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13. Transport and Roads

13.1 Introduction

The predominant transport infrastructure within the study area is roads. **Figure 13-1** shows the regional road network in the vicinity of Hinze Dam. The project area is situated approximately 7 kilometres from Pacific Highway, the main north-south connection. Main roads link Pacific Highway to Mudgeeraba and Springbrook at South and Clagiraba and Canunga at West and then further to Mount Tambourine. These roads provide access to the recreational facilities situated in the proximity of Advancetown Lakes and the natural parks and forests situated south of the lake.

13.2 Road Infrastructure

13.2.1 State-Controlled Roads

The principal State Controlled roads (Department of Main Roads) within the study area are detailed in **Table 13-1**

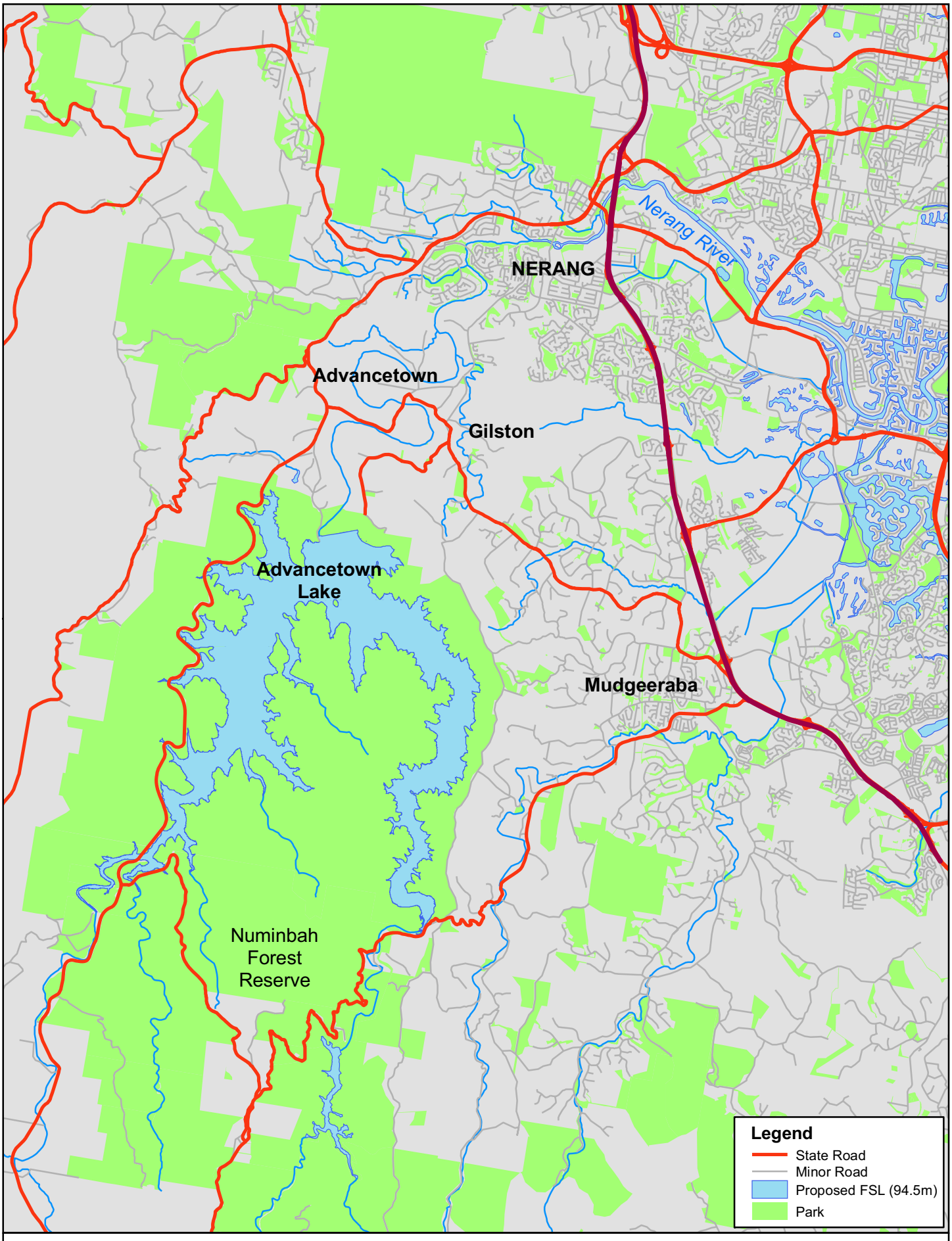
Table 13-1 State Controlled Roads and Multi-Combination Vehicle Permit

Road	Name	Category	Permitted Maximum Size of Vehicle
12A	Pacific Highway	National Highway (Auslink road)	23m and 25m B-doubles only
104	Gold Coast-Springbrook Road	District road (LRRS)[1]	B-doubles <19m
201	Nerang - Murwillumbah Road	District road (LRRS)	B-doubles <19m
202	Beaudesert – Nerang Road	District road (LRRS-partial)	B-doubles <19m
2017	Hinze Dam Road	District road (LRRS)	B-doubles <19m
2020	Beechmont Road	District road (LRRS)	B-doubles <19m
2041	Advancetown – Mudgeeraba Road	District road (LRRS)	B-doubles <19m

[1]Local Road of Regional Significance

The State Controlled roads detailed in **Table 13-1** are described below:

- Pacific Highway (12A)
  - connects Brisbane to the Gold Coast and further south to New South Wales. The Pacific Highway is situated approximately 7km east of Hinze Dam and will not be affected by the proposed works or impoundment area; and
  - this road is generally a four to six lane motorway with 110km/h speed limit forming part of the Auslink road network having national significance.
- Advancetown-Mudgeeraba Road (*Worongary Rd, Gilston Road, Hinde Road and Latimers Crossing Road*) (2041)
  - connects the Pacific Highway to Nerang and the Mudgeeraba township to Gilston and Advancetown; and
  - generally a two lane rural arterial 60 to 80km/h speed limited through rolling terrain. This road also serves as an east west connection between Gilston Road and Nerang-Murwillumbah Rd providing direct access to a number of residential properties. This road will not be affected by the proposed works or impoundment area.



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Projection: MGA Zone 56

Figure 13-1

Regional Road Network

Hinze Dam Stage 3 EIS

- Nerang-Murwillumbah Road (201)
  - the Nerang-Murwillumbah Road is a generally North-South road linking Nerang to the north of the dam to Murwillumbah in New South Wales along a route west of the current impoundment;
  - the majority of the current alignment of this road? exists following construction of Stage 1 of the dam which flooded the original route. The generally two lane alignment has an operating speed of approximately 80 km/h with speed limiting horizontal curves and follows rolling to mountainous terrain. The alignment follows the bank of Advancetown Lake crossing a series of watercourses that drain into the lake. The crossings of these watercourses consist of rock embankments incorporating metal arch and concrete pipe and box culverts at the base to pass flows from upstream catchments into the Lake. Currently, the road is built exceeding the Stage 2 Q100 (RL89.6m) and PMF levels. It is evident that the design of the existing road anticipated Stage 3 (proposed stage) augmentation of the dam; and
  - during Stage 2 augmentation of the dam the road was again relocated with a new crossing over the Nerang River as it currently exists.

- Gold Coast – Springbrook Road (104)
  - connects Mudgeeraba to Springbrook and runs south of Advancetown Lake connecting with Nerang-Murwillumbah Road; and
  - Gold Coast-Springbrook Road is a two lane 60-80km/h road through mountainous terrain. Within the study area, the road crosses a number of watercourses just east of Nerang-Murwillumbah Road by concrete pipe or box culverts. The road heads south through the Numinbah Forest Reserve to Little Nerang Creek. The road crosses Little Nerang Creek on a bridge then after a short rise falls down to a low level causeway before heading back up the range. This section of road provides direct access to a number of dwellings.

- Hinze Dam Road (Gilston Road) (2017)
  - connects to the dam from Advancetown-Mudgeeraba Road; and
  - this road is generally a 60km/h posted speed through winding and rolling to mountainous terrain limiting the operating speed. The road provides a second access to the dam and direct access to a number of dwellings along its length. This road will not be affected by the proposed dam impoundment.

- Beaudesert-Nerang Road (202)
  - alternate access from the Pacific Motorway and north Nerang to Nerang-Murwillumbah Road for connection to the western access to the dam; and
  - this road is generally 80km/h posted speed with sound geometry through flat to rolling terrain. This road will not be affected by the proposed dam impoundment.

Figure 13-2 shows the State Controlled road network within the area of this study.

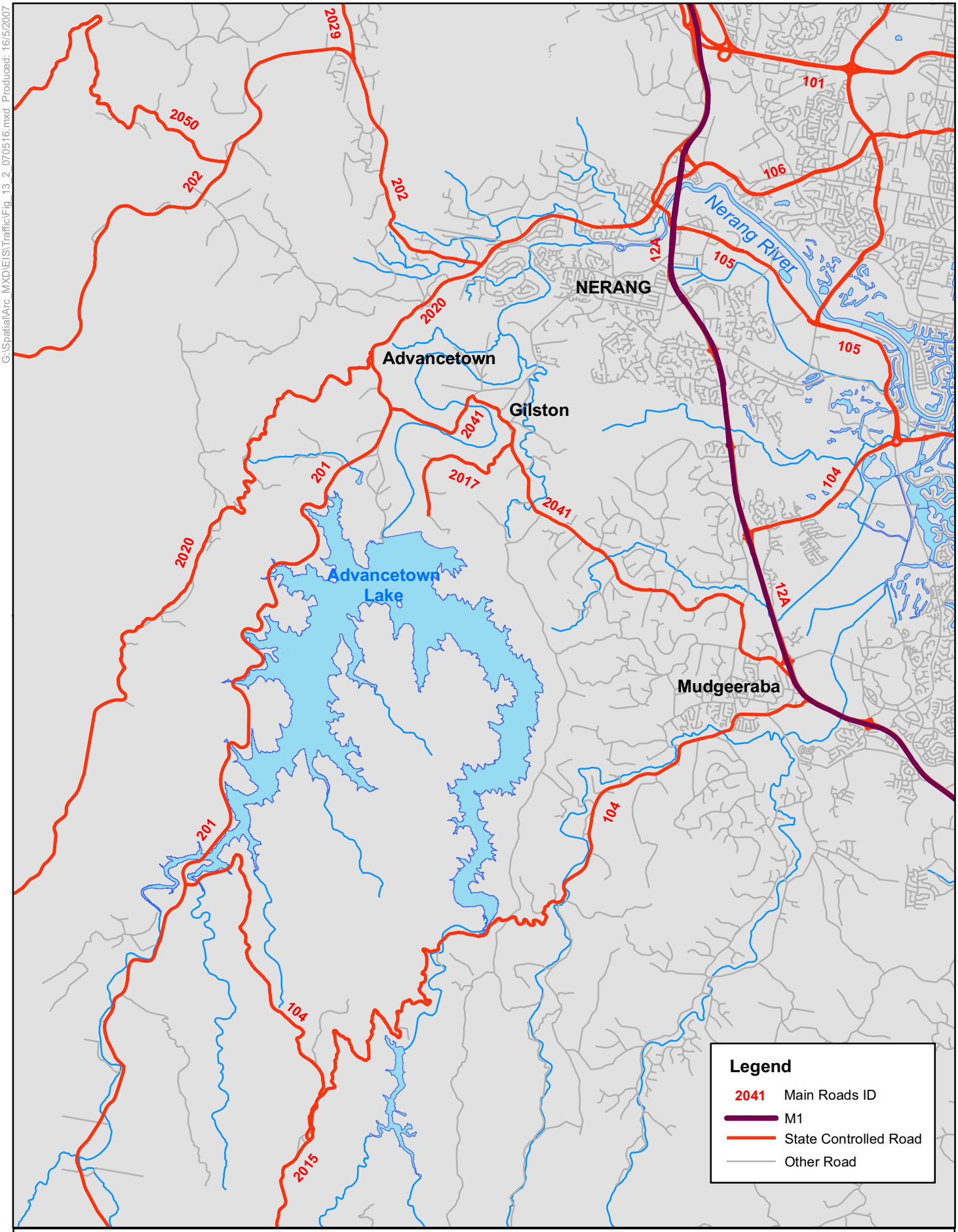

Figure 13-2

State Controlled Road Network

Hinze Dam Stage 3 EIS

13.2.2 Local Roads

The roads controlled by Gold Coast City Council and are either located within the study area and/or potentially impacted by the project are:

- **Alexander Drive** – Connects Pacific Highway to the Nerang residential area. The road is two-lanes, each way with a speed limit of 60km/h and shoulders each side. The road will not be affected by the project works;
- **Gilston Road** – A 60km/h two lane urban/semi-rural distributor servicing residential communities along its length as a primary access to Nerang. The road also connects Nerang to the Hinze Dam's eastern access via Hinze Dam Road and then further to connect with Advancetown-Mudgeeraba Road (*Worongary Road*) serving the Mudgeeraba township. Gilston Road is also used to provide access to the recreation areas located on the eastern side of the dam wall. This road will not be affected by the proposed dam impoundment; and
- **Advancetown Road** – a 40 to 60km/h two lane local access road providing access to a small number residential properties and the western access to the dam wall, spillway, intake tower and recreation areas located below the dam wall.

Figure 13-1 shows the regional road network within the study area.

13.3 Existing Traffic

13.3.1 Existing Traffic Volumes

The Average Annual Daily Traffic volumes (AADT) (as vehicle trips per day –vpd) and the percentage of commercial (heavy) vehicles for year 2006 on the key roads (source: DMR 2006) are provided in **Table 13-2**. A map containing the 2006 AADTs and the percentage of commercial (heavy) vehicles is shown in **Figure 13-3**.

- **Table 13-2 Actual Traffic Volumes**

Road	Year of Survey	Site	AADT (veh/day)	Commercial (Heavy) Vehicles (%)
Pacific Highway (12A)	2006	Smith Street Motorway to Southport – Nerang Road	96 332	N/A
		Southport – Nerang Road to Gooding Drive	75 384	10.0
Gold Coast-Springbrook Road (104)	2006	680m East of Nerang- Murwillumbah Road	550	3.5
		400m South of Little Nerang Creek	810	4.1
		100m East of Hinterland Drive	12 521	3.8
Nerang Connection Road (117)	2006	Between Paling Cr. and Evers St.	13 562	7.8
	2006	10m West of Nerang River bridge	19 387	5.4
Nerang - Murwillumbah Road (201)	2006	2km North of Gold Coast – Springbrook Road	1 240	8.4
Beaudesert – Nerang Road (202)	2006	Between McLaren Drive. and Crane Court.	11 748	6.4
		50m North of Tibbling Street.	22 884	4.5
Hinze Dam Road (2017)	2006	150 m North of Duncan Road	630	1.6
Beechmont Road (2020)	2006	2km South of Nerang – Murwillumbah Road	1 964	2.8
Advancetown – Mudgeeraba Road (2041)	2006	200m North of Tallai Road	13 573	4.7
		Between Panorama St. and Vince Hinde Drive	4 871	6.5
		380m east of Nerang – Murwillumbah Road *(Latimers Crossing Road)*	1 050	4.7

Source: DMR 2006

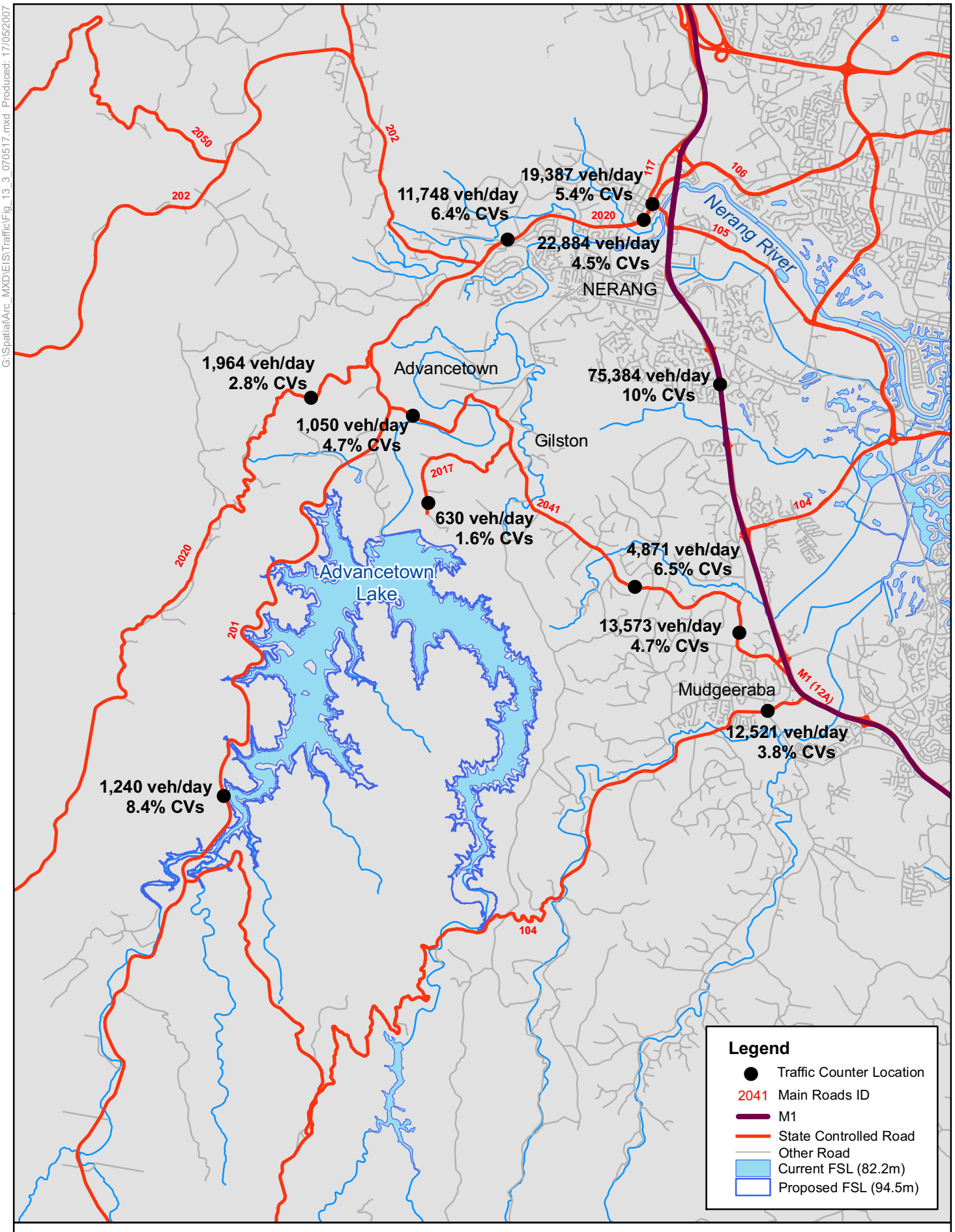

Figure 13-3

Traffic Count Sites

Hinze Dam Stage 3 EIS

13.3.2 Future Traffic Growth

QDMR has advised that an average annual growth rate of 3% should be used in the forecasting of future background traffic on roads throughout the area. This growth rate was applied accordingly as a compound growth to the surveyed traffic volumes for the impact analysis.

13.3.3 Existing Bus Services

No school bus route passes through the project area. There are, however, six bus routes that intersect the construction traffic routes at some points. These bus routes service the six schools in the area (Nerang High School, Nerang primary School, William Duncan primary School, Worongary Primary School, St. Brigids Catholic Primary School and Gibson Primary School). These bus routes are detailed in **Table 13-3**.

Table 13-3 Existing Bus Services

Route Number	Description	AM/PM
3202	**Numinbah and Advancetown** Natural Arch-Nerang – Murwillumbah Road – Latimers Crossing Road – Gilston Road – McLarens Road _ Nerang High School (School Bus Zone)	AM
3212	**Clearwater – Nerang** Clearwater –Nearng – Beaudesert – Nerang Road Yarrimbah – Nerang State High School (School Bus Zone)	AM
3224	**Canunga – Clagiraba** Canunga – Clagiraba – Beaudesert – Nerang Road - Nerang State High School (School Bus Zone)	AM
971	**Canunga - Clagiraba** Nerang State High School (School Bus Zone) – Clagiraba - Canunga	PM
3208 and 3217	**Nerang – Clearwater** Nerang High (school bus zone) Weedens Birribi – Nerang -Beaudesert Road – Clearwater - Nerang	PM

Source: Surfside Buslines

13.4 Construction Phase

13.4.1 Construction Workforce

Day time employment on the site will vary depending on the stage of construction. Initially approximately 150 persons will be on site during November 2007 which will increase constantly to a maximum of approximately 240 persons by April 2008. Construction workforce on site will stabilise at approximately 240 persons until August 2009 and then progressively reduce to zero by the end of construction in November 2010.

Construction work will be undertaken mainly during daylight hours, between 6AM (starting time) and 6PM (ending time), causing one peak arrival flow to occur on local roads between 5AM and 6AM and one peak departure flow to occur between 5PM and 6PM.

In addition to the day shift an afternoon shift for workshop and maintenance will be run between the hours of 3pm – 1am with this involving a total of 10 workers (20 vehicle trips per day). The workshop traffic will only use Route 1 as the workshop will be located near Advancetown Road. These traffic volumes will occur during the off peak hours and they were only considered for the daily volumes calculation and are not included in the peak-hour traffic volumes (6-7AM and 5-6PM).

The majority of the workforce will be sourced from Brisbane and the Gold Coast area.

The estimated average vehicle occupancy is assumed at one person per vehicle (assuming that car pooling is unlikely to occur), resulting in a maximum of 500 vehicle trips (250 in and 250 out) per day. The Alliance will

provide a bus service to transport workers to the site (see **Section 13.4.2**) and therefore the vehicle trips are a conservative assumption for the purpose of this assessment. Formal parking areas will be provided at the construction site to accommodate workforce vehicles.

13.4.2 Site Access

Two options for transport to bring the construction workforce to the site, these are:

- Option 1 - Two buses carrying up to 40 workers each will run between the Nerang train station and the Hinze Dam site along the Nerang - Murwillumbah Road and Advancetown Road. The remaining workers will travel by their own means; and
- Option 2 - All workers will travel by their own means.

The selected routes for the dam access during the construction are:

- Route 1 - 70% of the workforce is expected to be coming from Brisbane and therefore will most likely travel off the Pacific Highway at Nerang to the Hinze Dam site via Nerang Murwillumbah and Advancetown roads; and
- Route 2 - the remaining 30% will travel off the Pacific Highway at Mudgeeraba to the Hinze Dam site via Alexander Drive and Gilston Road.

The vehicle access routes are shown in **Figure 13-4.**

13.4.3 Construction Peak Flows (Light Vehicles)

The peak-hour volumes for both options of transporting the construction workforce and the two access routes are depicted in **Table 13-4**.

- **Table 13-4 Peak Hour Flows due to Workforce Commuting**

Option	Vehicle Type	Peak Hour Flows (vph)			
		Route 1		Route 2	
		In (AM Peak)	Out (PM Peak)	In (AM Peak)	Out (PM Peak)
Option 1	Buses	2	2	-	-
	Light Vehicles	120	120	50	50
Option 2	Buses	-	-	-	-
	Light Vehicles	175	175	75	75

13.4.4 Construction Materials (Equipment and Materials)

General Construction Traffic Access

General construction traffic is assumed to include all traffic other than construction workforce traffic which arrives and departs the construction site using the surrounding road network external to the CID boundary.

Construction equipment will be transported by road to the site on standard or over-sized loads. Large items of construction equipment that cannot be transported as smaller components will be transported on State Controlled roads under permit and, where necessary, accompanied by safety escorts.

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Scale - 1:40,000

Projection: MGA Zone 56

Figure 13-4

Hinze Dam Site Access During Construction

Hinze Dam Stage 3 EIS

Deliveries to the construction site will be limited to items such as concrete, steel, fuel and construction equipment and supplies that are not able to be sourced from the site. The haul routes described in **Section 13.4.2** are expected to be used for the construction materials delivery.

Concrete

Deliveries of materials for the manufacture of concrete will include sand, fly-ash and cement. Cement and fly-ash have been assumed to travel on the same type of vehicle. The aggregate used will be sourced on-site and is therefore included in the discussion of quarry traffic.

The sand will be transported by semi-trailers with approximately 20 tones capacity and/or trucks and dogs with approximately 18t capacity. The fly-ash and cement will be transported using B-Doubles with approximately 25 tones capacity. The average daily traffic due to concrete is summarised for each month in **Appendix F.13.1**. A maximum number of five trucks/day will occur in May 2009 (four B-double and one semi-trailer).

Equipment

The delivery and removal of equipment will occur over the entire length of the project. The total traffic flows for construction equipment are estimated in **Table 13-5**.

Table 13-5 Total Traffic Flow due to Delivery and Removal of Equipment

Item	Quantity	Trips/Item	Trips	Oversized
80t trucks	5	2	10	Yes
50t trucks	5	1	5	No
35t articulated trucks	5	1	5	No
300t excavator	1	8	8	Yes
150t excavator	1	5	5	No
80t excavator	1	1	1	No
30t excavator	1	1	1	No
Scraper	4	1	4	Yes
12t crane	1	1	1	No
50t rough terrain crane	1	1	1	No
150 crawler crane	1	8	8	No
Barge crane (crane)	1	1	1	Yes
Barge crane (barge)	1	8	8	Yes
Scaffold			10	No
Formwork			10	No
Site offices	35	2	50	No
Miscellaneous	50	2	100	No
Total Trips Oversized				**31**
Total Trips Normal Size				**228**
Total Trips due to Delivery and Removal of Equipment (whole project period)				**259**

Heavy Vehicles and Oversized Vehicles Access

An estimated 31 oversize loads will be required to deliver indivisible construction equipment to the construction site. The origin of these loads is likely to be Brisbane. Standard permit approval processes and arrangements for these deliveries, such as escorting vehicles will apply on a case-by-case basis. The access routes for the heavy vehicles are shown in **Figure 13-4** .

Service Vehicles

Service vehicle movements to and from the site during the construction phase are most likely to include postal deliveries, canteen and office supplies and Gold Coast City Council waste removal trucks. Approximately four service vehicle movements per day (2 in and 2 out) are expected during this period.

Materials

Materials delivery is summarised in **Table 13-6**.

Table 13-6 Material Delivery Traffic Volumes

Material	Quantity	Vehicle Type	Trips (veh/day)	Period
Steel Reinforcement bar	9 200t	Semi-trailer	4	October 2007- July 2008
Steel Reinforcement bar	12 880t	Semi-trailer	2	October 2007 – October 2010
Fuel	20t/day	B-double	4	Throughout Construction Phase

A maximum of 10 heavy vehicles per day is likely to occur during the construction peak period (October 2007 to July 2008).

Quarry (Internal) Traffic

The quarry traffic includes the movement of material from the quarry and clay borrow area to be used in the construction of the new saddle dam, and the raising of the main embankment and existing saddle dam. Quarry traffic also includes the movement of waste material due to excavations and the clearing of unsuitable material. All the quarry traffic will be restricted to the construction site and therefore will not affect the surrounding road networks.

The daily quarry traffic is given in tonnes per day and loads per day in **Appendix F.13.1.** Loads per day are based on a 50t truck. A maximum of 9000 tonnes (equivalent of 182 loads) per day is reached during the March – May 2008 period.

13.4.5 Summary of Estimated Vehicle Trips for the Construction Phase

The total estimated number of vehicle trips to and from the site during the construction phase is summarised in **Table 13-7**. Daily traffic during the construction peak is estimated as vehicle trips per day (vpd).

Table 13-7 Estimated Vehicle Movements Generated During Project Construction

Generation Type	Daily Traffic Generation (vpd) (Peak Construction Period)			Total Heavy Vehicles, During Construction (construction equipment) (vehicles) (All periods)
	Light Vehicles (Option 2)	Buses (Option 1)	Heavy Vehicles	
Workforce	520	4	-	-
Visitors	6	-	-	-
Concrete materials (including ash, cement and sand)	-	-	10	-
Equipment	-	-	-	259
Service Vehicles	-	-	4	-
Materials	-	-	8	-
Total	**526**	**4**	**22**	**259**

13.4.6 Traffic Generation and Distribution

The traffic generation and distribution for the operational phase is depicted in **Table 13-8** (daily) and **Table 13-9** (peak hours).

Table 13-8 Distribution of Traffic Generated by the Development (Daily Trips)

Route		Trips (vpd)	
		Light Vehicles	Buses + Heavy Vehicles
1	Pacific Highway Interchange; Beaudesert - Nerang Road; Nerang – Murwillumbah Road; Advancetown Road (70% of the total traffic)	368	36
2	Pacific Highway Interchange - Alexander Drive/Gilston Road; Latimer Crossing Road; Advancetown Road (30% of the total traffic).	158	16

For the peak hour assessment purpose, the traffic has been distributed as follows:

1) The worse case scenario (all personnel will commute by light vehicles) has been considered;
2) for light vehicles - 100% for entry (AM Peak) and 100% for exit (PM Peak) of the daily volumes; and
3) the construction equipment movements - from a total of 259 trips generated over the whole construction period, it was assumed that 10% occur in any peak day and a very conservative proportion of 20% of the daily volumes has been assumed (10% inward and 10% outward for both AM and PM peak).

Table 13-9 Peak Hour Traffic Volumes due to Construction Phase

Route		Trips (vph)							
		Light Vehicles				Heavy Vehicles			
		AM		PM		AM		PM	
		In	Out	In	Out	In	Out	In	Out
1	Pacific Highway Interchange; Beaudesert - Nerang Road; Nerang – Murwillumbah Road; Advancetown Road	184	-	-	184	4	4	4	4
2	Pacific Highway Interchange - Alexander Drive/Gilston Road; Latimer Crossing Road; Advancetown Road	79	-	-	79	1	1	1	1

13.4.7 Construction Stage Traffic Impact Assessment

The performance criterion for road links is the Level of Service (LoS) as it is defined in Austroads *Guide to Traffic Engineering practice (GTEP) – Part 2 - Roadway Capacity*. In rural areas, LoS 'C' can be considered minimum standard, changes between the LoS ranking above LoS 'C' imply remedial measures to maintain the existing LoS would be required.

For the purpose of this project, the following assumptions have been made:

- AADTs levels for various LoS for level or rolling terrain, two-lane, two-way rural roads; and
- the ratio between the design hour volume and the annual average daily traffic (AADT) of 0.10.

The road link impact assessment includes the results of the assessment and a comparison between the background traffic (without the dam) and the construction phase of the dam. These are shown in **Table 13-10.**

- **Table 13-10 Road Link Impact Assessment**

Road	Section	Background Traffic (veh/day) (2006)			Construction Phase Traffic (veh/day) (2007)		
		AADT	Heavy Vehicles (%/ volume)	LoS	AADT	Heavy Vehicles (%/ volume)	LoS
Advancetown Road	Hinze Dam to Nerang – Murwillumbah Road	345[1]	2% (7)	**A**	917	4.7% (43)	**A**
Nerang - Murwillumbah Road (201)	Between Latimers Crossing and Beechmont Road	1995[1]	6.3% (125)	**B**	2450	6.3% (154)	**B**
	Between Beechmont Road and Beaudesert – Nerang Road	3744	5.3% (198)	**C**	4251	5.4% (229)	**C**
Beaudesert – Nerang Road (202)	Between Nerang – Murwillumbah Road and Price Road	11750	6.4% (752)	**D**	12497	6.4% (800)	**D**
Gilston Road	East of Alexander Drive./McLaren Road Intersection	5300[1]	4% (212)	**D**	5626	4.1% (229)	**D**
Latimers Crossing	Between Nerang – Murwillumbah Road and Hinde Road	1050	4.6% (48)	**A**	1249	4.8% (60)	**B**

[1] Estimated as 10 times the average AM/PM flows.

The construction phase of the project is not expected to have significant impact on traffic operations of any of the studied road links. The Level of Service (LoS) for the construction phase scenario is unchanged for each road section in comparison to the background traffic volumes. The traffic generated during the construction phase of the project will not significantly impact the capacity of the roads situated on the delivery routes.

Although for the calculation purposes we considered the worst case scenario, being all construction personnel travelling to/from the site by light vehicles, consideration should be given to the fact that the extra traffic on the generally rural roads may impact on the residents and communities around the roads on the proposed routes.

Potential impacts of the increased traffic volumes including the heavy vehicle component on the roads in the project area are as follows:

- potential conflicts between the construction traffic and the local traffic, including vehicles pedestrians and cyclists attending the recreational facilities in the area;
- potential safety issues for passengers on their way to and from school bus stops during haulage and construction equipment delivery; and
- noise, dust and vibration, issues addressed in **Sections 12 and 18** of the present EIS.

Mitigation

In order to minimise the potential impact of the increased traffic flows on the community and the operation of the road network, the following mitigation measures will be undertaken:

- use of the established truck routes and arterial roads for the haulage of construction materials and spoil in order to minimise truck traffic on local roads;
- avoid haulage tasks during peak traffic periods and during the school drop-off and pick-up times. Where haulage in peak hours in unavoidable, such activities should be managed in accordance with specific traffic management plans provided to the relevant agencies and Gold Coast City Council in advance; and

- control heavy vehicle movements to avoid interference with major events (e.g. competitions at Gold Coast Regatta Centre, Scout Association, Model Flying Club and Numinbah Flying Field and Numinbah Valley Environmental Education Centre);
- notify the local communities about proposed changes to local traffic access due to construction activities and provide clear signage of changed traffic conditions;
- adequate on-site parking will be provided accommodate the employees' vehicles and instruct the commuting employees to use the provided parking facilities in order to avoid traffic disruption due to road side parking;
- provision of buses for transportation of construction workforce. Two buses will be provided for each peak hour between the Nerang Railway Station and the project site;
- at all times maintain at least one lane open for traffic on roads near the construction site;
- maintain safe vehicular, pedestrian and cycling movements near the construction site and access to the recreational areas;
- notify the local communities about the changes in the traffic arrangements during the construction phase; and
- provide traffic control measures designed for the safe movement of vehicles, pedestrians and cyclists accessing the recreation facilities.

Intersections Impact Assessment

Three intersections that were considered most affected by the construction phase have been tested using the SIDRA Intersection V3.0 computer package for intersection analysis.

The key indicator for operational performance for unsignalised intersections is the volume/capacity ratio (measured as the Degree of Saturation -DoS) for entering movements. For priority junctions, the DoS level for any movement should not exceed 0.80 as per the DMR's *Guidelines for Assessment of Road Impacts of Developments (April 2006)* standard requirements.

The outputs from the 2006 'without the development' and 2007 'with the construction traffic in place' scenarios are summarised in **Table 13-11** and the summary sheets are in **Appendix F.13.2**.

Table 13-11 Intersection Performance Comparison

Intersection			Background Traffic (2006)			Construction Phase Traffic (2007)		
			Max DoS	Queue Length (m)	Average Delay (sec)	Max DoS	Queue Length (m)	Average Delay (sec)
Gilston Road/McLaren Road/Alexander Drive	Round-about	AM	0.421	23	8.3	0.421	23	8.3
		PM	0.528	32	9.0	0.546	34	9.3
Nerang –Murwillumbah Road/Latimers Crossing Road	Give Way	AM	0.081	3	4.6	0.306	16	4.4
		PM	0.078	3	4.4	0.292	15	4.0
Nerang –Murwillumbah Road/Advancetown Road	Give Way	AM	0.084	3	1.5	0.147	3	5.5
		PM	0.069	2.3	2.3	0.151	4	6.8

1. The Degree of Saturation (DoS) represents the ratio of demand to available capacity for the most critical movement at the intersection. A DoS of 0.90 represents a desirable maximum for acceptable operation of signalised intersection and roundabouts. For priority intersections a DoS above a.80 indicates that more formal control is warranted.
2. Maximum 95th percentile queue length for intersection.

The intersection analysis for 2006 and 2007 (with the construction traffic) for AM and PM peak hours indicates that all studied intersections operate within the acceptable Degree of Saturation (DoS) range and there is considerable spare capacity. No remedial works are therefore required in order to improve the intersections' performance are required.

13.4.8 Impacts on School Bus

School buses will not be directly affected by the project, except for a possible increase in travel time due to the construction equipment being delivered. Consultation with Queensland Transport indicates that the current contractual arrangements with the bus service provider (Surfside Buslines) will not have to change. In order to minimise this impact, the construction equipment conveyance and the haulage will be scheduled outside the school drop-off and pick-up times

13.4.9 Impacts on Road Pavement during Construction

Pavement impacts have been assessed along the proposed construction transport routes as identified in **Figure 13-4.** These routes are:

- Route 1: Commences at Exit 69 of the Pacific Highway and extends westwards along Beaudesert-Nerang Road and continues along Nerang-Murwillumbah Road and then southwards along Advancetown Road to the dam embankment; and
- Route 2: commences at Exit 73 of the Pacific Highway and extends westwards along Alexander Drive, Gilston Road, Hinde Road and Latimers Crossing which links up with Nerang-Murwillumbah Road. The route then extends southwards along Nerang-Murwillumbah Road and Advancetown Road to end at the dam embankment.

Routes 1 and 2 extend along the same northern section of Nerang-Murwillumbah Road and Advancetown Road as indicated in **Figure 13-4.**

Design Traffic

The estimated vehicle movements for the proposed transport of construction equipment and materials and the transport of construction personnel to and from the dam site during the dam construction phase are set out in **Section 13.4.1**. The distribution of traffic loads along both proposed construction transport roads is summarised in **Table 13-12** below.

Table 13-12 Construction Traffic Loading Along Haulage Routes

Road	20 Year Design Traffic (ESA)	Construction Traffic			
		Traffic Loading along Haulage Route (ESA)		Proportion of 20 Year Design Life	
		Westbound Lane	Eastbound Lane	Westbound Lane	Eastbound Lane
Nerang Connection Road (117)	16.6×10^6	2.8×10^4	3.2×10^3	0.2%	<0.1%
Beaudesert-Nerang Road (202)	12.1×10^6	2.8×10^4	3.2×10^3	0.2%	<0.1%
Nerang-Murwillumbah Road (201)	1.7×10^6	2.8×10^4 (north of Hinde Rd)	3.2×10^3	1.6%	<0.1%
		3.9×10^4 (south of Hinde Rd)	3.2×10^3	2.3%	<0.1%
Advancetown Road	$\pm 1 \times 10^6$	3.9×10^4	3.2×10^3	3.9%	<0.1%
Alexander Drive	10×10^6	1.1×10^4	-	0.1%	-
Gilston Road	5×10^6	1.1×10^4	-	0.2%	-
Hinde Road	8.0×10^5	1.1×10^4	-	1.4%	-
Latimers Crossing Road	8.0×10^5	1.1×10^4	-	1.4%	-

Mitigation

The existing road pavements consist of unbound granular base and sub-base layers with an asphalt or bituminous seal surfacing except for the short section of Beaudesert-Nerang Road and the Nerang Connection Road near the Pacific Motorway which have thick asphalt layers.

The transport of construction equipment and materials along the two designated haul routes from the Pacific Highway to the dam site is expected to result in the slight deterioration of the pavements with associated cracking of the asphalt surfacing and smoothening of the surfacing seal. The pavement distress is only expected to occur along the westbound traffic lanes carrying the heavy fully laden construction transport vehicles to the dam site. No significant distress of the pavements and surfacing layers is expected along the eastbound traffic lanes of both haulage routes which will carry the light unladen vehicles returning to Brisbane after depositing their loads at the dam site. Localised areas may require repair but these are expected to only be minor road surface repairs.

An assessment was carried out on the existing pavement condition and pavement maintenance and anticipated repairs that may be required during and after construction phase. The maintenance strategy for each of the impacted roads is presented in **Table 13-13.** This table also includes an assessment of the existing pavement.

Table 13-13 Pavement Assessment and Maintenance Synopsis

Road	Existing Pavement Structure	Existing Condition	Routine Pavement Maintenance During Haulage of Construction Materials	Road Pavement Rehabilitation at end of Construction Period
Nerang Connection Road (117)	Full Depth Asphalt Pavement	Variable condition with the initial section of road being in a very poor condition.	Full depth (240mm asphalt) patch of localised distressed areas	Repair localised distressed areas and mill and replace 45mm DG14 asphalt surfacing layer where required
Beaudesert-Nerang Road (202)	Western section comprises asphalt surfacing and 200mm to 300mm unbound granular layers. Eastern section from Oak Street to Lavelle Street consists of full depth asphalt pavement (240mm) over 250mm granular layers	Section from Oak Street to Lavelle Street is in a good condition. The next section from Oak Street to Yalkuri Drive is in a very poor condition with extensive cracking of the asphalt surfacing. The western section of road is in a good condition.	Patch localised distressed surfacing layer (45mm asphalt)	Repair localised distressed areas and mill and replace 45mm DG14 asphalt surfacing layer where required
Nerang-Murwillumbah Road (201)	Surfacing seal and 200mm unbound granular layers.	The surfacing seal is in a good condition. Main Roads is presently repairing and resealing the section of road to the south of Latimers Crossing.	Patch localised failures of surfacing seal	Mill off existing surface seal and replace with double seal surfacing (polymer modified binder and 14mm/7mm aggregate) where required
Advancetown Road	Unbound granular pavement with surfacing seal.	The road is in a fair condition with some patched areas and a bumpy road surface.	Patch localised failures of surfacing seal	Mill off existing surface seal and replace with a double seal surfacing (polymer modified binder and 14mm/7mm aggregate) where required
Alexander Drive	Unbound granular pavement with asphalt surfacing.	The road is in a very good condition with localised cracking requiring patching.	Patch localised distressed surfacing layer (45mm asphalt)	Repair localised distressed areas and mill and replace 45mm DG14 asphalt surfacing layer where required
Gilston Road	Unbound granular pavement with asphalt surfacing.	The road is in a good condition.	Patch localised distressed surfacing layer (45mm asphalt)	Repair localised distressed areas and mill and replace 45mm DG14 asphalt surfacing layer where required

Road	Existing Pavement Structure	Existing Condition	Routine Pavement Maintenance During Haulage of Construction Materials	Road Pavement Rehabilitation at end of Construction Period
Hinde Road	Surfacing seal and thin unbound granular layer.	The road is very bumpy and is in fair condition.	Patch localised failures of surfacing seal	Mill off existing surface seal and replace with a double seal surfacing where required
Latimers Crossing Road	Surfacing seal and thin unbound granular layers.	The road is in a poor condition with a very bumpy surface and cracking and patching of the surface seal.	Patch localised failures of surfacing seal	Mill off existing surface seal and replace with a double seal surfacing where required

To take into account seasonal considerations, in particular wet weather, consideration will be given to control truck movements to limit pavement impact. Deliveries of oversize and overmass loads will be assessed with Main Roads and limitations imposed due to flooded or waterlogged roads will be adhered to where appropriate.

Summary

Construction traffic is expected to have an effect on the pavement condition over the duration of the construction period.

A maintenance strategy will be developed in collaboration and agreement with Main Roads to address any accelerated pavement deterioration as a result of the construction transport traffic.

The condition of the pavement will be monitored continuously throughout the duration of the construction phase of the project with any routine maintenance issues addressed as required. The Alliance will continue to consult with the Department of Main Roads to establish maintenance requirements to address project impacts.

13.5 Operational Stage

13.5.1 Traffic Impacts

It is proposed that the current use of Hinze Dam will not change upon completion of Hinze Dam Stage 3. As such, traffic flows in the neighbouring road network will not be significantly affected during the operational phase therefore it is not envisaged that there will be traffic impact on the surrounding environment.

However, local accessability will be impacted due to the proposed closure of public access across the existing dam crest and spillway. With the removal of access across the dam local residents along Gilston Road and visitors approaching from Gilston Road will be subject to some additional travel time to access the recreation facilities on the western side of the dam wall or Advancetown Road. The impact and mitigation for the closure of the access across the dam wall is discussed is **Section 13.6.6**.

13.6 Infrastructure Impacts and Mitigation

13.6.1 Introduction

The following section identifies the impact on infrastructure and proposed mitigation measures.

The increase in the FSL to 94.5m AHD results in increased flood levels within the upstream catchment. The flood levels are average recurrence intervals between 5 and 100 years is detailed in **Table 13-14**.

Table 13-14 Proposed Dam Surface Levels during Flood Events

Average Recurrence Interval (Years)	Stage 3 Water Level (m AHD[2])
100	101.03
50	100.30
20	99.51
10	98.55
5	97.76
FSL[1]	**94.5**

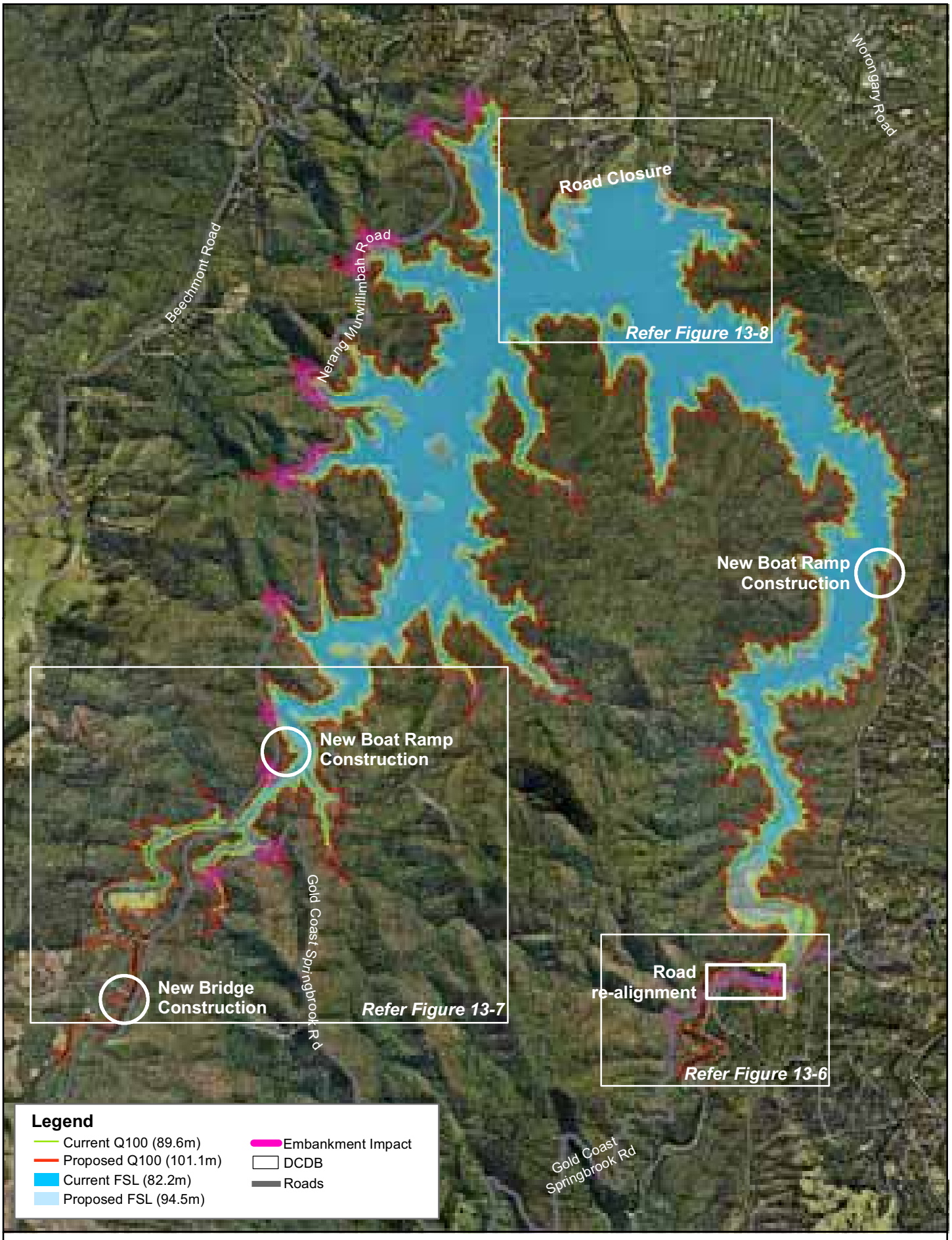
[1] Full Supply Level
[2] Australian Height Datum

Both State and Local roads and recreational infrastructure will be impacted upon by the project. **Figure 13-5** shows the extent of impact on existing infrastructure affected by the Stage 3 works.

In general, the project has the following impacts on infrastructure:

- partial inundation of the road embankments during FSL or flood events, compromising the stability and integrity of embankment materials (refer **Figure 13-5**);
- inundation of cross-road culvert outlets affecting performance and capacity during flood events (refer **Figure 13-5**);
- full inundation of roads during flood events reducing current flood immunity (refer **Figure 13-6**);
- increased Time of Submergence (ToS) of the bridge over the Nerang River along Pocket Road (refer **Figure 13-7**); and
- permanent closure of access roads within the CID for access to community facilities (refer **Figure 13-8**).

These impacts and their proposed mitigation are discussed in the following sections.



N

0 0.5 1 2

Kilometres

Scale - 1:50,000

Projection: MGA Zone 56

Figure 13-5

Impacts on Infrastructure Overview

Hinze Dam Stage 3 EIS

N

0 62.5 125 250

Metres

Scale - 1:7,000

Projection: MGA Zone 56

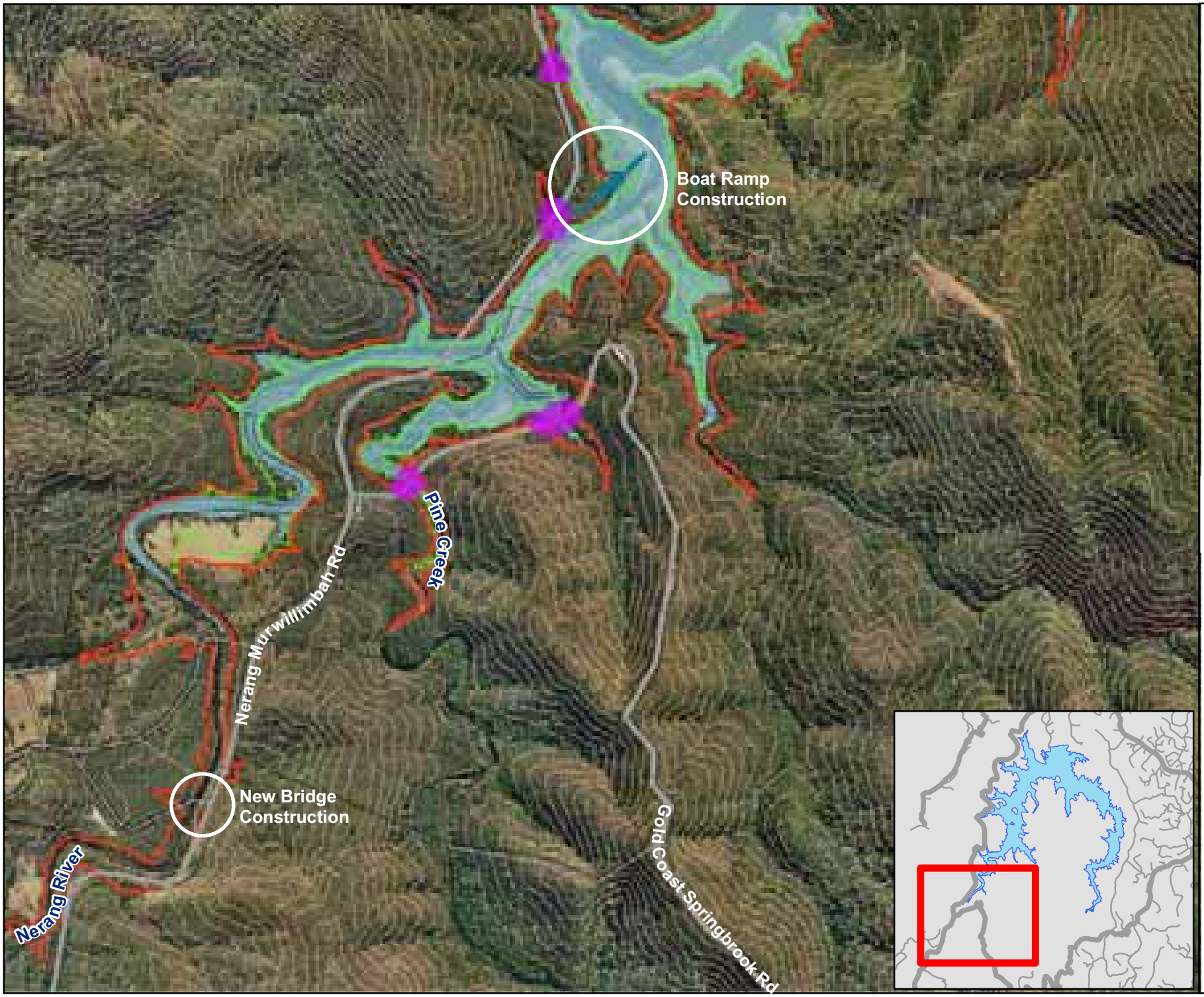
Legend

- Proposed FSL (94.5m)
- Current Q100 (89.6m)
- Proposed Q100 (101.1m)
- Road Re-alignment
- DCDB
- Contours (5m)
- Roads

Figure 13-6

Impacts on Infrastructure East Arm

Hinze Dam Stage 3



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Meters

Scale -1:20,000

Projection: MGA Zone 56

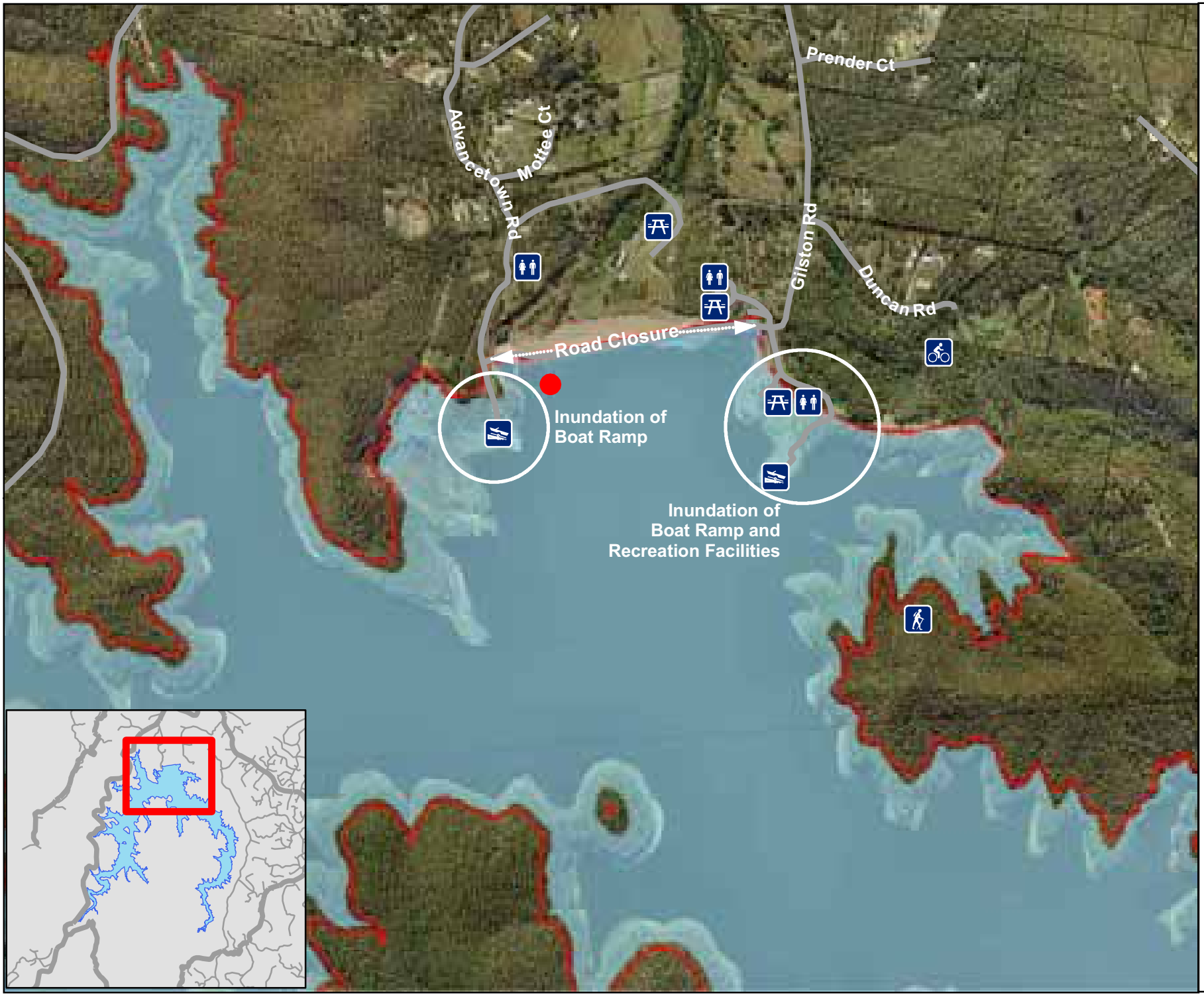
Legend

- Proposed FSL (94.5m)
- Current Q100 (89.6m)
- Proposed Q100 (101.1m)
- Embankment Inundation
- DCDB
- Contours (20m)
- Roads

Figure 13-7

Impacts on Infrastructure West Arm

Hinze Dam Stage 3



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0 115 230 460
Metres

Scale - 1:15,000

Projection: MGA Zone 56

Legend

- Proposed FSL (94.5m)
- Proposed Q100 (101.1m)
- DCDB
- Contours (5m)
- Intake tower
- Biking
- Walking
- Toilets
- Boat Ramp
- Picnic Area

Figure 13-8

Impacts on Infrastructure Dam Area

Hinze Dam Stage 3

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13.6.2 Partial Embankment Inundation

Impact

The stability and integrity of road embankment along Nerang-Murwillumbah Road (Main Roads road 201) and Gold Coast-Springbrook Road (Main Roads road 104) is affected nominally in 15 locations. During significant storm events, flood waters partially inundate the embankment introducing the risk of slope failure due to saturation of any non free draining materials that may be present.

From preliminary investigations it is evident that rock-fill was utilised to construct the embankments and capped with compacted granular layers before the structural road pavement. It should be reiterated that the road surface is not inundated by dam flood tail-water in any of these scenarios.

Mitigation

To clarify the impact on the stability of the embankments partially inundated by flood events, the characteristics and interface of the embankment layers will be confirmed through detailed invasive investigations. Should the factor of safety of the embankment be found to be compromised, ameliorative measure will be undertaken to ensure the stability and integrity of the fines is maintained.

Possible scenarios include:

- if the embankment natural foundation material is susceptible to erosion and is inundated by FSL - in the instance the dam water compromises the stability slope and stabilisation measure will therefore be undertaken; or
- if the interface between the rock-fill and granular layers falls above the future 1 in 100 year Average Recurrence Interval (ARI) water level and the rock fill is free draining and natural foundation material is sound - no slope stabilisation measures will be required for the embankments; or
- if the interface between the rock-fill and granular layers falls below the future 1 in 100 year ARI water level or the rock-fill is deemed not to be adequately free draining - slope stabilisation measures will be undertaken for the embankments as well as appropriate measures to prevent the excessive loss of fines from the upper granular layer drawing out of the embankment.

Following extensive consultation with Main Roads, it is proposed that a detailed geotechnical investigation be carried out to at the detailed design stage to investigate the permeability of the embankment materials and to establish the material characteristics and position of the rock/granular interface in the embankments and foundation materials. This will assist in finalising the type and extent of the slope stabilisation measures required for the embankments along the identified roads under the requirement of Main Roads.

Land Requirement

All works will be confined to the immediate embankment area and it is not envisaged that there will be any additional land requirements.

13.6.3 Culvert Inundation

Impact

Cross road drainage culvert performances are affected due to the tail-water of the dam extending further into the catchment inundating the culvert outlets during storm events. However, analysis has shown that the level of headwater from the culverts does not overtop the road during a 1 in 50 year ARI critical storm except in one location on Gold Coast-Springbrook Rd. This culvert is referred to as culvert S-B for the purpose of this report.

In this location on Gold Coast-Springbrook Rd, culvert S-B has been modelled showing it currently has 1 in 20 year ARI immunity with no water inundating the road during a 180 min 1 in 20 year ARI storm. In the event of a 1 in

50 year ARI storm the headwater from the culvert would currently overtop the road by approximately 500mm. This is under free outflow conditions with no tailwater effects from the dam.

To determine the level of impact on culvert S-B, joint probability analysis was carried out to determine the worst case 1 in 50 year ARI storm scenario. It was determined that the critical 1 in 50 year ARI storm combination to the performance of the culvert was a 72 hr 1 in 5 year ARI storm in the dam coinciding with a 180 min 1 in 50 year ARI storm through the culvert. Under this absolute worst case scenario, during a 1 in 50 year ARI storm event through culvert S-B, the tail-water effect of Hinze Dam Stage 3 is expected to increase the depth of water over the road by 120mm to 620mm.

However, while probability suggests that this occurrence would produce a 1 in 50 year ARI storm event that should be conveyed through culvert S-B, the risk of this event effecting the performance of culvert S-B is considered extremely low. The modelling scenario assumed the storm peaks in the dam and culvert would occur simultaneously, which is considered be a very low probability. While these storm events may occur concurrently, it is a very low probability that their peak intensities producing peak hydrographs through the culvert and dam would also coincide. Additionally, it is considered a low probability that the dam level starts at FSL at the beginning of the storm event. This is also considered to have a low probability as the dam drawdown is 55% of the time at an amount equal to the storm inflow. This would mean that the freeboard within the dam due to drawdown would accommodate the storm inflow giving an approximate maximum water level in this situation equal to the proposed FSL.

Given this, modelling has determined that with a tailwater level at the outlet of culvert S-B of 94.5m AHD which is equal to the FSL of Hinze Dam Stage 3, the performance of the culvert would not be affected. This is considered the most probable scenario.

Mitigation

This analysis has been discussed in detail with Main Roads and it has been agreed in principle that there is no requirement to propose any remedial treatment to culvert S-B at this location. However, further detailed analysis will be carried out to confirm there is no safety risk imposed by any scenario the project would produce.

13.6.4 Road Re-alignment

Impact

One section of Gold Coast-Springbrook Road has been identified as being susceptible to flooding. This section is located approximately 250 m east of Little Nerang Creek across the upper eastern arm of the impoundment. This section of road drops to an approximate height of 98 m Australian Height Datum (AHD) over an approximate length of 250 m, which is 2.3 m below the 1 in 50 year ARI flood level.

Figure 13-6 shows the section of road along Gold Coast-Springbrook Rd inundated by dam flood levels.

Mitigation

It is proposed to realign Gold Coast-Springbrook Road vertically under the requirements of the Department of Main Roads. This is proposed over a length of approximately 700 m starting approximately 250 m east of the Little Nerang Creek Bridge to a maximum height of 100.7m AHD, 2.7 m above current road levels to achieve 1 in 50 year ARI flood immunity. Access to adjacent properties will have to be upgraded to suit the proposed new road level. Further, Telstra and Energex services will need to be relocated to accommodate the new road formation.

Land Requirement

There are three residential properties located on the Gold Coast-Springbrook Road in the vicinity of Little Nerang Creek, which will be directly affected by the road's re-alignment (required to ensure the road is above the increased flood levels). The maximum effect expected is the permanent requirement for frontage across one property and temporary easement over part of two properties to allow for temporary diversion routes during construction.

Temporary use required (on preliminary design) appears to be well clear of any buildings on these properties, and it is unlikely that the easements will cause a significant restriction on property owners' use of their property. However, works will be required on accesses within property boundaries to allow connection to the proposed new road alignment. The need for easements and the process for obtaining them will be discussed with the lot owners during the detailed design phase of the project. Every effort will be made to obtain these through voluntary means.

Detailed survey and design will be carried out to determine the real property boundary and extent of land requirements.

13.6.5 Bridge on Pocket Road

Impact

A low level timber structure bridge across the Nerang River on Pocket Road is affected by dam flood waters (for study purposes "Pocket Road Bridge"). The Pocket Road Bridge has a current flood immunity of less than the 1 in 5 year ARI event based on the current deck level of RL 98.0 m AHD. The peak flood levels at the bridge site predicted for the 5 year through to the 1 in 100 year ARI floods are not affected by the Stage 3 dam raise; however, the time of submergence will increase for all events. The hydraulic modelling results for Pocket Road Bridge depicting impacts on flood levels and times of submergence are summarised in **Section 7**. The estimated increase in time of submergence ranges from approximately 36 hours during the 1 in 100 year ARI to approximately 4 hours during a 1 in 5 year ARI flood event.

Mitigation

It is proposed to raise the deck level of the Pocket Road Bridge to an elevation of approximately 104.0 m AHD to ensure a flood immunity of 1 in 10 year ARI for the Stage 3 upgrade. This level of flood immunity was requested by GCCC Roads Asset Management Business Unit of the Engineering Services Department. This will have to be constructed off-line to the existing bridge to maintain traffic flow.

This will be a significant improvement in the level of service provided to the residents of the Pocket Road district, with the flood immunity of the bridge increased from less than 1 in 5 year ARI to 1 in 10 year ARI and the total time of submergence for the 1 in 100 year ARI flood reduced from 76 hours to approximately 7 hours.

Further survey and analysis is to be carried out to determine if any reduction in deck height is available together with any opportunity to optimise the design giving consideration of local traffic volumes and currently Level of Service. **Figure 13-7** shows the location of the Pocket Road Bridge.

Land Requirements

For the construction of the Pocket Road Bridge, land will be required from Lot 702 on AP6298 State Forest Land. A detailed survey and design will be conducted to determine the real property boundaries in the area and the extent of land requirement.

13.6.6 Local Dam Access Roads

Impact

Due to the augmentation of the dam wall, local roads within the Gold Coast City Council (GCCC) area will be impacted upon. Access to the community recreation areas, and some of the facilities themselves will either be inundated or within the proposed embankment footprint. Access to the water from the eastern side of the dam near the dam wall will not be available. **Figure 13-8** shows the impacts around the dam area.

Access across the dam wall and spillway will be impacted by the project. It is proposed to remove public access across the Hinze Dam Stage 3 wall and spillway for the following reasons:

- Latimers Crossing Rd downstream of the dam provides a satisfactory link between Gilston Rd and Advancetown Rd. This was the only access during Stage I. Analysis indicates that closing Spillway Rd will result in slightly longer travel times for some Gilston Rd residents travelling to Nerang-Murwillumbah Rd (3-5 minutes), whilst travel times from Advancetown Rd to the Gilston Rd / Worongary Rd intersection are essentially unchanged;
- reinstating Gilston Rd cannot reasonably be achieved as the saddle dam embankment will be 15m higher than existing. A new road alignment would therefore be required to maintain trafficability. The alternative alignments investigated during the preparation of the EIS indicates that such alignment would impact considerably on the downstream environment and on Gilston Rd / Duncan Rd residents, and would be costly to achieve;
- with limited recreation facilities proposed on the eastern side of the dam and the recreation focus on the western side, there is little reason to maintain public vehicle access across the dam crest;
- there are no identified agencies (Emergency Services, police, GCCC, Gold Coast Water) that require the lint across the dam to be maintained. Access for emergency and maintenance vehicles will be available;
- provision of public vehicle access across the dam would require dual lanes. As the dam crest is only 10m wide this would severely limit pedestrian and bicycle access; and
- removing public vehicle access reduces water quality risks from spillages, accidents, contaminants etc.

With the removal of access across the dam local residents along Gilston Road and those tourists approaching from Gilston Road will be subject to approximately an additional 5 to 7 minute extra travel time to access the recreation facilities on the western side of the dam wall or Advancetown Road.

Mitigation

Maintenance vehicles will have access to the dam crest via the spillway bridge in order to undertake required maintenance to dam wall and the Saddle Dam. Emergency Services vehicles will also be able to travel across the dam crest to access existing fire trails immediately east of the Saddle Dam. Access will be controlled by boom gates to restrict public traffic.

The road over the dam crest will consist of a single lane road 3.5m wide with passing bays at nominated intervals. Safety barriers will be installed to prevent vehicles diverting off the roadway and down the dam embankment.

Shortly after the main entrance to the Hinze Dam from Advancetown Rd, motorists will enter a roundabout which provides improved intersection safety and lower speed environment. Turning left onto Hoop Pine Rd will provide access to the recreation area below the dam wall and link to cycling / walking tracks that will eventually join with the Saddle Dam A. Travelling straight ahead will take motorists to the existing spillway carpark and viewing area, while a right turn will bring motorists to the main recreation area.

From the Gilston Rd entry, a completely separate carpark will be provided at the point at which the access will be terminated to service the proposed mountain bike circuit on the eastern side of the dam wall.

Public access across the dam crest will consist of bicycle and pedestrian traffic only. Locked boom gates or similar devices at the spillway bridge's western end will prevent public vehicles accessing the dam crest.

Proposed new public roadways will consist of dual 3.0m wide traffic lanes with 1.5m bicycle lanes either side. Concrete kerbing and a raised 4.0m wide footpath will be provided on one side. Providing these bicycle lanes and footpaths is expected to increase the recreational amenity of the dam environs. Public roads will be carrying low volumes and given the steep terrain the design speed should be no more than 40 km/h. Steeper sections of road where horizontal curve radii are low, should be limited to 20 km/h.

The internal road network for the operation phase of the project is shown on **Figure 3-10** in **Section 3**.

13.6.7 Impact on Community

During the operational stage of the project, journey travel times for motorists will not be significantly affected. In general, existing connectivity in the transport network will be maintained with no potential to isolate communities.

While the access over the dam wall will be restricted for the public, the demand for this road connection is would be expected to be significantly lower as most of the recreation facilities will be situated on the western side of the dam wall. A small number of residents along Gilston Road will have some additional travel time to access these recreation facilities by car, but access by foot or bicycle will be available from the end of Gilston Road.

In the event that Gilston Rd is blocked off, emergency access across the dam crest will be available.

13.6.8 Traffic Management during Construction

It is proposed for traffic flow to be maintained at all times along Gold Coast-Springbrook Rd and Nerang-Murwillumbah Rd during the construction stage.

Access impacts during construction for individual sections of works are as follows:

- limited by service roads during the construction of the realignment of Gold Coast-Springbrook Rd;
- reduced to single lane controlled flow during construction of embankment protection structures along Nerang-Murwillumbah Rd; and
- maintained across the existing bridge for the construction of the bridge of the bridge on Pocket Road with management of connections between new and existing approach road alignments.

A Traffic Management Plan will be developed to effectively manage the safety and performance of motorists and community (schools) during construction. This plan will be developed in consultation with the relevant authorities.

13.6.9 Consultation with Stakeholders

Consultation is ongoing with the Department of Main Roads to negotiate the approvals for the upgrade to impacted infrastructure. The Alliance will also continue to engage community stakeholders to identify community issues arising from the project and collaboratively ensure that adverse impacts are minimised or avoided.