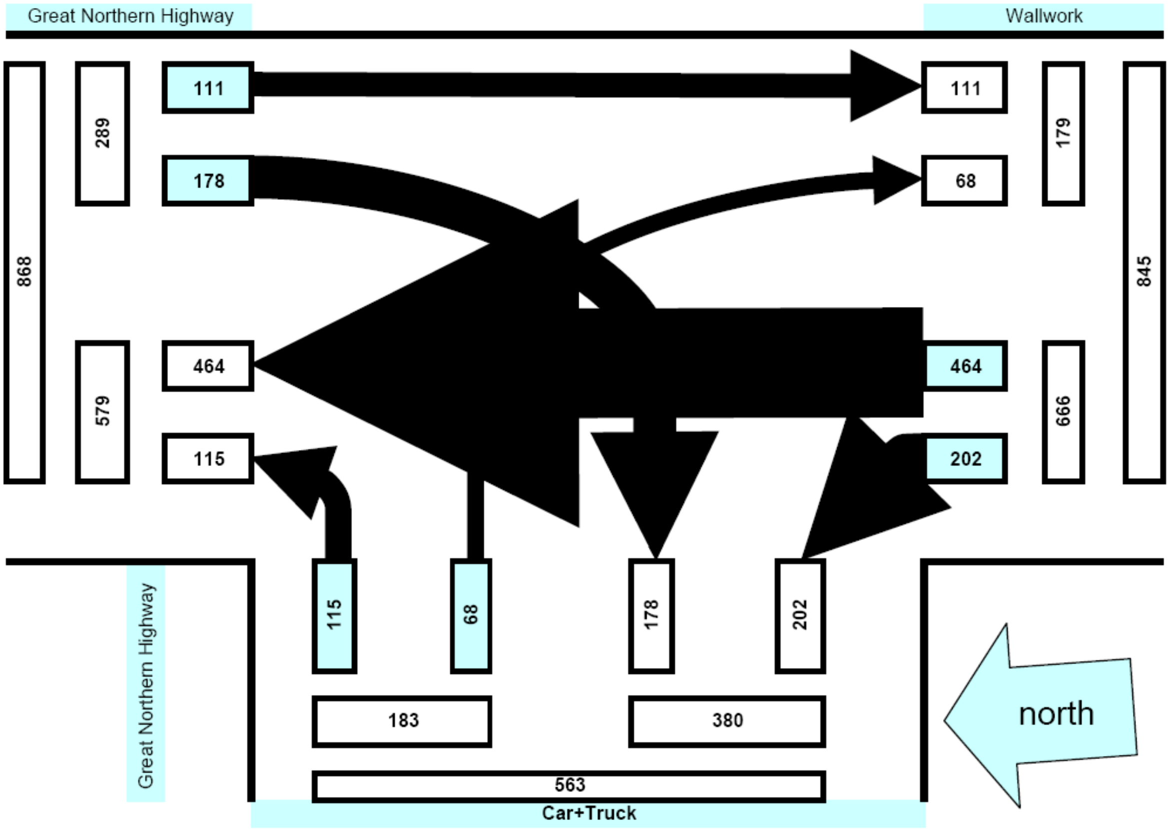


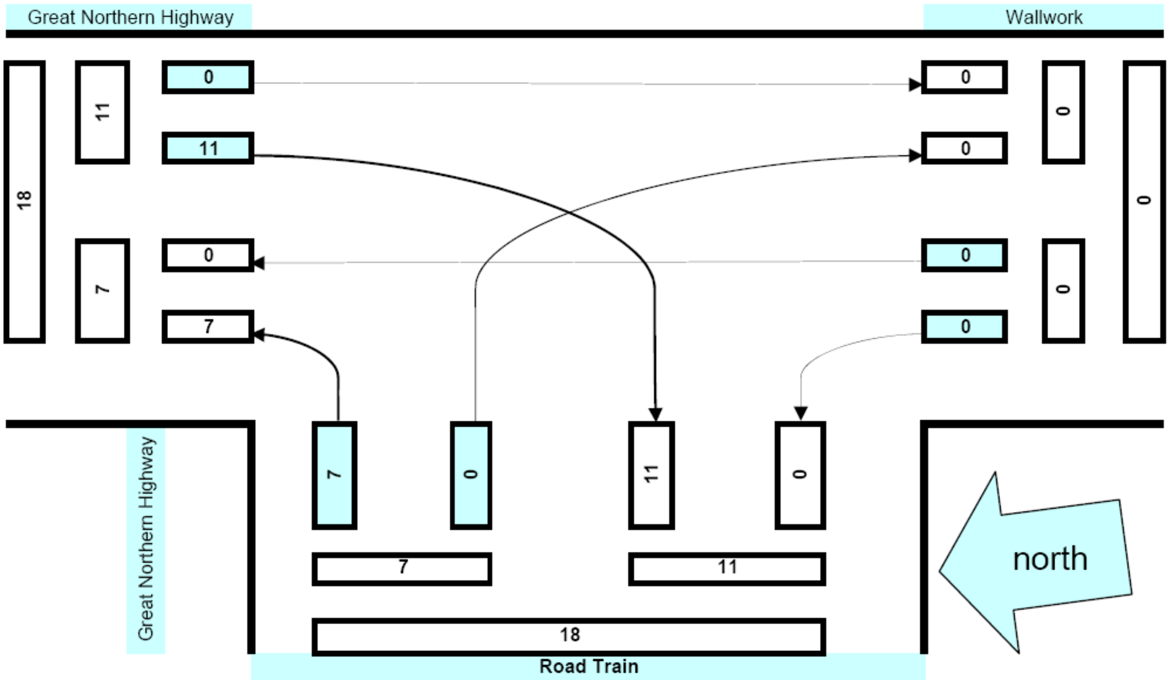



- **Figure 36 Existing 2007 PM peak hour traffic volumes for Great Northern Highway/ Port Hedland Road**

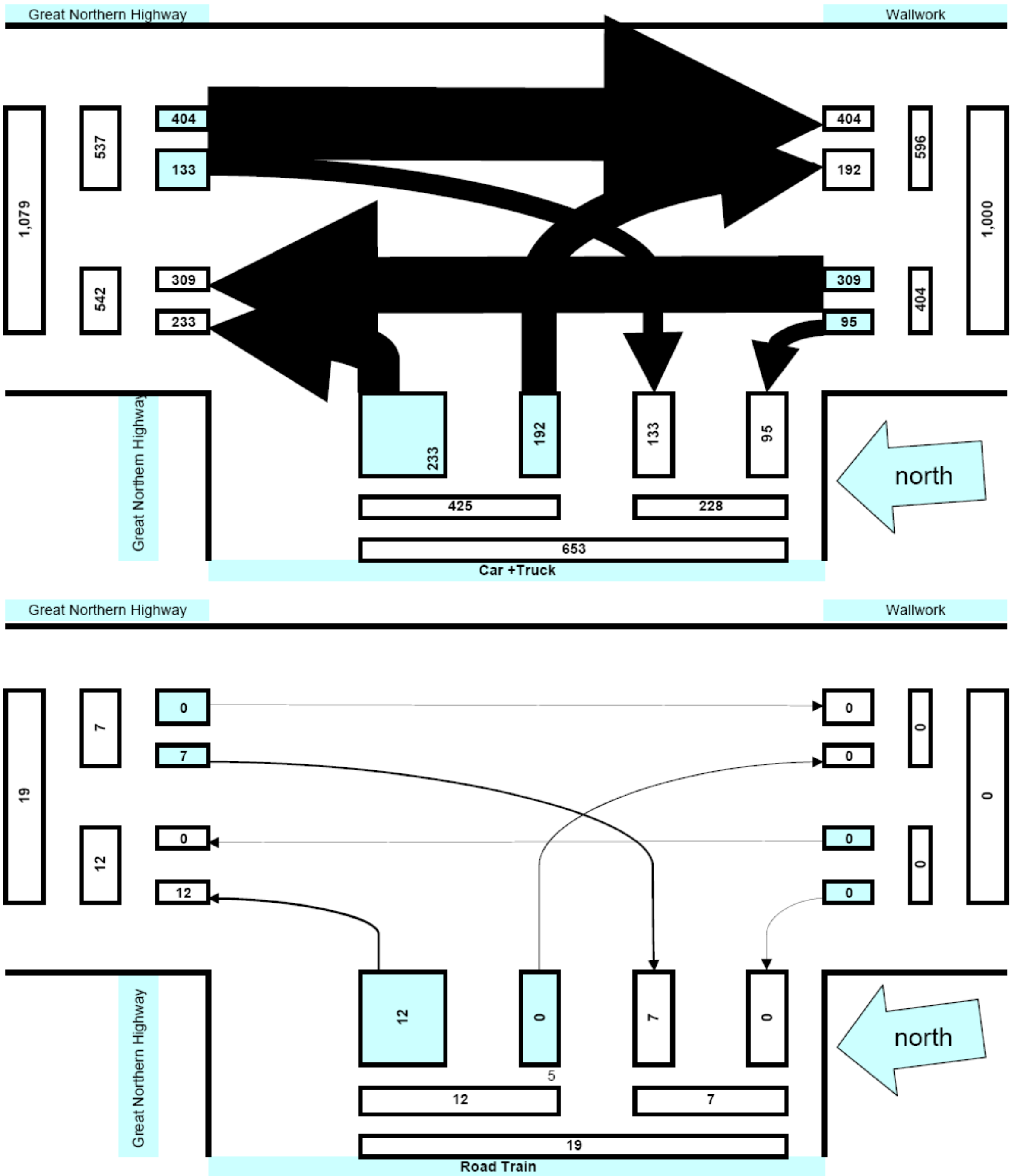


- **Figure 37 Existing 2007 AM peak hour traffic volumes for Great Northern Highway/ Wallwork Road**



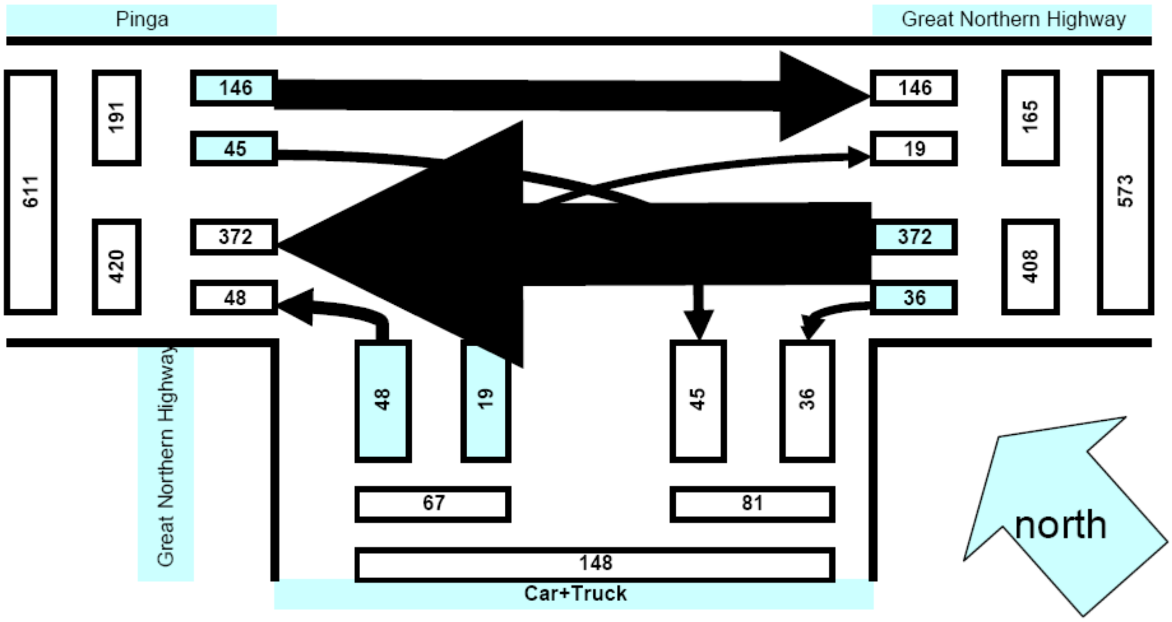



- **Figure 38 Existing 2007 PM peak hour traffic volumes for Great Northern Highway/ Wallwork Road**



SKM

- **Figure 39 Existing 2007 AM peak hour traffic volumes for Great Northern Highway/ Pinga Road**



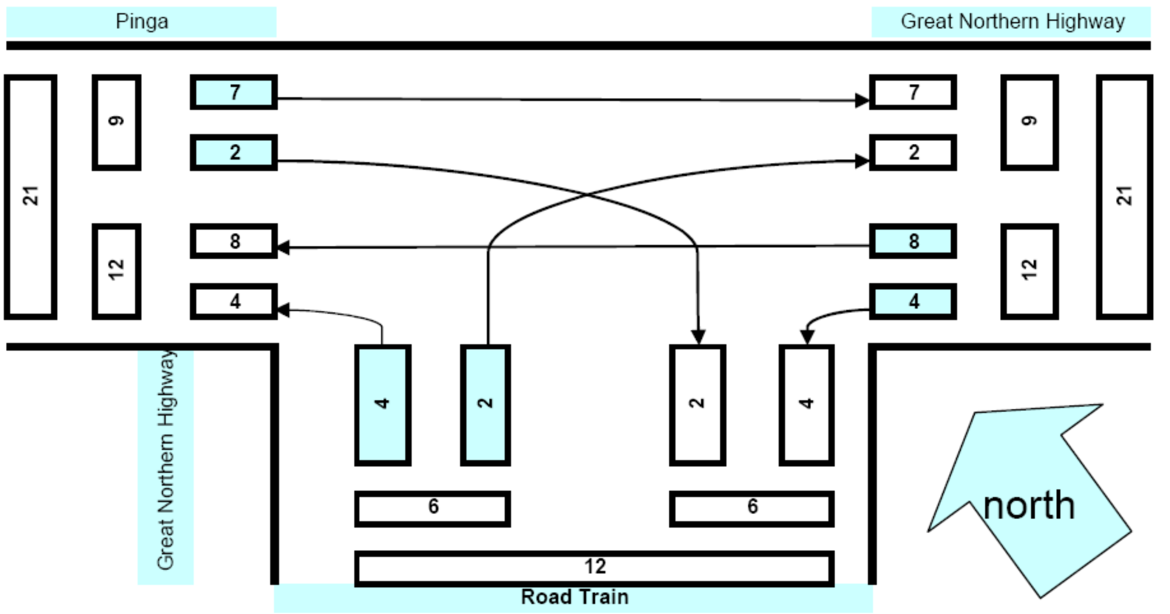
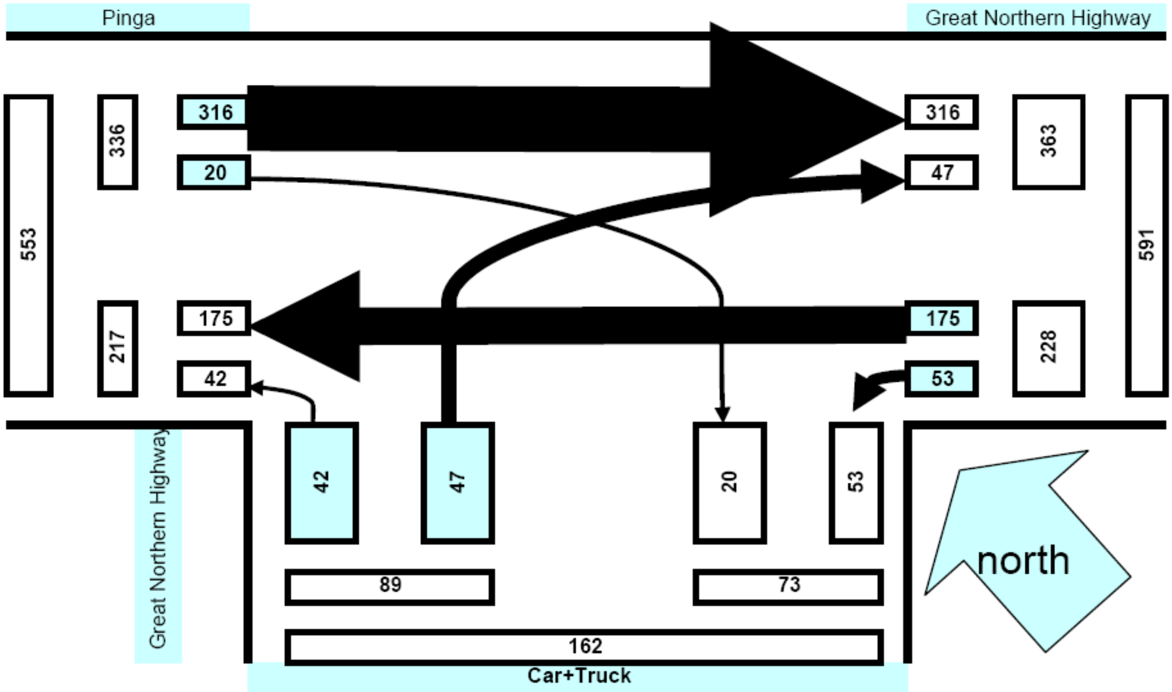
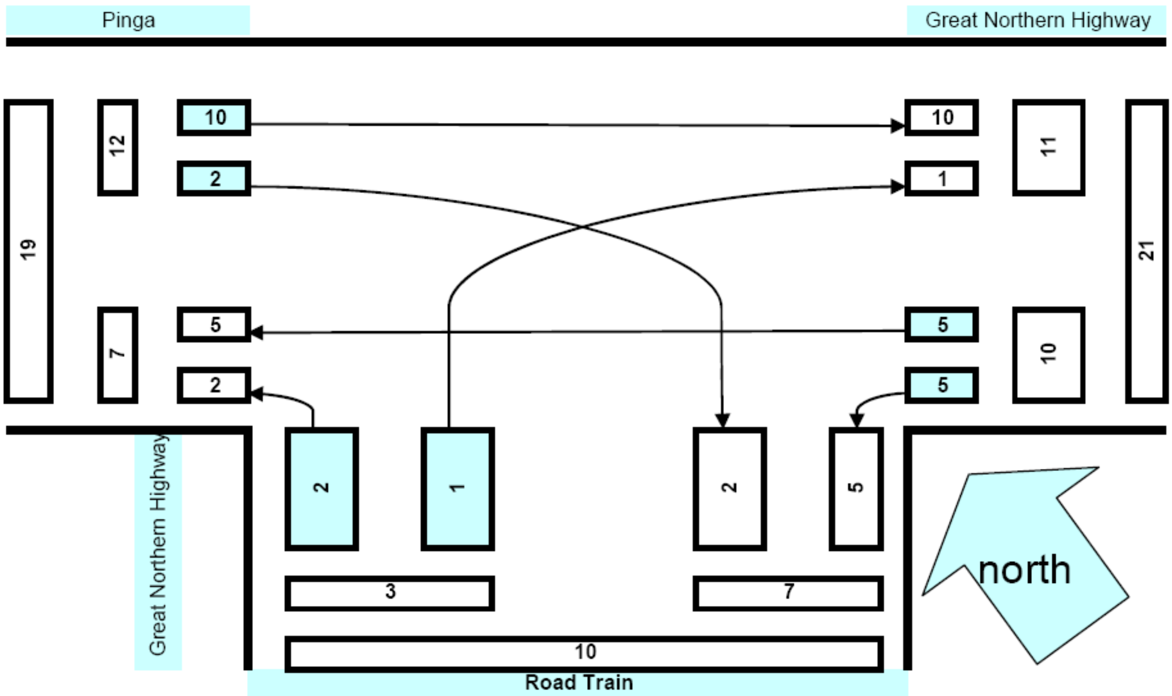



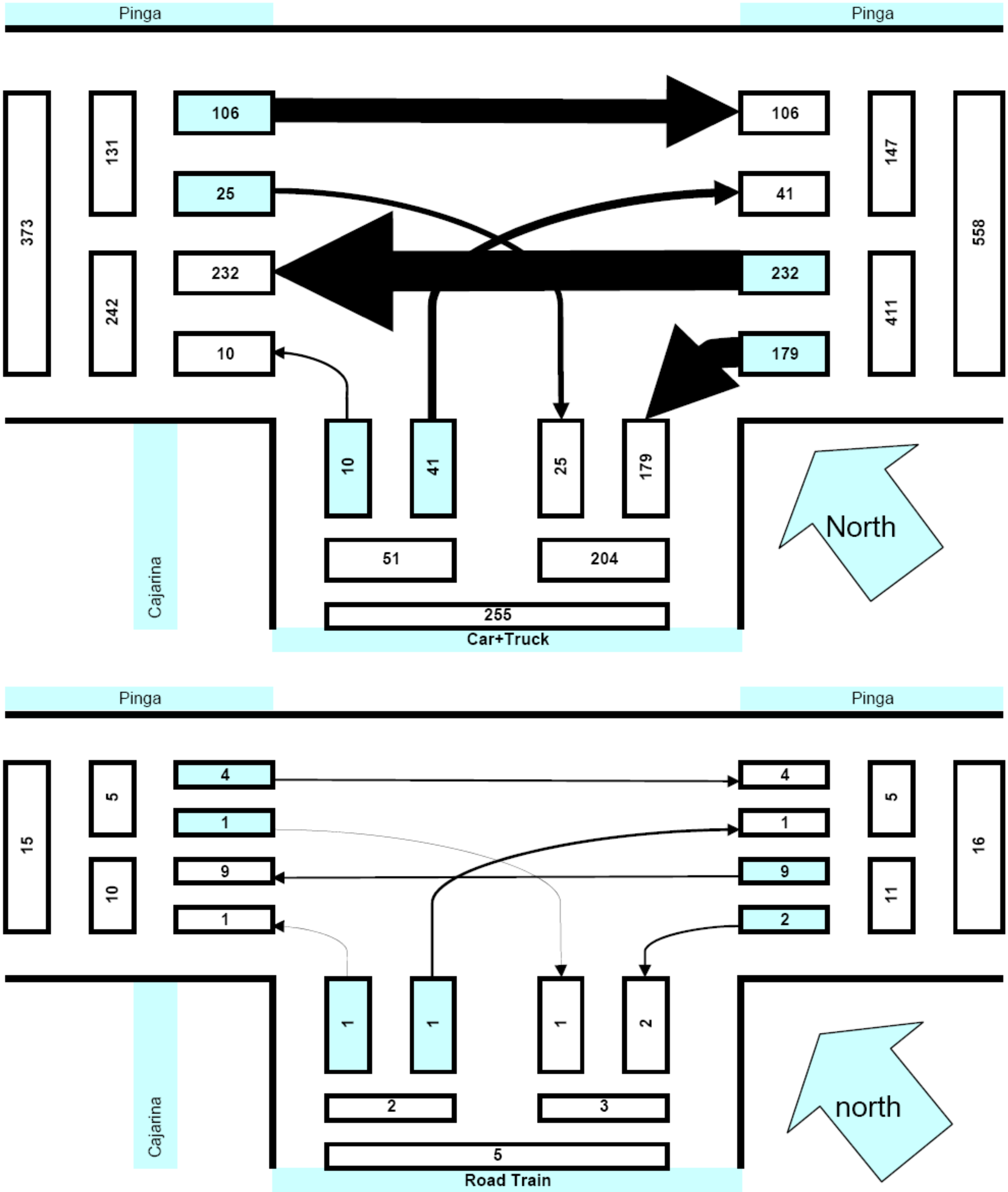
**Figure 40 Existing 2007 PM peak hour traffic volumes for Great Northern Highway/ Pinga Street**



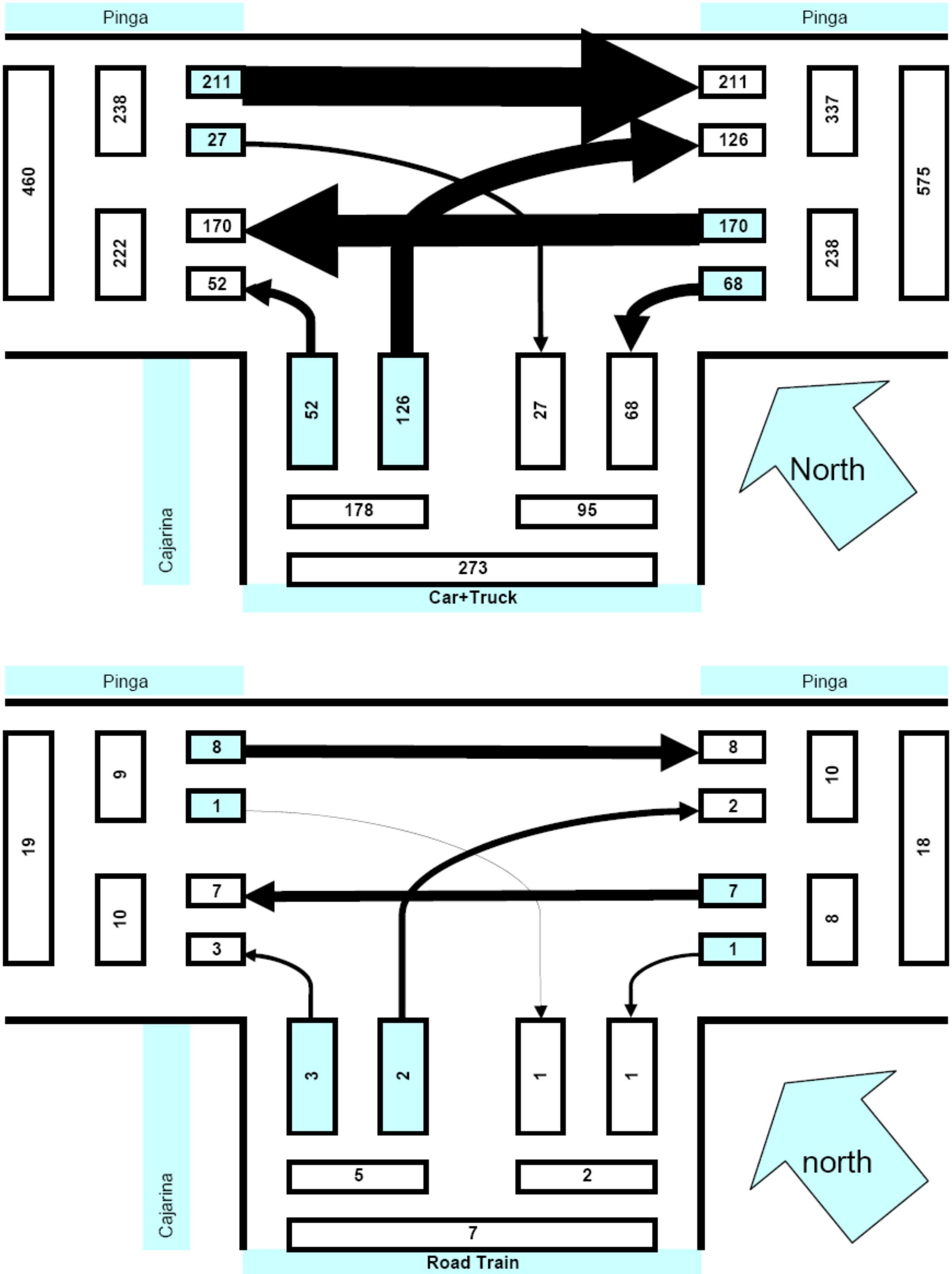
SKM

- **Figure 41 Existing 2007 AM peak hour traffic volumes for Cajarina Road/ Pinga Street**



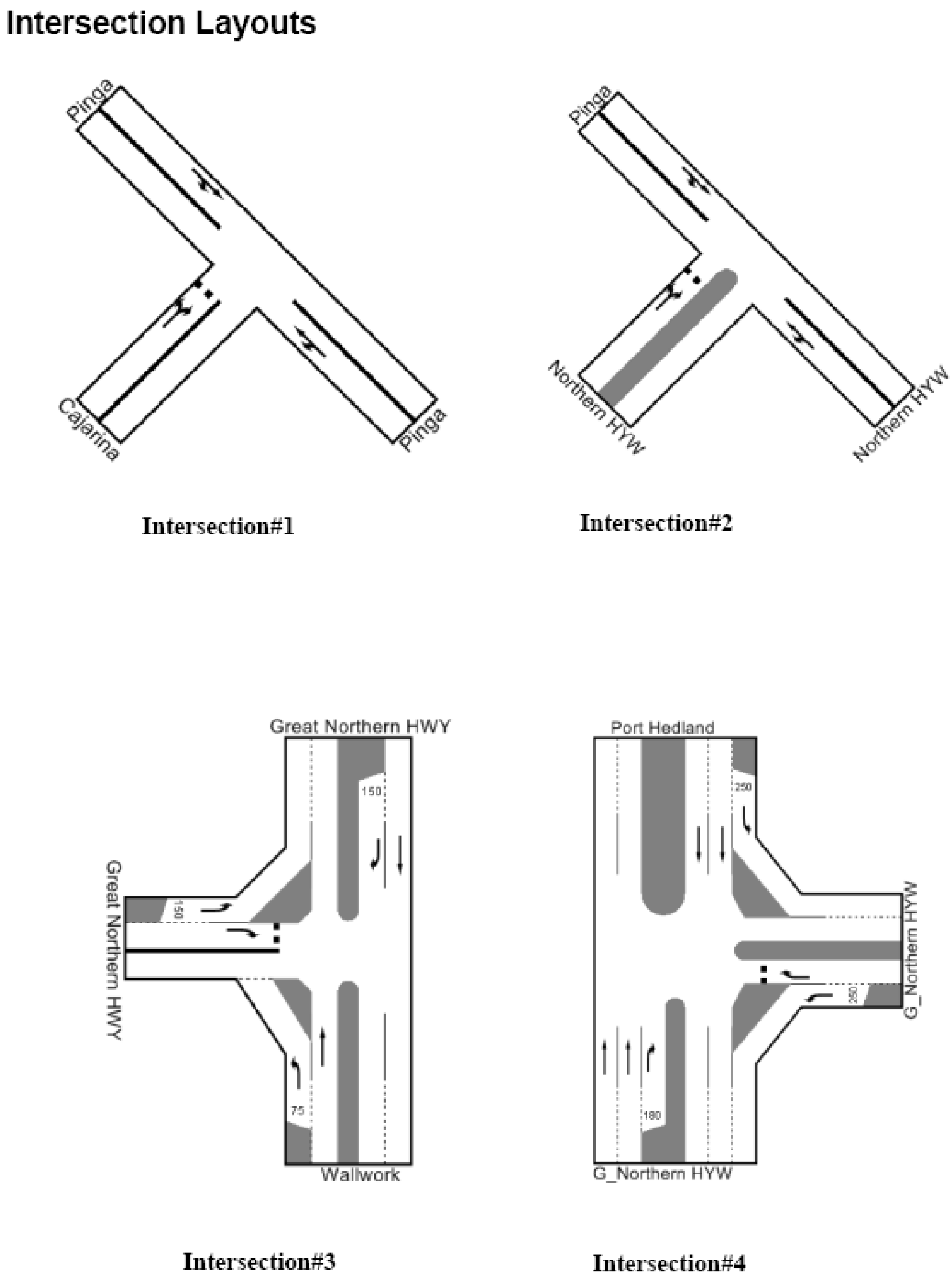
SKM

- **Figure 42 Existing 2007 PM peak hour traffic volumes for Cajarina Road/ Pinga Street**



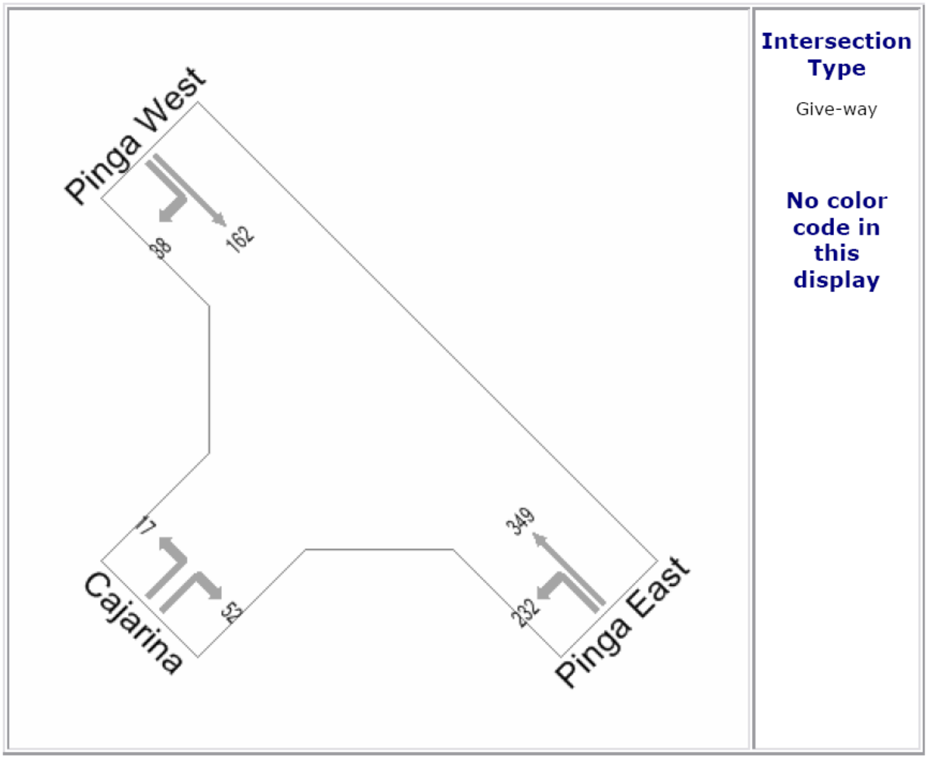
# Appendix C Existing (2007) and Forecast (2009) intersection turning movements (aaSIDRA)

- **Figure 43 Existing (2007) layouts of the Intersections**

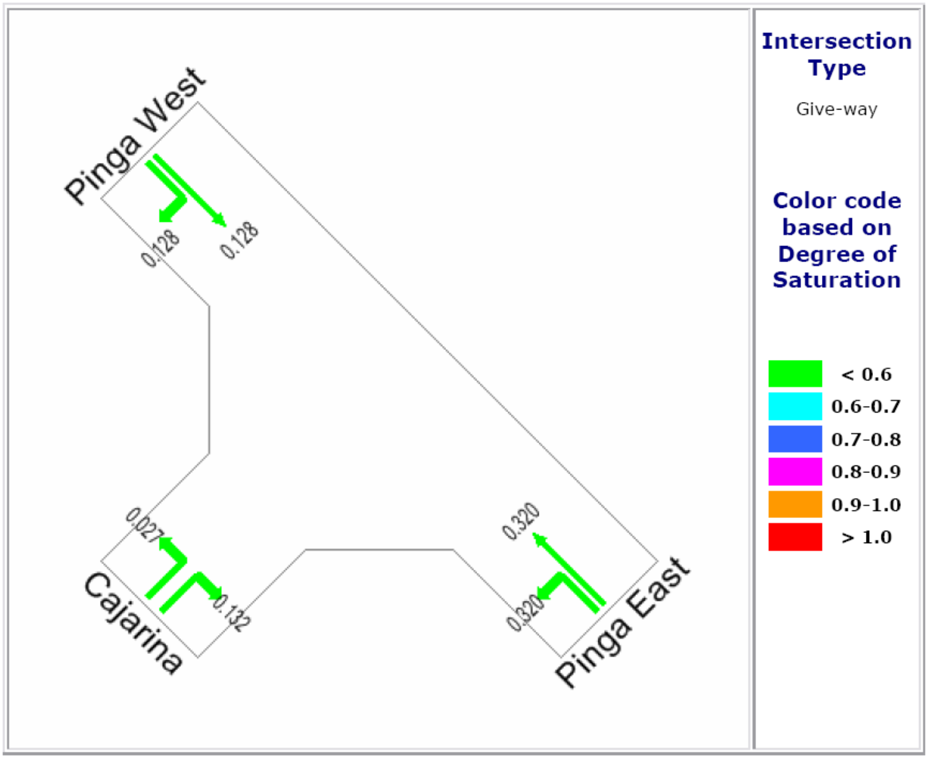


SKM

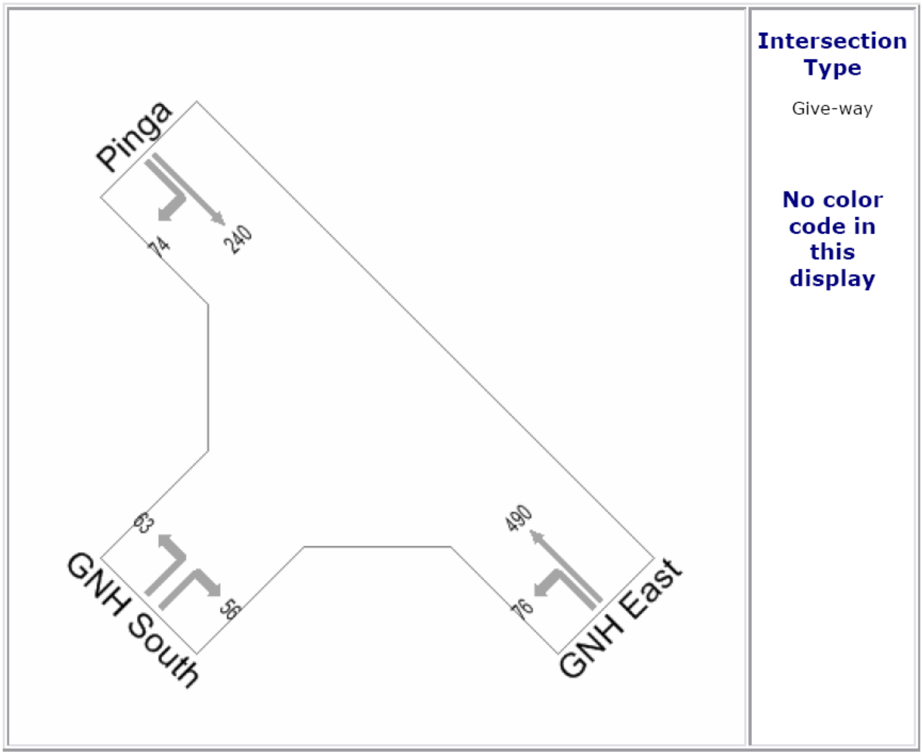
- **Figure 44 2007 AM peak hour turning volumes for Cajarina Rd/ Pinga St**



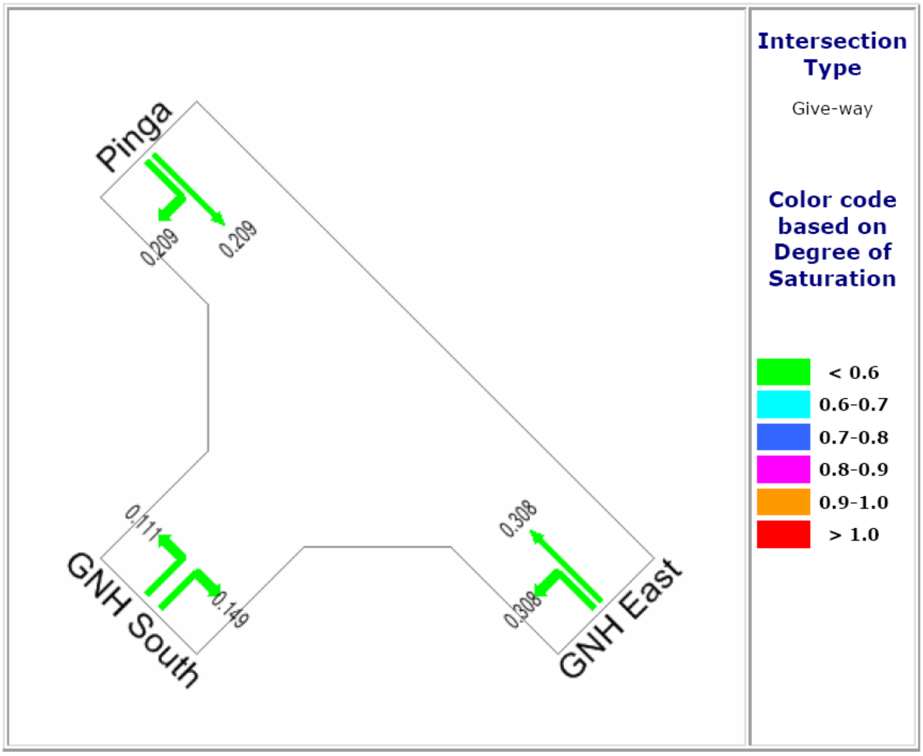

- **Figure 45 2007 AM Degree of saturation for Cajarina Rd/ Pinga St**



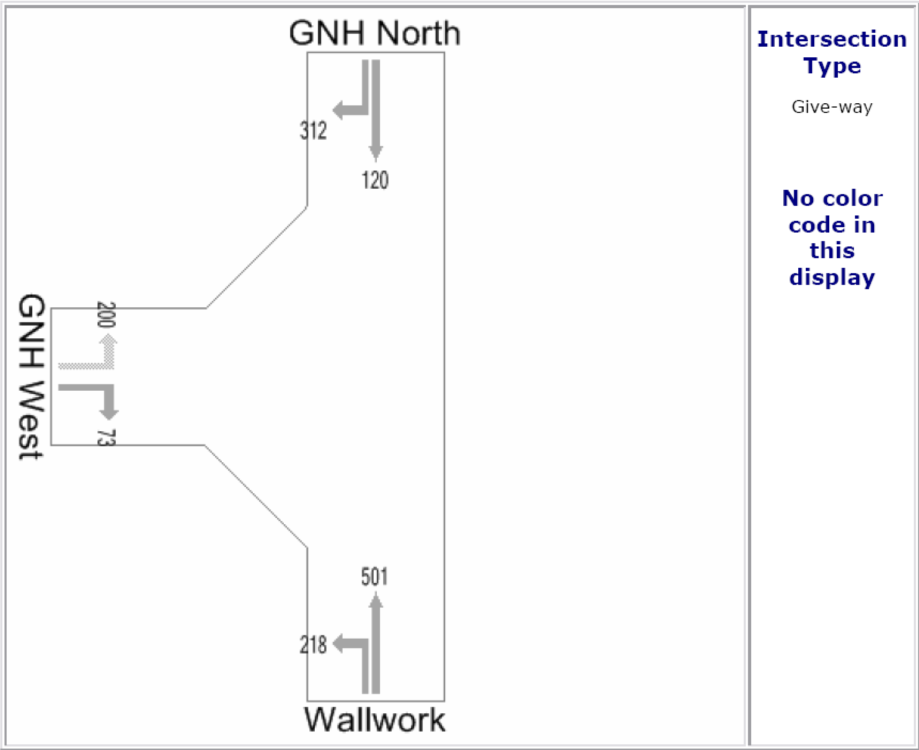
- **Figure 46 2007 AM peak hour turning volumes for Great Northern Hwy/ Pinga St**



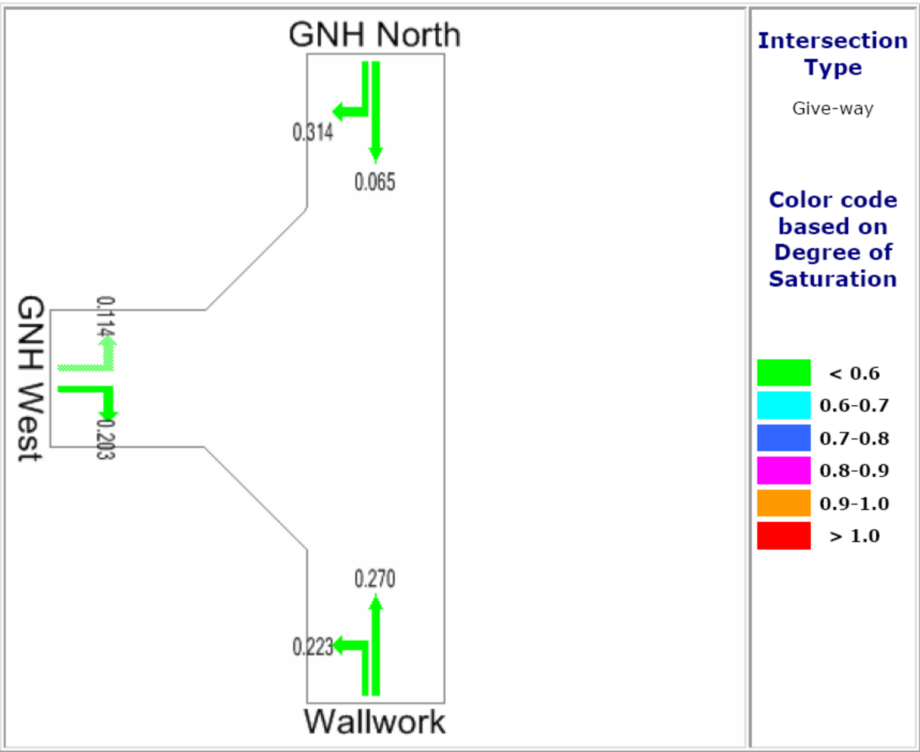

- **Figure 47 2007 AM Degree of saturation for Great Northern Hwy/ Pinga St**



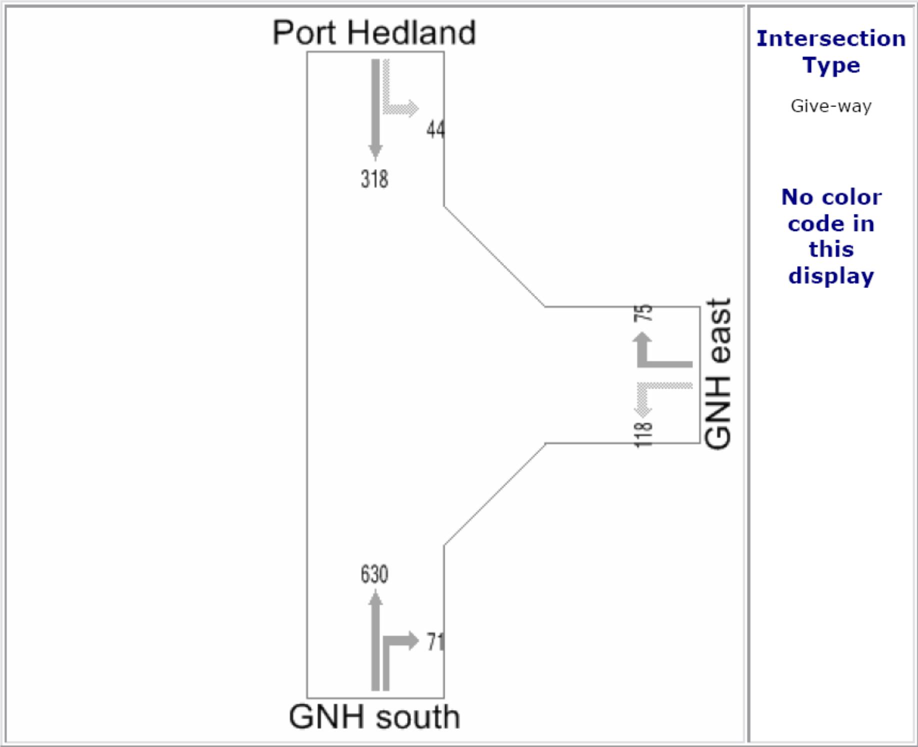
■ **Figure 48 2007 AM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd**



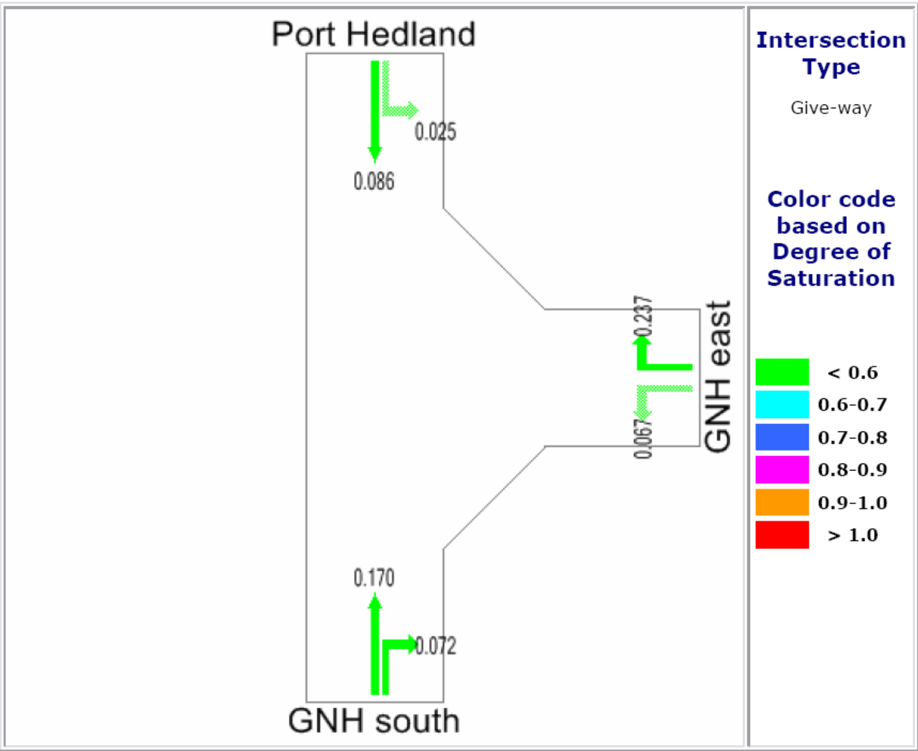

■ **Figure 49 2007 AM Degree of saturation for Great Northern Hwy/ Wallwork Rd**



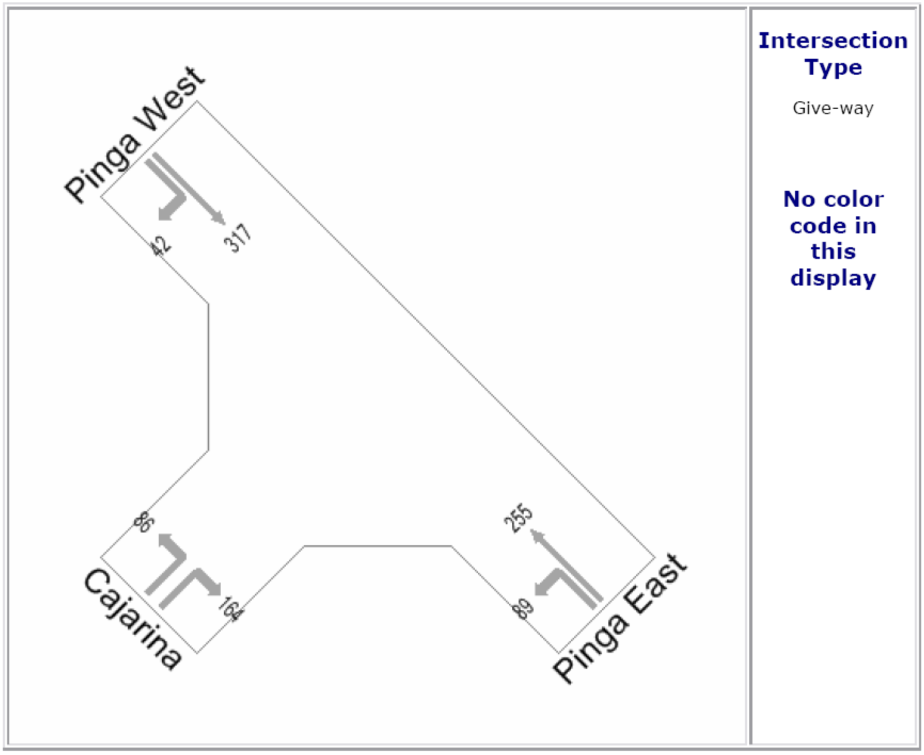
- **Figure 50 2007 AM peak hour turning volumes for Great Northern Hwy/ Port Hedland**



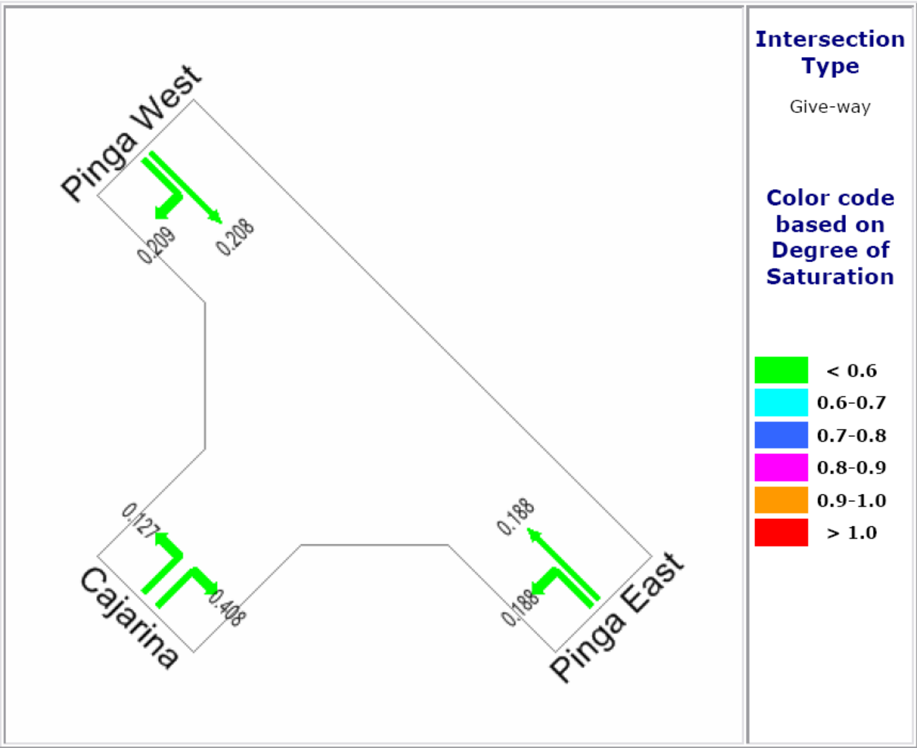

- **Figure 51 2007 AM Degree of saturation for Great Northern Hwy/ Port Hedland Rd**



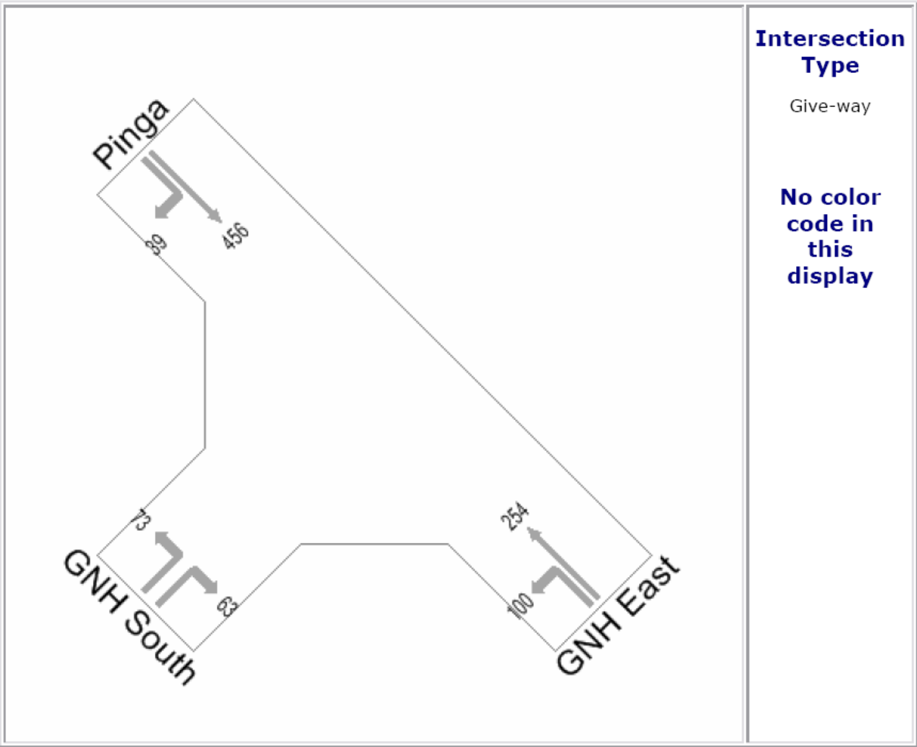
- **Figure 52 2007 PM peak hour turning volumes for Cajarina Rd/ Pinga St**



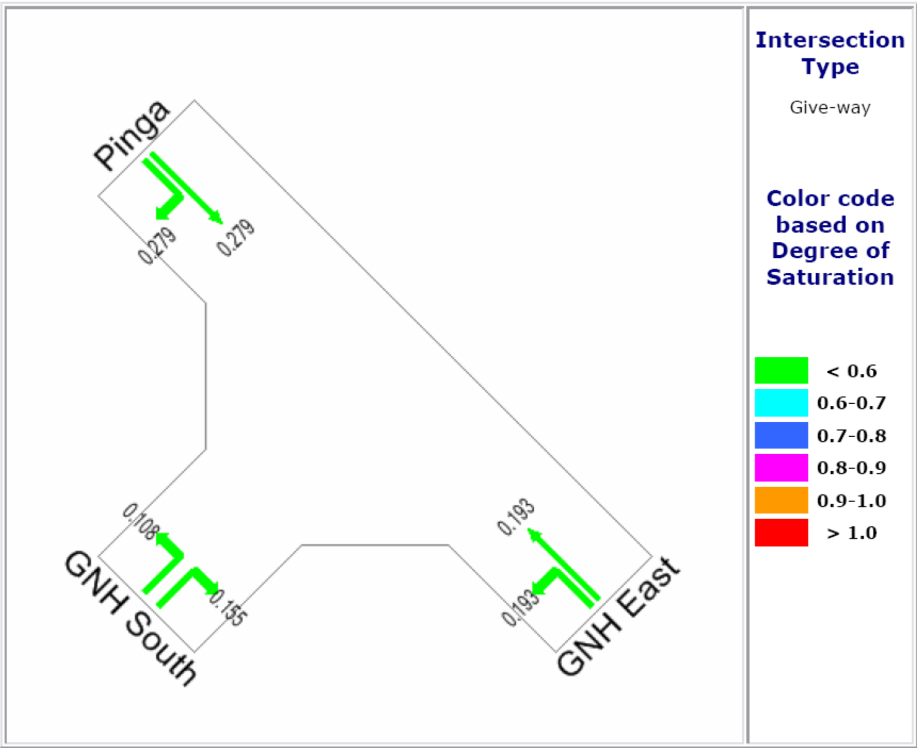

- **Figure 53 2007 PM Degree of saturation for Cajarina Rd/ Pinga St**



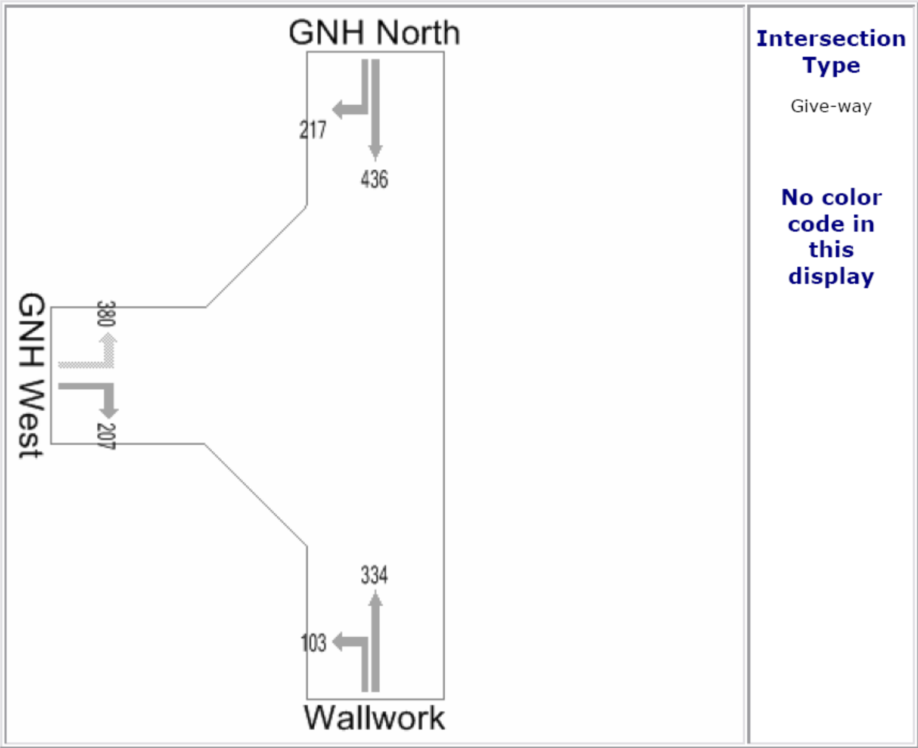
- **Figure 54 2007 PM peak hour turning volumes for Great Northern Hwy/ Pinga St**



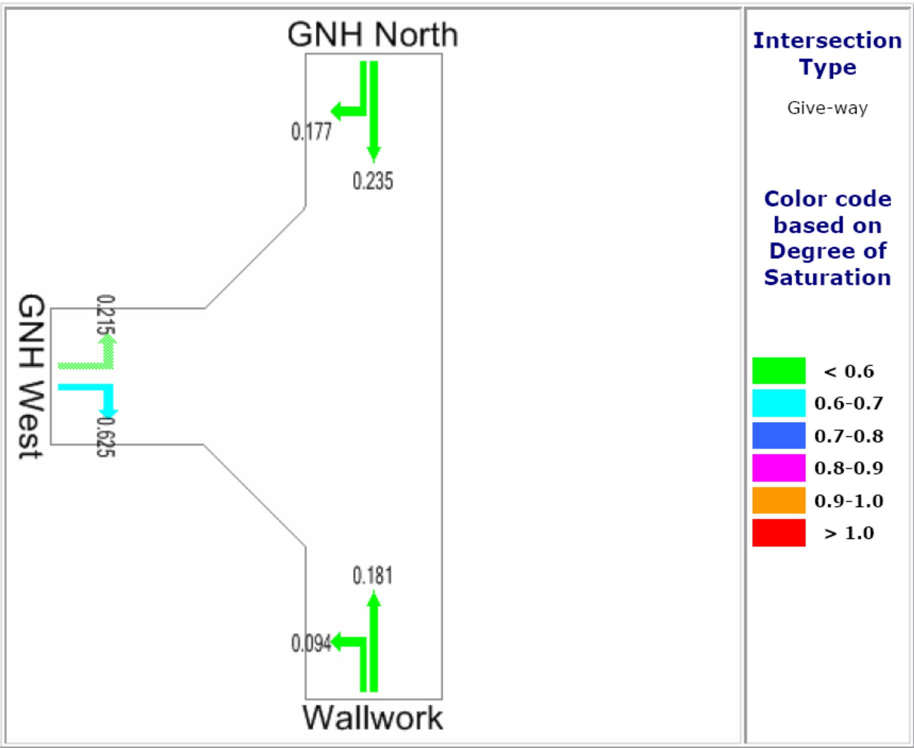

- **Figure 55 2007 PM Degree of saturation for Great Northern Hwy/ Pinga St**



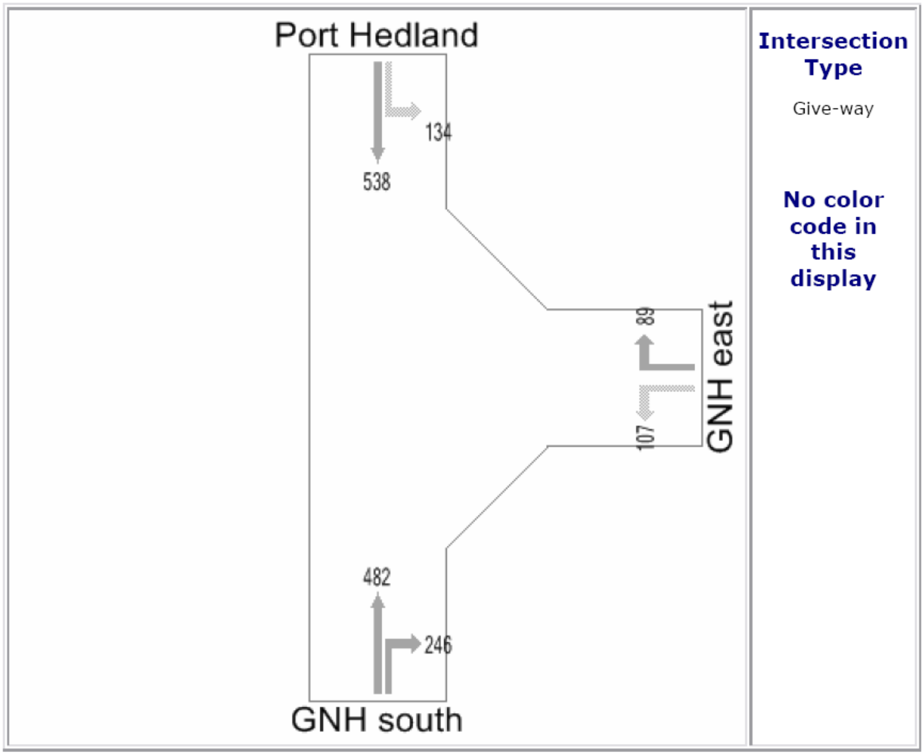
- **Figure 56 2007 PM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd**



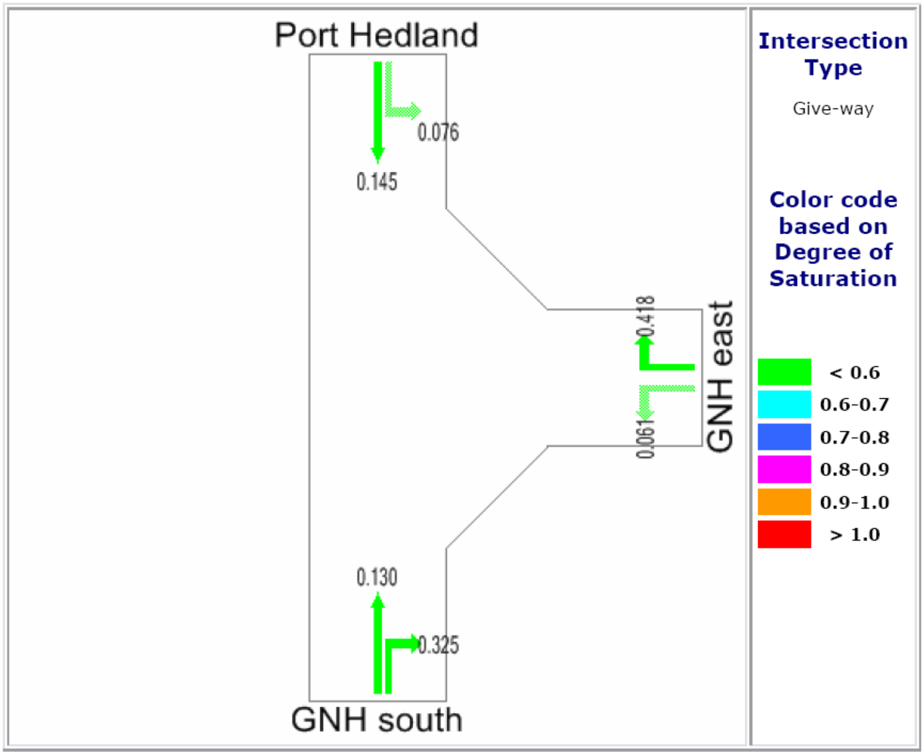

- **Figure 57 2007 PM Degree of saturation for Great Northern Hwy/ Wallwork Rd**



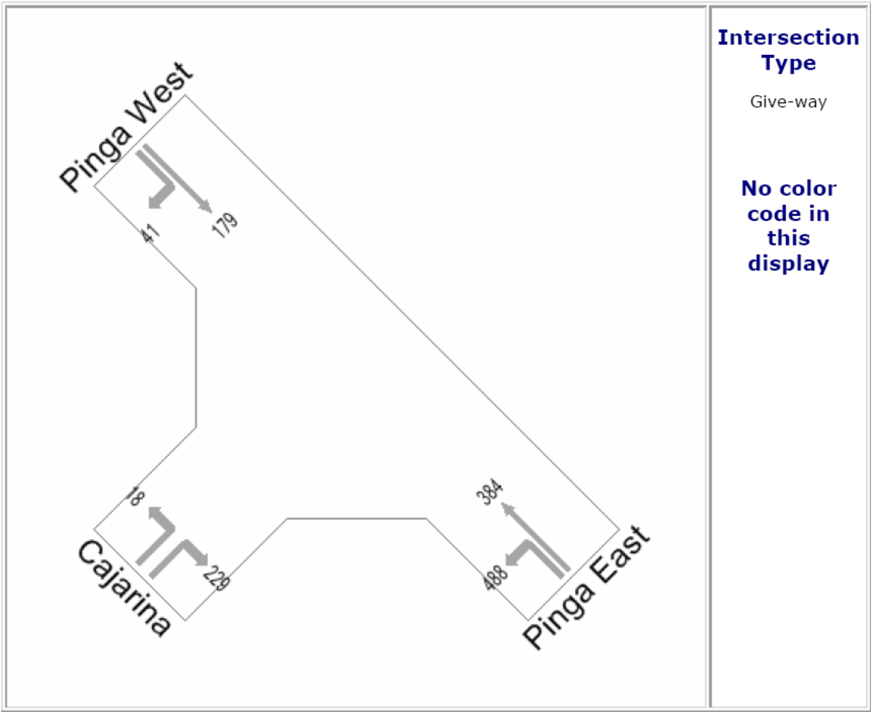
▪ **Figure 58 2007 PM peak hour turning volumes for Great Northern Hwy/ Port Hedland**



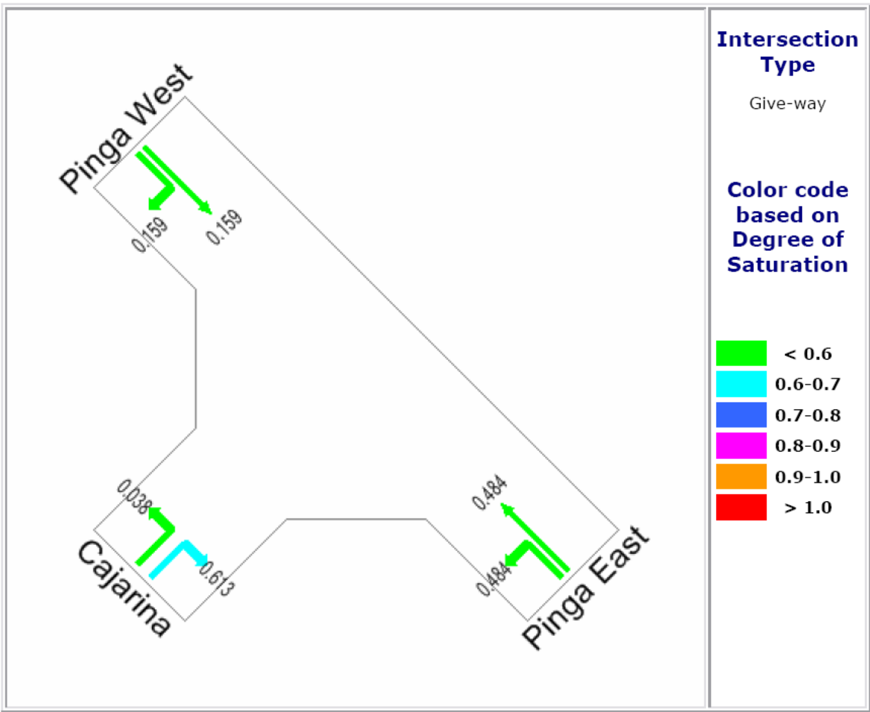

▪ **Figure 59 2007 PM Degree of saturation for Great Northern Hwy/ Port Hedland Rd**



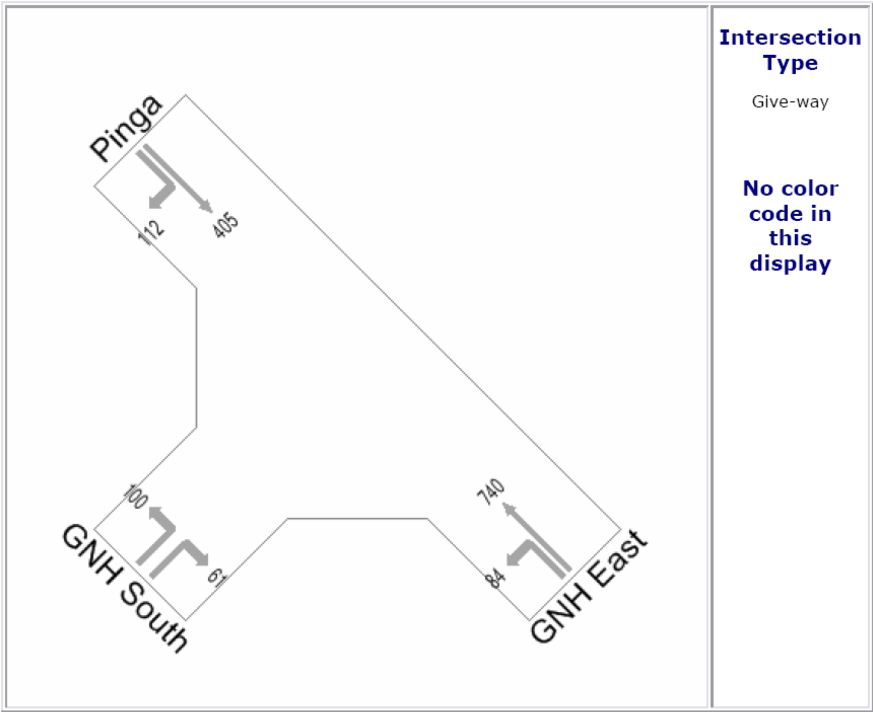
- **Figure 60  Forecast (2009) AM peak hour turning volumes for Cajarina Rd/ Pinga St with triple road trains**



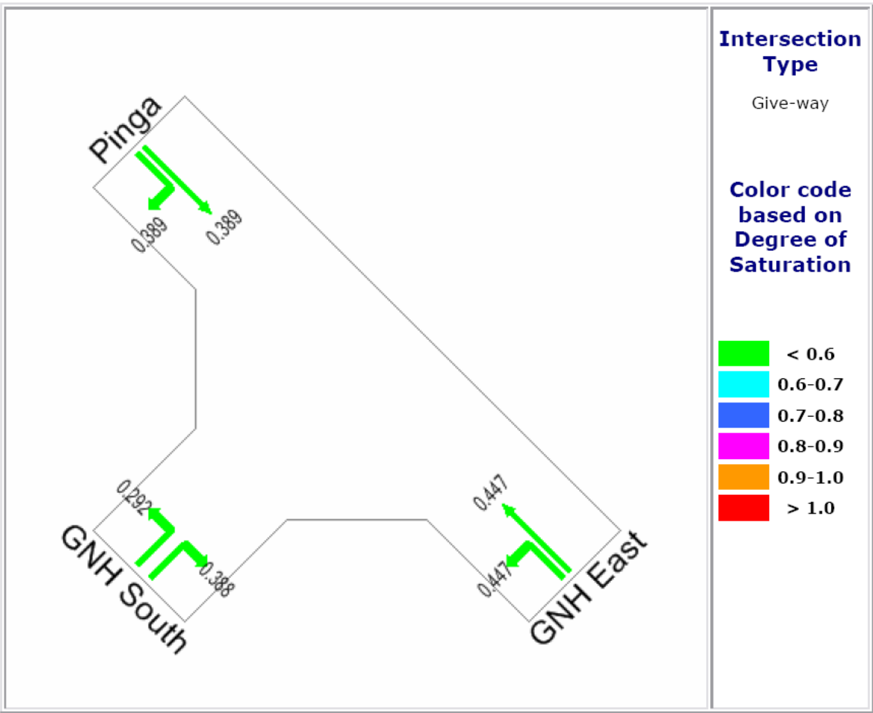

- **Figure 61  Forecast (2009) AM Degree of saturation for Cajarina Rd/ Pinga St with triple road trains**



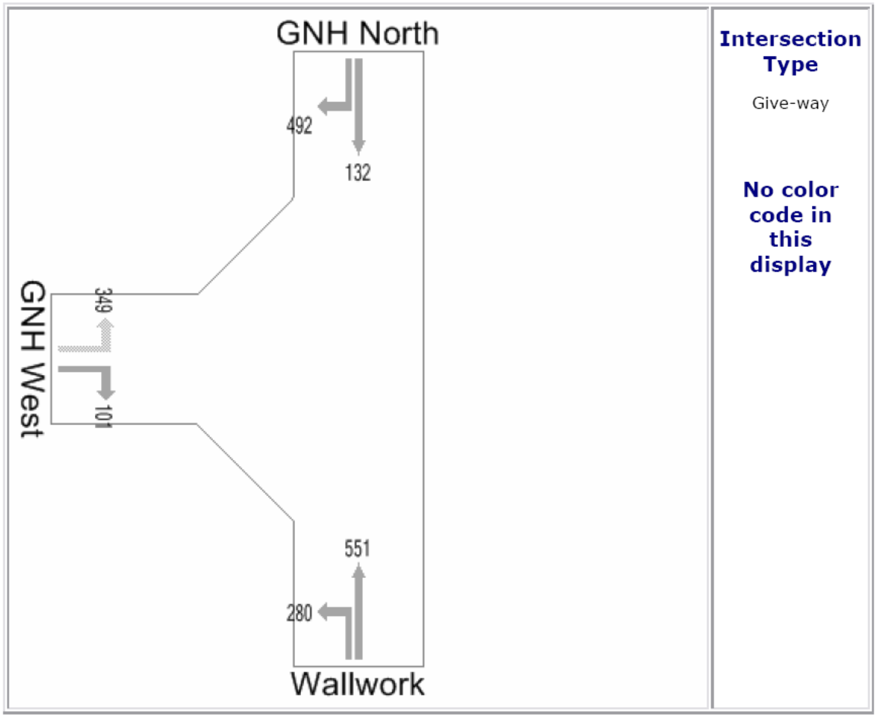
- **Figure 62 Forecast (2009) AM peak hour turning volumes for Great Northern Hwy/ Pinga St with triple road trains**



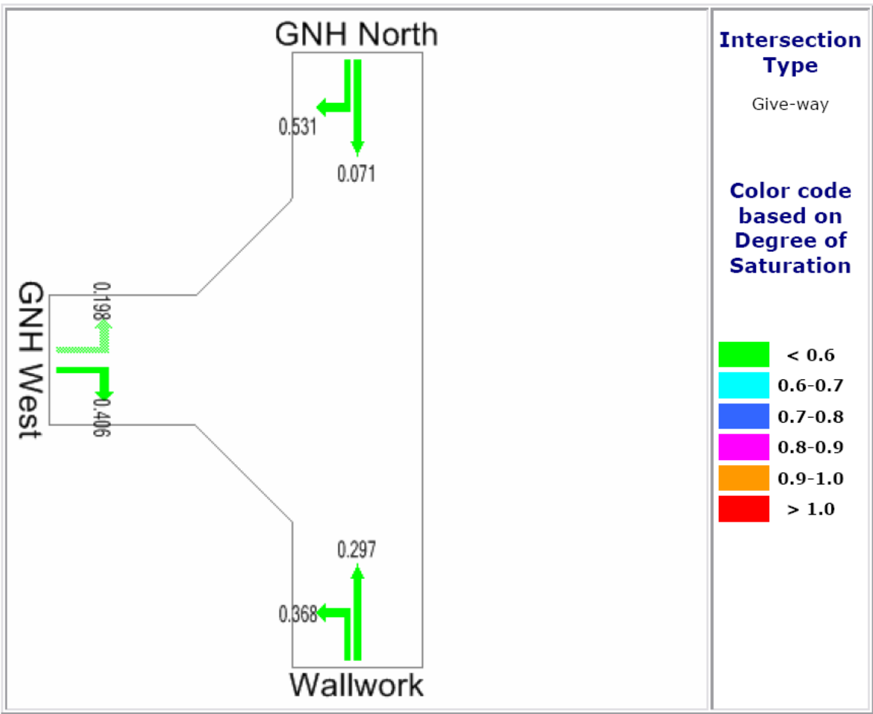

- **Figure 63 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Pinga St with triple road trains**



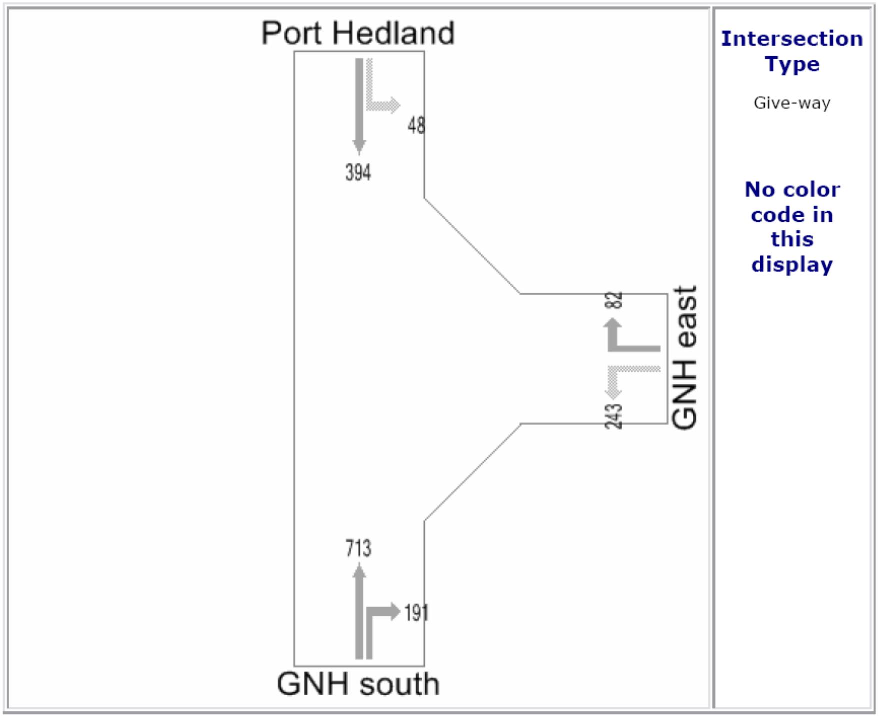
- **Figure 64 Forecast 2009 AM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd with triple road trains**



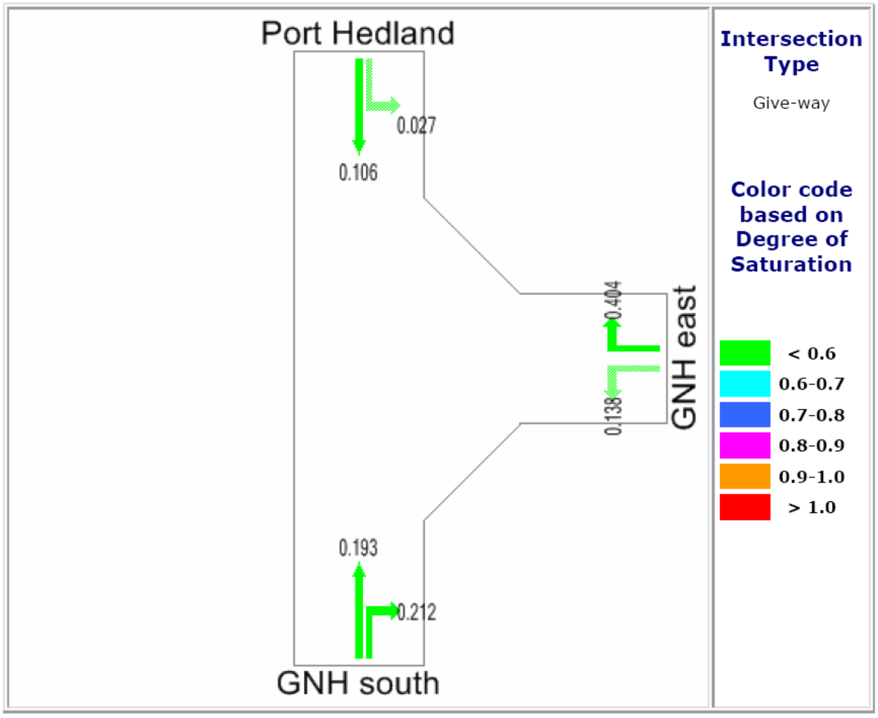

- **Figure 65 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Wallwork Rd with triple road trains**



- **Figure 66 Forecast 2009 AM peak hour turning volumes for Great Northern Hwy/ Port Hedland Rd with triple road trains**




- **Figure 67 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Port Hedland Rd with triple road trains**



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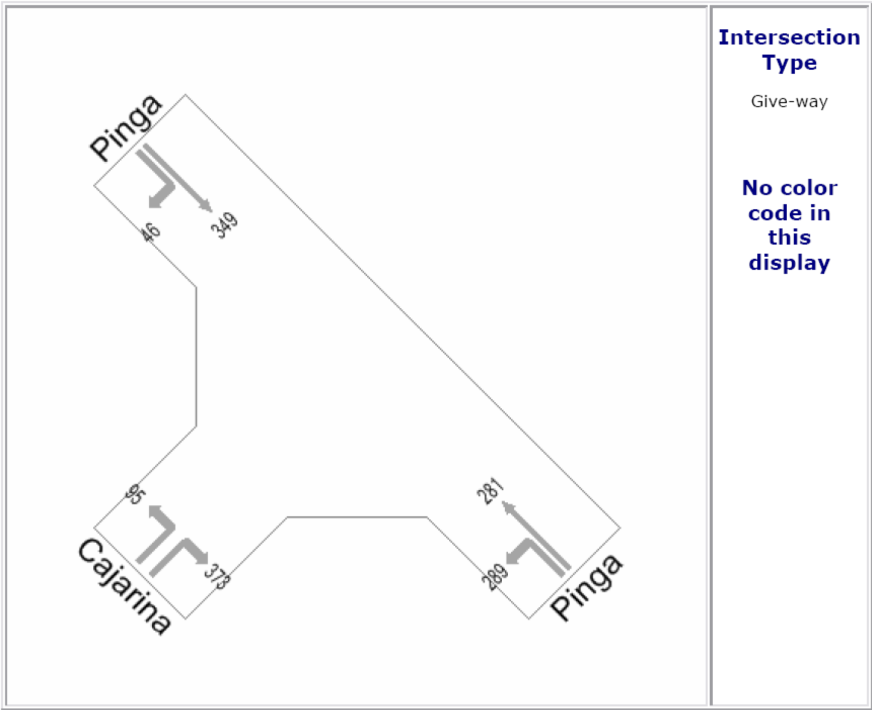
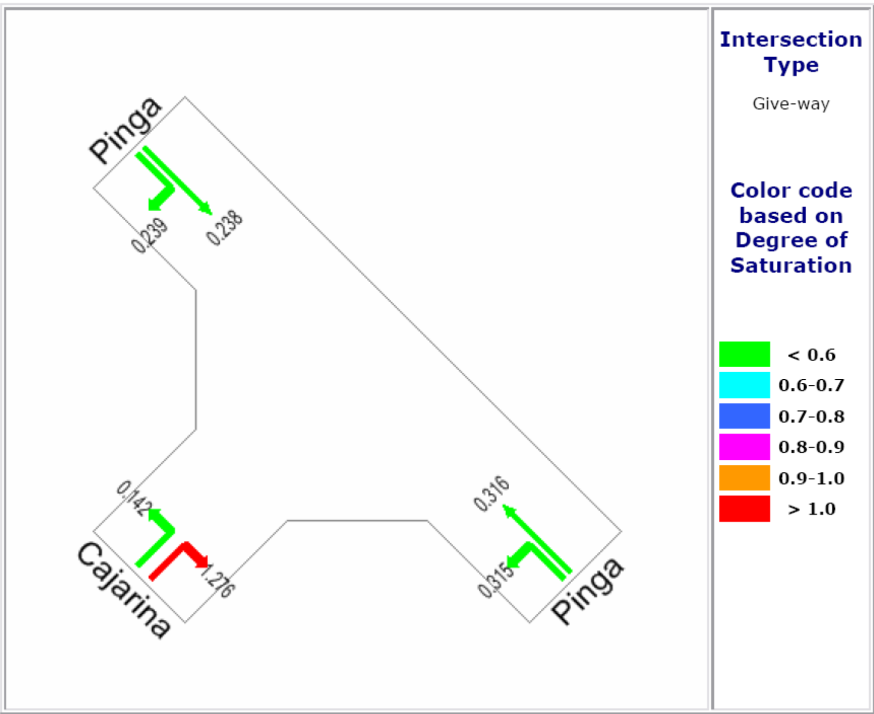
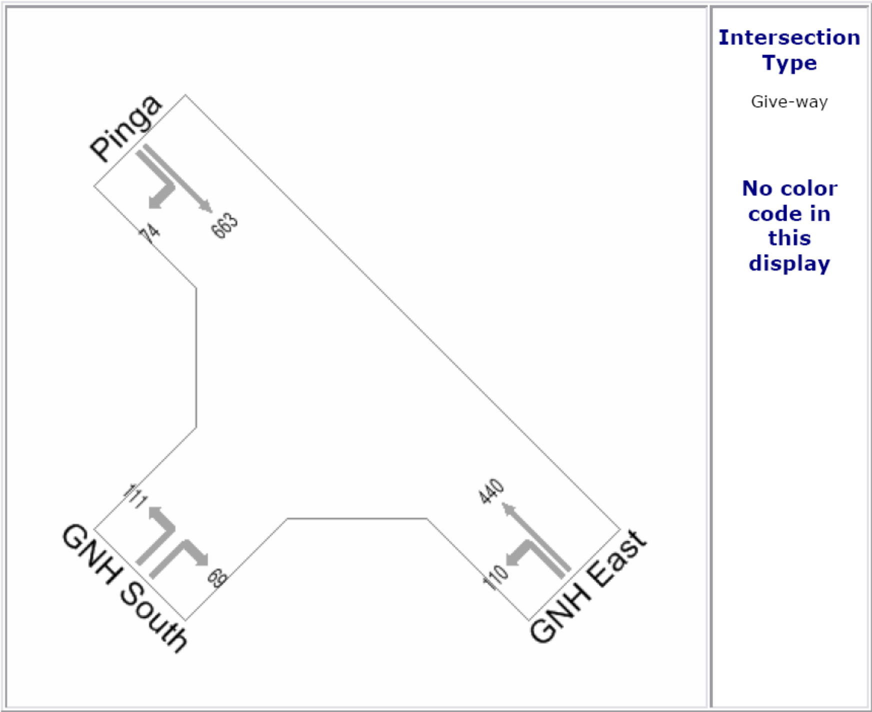
- **Figure 68 Forecast 2009 PM peak hour turning volumes for Cajarina Rd/ Pinga St with triple road trains**



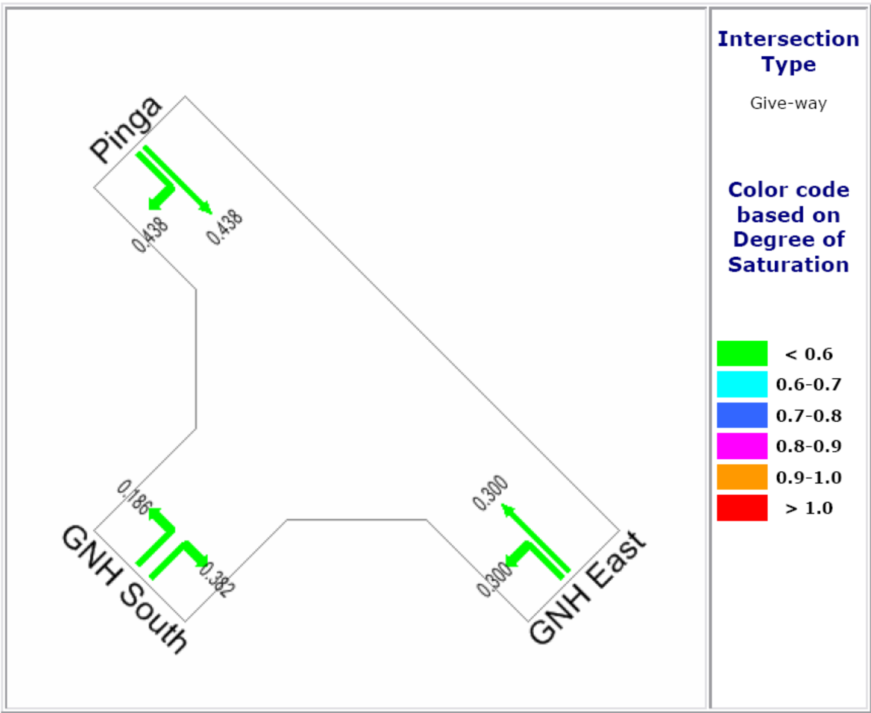

- **Figure 69 Forecast 2009 PM Degree of saturation for Cajarina Rd/ Pinga St with triple road trains**



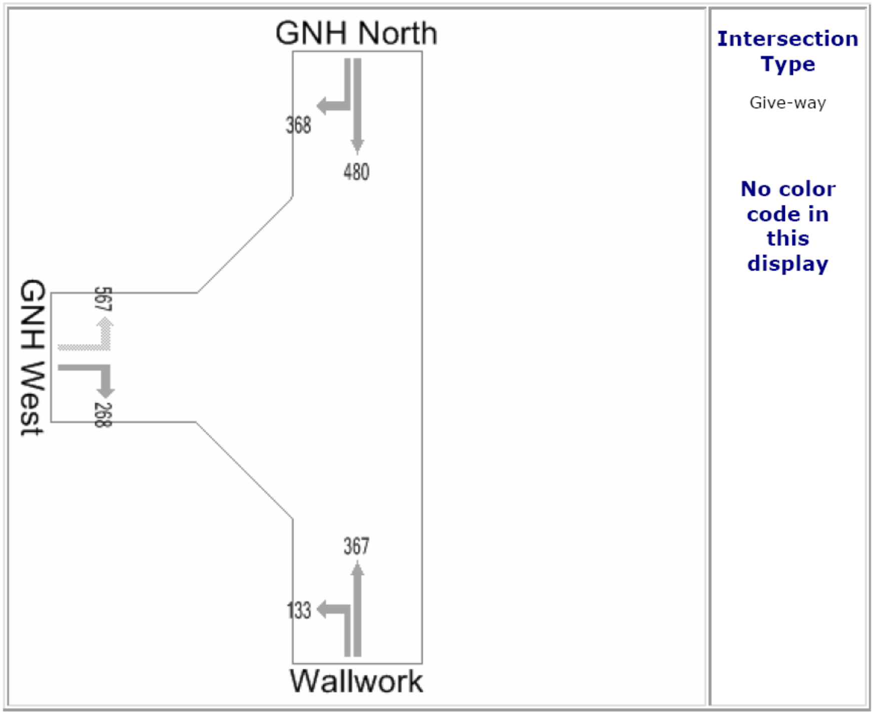
- **Figure 70 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Pinga St with triple road trains**



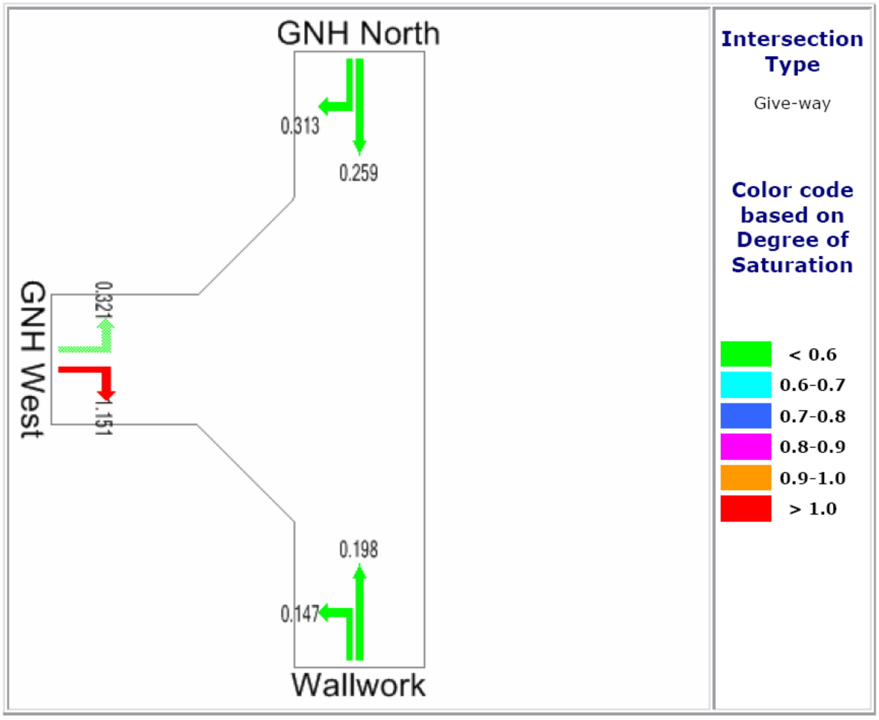

- **Figure 71 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Pinga St with triple road trains**



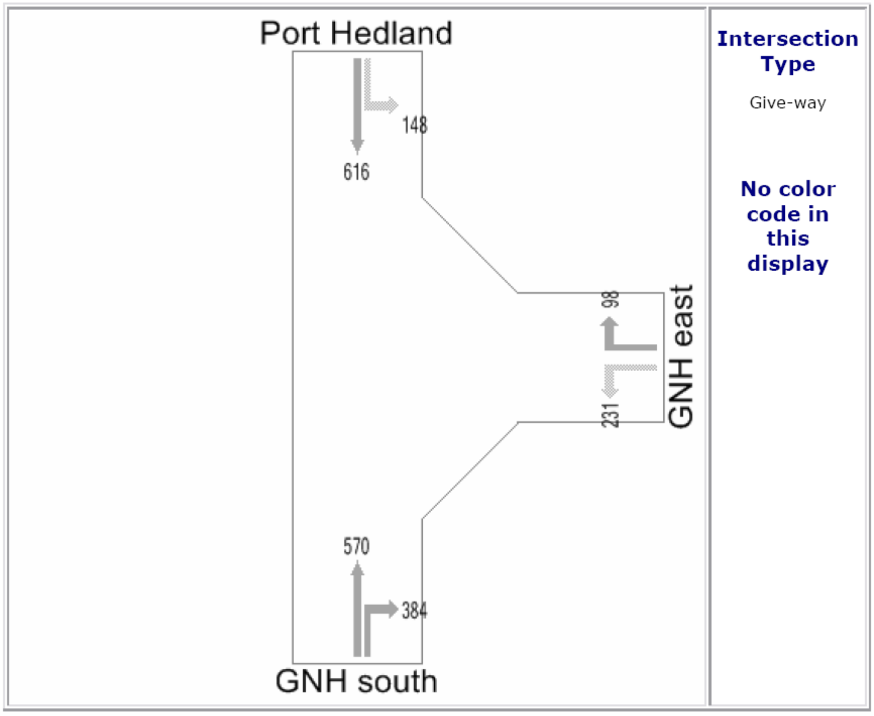
- **Figure 72 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd with triple road trains**



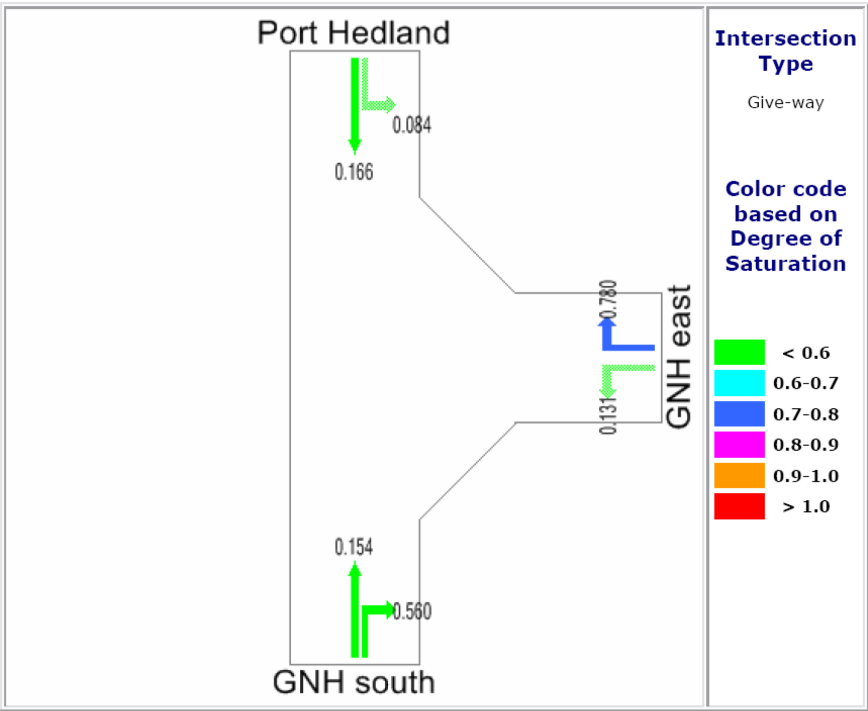

- **Figure 73 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Wallwork Rd with triple road trains**



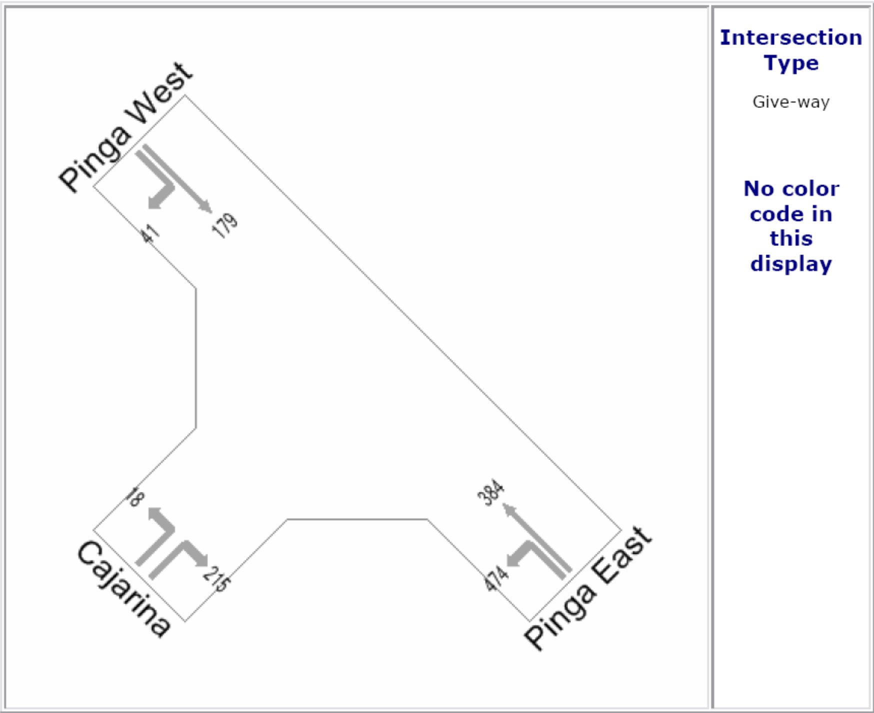
- **Figure 74 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Port Hedland Rd with triple road trains**



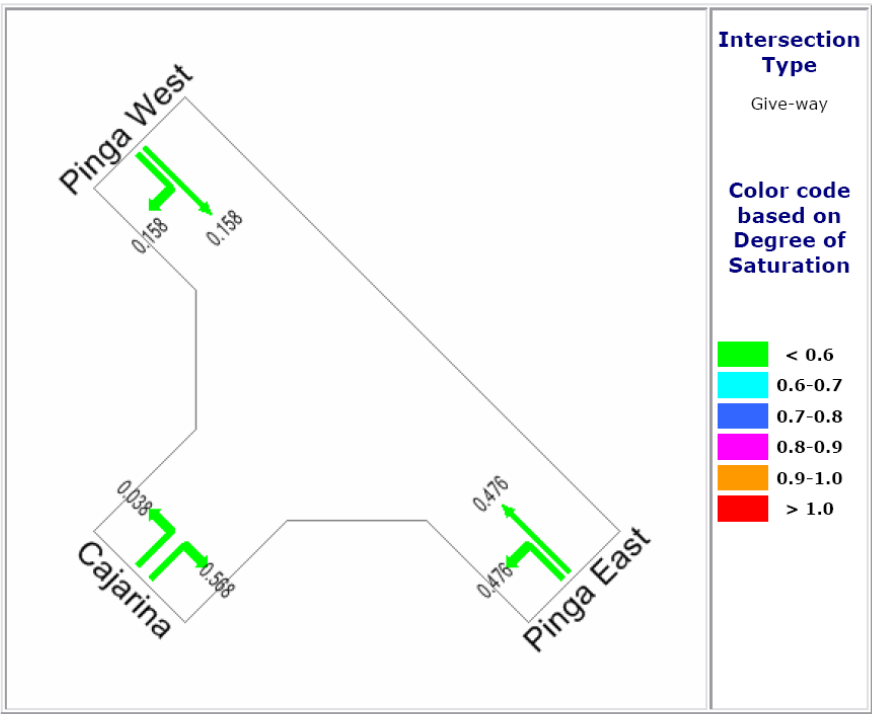

- **Figure 75 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Port Hedland Rd with triple road trains**



- **Figure 76 Forecast 2009 AM peak hour turning volumes for Cajarina Rd/ Pinga St with quad road trains**




- **Figure 77 Forecast 2009 AM Degree of saturation for Cajarina Rd/ Pinga St with quad road trains**



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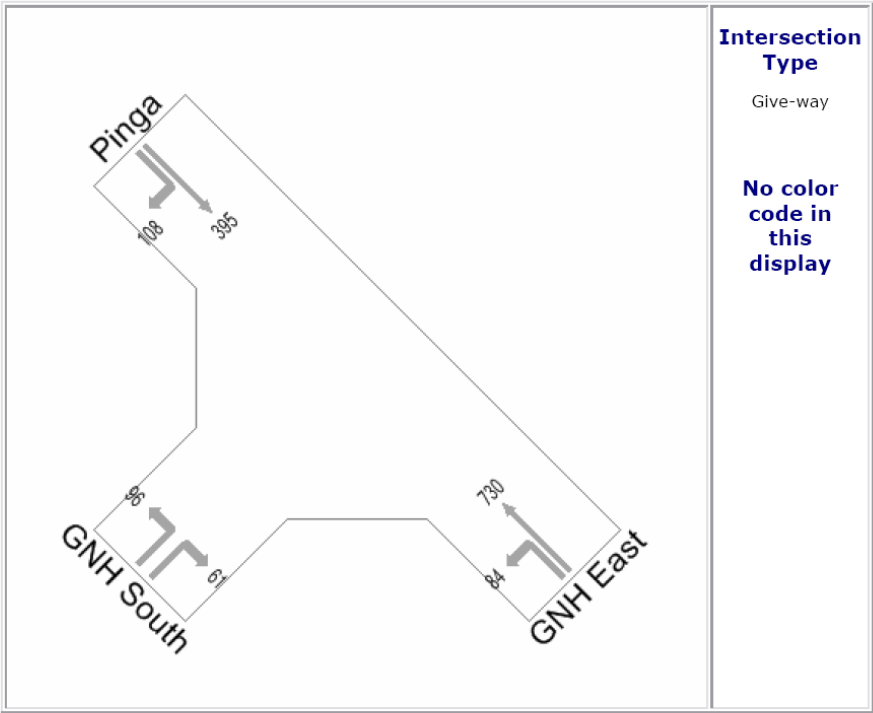
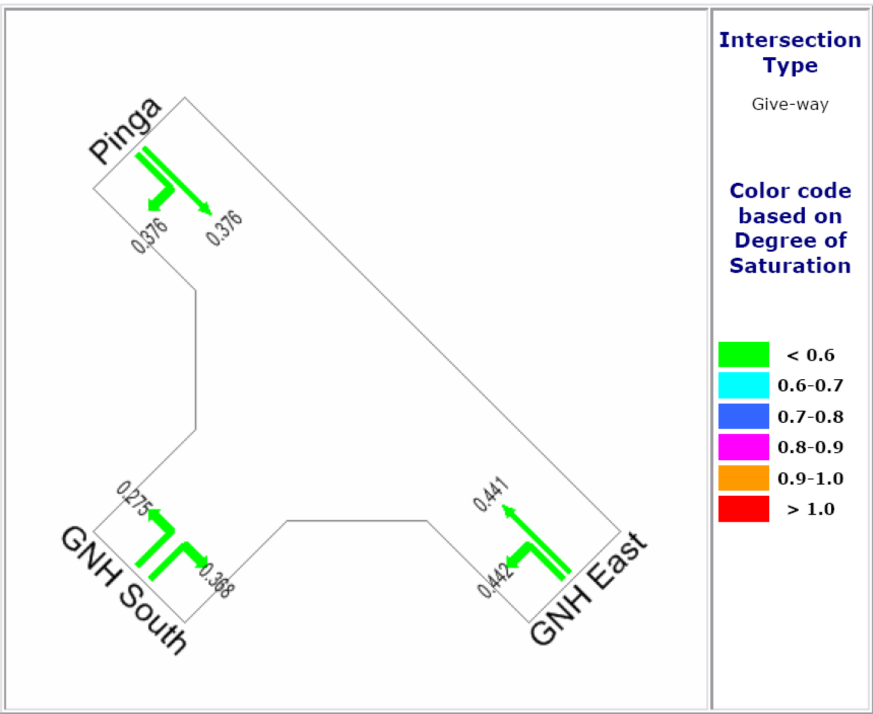
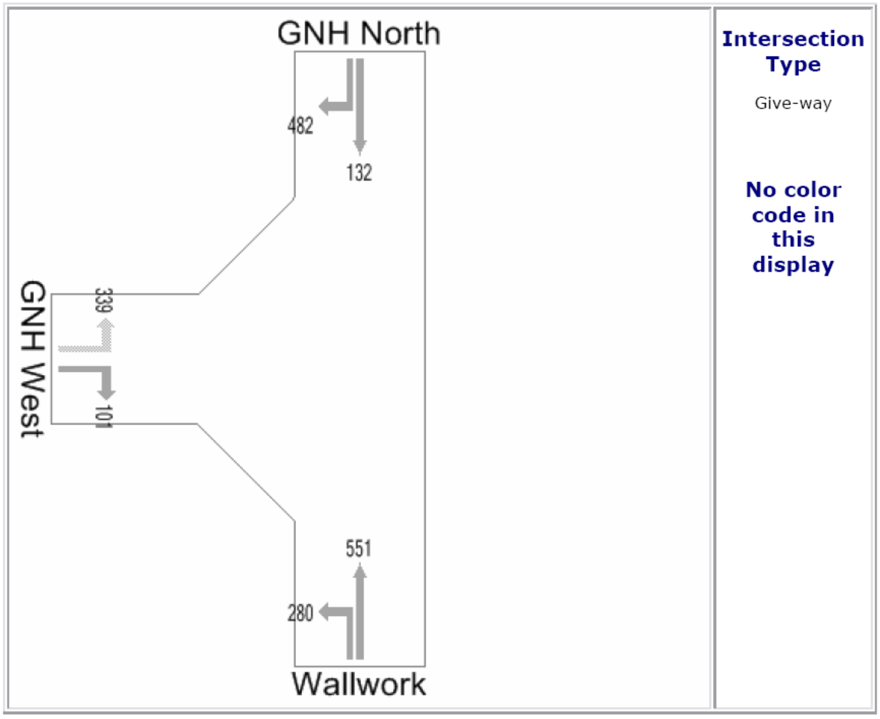
- **Figure 78 Forecast 2009 AM peak hour turning volumes for Great Northern Hwy/ Pinga St with quad road trains**



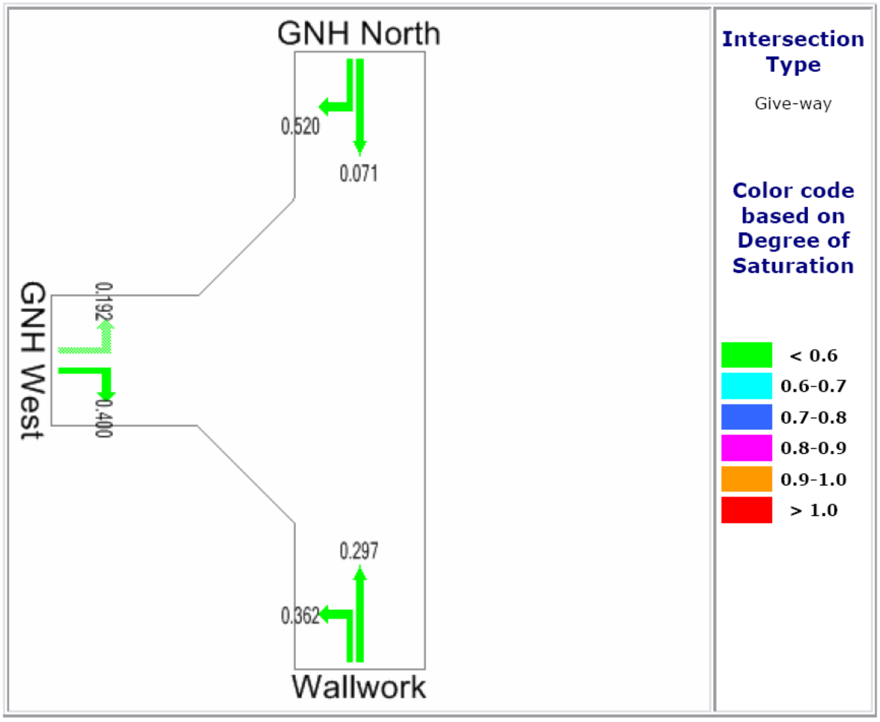

- **Figure 79 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Pinga St with quad road trains**



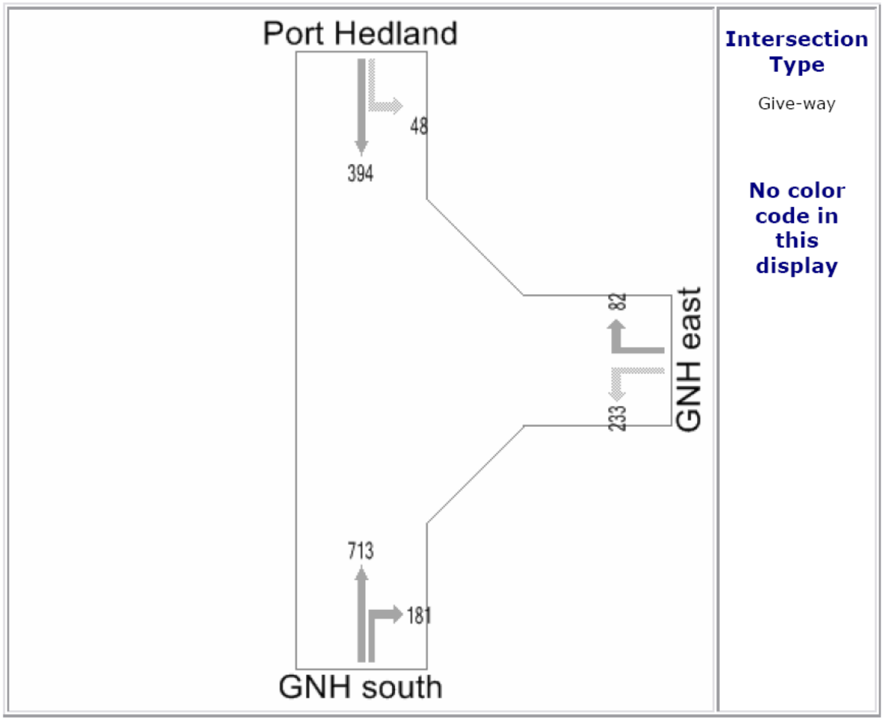
- **Figure 80 Forecast 2009 AM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd with quad road trains**



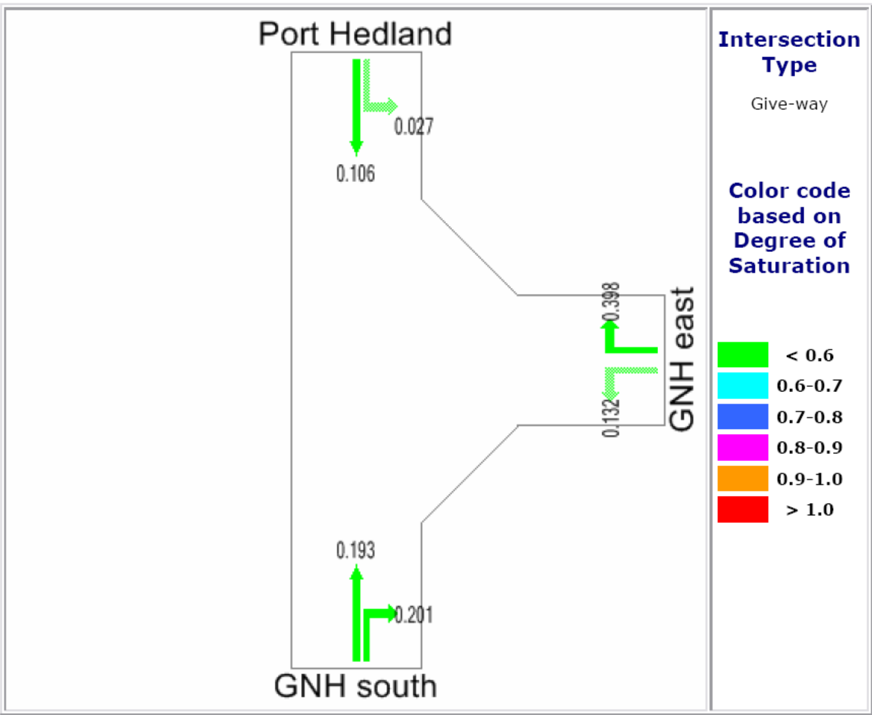

- **Figure 81 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Wallwork Rd with quad road trains**



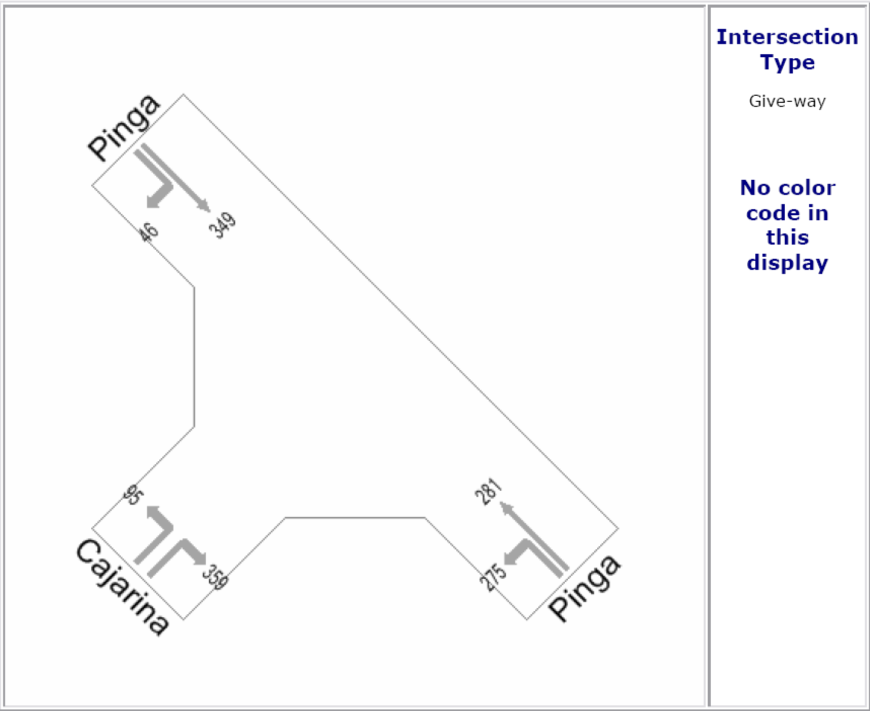
- **Figure 82 Forecast 2009 AM peak hour turning volumes for Great Northern Hwy/ Port Hedland Rd with quad road trains**



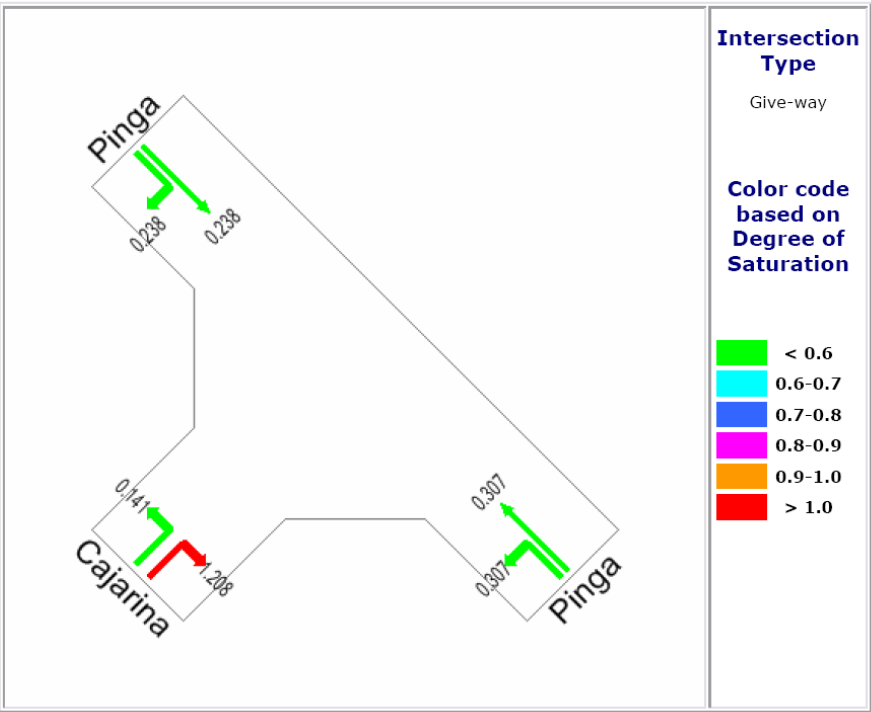

- **Figure 83 Forecast 2009 AM Degree of saturation for Great Northern Hwy/ Port Hedland Rd with quad road trains**



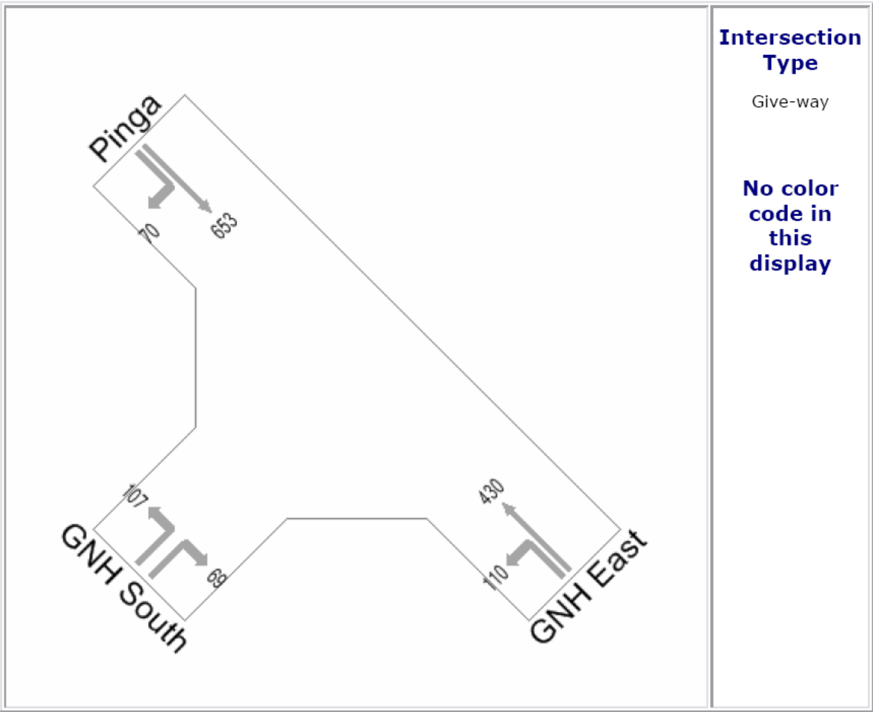
- **Figure 84 Forecast 2009 PM peak hour turning volumes for Cajarina Rd/ Pinga St with quad road trains**



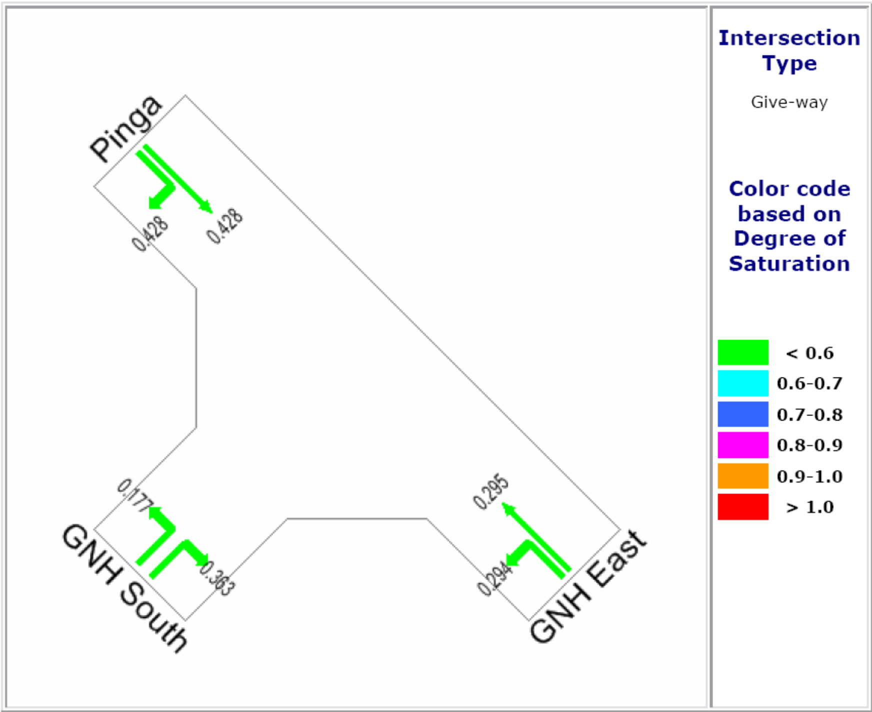

- **Figure 85 Forecast 2009 PM Degree of saturation for Cajarina Rd/ Pinga St with quad road trains**



- **Figure 86 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Pinga St with quad road trains**




- **Figure 87 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Pinga St with quad road trains**



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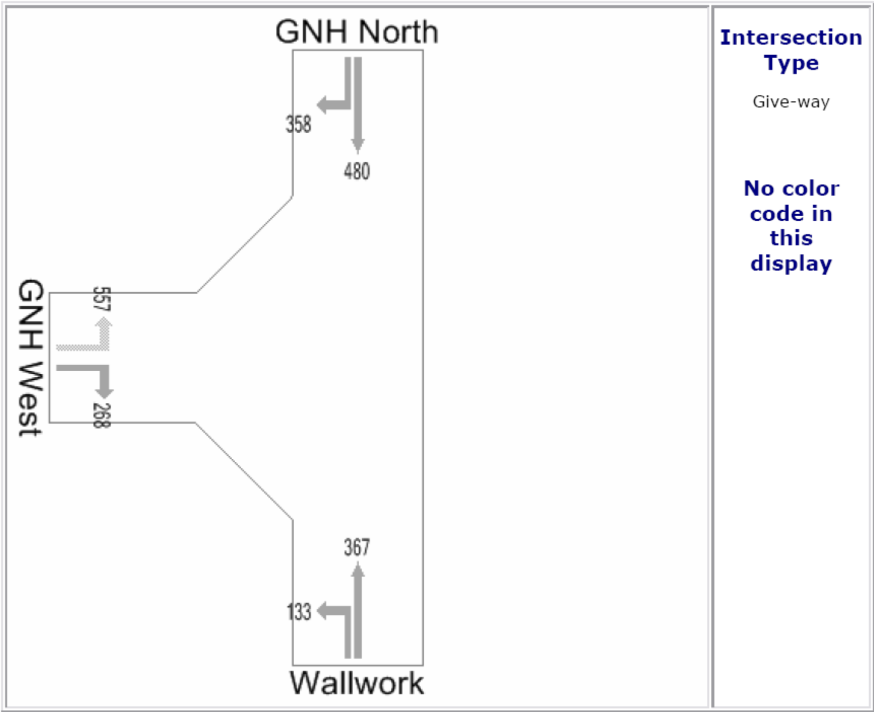
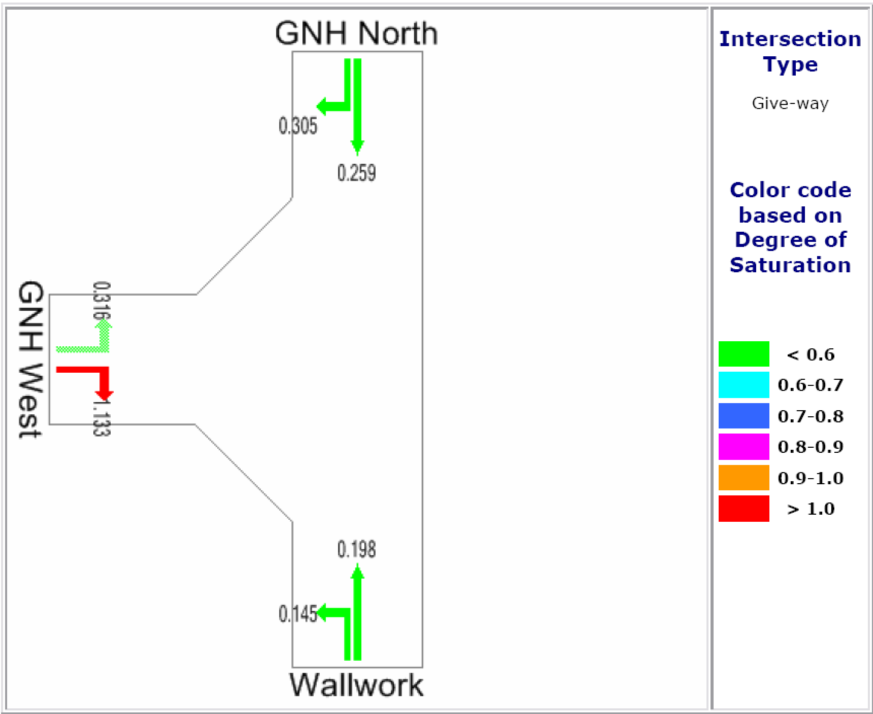
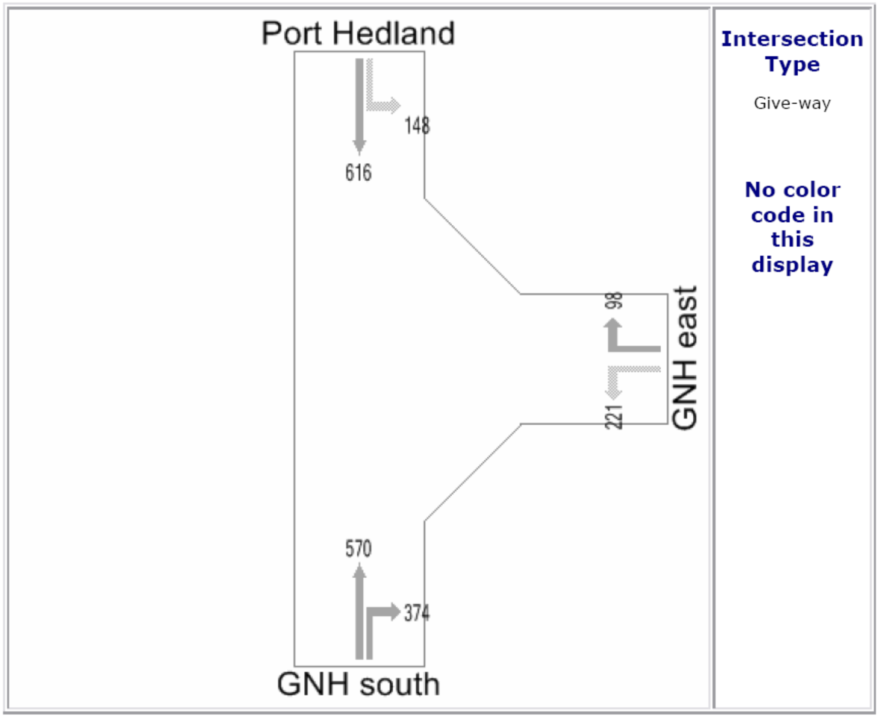
- **Figure 88 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Wallwork Rd with quad road trains**



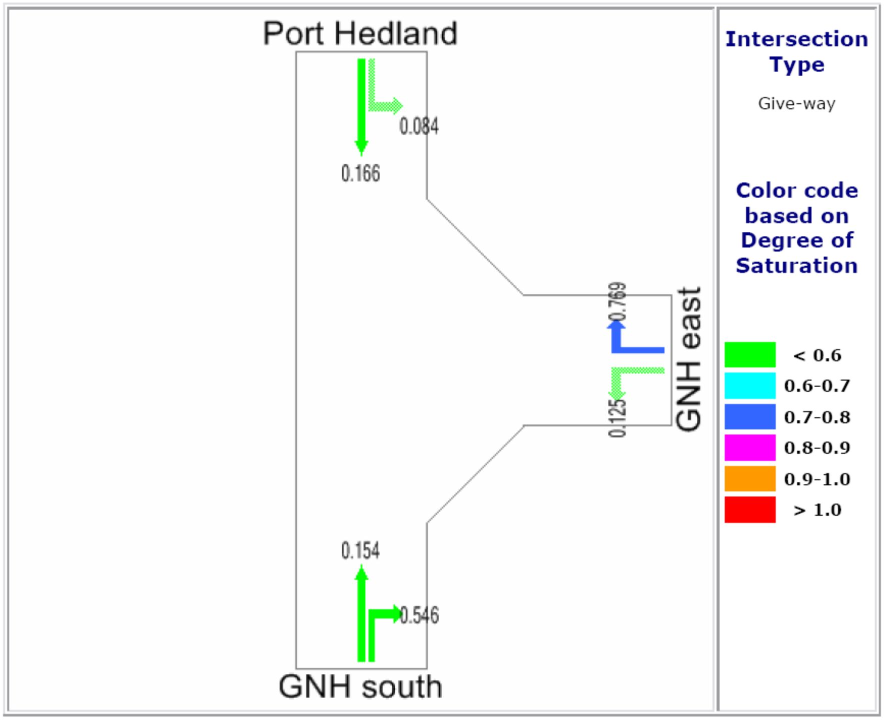

- **Figure 89 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Wallwork Rd with quad road trains**



- **Figure 90 Forecast 2009 PM peak hour turning volumes for Great Northern Hwy/ Port Hedland Rd with quad road trains**




- **Figure 91 Forecast 2009 PM Degree of saturation for Great Northern Hwy/ Port Hedland Rd with quad road trains**



# Appendix D Main Roads WA Drawing 0811-097

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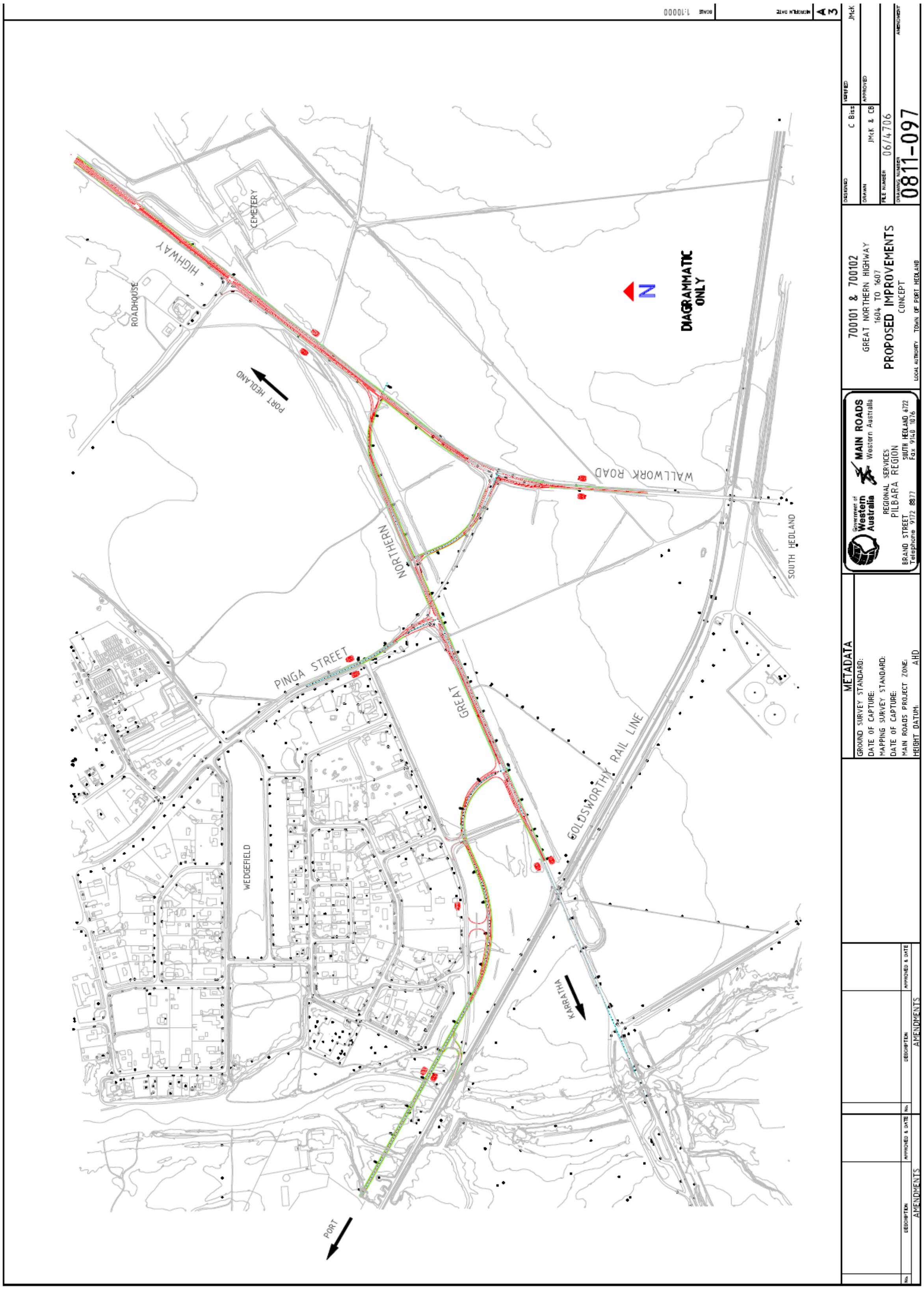


SINCLAIR KNIGHT MERZ