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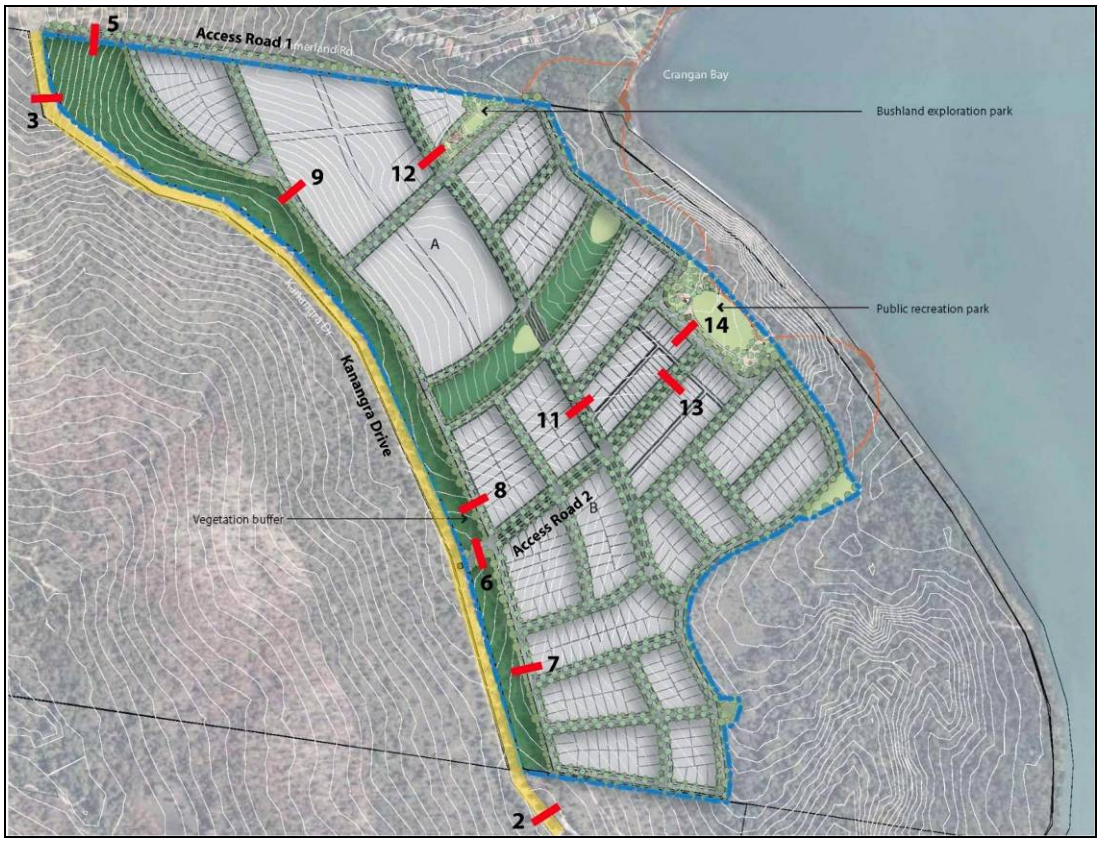
Lower Hunter Lands Project

Gwandalan

Traffic and Transport



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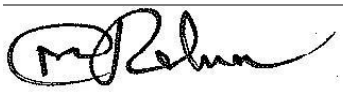
Approver	Mukit Rahman	

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Final Report

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1 Introduction

1.1 Background

It is proposed that the entire Coal & Allied Industries Limited (Coal & Allied) owned Gwandalan site be rezoned/listed as a 'State Significant Site' (SSS) in Schedule 3 of State Environmental Planning Policy (Major Development). A draft Schedule 3 listing will be prepared with the Concept Plan Application.

The Concept Plan for a residential subdivision of the Gwandalan site will apply to the entire 268 ha Gwandalan site. The key parameters for the future development of the site are as follows:

- Dedication of 205.75 ha of conservation land to the New South Wales Government (NSWG) that is identified in the Lower Hunter Regional Strategy and Lower Hunter Regional Conservation Plan, comprising approximately 77% of the Gwandalan site.
- Maximum dwelling yield of 623 dwellings over 62.24 ha.
- Indicative development staging. The number of dwellings and extent of staging for release areas will be largely dictated by the service infrastructure requirements as well as responding to market forces.
- The provision of associated infrastructure.
- Torrens title subdivision of the Gwandalan site. The Torrens title subdivision and boundary realignment of Coal & Allied land will enable land 205.75 ha in area that is owned by Coal & Allied to be excised and dedicated to NSWG for conservation land.

Approval will not be sought under the Concept Plan for a specific lot or road layout. An indicative lot layout will indicate how the maximum dwelling yield of 623 dwellings could be achieved on the site.

Similarly, approval will not be sought under the Concept Plan for subdivision or construction of individual houses. However, the desired future character of the proposed concept plan will be included in Urban Design Guidelines. Urban Design Guidelines will be prepared to inform the Concept Plan in respect of urban form, built form, open space and landscape, access and movement and visual impact for the site.

It is proposed to dedicate land for conservation purposes as part of the Major Project Application via a Voluntary Planning Agreement (VPA) between Coal & Allied and the NSWG in accordance with s.93F of the Environmental Planning & Assessment Act, 1979 (EP&A Act).

The proposed Concept Plan and a Plan showing the proposed development areas and conservation areas is included in the Environmental Assessment (EA) prepared by Urbis.

1.2 Director General's Requirements

The Director-General's Requirements (DGRs) for the subject land were issued on the 19th of August 2010 and are summarised as follows:

(1) Prepare a Traffic Study in accordance with RTA's *Guide Traffic Generating Developments* that includes (but is not limited to) the following:

a) An identification of all relevant vehicular traffic routes and intersection for access to/from the area;

b) Current traffic counts for all of the above traffic routes and intersections;

c) The anticipated vehicular traffic generated from the proposed development and associated trip distribution on the road network;

d) Consideration of the traffic impact on the existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated;

e) An analysis of the cumulative traffic and transport impacts of the development taking into consideration other proposed developments;

f) Details of necessary road network infrastructure upgrades required to maintain existing levels of service both on the local and classified road network;

g) An intersection analysis, using SIDRA or similar traffic model, as well as a micro simulation model to determine the need for intersection and mid block capacity upgrades and to ensure traffic signal coordination;

h) Proposed pedestrian and cycleway access within and to the site that connects to all relevant transport services, nearby settlements, and other key off-site locations having regard to the *NSW Planning Guidelines for Walking and Cycling* (2004), and the *NSW Bike Plan* (2010);

i) Timing of delivery of proposed transport infrastructure including road and intersection upgrades, pedestrian and cycle paths, and public transport infrastructure; and

j) Consideration of impacts on existing property access.

(2) Assess the proposal against the objectives of the Integrating Land Use and Transport policy package.

Coal & Allied commissioned Hyder Consulting Pty Ltd (Hyder) to carry out the traffic study to address the DGRs and examine the traffic and transport issues associated with the concept plan of the subject site. Hyder met with the RTA on 17 September 2010 and discussed issues and traffic works in relation to the above DGRs. Hyder has consulted the following state and local government planning policies and instruments that may apply for the subject site:

a) RTA's *Guide Traffic Generating Developments, 2002.*

b) *NSW Coastal Design Guidelines.* The Minister for Planning has issued a Direction under section 117 of the Environmental Planning and Assessment Act 1979 to all local councils in the coastal zone regarding the Coastal Design Guidelines 2003.

c) *Central Coast Regional Strategy*, NSW Department of Planning 2008. The Strategy represents an agreed NSW Government position on the future of the Central Coast. The Central Coast Regional Strategy applies to the period 2006-2031 and will be reviewed every five years.

d) *Lower Hunter Regional Strategy*, NSW Department of Planning 2006. The Lower Hunter Regional Strategy plans for approximately 160,000 additional people by

2031. Future additional residential development is planned for the Wyee, Nords Wharf, Gwandalan and parts of Catherine Hill Bay, which are in and to the north of Central Coast Region. The Lower Hunter will continue to provide jobs for residents of the Central Coast and vice versa. The Lower Hunter Regional Strategy applies to the period 2006-2031 and will be reviewed every five years.

e) The RTA and Wyong Shire Council's response to DGRs requirements for the subject site issued in July and August 2010.

f) *The Integrating Land Use & Transport Planning Policy Package (ILUT),* NSW Department of Urban Affairs and Planning, 2002. The ILUT provides a framework for State Government agencies, councils and developers to integrate land use and transport planning at the regional and local levels. The ILUT is designed to increase access to services and improve the choice of transport available.

g) *NSW Planning Guidelines for Walking and Cycling,* NSW Government, 2004;

h) *NSW Bike Plan*, NSW Government 2010.

Hyder has prepared this traffic and transport report to respond to key issues associated with the Gwandalan Concept Plan for the development of 623 dwellings.

1.3 Study area

Figure 1-1 shows the study area in the context of site access and local road network. Access to the site is available via Kanangra Drive providing a direct connection to the Pacific Highway south. A secondary access route (unregistered road) is available via a gravel fire trail known as Link Road and Chain Valley Bay Road. The Gwandalan site is located adjacent to the southern end of the Gwandalan Township, which is situated on the western shore of Crangan Bay at the southern end of Lake Macquarie. Gwandalan is within convenient proximity by vehicle to the Pacific Highway (4km) and the F3 Freeway (20km) which is the major transportation corridor to Newcastle, Sydney and the North Coast. Swansea is the closest town centre, 19 kilometres north east of the site, providing shopping and business services. Morisset is 26 kilometres to the south west and is identified as an emerging major regional centre which provides a wider array of employment, business, higher order retailing, professional services and other sub regional functions.

1.4 Study objectives

The purpose of the traffic study is to assess existing traffic patterns, undertake traffic projections for the study area and to conduct an evaluation of the traffic implications of the proposed Gwandalan development on the road network. Key specific purposes were to:

- Address the Director-General's Requirements (DGRs) specifically for Traffic and Transport;
- Assess the overall impact of the proposed residential development on the road network considering current traffic counts at all relevant vehicular traffic routes and intersections;
- Identify key access points for the proposed development considering the existing constraints and opportunities from the perspective of both traffic and road safety;
- Determine the capacity of key intersections providing access & egress for the proposed development;

- Predict and assess the additional traffic generated from the proposed development, based on RTA's Guide to Traffic Generating Developments (2002); and
- Assess the cumulative traffic impact of proposed development at Gwandalan considering potential development of the Rose Group zoned sites.

1.5 Approach to traffic investigation

This traffic report was prepared to examine the impact on the road network from the 623 dwellings at Gwandalan site. Cumulative impact was also assessed based on the potential lot yield on the Rose Group zoned sites and Coal & Allied developments at Catherine Hill Bay, Nords Wharf and Gwandalan. In assessing the traffic impact Hyder looked at the broader traffic assumptions of the impact on the road network and the implication of traffic generation on the Pacific Highway intersection performance from the cumulative impact. Hyder evaluated the traffic impact in the following areas:

- Additional development trips
- Future forecasts on internal and external network
- Model assumptions and scenarios
- Impact on regional road network and intersection operation (for all three scenarios 1 to 3);
- Impact of traffic from the Coal & Allied Gwandalan site. This is documented as Scenario S2;
- Cumulative traffic impact. This is documented as Scenario S3;
- Impact of holiday traffic
- Concept plan assessment and
- Management and mitigation

Table 1-1 summarises the key development assumptions likely to affect traffic outcomes. In summary, the concept plan at Gwandalan involved:

- Residential development of 415 dwellings;
- Retirement village of 208 dwellings; and
- 2800m^2 GFA of retail;
- Full development at Coal & Allied Gwandalan site could occur by 2018;
- Assumptions in association with the potential development of the Rose Group zoned sites included an assumed yield of 187 dwellings for the Gwandalan site
- Hyder's assessment assumed the cumulative impact from 1,722 dwellings.

Table 1-1 Key development assumptions

		Concept Plan/Zoned Land
Developers	**Sites**	**No of dwellings**
Coal & Allied	Middle Camp	222
Coal & Allied	Gwandalan	415 residential dwellings +208 dwellings (retirement village)+2800m^2 GFA of retail
Coal & Allied	Nords Wharf	90
Rose Group	Catherine Hill Bay	Potential yield of 600 residential dwellings
Rose Group	Gwandalan	Potential yield of 187 residential dwellings
Totals		**1,722**

Figure 1-1 Study area and Coal & Allied Gwandalan development

1.6 Report structure

This report has the following structure:

- Section 1: Introduction- background of the study area, traffic study process and objectives of this study.
- Section 2: Key transport indicators- provide a review of the road network, land use, journey to work data, public transport network and usage, road hierarchy and traffic data service and results.
- Section 3: Impact assessment- describes the impacts on regional and local road networks from the proposed development at Gwandalan.
- Section 4: Summary of findings.

2 Key transport indicators

2.1 Road hierarchy and network

The RTA Road Design Guide defines the functional road hierarchy in urban area to establish a consistent basis for traffic management. There are four levels of road and their functions are stated as below:

- Arterial roads – predominantly carry through traffic from one region to another, forming principal avenues of communication for urban traffic movements;
- Sub Arterial Roads – connect the arterial road to areas of development and carry traffic directly from one part of a region to another. They may also relieve traffic on arterial roads in some circumstances;
- Collector Roads – connect the sub-arterial roads to the local road system in developed areas; and
- Local Roads – are the sub-divisional roads within a particular developed area. These are used solely as local access roads.

The key roads provide access to the proposed Gwandalan development site are summarised in Table 2-1.

Table 2-1 Road hierarchy in the context of the Gwandalan development proposal

Road Names	Road Hierarchy	Characteristics
Pacific Highway	Arterial	The Pacific Highway is the main arterial route in the vicinity of the subject area, providing access to Newcastle to the north, and connection to the Sydney-Newcastle Freeway (F3) to the south. Near the site, the Pacific Highway is a four-lane divided highway. It has a sign posted speed limit of 100 km/h.
Kanangra Drive	Collector	Kanangra Drive is a two lane undivided road and has a sign posted speed limit of 80 km/h. The approximate width of the carriageway is approximately eight metres consisting of a 0.5m seal shoulder on either side
Summerland Road	Local	Summerland Road is a local road connecting Kanangra Drive at a roundabout on the northern border of the proposed site. Summerland Road is a two lane undivided road

2.1.1 Key intersections

Key intersections related to the Coal & Allied Gwandalan development are listed in Table 2-2. Any future development in the Gwandalan area is likely to be governed by the future spare capacity of these intersections.

Table 2-2 Key Intersections

ID	Intersection	Control Type and Characteristics
I-6	Pacific Highway/Kanangra Drive	Four way signal controlled intersection
I-7	Kanangra Drive/Summerland Rd	Roundabout

2.2 Demographic

The existing township of Gwandalan is characterised by traditional detached housing dwellings. Gwandalan contains an estimated population of approximately 2,940 people (Census 2006). Existing land use at Gwandalan includes a community hall, two pre-schools, a primary school, a doctor's surgery, bowling club, convenience shops, foreshore reserves, a sporting complex (oval, skate and tennis courts) and number of sporting and community groups.

Gwandalan forms a small part of travel zone (TZ 3143, see Figure 2-1) defined by the Census Journey to Work 2006. This travel zone also constitutes work trip information for Summerland Point and Point Wolstoncroft areas. The Journey to Work data indicates about 95 percent work trips were made by private car followed by 3 percent by bus. Walking, cycling and other forms of travel accounted for about 2 percent of all work trips. The Journey to Work data showed that about 20% of people did not travel (or unstated trips) on the Census day. The unstated trips are not included in the mode share estimation as stated above.

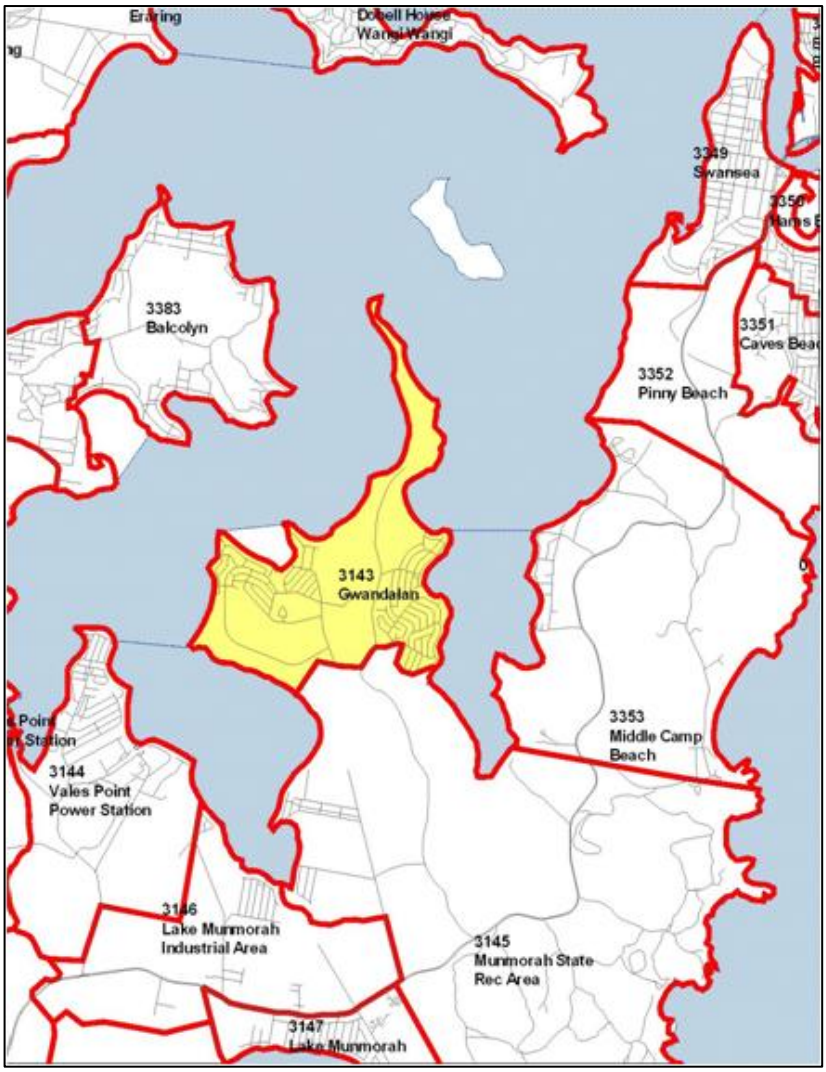


Figure 2-1 Travel zone boundaries, 2006 Bureau of Transport Statistics

2.3 Public transport network and use

2.3.1 Bus services

The operator of the bus service in Gwandalan is Busways Wyong. Figure 2-2 shows existing bus route map serving Gwandalan. The subject site is serviced directly by Busways Route 99 which runs from Lakehaven Shopping Centre and Swansea. It calls at Gwandalan, Nords Wharf and Catherine Hill Bay. Route 99 travels along Kanangra Drive and provides the public transport access opportunity to the subject site. Route 99 operates fourteen services per day through Gwandalan connecting Lake Haven and Charlestown. The operator of Busways was contacted regarding upgrades to the service. Busways advised that bus services were continually under review and that more frequent services would be considered as additional residential development occurs in, Gwandalan, Catherine Hill Bay and Nords Wharf.

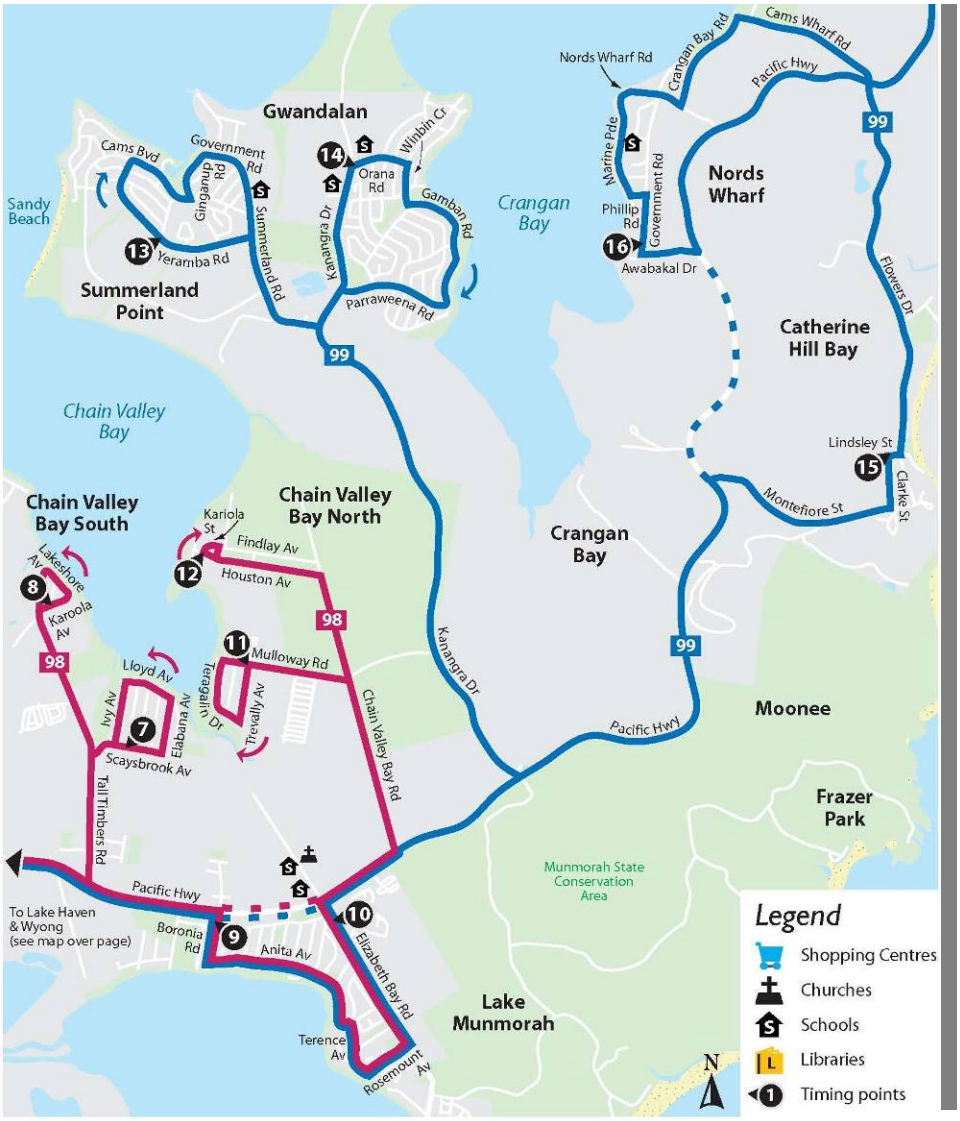


Figure 2-2 Busways existing bus route map serving Catherine Hill Bay, Gwandalan and Nords Wharf (*source:www.131500.com.au)*

2.3.2 Rail services

The nearest rail station to Gwandalan is approximately 24 km away at Wyee, on the Newcastle and Central Coast line. Commuters wanting to use the rail service would need to drive or cycle to the station. From Wyee passengers can travel to Gosford or Wyong on the Central Coast, Sydney, or Newcastle. Train services are provided over 24 hours and at weekends. Weekday day time/commuter services are shown in Table 2-3.

Table 2-3 Train Frequency

Time Period	Trains Wyee to Newcastle	Trains Wyee to Central
06:00-09:00	6	5
09:00-16:00	7	7
16:00-19:00	7	6

2.4 Pedestrian and cyclist network

In Gwandalan, all local streets are designated as shared cycling and pedestrian usage. Regional arterials like the Pacific Highway are also designated as shared vehicular and cycling routes.

2.5 Parking

Currently no parking restrictions are in place on either side of Kanangra Drive in the vicinity of subject site.

2.6 Historical traffic growth

Historical traffic data on the Pacific Highway was obtained from the RTA Hunter Region. Table 2-4 shows recorded traffic volumes from 1995 to 2010 on the Pacific Highway, approximately ten kilometres north of Kanangra Drive, Gwandalan (RTA station number 05.002), Swansea. Annual traffic growth rates on the Pacific Highway over the last 15 years are summarised in Table 2-5.

Table 2-4 Historical traffic data (AADT) on Pacific Highway

		Year of Counts									
Station	Road	1995	1998	2001	2004	2005	2006	2007	2008	2009*	2010*
05.002	Pacific Highway (5 km north of Flowers Drive)	13,346	13,948	14,771	15,732	15,472	15,130	15,458	15,647	15,644	16,193

*Note: 2009 and 2010 volumes represent provisional Average Daily Traffic (ADT) provided by RTA (data sample is smaller than one complete year).

Table 2-5 Annual traffic growth rates

Road	RTA Count station	Annual Average Growth			
		Between 1995-2001	Between 2001-2006	Between 2007-2010	Overall average 1995-2010
Pacific Highway (5 km north of Flowers Drive)	05.002	▲ 1.7 %	▲ 0.4 %	▲ 1.6 %	▲ 1.3 %

The following observations are noted from historical traffic data presented in Tables 2-4 and 2-5.

- Between 1995 and 2001 traffic on the Pacific Highway has grown from 13,300 to 14,700, an annual growth rate of 1.7% per annum.
- The growth rate reduced significantly between 2001 and 2006 to for the last five years being only 0.4% per annum. In fact, traffic reduced between 2005/2006 compared to 2004 data.
- Between 2007 and 2010 traffic growth on the Pacific Highway was 1.6% per annum;
- On average, in the last 15 years,, between 1995 and 2010, traffic growth was 1.31% per annum;
- A conservative estimate of 2% per annum for background traffic growth on the Pacific Highway was assumed as a future proof for intersection modelling.

2.7 Crash data analysis

This assessment is based on the crash data supplied by the RTA for the six year period from October 2004 to June 2010 including the provisional data. Crash data between November 2009 and June 2010 is provisional.

Crash data between 2004 and 2010 indicates that the majority of crashes (about 146) occurred on the Pacific Highway from Mine Camp Road to Chain Valley Bay Road (see Table 2-6 below). Of that three fatal crashes were recorded on the Pacific Highway. During the same period, about 23 crashes were recorded on the Kanangra Drive between Pacific Highway and Orana Road. One fatal crash was recorded on Kanangra Drive.

Table 2-6 Summary of the crash data for the period from 10/2004 to 6/2010

Location	Total Number of Crashes	Fatal Crashes	Injury Crashes	Non Injury Crashes	Casualties		
					Killed	Injured	Total
Pacific Highway from Mine Camp Road to Chain Valley Bay Road	146 (100%)	3 (2.1 %)	54 (37 %)	89 (61 %)	3	80	83
Kanangra Drive	23 (100%)	1 (4.3%)	18 (78.3%)	4 (17.4%)	1	21	22

Note: Crash occurred at intersections are also included in the Table 2-6.

Figure 2-3 and Figure 2-4 show numbers of crashes by crash type that occurred on Pacific Highway and Kanangra Drive respectively. The data showed that on both Pacific Highway and Kanangra Drive “off road on curve (hit object)” crashes dominated with 92 crashes on the Pacific Highway and 9 crashes on the Kanangra Drive. No pedestrians were involved in any crashes.

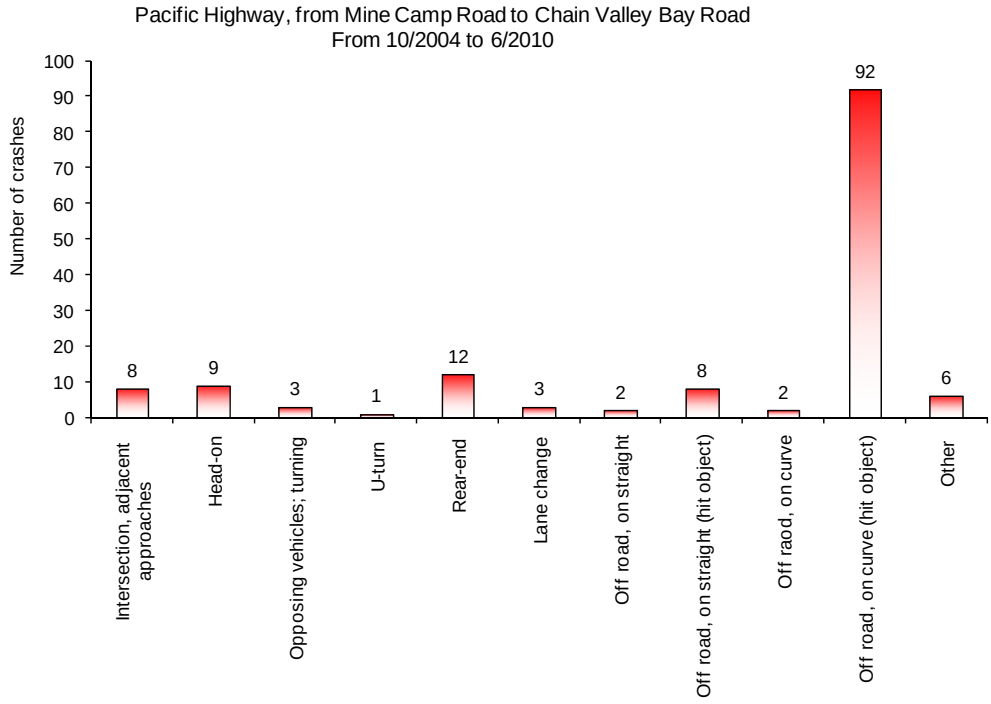


Figure 2-3 Pacific Highway-Number of crashes per crash movement (10/2004-6/2010)

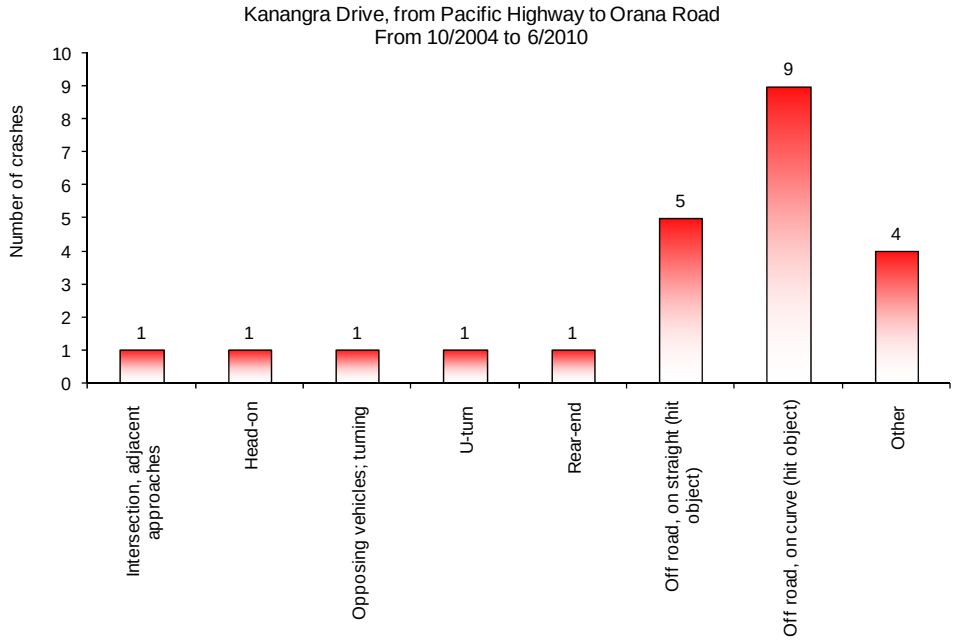


Figure 2-4 Pacific Highway-Number of crashes per crash movement (10/2004-6/2010)

Figure 2-5 and Figure 2-6 show crash locations visually along the Pacific Highway and Kanangra Drive respectively. Crash data on Pacific Highway and Kanangra Drive show that, in general, crashes occurred along the full length but are more concentrated on the curve sections of Pacific Highway, Kanangra Drive and other traffic conflicting areas, for instance at intersections.

The additional traffic generated by the proposed development at Gwandalan is unlikely to have any significant impact on the current crash rate or severity of crashes on the Pacific Highway and Kanangra Drive in the vicinity of Gwandalan.

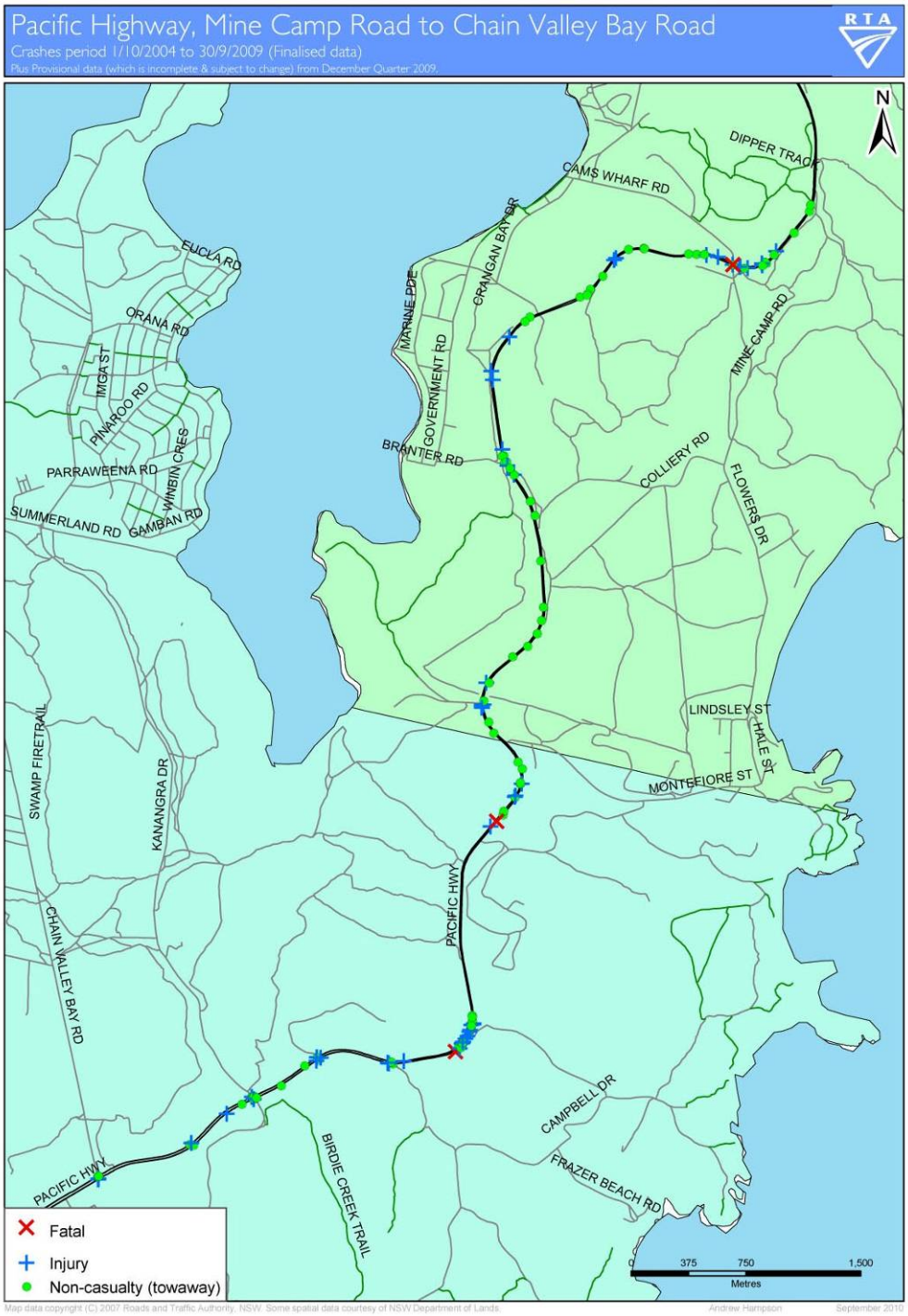


Figure 2-5 Pacific Highway, spatial distribution of crashes (10/2004 to 6/2010)

Figure 2-6 Kanangra Drive , spatial distribution of crashes (10/2004 to 6/2010)

2.8 Traffic data

Coal & Allied previously commissioned traffic count for all key roads and intersections for the Southern Estates. These counts were undertaken in July 2007. Between 2007 and 2010 there were no significant changes in the land use in and around the study area. Between 2007 and 2010, local traffic movements (in/out) at Flowers Drive, Montefiore Street, Nords Wharf Road, Awabakal Drive and Kanangra Drive are unlikely to have changed. With RTA's concurrence, 2007 traffic counts have been used to update traffic volumes to year 2010. Extrapolation of the 2007 traffic data was undertaken using the historical traffic growth on the Pacific Highway. Traffic volumes for year 2010 were extrapolated from 2007 using a 2 percent growth per annum. It is expected that daily traffic profile, hourly traffic profile and proportion of heavy vehicles derived from 2007 counts will maintain similar traffic patterns in year 2010.

In the following sections, the estimated 2010 traffic volumes on the Pacific Highway are noted, where appropriate.

- Mid-block tube counts for periods of at least a week; and
- Intersection turning movement counts during morning and afternoon peak periods.

Two sites were selected for mid-block traffic counts (see Table 2-7):

Table 2-7 Mid-block traffic survey locations

ID	Location	Survey Period
M-2	Pacific Highway, south of Awabakal Drive	From 17July 2007 to 23July 2007
M-5	Kanangra Drive north of Pacific Highway	From 17July 2007 to 23July 2007

From this count data all vehicles were then classified into the twelve Austroads standard vehicle classes. Similar to midblock count, two locations were selected for peak period intersection counts as follows (see Table 2-8):

Table 2-8 Intersection survey locations

ID	Location	Survey Period
I-6	Pacific Highway/Kanangra Drive	Friday, 20 July 2007
I-7	Kanangra Drive/Summerland Road	Friday, 20 July 2007

The intersection surveys were fully classified turning counts, conducted for both AM (7am to 10am) and PM (3pm to 6pm) peaks on Friday 20 July 2007 being the critical day found from other survey locations in this corridor. The following sections provide a summary of traffic results based on counts undertaken in 2007.

2.8.1 Average weekday and weekend traffic

Daily traffic volumes for the key roads were calculated (see Table 2-9 below) for an average weekday (5 days) and an average weekend (2 days) traffic. These two

variations of traffic volume are derived from the mid-block surveys conducted during a 'typical' week, i.e. not during school holidays.

Table 2-9 Daily traffic volumes on key roads

Site ID	Road sections	Average Weekday (Counts)	Average Weekend (Counts)	Traffic Changes (Weekend)
M-2	Pacific Hwy, south of Awabakal Dr	13,800	11,000	-20%
M-5	Kanangra Dr, north of Pacific Hwy	7,100	5,700	-20%

Below points are noted from Table 2-9 traffic results:

- During 2007, Pacific Highway carried approximately 13,800 vehicles per day during a weekday.
- In 2010, traffic volume on Pacific Highway is estimated at approximately 14,600 vehicles per day. This represents about an 800 vehicle increase in three years. This increase is unlikely to change traffic performance which was determined from 2007 counts.
- Weekend traffic is about 20% lower than weekday traffic. The data suggests Pacific Highway in this section carries high commuter demand between Central Coast and Newcastle;
- Weekday traffic on this section is about 10% lower than annual average daily traffic (AADT) on the Pacific Highway near Swansea (see Table 2-4 for AADT data);
- As a collector road standard, Kanangra Drive carries between 7,100 and 7,500 vehicles per day during weekday. The census 2006 population for Gwandalan and Summerland Point indicates that an equivalent of approximately 2,000 dwelling (assuming occupancy of 2.5 persons per dwelling) can use Kanangra Drive at any point in time. The actual highest trip rate from above data indicates between 3.5 and 4 trips per day less than half of RTA's daily trip rate (9 trips) for residential development. This implies, about 50% of trips within Gwandalan and Summerland Point are self contained trips (internal trips) and has no impact either on the Kanangra Drive or Kanangra Drive/Pacific Highway signals operation.

2.8.2 Daily traffic profiles

Figure 2-7 shows the variations of traffic profile over one week period.

Key findings from Figure 2-7 indicate that:

- Traffic on surveyed roads is not constant but varies from day to day.
- Traffic on the Pacific Highway is relatively constant. Peak traffic occurred on Friday.
- Kanangra Drive shows similar to Pacific Highway profile. Weekend traffic on Kanangra Drive is about 20% less than weekday traffic.

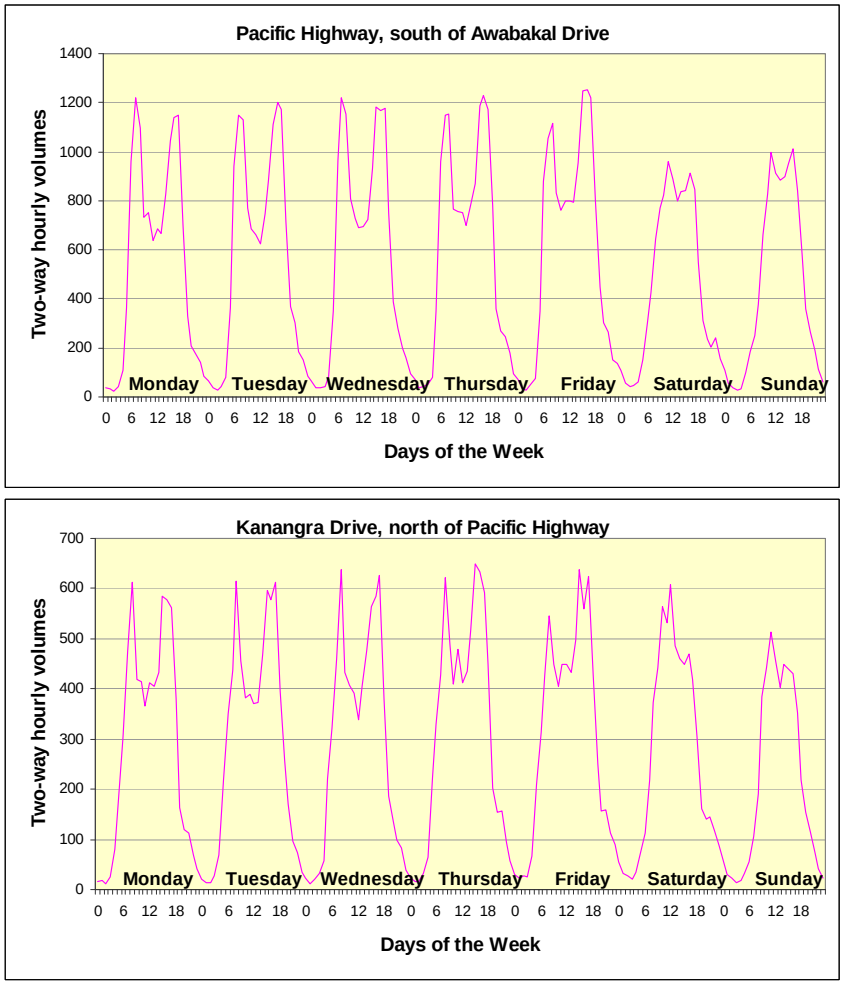
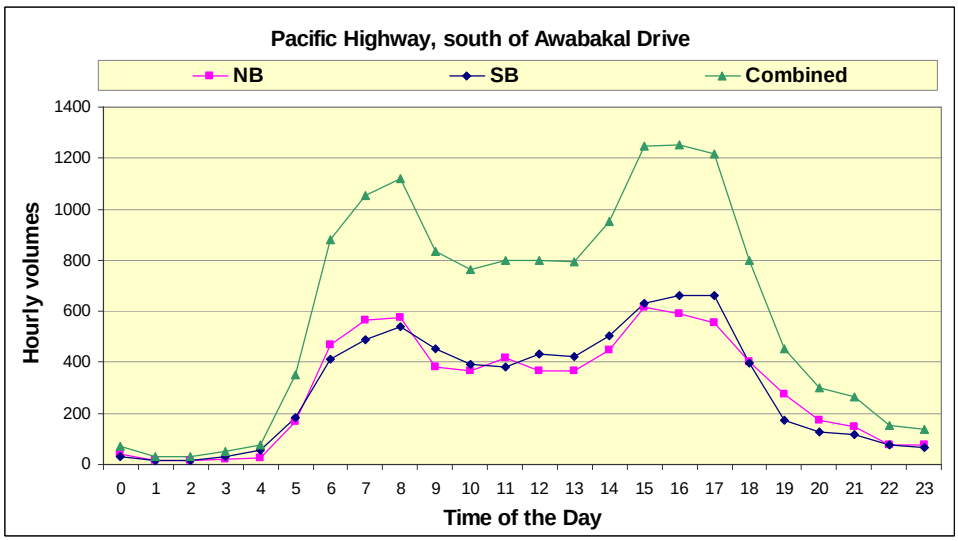


Figure 2-7 Daily variation of traffic volumes

2.8.3 Hourly variations

Figure 2-8 shows the hourly traffic volumes on weekday by directional of travel. The data showed morning peak between 8 am and 9 am on the Pacific Highway, north of Gwandalan and afternoon peak between 3 pm and 4 pm.



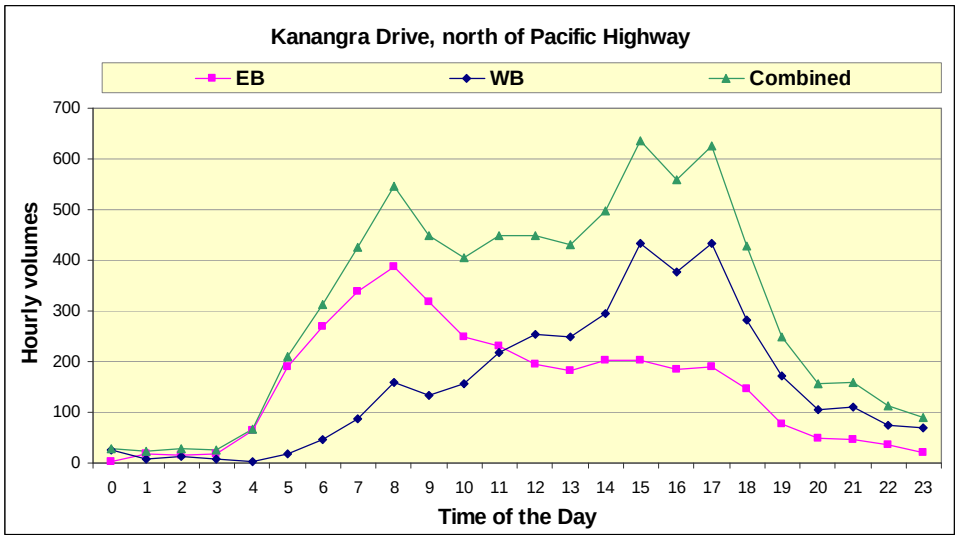


Figure 2-8 Hourly traffic variation at key roads

Table 2-10 summarised traffic data for Friday for both AM and PM peak hour.

Table 2-10 AM and PM peak hour volumes on key roads (Friday)

Site ID	Road sections	AM Peak (8 to 9am)			PM Peak (3 to 4pm)		
		NB/EB	SB/WB	Total (2-way)	NB/EB	SB/WB	Total (2-way)
M-2	Pacific Hwy, south of Awabakal Dr	580	540	1,120	620	630	1,250
M-5	Kanangra Dr, north of Pacific Hwy	390	160	550	200	440	640

Below points are noted from peak hour data from Table 2-10:

- During 2007, peak hour traffic on the Pacific Highway was between 1,120 and 1,250 vehicles per hour. In 2010, traffic volume on Pacific Highway is estimated at approximately 1,190 to 1,330 vehicles per hour during AM and PM peak periods respectively. In hourly terms, this represents about a 70 to 80 vehicle increase in three years. This increase is unlikely to change traffic performance which was determined from 2007 counts. The notional capacity of a 4 lane Pacific Highway can be 5,000 vehicles per hour assuming 1,250 vehicles per lane. This suggests the Highway has spare capacity for further growth.
- Kanangra Drive is a two lane undivided road and carries between 500 and 700 vehicles per hour. The notional capacity of a collector road like Kanangra Drive can be 1,550 vehicles per hour. This suggests from a capacity perspective that Kanangra Drive has spare capacity for additional traffic growth.

2.8.4 Heavy vehicles

According to AUSTROADS vehicle classification system, heavy vehicles include trucks with two or more axles, buses, semi-trailers and B-doubles (classification categories 3-12). Table 2-11 below shows the number of heavy vehicles recorded during the morning (8:00 am – 9:00 am) and afternoon (3:00 pm – 4:00 pm) peak hours and over

the entire day. The numbers in parentheses contain the percentage of heavy vehicles of the total volume on that road.

Table 2-11 Heavy vehicles (2-way) on key roads (Friday)

Site ID	Road sections	AM Peak	PM Peak	Daily
M-2	Pacific Hwy, south of Awabakal Dr	100 (9%)	90 (8%)	1,200 (8%)
M-5	Kanangra Dr, north of Pacific Hwy	32 (6%)	23 (4%)	340 (5%)

The heavy vehicle data from Table 2-11 showed the following patterns:

- The heavy vehicle data recorded in 2007 showed the Pacific Highway carried about 1,200 heavy vehicles per day;
- On Pacific Highway, the heavy vehicle proportion was about 8% to 9% of total traffic. This trend is consistent with the heavy vehicle proportion on other state roads (between 8% and 12 %).
- Heavy vehicles on the Kanangra Drive were recorded about 340 vehicles per day accounted for 5% of total traffic.

2.8.5 Intersection turning volumes

Intersection turning movement data was a key input to the SIDRA intersections capacity analysis. This data also provided traffic distribution at the local level.

Figure 2-9 presents surveyed 2007 turning movements at three key intersections for both AM (8:00-9:00) and PM (15:00– 16:00) peak periods. Turning movement data was counted during Friday peak travel conditions.

Figure 2-10 presents estimated 2010 turning movements at the same intersections for both AM (8:00-9:00) and PM (15:00-16:00) peak periods.

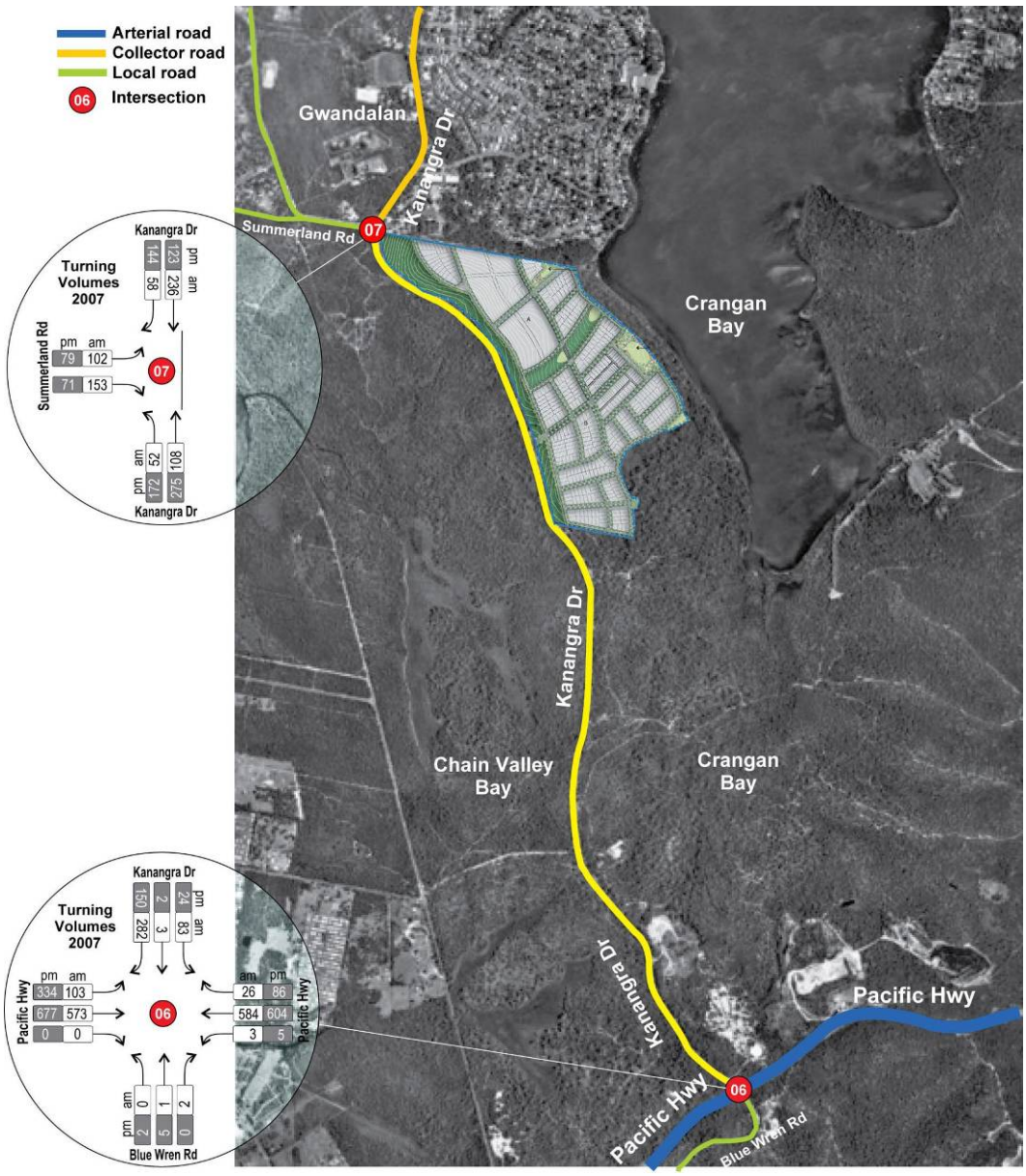


Figure 2-9 Intersection turning volumes for the AM and PM peak hours in 2007

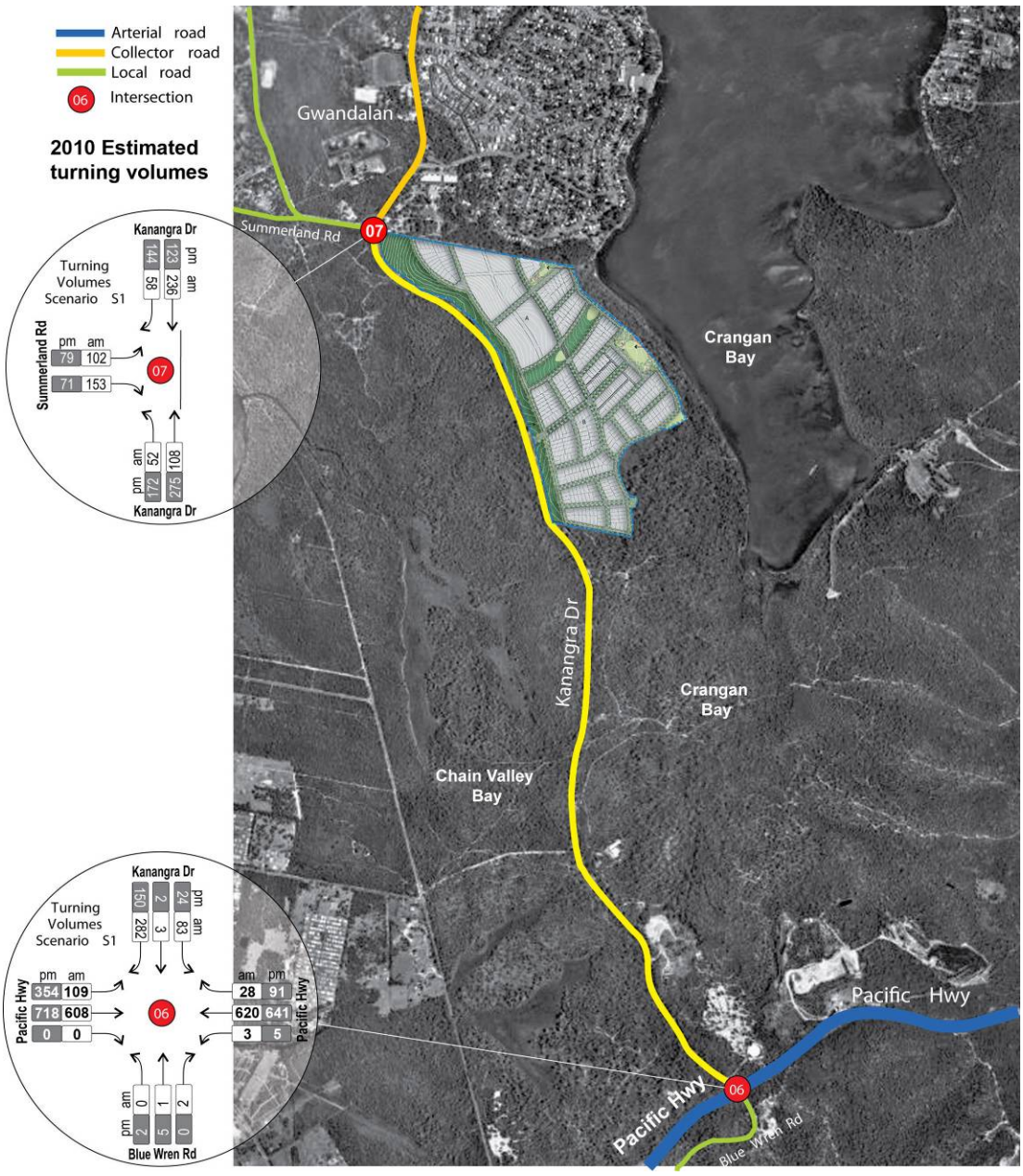


Figure 2-10 2010 Estimated intersection turning volumes for the AM and PM peak hour

2.9 Road network capacity

Hyder used SIDRA traffic modelling software for assessing intersection performance. As per the DGRs', the need for a micro-simulation (Paramics) model for the subject site was discussed with the RTA. With RTA's concurrence, micro-simulation model (Paramics) was not required. SIDRA modelling was adequate for the subject site.

Assessment Criteria of Intersection

The standard intersection analysis program is SIDRA, which analyses the performance of single intersections and can thus determine the impact of a number of development options. For the assessment of the traffic impact by the Gwandalan development, the four accepted measures of performance have been considered, which are:

- Level of Service (LoS);
- Degree of Saturation;
- Average Delay; and
- Maximum Queue Length.

These four measures are discussed below.

Level of Service (LoS)

This is a measure of the delay a vehicle suffers in negotiating an intersection. LoS applies to the intersection as a whole and to individual turning movements. Ratings of LoS A to C are in the acceptable range, with E and F considered unacceptable. LoS D may be acceptable in certain circumstances. The standard NSW Level of Service criteria for intersections are summarised in Table 2-12:

Table 2-12 LoS Criteria

Level of Service	Average Delay per Vehicle (secs/veh)	Traffic Signals, Roundabout	Give Way & Stop Signs
A	<14	Good operation	Good operation
B	15 to 28	Good with acceptable delays & spare capacity	Acceptable delays & spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity & accident study required
E	57 to 70	At capacity; at signals, incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	>70	Unsatisfactory with excessive queuing	Unsatisfactory with excessive queuing

Source: RTA Guide to Traffic Generating Developments

Degree of Saturation (DoS)

This is the ratio of traffic flow for a particular vehicle movement to the capacity flow for that movement. The highest DoS is the DoS for the intersection.

Average Delay

The average delay is a simple calculation to find the difference between the travel times of vehicles delayed by traffic, compared to the travel time expected if there were no interruptions to the flow through an intersection. This is usually presented as seconds per vehicle.

Maximum Queue Length

The queue length figures used in this assessment are usually calculated as the '95th percentile back of queue.' This is the measure which 95% of all queues are within.

2.9.1 Existing intersection performance

The Pacific Highway/Kanangra Drive and Kanangra Drive/Summerland Road intersection modelling was carried out using SIDRA software for both years 2007 and 2010. The existing layout and traffic control was modelled for Pacific Highway/Kanangra Drive and Kanangra Drive/Summerland Road intersections. Four performance measures detailed above are estimated. LoS results for year 2007 and 2010 are presented in Table 2-13 and Table 2-14 respectively.

Table 2-13 Intersection LoS for 2007 traffic conditions

ID	Intersection Name	Control Type	DOS	Ave Delay (s)	LOS	Queue (veh)
	Morning peak					
I-06	Pacific Hwy-Kanangra Dr	Signals	0.58	22	B	11
I-07	Kanangra Dr-Summerland Rd	Roundabout.	0.26	9	A	2
	Evening peak					
I-06	Pacific Hwy-Kanangra Dr	Signals	0.66	22	B	13
I-07	Kanangra Dr-Summerland Rd	Roundabout.	0.38	8	A	3

Note: For sign controlled intersections LoS is determined by worst movement (highest delay)

Table 2-14 Intersection LoS for 2010 traffic conditions

ID	Intersection Name	Control Type	DOS	Ave Delay (s)	LOS	Queue (veh)
	Morning peak					
I-06	Pacific Hwy-Kanangra Dr	Signals	0.61	22	B	11
I-07	Kanangra Dr-Summerland Rd	Roundabout.	0.26	9	A	2
	Evening peak					
I-06	Pacific Hwy-Kanangra Dr	Signals	0.69	22	B	14
I-07	Kanangra Dr-Summerland Rd	Roundabout.	0.38	8	A	3

Note: For sign controlled intersections LoS is determined by worst movement (highest delay)

The result for worst (highest delays) movements from 2010 models are summarised in Table 2-15.

Table 2-15 Movements with the highest delays as per 2010 models

ID	Intersection Name	Control Type	Critical Movements
	Morning peak		
I-06	Pacific Hwy-Kanangra Dr	Signals	* 282 veh/h right turn from Kanangra Dr DoS=0.57; LoS=C * 27 veh/h right turn from Pacific Hwy DoS=0.19; LoS=D
I-07	Kanangra Dr-Summerland Rd	Roundabout.	* 58 veh/h right turn from Kanangra Dr DoS=0.26; LoS=A * 153 veh/h right turn from Summerland Rd DoS=0.22; LoS=A
	Evening peak		
I-06	Pacific Hwy-Kanangra Dr	Signals	* 150 veh/h right turn from Kanangra Dr DoS=0.32; LoS=C * 91 veh/h right turn from Pacific Hwy DoS=0.60; LoS=D
I-07	Kanangra Dr-Summerland Rd	Roundabout.	* 144 veh/h right turn from Kanangra Dr DoS=0.21; LoS=A * 71 veh/h right turn from Summerland Rd DoS=0.15; LoS=A

Key observations from Table 2-14 and Table 2-15 are noted below:

- There was no significant change in the intersections performance results between 2007 and 2010 traffic conditions. Level of Service (LoS) for both modelled intersections, during AM and PM peak periods, remained unchanged;
- Pacific Highway/Kanangra Drive intersection operates at Los B. The right turn movement out of Kanangra Drive experienced higher delays (LoS C). Kanangra Drive/ Summerland Road roundabout shows good operation with a LoS A during peak period.

3 Impact Assessment

3.1 Additional development trips

In assessing the total number of trips generated from Gwandalan, we used RTA's agreed peak trip generation rates of 0.85 vehicle trips for detached dwellings and 0.2 trips for retirement villages. The internal trips were assumed to be 25% as per RTA guideline. The proposed development yields at Gwandalan will generate 394 peak hour two way trips.

3.2 Access and circulation

Access to the site is available via Kanangra Drive providing a direct connection to the Pacific Highway. A secondary access route (unregistered road) is available via a gravel fire trail known as Link Road and Chain Valley Bay Road. The external road network, serving the Coal & Allied Gwandalan development comprises Kanangra Drive which links to the Pacific Highway.

The Gwandalan concept plan shows two key access points as follows:

- A new T-junction on Kanangra Drive about 800 m south of the existing roundabout at the Kanangra Drive/Summerland Point Road intersection;
- A new connecting road on the eastern side of the Kanangra Drive/Summerland Point Road roundabout. The Coal & Allied access will form the fourth leg of the existing roundabout.

3.3 Future trip distribution and growth on Pacific Highway

In assessing the traffic impact from the Gwandalan site, three important assumptions were considered as follows:

- Future traffic distribution to and from the Gwandalan site;
- Traffic distribution to and from other developments to be used in the cumulative assessment. This included the Coal & Allied sites at Nords Wharf and Catherine Hill Bay, and the potential development yield from the Rose Group zoned sites at Gwandalan and Catherine Hill Bay; and
- Background traffic growth on the Pacific Highway.

Future traffic distribution from both the Coal & Allied estates and Rose Group zoned sites, in conjunction with background growth on the Pacific Highway, are summarised in Table 3-1. A conservative estimate of 2 percent growth rate per annum on the Pacific Highway in the next 10 years is appropriate and is consistent with the historical growth observed at RTA's permanent count site two kilometres south of Macquarie Bridge at Swansea.

Table 3-1 Trip distribution and background traffic growth assumptions

Developers	Sites	Basic model assumptions and data
Coal & Allied	Middle Camp	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2012; 60 % of trips would travel north to/from Newcastle via Pacific Highway/Flowers Drive intersection under existing intersection controls; 40 % of trips would travel south to/from Wyong/Gosford areas via Pacific Highway/Montefiore Street under existing intersection controls;
Coal & Allied	Gwandalan	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2018; 20 % of trips would travel north to/from Newcastle via Pacific Highway/Kanangra Drive Intersection; 80 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Kanangra Drive intersection;
Coal & Allied	Nords Wharf	80 % of new trips are outbound and 20% inbound during AM peak. PM peak will mirror the AM peak pattern; Future horizon year for full development is 2011; 60 % of trips would travel north to/from Newcastle via Pacific Highway/Awabakal Drive intersection; 40 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Awabakal Drive Intersection;
Rose Group	Catherine Hill Bay	60 % of trips would travel north to/from Newcastle and would use both the Pacific Highway/Flowers Drive and the Pacific Highway/Montefiore Street intersections under existing intersection controls; 40 % of trips would travel south to/from Wyong/Gosford via Pacific Highway/Montefiore Street under existing intersection controls; Future horizon year for full development is 2018
Rose Group	Gwandalan	During the morning peak, around 70% of total traffic in and out of Gwandalan/Summerland Point is outbound, and in the evening peak, around 65% is inbound; Future horizon year for full development is 2018
-		A conservative estimate of 2% per annum background traffic growth on the Pacific Highway; Peak hour through traffic for holiday period would increase by about 10% above the weekday counts.

In the instance of potential delays to Coal & Allied's Nords Wharf and Middle Camp developments; the study has assessed the cumulative traffic impact at key intersections with the Pacific Highway up to year 2018.

3.4 Future forecast and impact on key intersections

Traffic forecasts were prepared for three scenarios at Gwandalan:

- S1 represents the base case;
- S2 represents the base case plus development traffic;
- S3 cumulative impact includes other developments in and around Gwandalan.

The trip generation was applied to scenarios S2 and S3. Table 3-2 summarises the assumptions associated with the three scenarios.

Table 3-2 Scenario description

The scenarios	Description
S1 Base Case	Reflects background traffic growth of 2% per annum on the Pacific Highway
S2 Development Case	Reflects Base Case (S1) plus the proposed residential dwellings at the Coal & Allied Gwandalan site.
S3 Cumulative Case	Reflects Development Case (S2) plus all other proposed developments including Middle Camp, Nords Wharf and the potential development yield from the Rose Group zoned sites at Catherine Hill Bay and Gwandalan. Cumulative traffic was assessed for year 2018.

Intersection performance was reported in terms of degree of saturation (DoS), level of service (LoS), average delay per vehicle and 95th percentile queue length.

The model results for all three scenarios showed intersection performance (LoS, DoS, queue) followed by forecasts of turning movements, which formed the basis of intersection models. This clearly demonstrated the impact from the Gwandalan development alone followed by the cumulative impact.

Results are summarised at both the Pacific Highway/Kanangra Drive and Kanangra Drive/Summerland Road intersections as follows:

- Table 3-3 shows SIDRA results for the *base case S1*
- Figure 3-1 shows turning movements for the *base case S1*
- Table 3-4 shows SIDRA results for the *development case S2*
- Figure 3-2 shows turning movements for the *development case S2*
- Table 3-5 shows SIDRA results for the *cumulative case S3*
- Figure 3-3 shows turning movements for the *cumulative case S3*

Table 3-3 Intersection performance at Pacific Highway intersection (Base Case S1)

Site ID	Intersection	Control	2010				Gwandalan (Base Case S1)			
			DoS	Delays (S)	LoS	Queue (Veh)	DoS	Delays (S)	LoS	Queue (Veh)
	Morning peak									
I-6	Pacific Hwy-Kanangra Dr	Signals	0.61	22	B	11	0.68	22	B	13
	Evening peak									
I-6	Pacific Hwy-Kanangra Dr	Signals	0.69	22	B	14	0.79	23	B	17

Note: Intersection performance results from background growth (base case) on Awabakal Drive, Flowers Drive and Montefiore Street intersections with Pacific Highway are summarised in Coal & Allied's Nords Wharf and Middle Camp traffic reports prepared by Hyder.

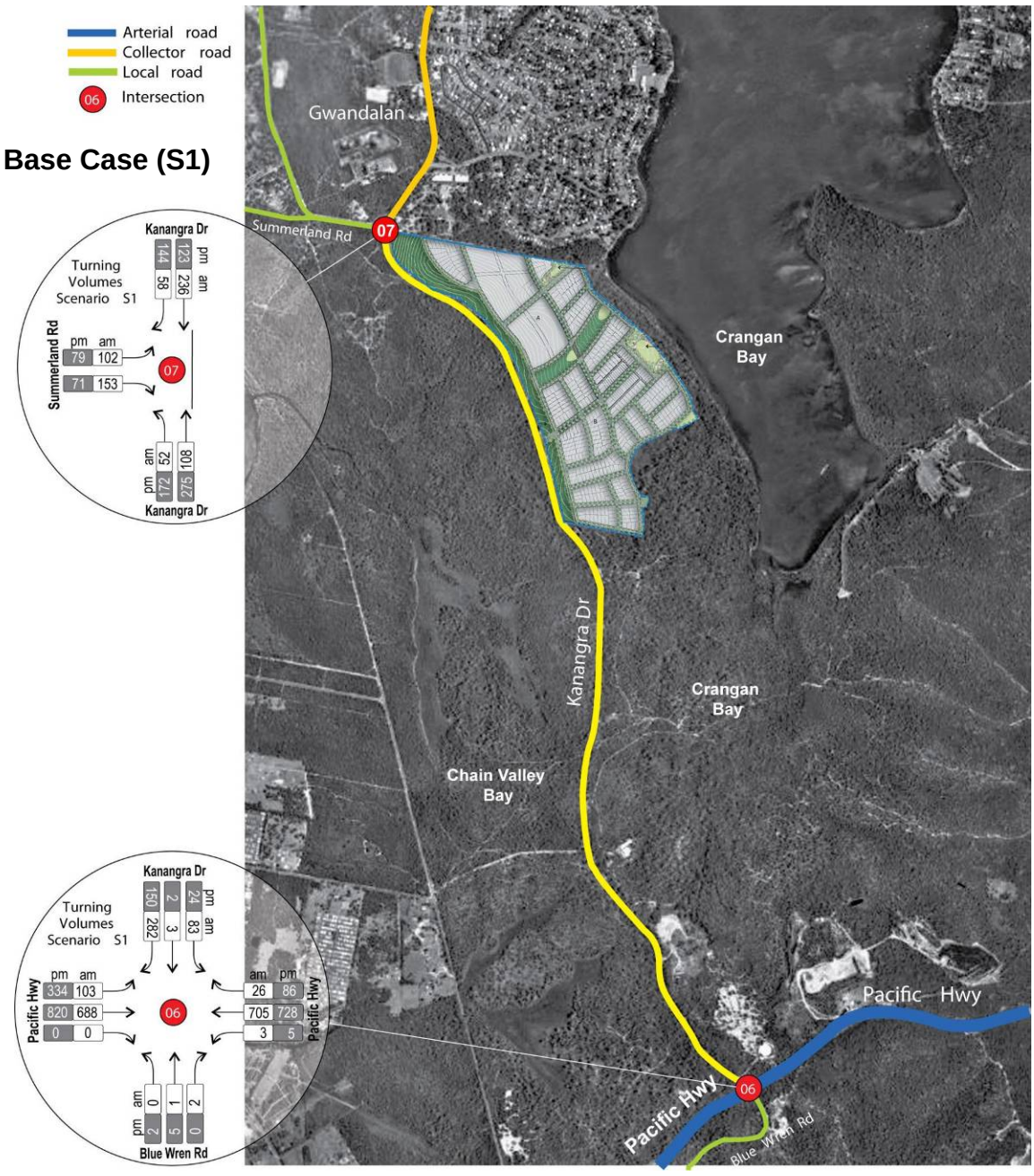


Figure 3-1 Forecasts of intersection turning volumes with Base Case S1

Table 3-4 Intersection performance with Gwandalan full development (Development Case S2)

ID	Intersection Name	Control	DoS	LoS	Queue (veh)	Critical Movements
	Morning Peak					
	Pacific Hwy-Kanangra Dr	Signals	0.83	B	19	471 veh right turn from Kanangra Dr, DoS=0.82, LoS=C (38) veh right turn from Pacific Hwy to Kanangra Dr DoS=0.26; LoS=D
	Kanangra Dr-Summerland Rd-Access road 1	Roundabout	0.27	A	2	Intersection is operating at LoS A for all movements
	Kanangra Dr-Access road 2	Give way	0.24	A	1	Intersection is operating at LoS A for all movements
		Roundabout	0.32	A	3	Intersection is operating at LoS A
	Evening Peak					
	Pacific Hwy-Kanangra Dr	Signals	0.87	B	17	523 veh left turn from Pacific Hwy to Kanangra Dr DoS=0.87, LoS=B 133 veh right turn from Pacific Hwy to Kanangra Dr DoS=0.75; LoS=D
	Kanangra Dr-Summerland Rd-Access road 1	Roundabout	0.41	A	4	Intersection is operating at LoS A for all movements
	Kanangra Dr-Access road 2	Give way	0.26	A	1	Intersection is operating at LoS A for all movements
		Roundabout	0.44	A	5	Intersection is operating at LoS A for all movements

Development Case (S2)

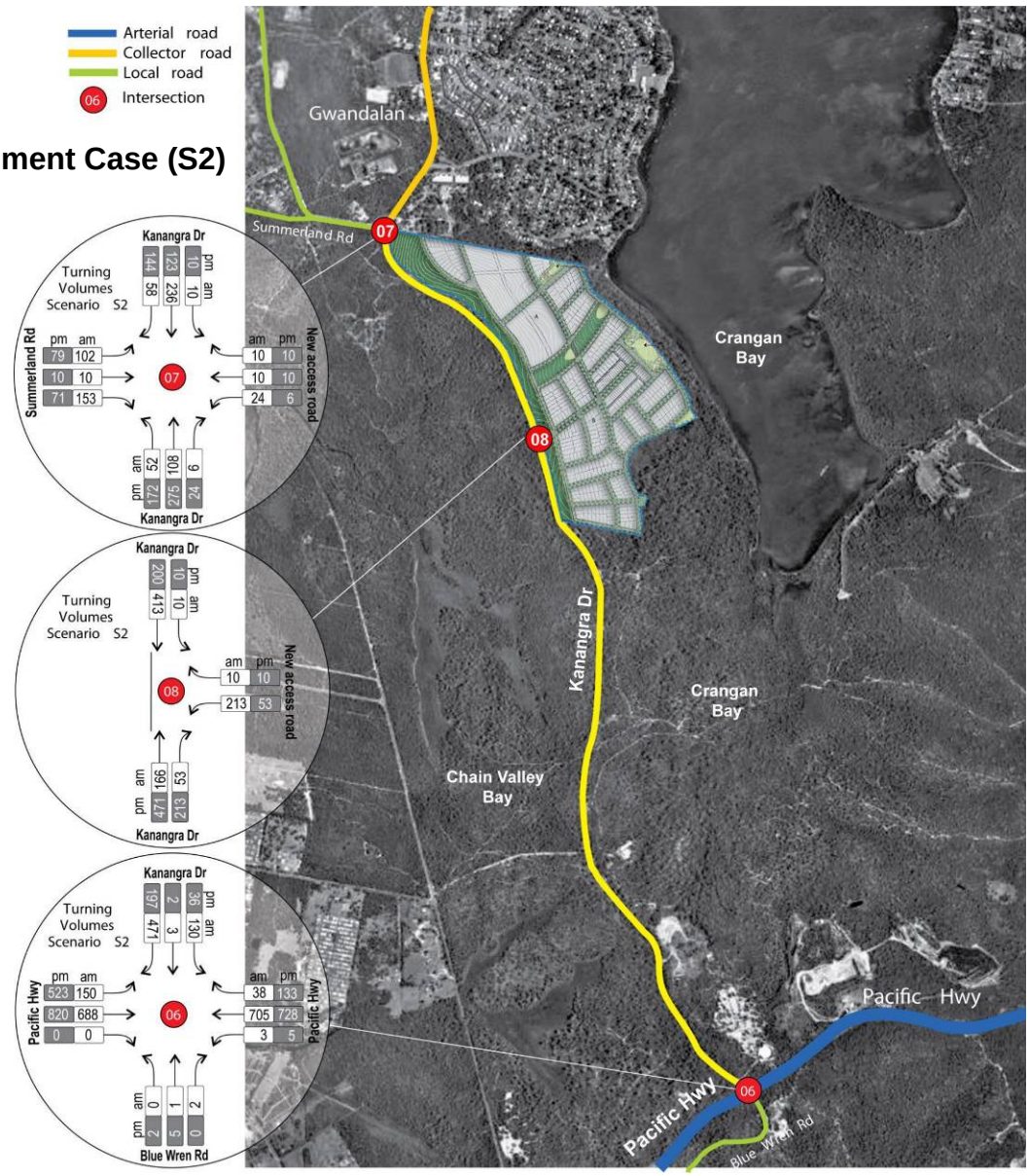


Figure 3-2 Forecasts of intersection turning volumes with Gwandalan development in 2018 (Development Case S2)

Note: Intersection **08** represents a new access from Gwandalan development

Table 3-5 Intersection performance with cumulative traffic impact (Cumulative Case S3)

ID	Intersection Name	Control Type	DOS	LOS	Queue (veh)	Critical Movements
	Morning Peak					
I-06	Pacific Hwy-Kanangra Dr	Signals	0.91	**C**	26	547 veh right turn from Kanangra Dr DoS=0.91; LoS=D 747 through veh from Pacific Hwy NB, DoS=0.92; LoS=D
	Evening Peak					
I-06 PM	Pacific Hwy-Kanangra Dr	Signals	0.98	**C**	30	596 veh left turn from Pacific Hwy to Kanangra Dr DoS=0.97, LoS=F 148 veh right turn from Pacific Hwy to Kanangra Dr DoS=0.98; LoS=F

Note: Intersection performance results from cumulative growth (cumulative case) on Awabakal Drive, Flowers Drive and Montefiore Street intersections with Pacific Highway are summarised in Coal & Allied's Nords Wharf and Middle Camp traffic reports prepared by Hyder.

Cumulative Case (S3)

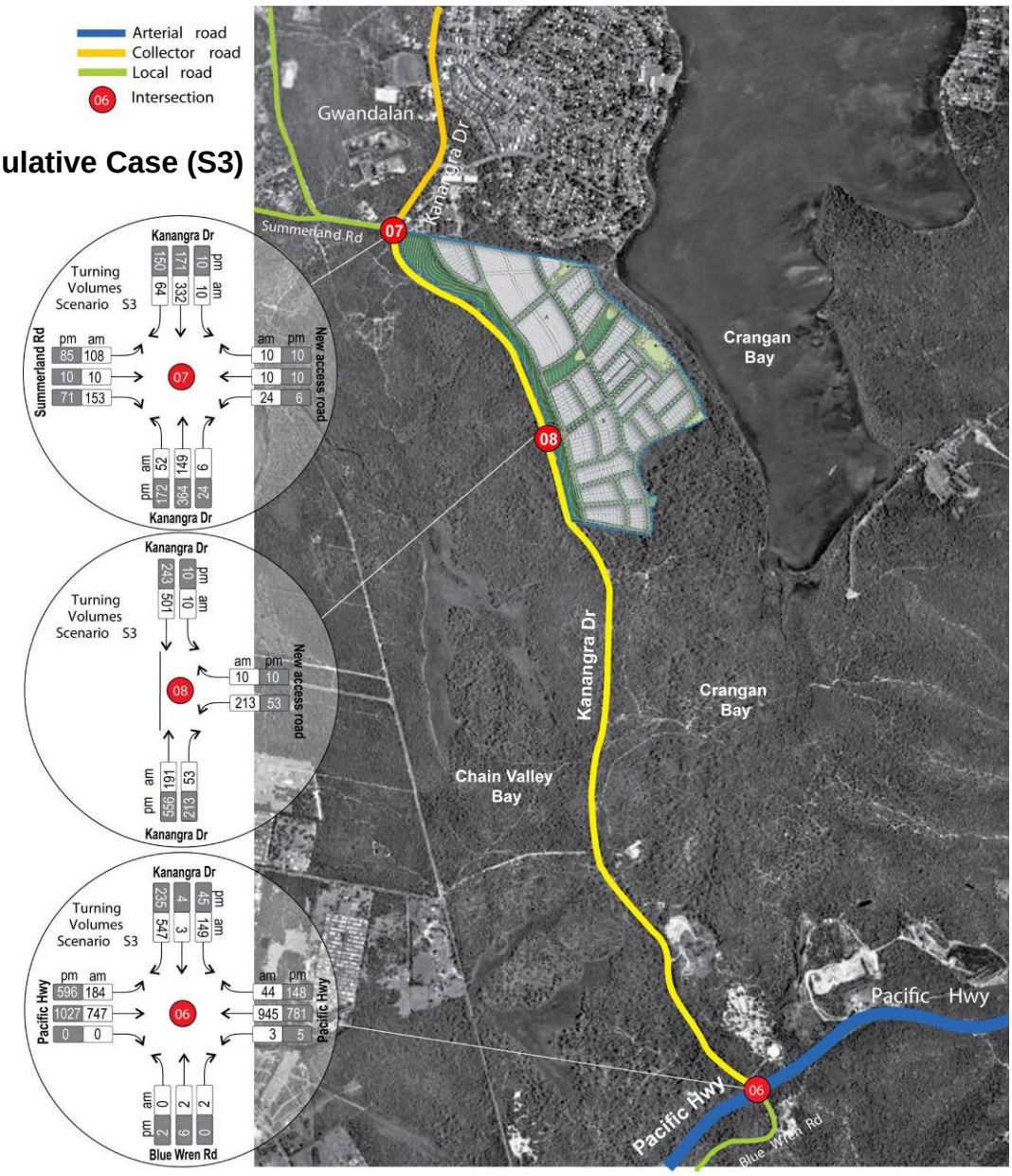


Figure 3-3 Forecasts of intersection turning volumes with cumulative traffic impact (Cumulative Case S3)

Note: Intersection **08** represents a new access from Gwandalan development.

Key findings from Table 3-3 to Table 3-5 are as follows:

- At present, the Pacific Highway/Kanangra Drive signals show LoS B with DoS between 0.58 and 0.66 for the AM and PM peaks. The Kanangra Drive/Summerland Road roundabout shows LoS A with DoS between 0.26 and 0.38. Modelling results imply that key intersections providing access to Gwandalan do not show any significant capacity issues. The data suggests sufficient spare capacity to accommodate the future development;
- Under Base Case S1, the model predicts LoS B and DoS between 0.68 and 0.79 for the AM and PM peaks at the Pacific Highway/ Kanangra Drive intersection. Comparing data with the existing condition (DoS between 0.58 and 0.66) it appears there is only a minor impact on the signals performance attributable to background growth on the Pacific Highway;

- Coal & Allied development at Gwandalan will increase the impact on both the Pacific Highway/Kanangra Drive signals, and Kanangra Drive/Summerland Road roundabout. The traffic model suggests LoS B with DoS between 0.83 and 0.87 at signals. The predicted LoS from additional trips is unlikely to be affected during the AM and PM peaks. But DoS for key movements is increased as a result of the additional Coal & Allied traffic;
- The impact from the cumulative traffic (Coal & Allied and potential Rose Group zoned site) at the Pacific Highway/Kanangra Drive signals was the highest. The model suggests a DoS of between 0.92 and 0.98 which is close to capacity. This confirmed some form of upgrading works at the signals is required to reduce impact.

3.5 Testing of upgrading works

In considering development at Gwandalan and cumulative traffic impact, the LoS was tested for the Pacific Highway/Kanangra Drive intersection for a post upgrade condition. Figure 3-4 shows the conceptual intersection improvements at Pacific Highway/Kanangra Drive intersection including:

- One left turn slip lane (100m) turning north from Pacific Highway to Kanangra Drive
- One left turn slip lane (50m) turning north from Kanangra Drive to Pacific Highway
- Additional right turn storage lane (100m) for southbound traffic from Kanangra Drive to Pacific Highway

Figure 3-4 Conceptual improvements at Kanangra Drive/Pacific Highway intersection

Table 3-6 shows the intersection performance with the above upgrading works. As expected, the Pacific Highway intersection is likely to operate with a good LoS. The critical DoS with cumulative traffic are forecast between 0.57 and 0.65 within an acceptable threshold.

Table 3-6 Intersection performance for cumulative condition (weekday traffic) with proposed improvements

		AM peak			PM peak		
Ints ID	**Intersection Name**	**DOS**	**LOS**	**Queue (veh)**	**DOS**	**LOS**	**Queue (veh)**
	Pacific Hwy-Kanangra Dr	0.57	**B**	17	0.65	**B**	21

For a worst case scenario, the above upgrading works were tested considering increased traffic on the Pacific Highway during the holiday period. We ran the SIDRA model with a 10 percent traffic increase. Table 3-7 shows the intersection performance with seasonal factors. The results indicate that the Pacific Highway intersection will operate at a good LoS during the critical holiday period.

Table 3-7 Intersection performance for cumulative condition (with the seasonal factor)

		AM peak			PM peak		
Ints ID	**Intersection Name**	**DOS**	**LOS**	**Queue (veh)**	**DOS**	**LOS**	**Queue (veh)**
	Pacific Hwy-Kanangra Dr	0.58	**B**	18	0.70	**B**	24

The development will be carried out in accordance with the Environmental Assessment Report (EAR) prepared by Urbis and associated plans and supporting reports. Works in kind (WIK) relating to the upgrading of the intersection of Pacific Highway / Kanangra Drive will be concurrent with subdivision works to be completed prior to registration of the first stage subdivision.

3.6 Future traffic volumes under concept plan

Traffic forecasts on key access points and internal roads within the subdivision were summarised. Table 3-8 presents forecast traffic at Gwandalan. Traffic was forecast for both peak and daily conditions. Figure 3-5 shows the locations where traffic forecasts were prepared. In general, the Coal & Allied development will increase peak traffic between 40 and 300 vehicles per hour depending on location. In terms of daily traffic, the increase could be between 300 and 2600 vehicles per day lower than RTA's recommended environmental capacity guidelines for local and collector roads.

Figure 3-5 Area of influence of Coal & Allied Gwandalan concept plan showing traffic forecast locations (indicative layout)

Table 3-8 Existing traffic and forecasts on key roads

Location	Road	Classification	Existing[1]			Existing plus development traffic -2018-			Change due to Gwandalan development traffic		
			AM	**PM**	**Daily**	**AM**	**PM**	**Daily**	**AM**	**PM**	**Daily**
	Pacific Hwy, south of Awabakal Dr	Arterial	1,120	1,250	14,500	1,430	1,590	18,220	310	340	3,720[2]
2	Kanangra Dr, west of Pacific Hwy	Collector	550	640	7,300	850	940	9,960	300	300	2,660
3	Kanangra Dr, south of Access Rd 1	Collector	550	640	7,300	580	670	7,570	30	30	270
5	Access Rd , east of Kanangra Rd	Proposed Collector	-	-	-	30	30	270	30	30	270
6	Access Rd , east of Kanangra Rd	Proposed Collector	-	-	-	270	270	2,390	270	270	2,390
7	Access Rd	Proposed Local	-	-	-	40	40	400	40	40	400
8	Access Rd	Proposed Local	-	-	-	40	40	400	40	40	400
9	Access Rd	Proposed Local	-	-	-	30	30	300	30	30	300
11	Access Rd	Proposed Collector	-	-	-	80	80	800	80	80	800
12	Access Rd	Proposed Collector	-	-	-	50	50	500	50	50	500
13	Access Rd	Proposed Local	-	-	-	30	30	300	30	30	300
14	Access Rd	Proposed Local	-	-	-	30	30	300	30	30	300

Note: (1) The existing traffic data shown in Table 3-8 were based on weekday (Friday) traffic. Existing traffic data is as per 2007 counts. (2) The Pacific Highway forecast included development traffic plus background traffic which was grown by 2% per annum up to 2018.

3.7 Non-car modes strategy

Public transport in the Gwandalan area is limited. The operator of the bus service in Gwandalan is Busways Wyong. The subject site is serviced directly by Busways Route 99 which runs from Lakehaven Shopping Centre and Swansea. It calls at Gwandalan, Nords Wharf and Catherine Hill Bay. Route 99 travels along Kanangra Drive and provides the public transport access opportunity to the subject site. The operator of Busways was contacted regarding upgrades to the service. Busways advised that bus services were continually under review and that more frequent services would be considered as additional residential development occurs in, Gwandalan, Middle Camp, Catherine Hill Bay and Nords Wharf. Table 3-9 summarises broader assessment of the proposal against the objectives of the Integrating Land Use and Transport policy (ILUT) package.

Table 3-9 ILUT objectives and compliance

ID	ILUT objectives	Compliance
1	Improving access to housing, jobs and services by walking, cycling and public transport	A pedestrian and cycleway network will be provided to facilitate the movement of pedestrians and cyclist through the development area. Within the development proposal, the street network will be designed to provide safe walking routes and bicycle routes that link the site with the existing services and facilities in Gwandalan and Summerland Point areas which contain schools, entertainment and recreational areas. Due to low volume of traffic on local roads, it is expected that cyclist demand could be catered for on –road. The shared use paths provide an incentive for residents to choose cycling as their transport mode, for work or other purposes such as school or recreation. Through the NSW Government's Bike Plan, the Government will work in partnership with local Councils communities and business to encourage bike riding growth and safer cycling in New South Wales.
2	Increasing the choice of available transport and reducing dependence on cars;	The concept plan for Gwandalan proposal will create an environment that is friendly to pedestrians, cyclists and public transport users, including elderly people and people with disabilities. A pedestrian network will be installed to provide for movements of pedestrians throughout the development area. The new roads within the development will be designed to provide safe walking and bicycle routes that link with foreshore, its park and other existing services and facilities in Gwandalan and Summerland Point areas Due to low volume of traffic on local roads, it is expected that cyclist demand could be catered for on –road.
3	Reducing travel demand including the number of trips generated by development and	Pedestrian and cycle way routes within the development will connect with existing facilities provided along Kanangra Drive including existing

ID	ILUT objectives	Compliance
	the distances travelled, especially by car	public transport services.
4	Supporting the efficient and viable operation of public transport services	The existing bus service (Route 99) runs along the Kanangra Drive between the Pacific Highway and the existing developments at Summerland Point and Gwandalan. Discussion should be held with the bus operator to determine a likely bus route through the development. Subject to a new route through the development, new bus stops would serve the majority of residential development within a 400 metres walk.
5	Providing for the efficient movement of freight	Not applicable for Gwandalan site.

4 Summary of findings

This report was prepared to examine the impacts on road network from 623 dwellings of Coal & Allied development in Gwandalan. This study presents the findings of the assessment of the traffic implications of the proposed Gwandalan development.

Key findings from our investigation are as follows:

- Access to the Gwandalan area is generally available via Kanangra Drive which provides a direct connection to the Pacific Highway to the north and south. A secondary access (unregistered road) is available via a gravel fire trail known as Link Road and Chain Valley Bay Road. The Kanangra Drive/Pacific Highway intersection is signalised.
- 2006 Journey to Work data indicates that journeys to and from work for Gwandalan travel zone residents is predominantly by private car (95%) with Lake Macquarie, Wyong and Newcastle LGAs the principal destinations. Travel by public transport amounted to a further 3% of trips, while other modes such as walking or cycling constituted the remaining 2% of trips.
- Between 2004 and 20010, about 169 crashes were recorded in the study area network. Of that 146 crashes occurred on Pacific Highway and 23 crashes on the Kanangra Drive. The proposed development is unlikely to have significant impact on the number or severity of crashes.
- Recent traffic survey data indicates Kanangra Drive carried about 7,100 to 7,500 vehicles per day. The data suggests Kanangra Drive currently has no major capacity constraints including the Kanangra Drive traffic signals at Pacific Highway.
- The proposed Gwandalan development will generate in the order of 394 peak hour two way trips. The additional traffic generated by the Gwandalan development in conjunction with cumulative growth from other proposed development will impact the performance of Pacific Highway and Kanangra Drive signals.
- The impact from the cumulative traffic at the Pacific Highway/Kanangra Drive signals was the highest. The model suggests a degree of saturation (DoS) of between 0.92 and 0.98, which is close to capacity level.
- The traffic modelling results indicate that some form of improvement at Kanangra Drive /Pacific Highway intersection is required from purely a traffic capacity perspective. Figure 3-4 showed conceptual improvements tested at this intersection. Model results suggest that the changes will improve the level of service (LoS) to B and DoS to between 0.24 -0.44.
- A new roundabout is proposed at the intersection of Kanangra Drive and the Gwandalan access road serving the development.
- Cumulative impacts are likely to arise from the interaction of the construction and operation of the Coal & Allied site at Gwandalan with other development proposals planned for the Coal & Allied site at Catherine Hill Bay, Coal & Allied site at Nords Wharf and potential development of the Rose Group zoned sites at both Catherine Hill Bay and Gwandalan. The combination of these developments would result in impacts on key intersections with the Pacific Highway. The three intersections below would have a significant cumulative impact and would require improvements to operate at a reasonable level of service. They are:
    - Pacific Highway/Flowers Drive;

- Pacific Highway/Awabakal Drive; and
- Pacific Highway/ Kanangra Drive.

- Considering the cumulative impact from both Coal & Allied and Rose Group developments, the traffic analysis suggests that the Pacific Highway/Kanangra Drive intersection will have capacity problems. The following upgrading works would improve signal capacity:
    - One left turn slip lane (100m) turning north from Pacific Highway to Kanangra Drive
    - One left turn slip lane (50m) turning north from Kanangra Drive to Pacific Highway
    - Additional right turn storage lane (100m) for southbound traffic from Kanangra Drive to Pacific Highway
- The above mentioned upgrading measures are considered satisfactory to accommodate the cumulative impacts of the proposed developments. The traffic model also suggests only minor impacts on LoS at the Kanangra Drive/Summerland Road intersection as a result of cumulative impacts.

4.1 Director General's Requirements

Table 4-1 Director General's Requirements

DG Requirement	Relevant Report Chapter(s)
(1) Prepare a Traffic Study in accordance with RTA's *Guide Traffic Generating Developments* that includes (but is not limited to) the following:	
a) An identification of all relevant vehicular traffic routes and intersection for access to/from the area;	Chap.2.1 Chap 3.2
b) Current traffic counts for all of the above traffic routes and intersections;	Chap.2.8
c) The anticipated vehicular traffic generated from the proposed development and associated trip distribution on the road network;	Chap.3. Chap 3.3
d) Consideration of the traffic impact on the existing and proposed intersections and the capacity of the local and classified road network to safely and efficiently cater for the additional vehicular traffic generated;	Chap.3.4 Chap 3.5 Chap 3.6
e) An analysis of the cumulative traffic and transport impacts of the development taking into consideration other proposed developments;	Chap.3.4
f) Details of necessary road network infrastructure upgrades required to maintain existing levels of service both on the local and classified road network;	Chap.3.5
g) An intersection analysis, using SIDRA or similar traffic model, as well as a micro simulation model to determine the need for intersection and mid block capacity upgrades and to ensure traffic signal coordination;	Chap.3.5

h) Proposed pedestrian and cycleway access within and to the site that connects to all relevant transport services, nearby settlements, and other key off-site locations having regard to the *NSW Planning Guidelines for Walking and Cycling* (2004), and the *NSW Bike Plan* (2010);	Chap.3.7
i) Timing of delivery of proposed transport infrastructure including road and intersection upgrades, pedestrian and cycle paths, and public transport infrastructure; and	Chap. 3.5
j) Consideration of impacts on existing property access.	Chap.3.2
(2) Assess the proposal against the objectives of the Integrating Land Use and Transport policy package.	Chap.3.7