3 Operational traffic assessment

3.1 Traffic forecasts

Traffic volumes have been forecast using the SATURN traffic model by reference to growth projections under a "do-nothing" scenario of the existing Pacific Highway (Base case), and a "with project" scenario (comprising the new carriageway and remnant sections of the existing Pacific Highway). These have been developed from modelled traffic volumes for each section of the project at opening (2016) and after 10 years of operation (2026), and after 20 years of operation (2036) when the entire project is anticipated to be completed and operating as a class M motorway. Interchange traffic levels have been analysed using SIDRA (a software platform for analysis of intersection performance) to confirm satisfactory Levels of Service.

The growth indicators include regional population, employment and tourism growth. Also, reflections of regional and interregional economic activity that give rise to growth in heavy vehicle transport have been considered. Historical growth patterns have also been referenced, but greater reliance is placed on external factors, rather than simply repeating previous growth drivers. These have been applied individually to the five local government areas in the study area, as appropriate.

Benefits of reduced travel and travel time despite increased traffic volumes have been estimated, along with benefits of reduced crash frequency. Impacts on local road and property access, public transport, and bicyclist opportunities have been identified. Given the scale of this project and the proposed time frame for its implementation, construction impacts have been assessed to identify road user delays.

The results are presented in the following tables. Table 3-1 presents traffic volumes, while Table 3-2 presents travel characteristics in terms of total vehicle travel (vehicle kilometres travelled: VKT) and (vehicle hours of travel: VHT). Appendix A provides detail of the SATURN model development, calibration/validation and detail results.

Day/night traffic profiles and forecasts are required for noise assessment, while the peak one hour traffic volumes are required for air quality assessment. These have been developed from modelled traffic volumes for each section of the project at opening (2016) and after 10 years of operation (2026), applying the current hourly profile. Detail of these is presented in Appendix B.

3.2 Travel benefits

3.2.1 Kilometres of travel

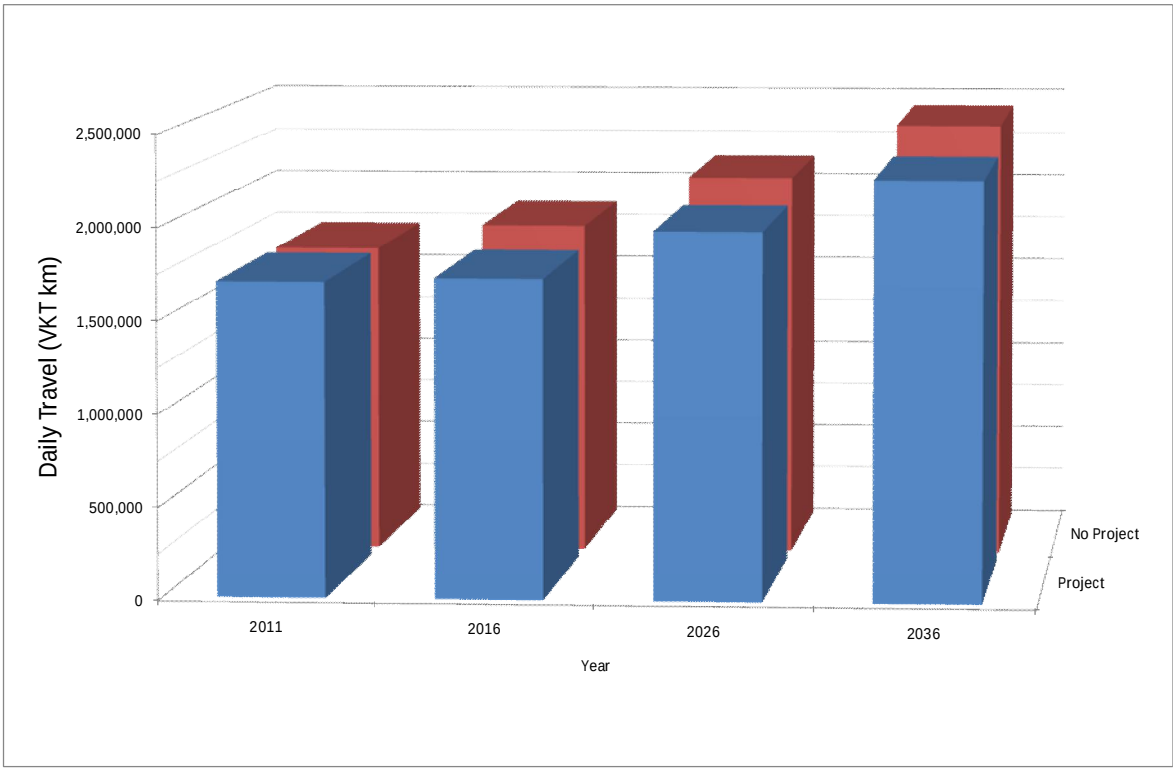
Table 3-2 and Figure 3-1 show at opening in 2016, travel in the corridor would have increased by eight per cent from the current daily 1.705 million vehicle kilometres travelled to 1.840 million vehicle kilometres travelled. However, the project is anticipated to result in an effective six per cent reduction in total travel in 2016 to 1.729 million vehicle kilometres travelled per day.

By 2036, daily travel would have been expected to grow by 42 per cent from current levels. However, the project would reduce this to a 33 per cent growth. This reduction arises as the increased traffic is offset by the reduced length of the project.

Heavy vehicle travel is anticipated to grow by 15.7 per cent to 2016, but adoption of the project would offset some of this growth, resulting in a net increase of only 6.8 per cent.

These savings in travel would continue into the future, culminating in 2036 with a reduction in heavy vehicle travel of 7.7 per cent against retaining the existing highway, and an overall savings of 6.1 per cent in all vehicle travel.

Figure 3-1 Effect of the project on daily kilometres of travel into the future

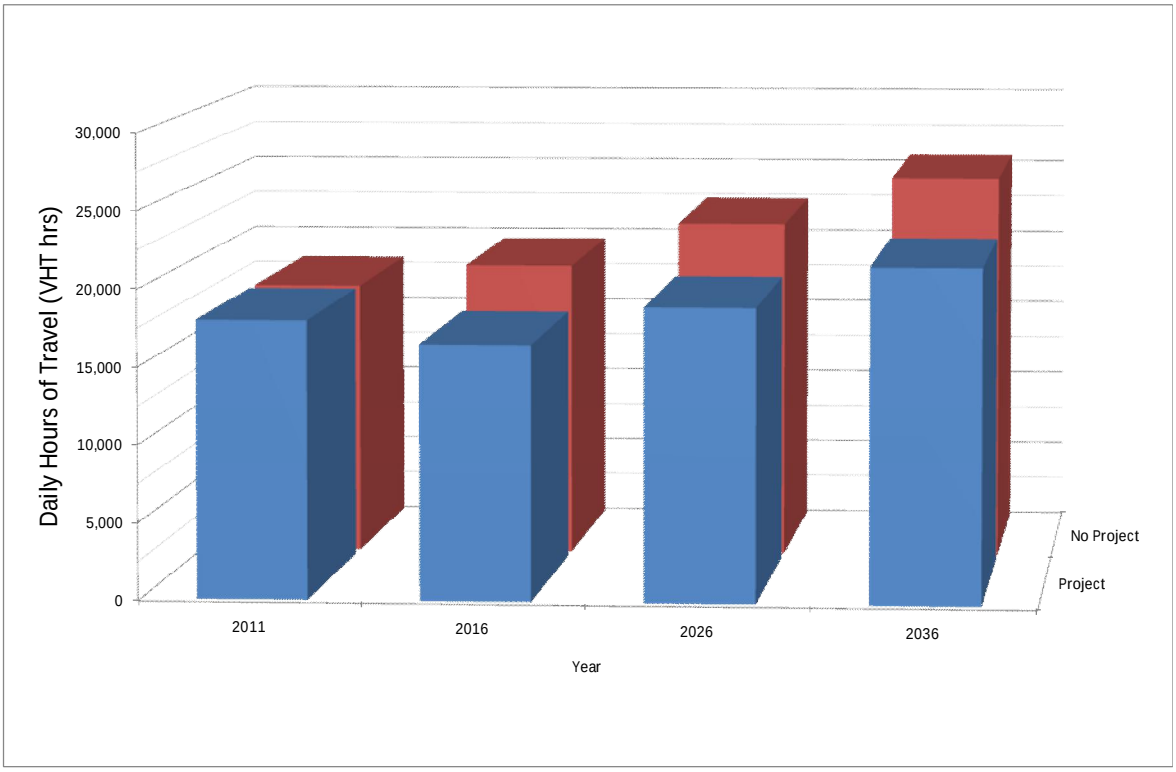


3.2.2 Hours of travel

In a similar vein, Table 3-2 and Figure 3-2 reveals that at opening, daily travel time on the existing highway would be expected to increase by 7.9 per cent for all vehicles and 15.7 per cent for heavy vehicles. However, the project would result in a net decrease of 8.2 per cent for all vehicles and 4.7 per cent for heavy vehicles. This arises from both reduced length of the highway and increased posted speed, rather than offsetting increased traffic volumes.

By 2036, when total travel time on the existing alignment would be expected to increase by 41.6 per cent from the current position, the project would have halved this growth, with a daily saving of some 3,850 vehicle hours of travel.

Figure 3-2 Effect of the project on daily hours of travel into the future



3.2.3 Latent traffic

It is widely recognised that development of infrastructure frequently results in increased trips over and above that expected by natural population and traditional economic growth. This relates to changes in travel patterns such as reduced travel time creating an opportunity for additional distance to be traversed. Indicative of this theme is tourists driving from Sydney to a destination such as Coffs Harbour as the natural reach of their willingness to drive in a single day. With improved accessibility, some would choose to travel further north in the little extra time required. This does not diminish the desirability of any particular destination, as it also applies for travellers from the north travelling south. This also opens additional markets for more efficient freight logistics.

The present modelling analysis has not embodied this aspect of latent demand, being based on natural population increases, projection of existing tourism trends, and traditional estimates of freight growth.

This apparent increase in demand is not covered in traditional economics, many suspecting that it diminishes the worth of the investment, rather than the realisation this latent travel indicates enhanced economic capacity.

Table 3-1 Traffic forecasts

Section	Location	2011 Base Model			2011 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	6,538	2,133	8,671	710	57	767	5,828	2,076	7,904
2	Halfway Creek upgrade to Glenugie upgrade	6,111	2,180	8,291	46	5	51	6,065	2,175	8,240
	Glenugie upgrade	6,063	2,178	8,241	20	0	20	6,043	2,178	8,221
3	Glenugie interchange to Tyndale	7,377	2,178	9,555	3,772	326	4,098	3,605	1,852	5,457
4	Tyndale to Maclean	7,327	2,151	9,478	0	0	0	7,327	2,151	9,478
5	Maclean to Iluka interchange	9,298	2,413	11,711	3,165	482	3,647	6,133	1,931	8,064
6	Iluka interchange to Devil's Pulpit upgrade	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
	Devil's Pulpit upgrade	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
7	Devil's Pulpit upgrade to Trustums Hill	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
8	Trustums Hill to Broadwater National Park	6,383	2,226	8,609	2,209	391	2,600	4,174	1,835	6,009
9	Broadwater National Park to Richmond River	6,797	2,233	9,030	2,715	412	3,127	4,082	1,821	5,903
10	Richmond River to Coolgardie Road	7,512	2,223	9,735	3,329	328	3,657	4,183	1,895	6,078
11	Coolgardie Road to Ballina	18,994	2,758	21,752	0	0	0	18,994	2,758	21,752

Section	Location	2016 Base Model			2016 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	6,960	2,469	9,429	767	71	838	6,193	2,398	8,591
2	Halfway Creek upgrade to Glenugie upgrade	6,490	2,522	9,012	48	6	54	6,442	2,516	8,958
	Glenugie upgrade	6,433	2,518	8,951	20	0	20	6,413	2,518	8,931
3	Glenugie interchange to Tyndale	7,767	2,518	10,285	3,981	384	4,365	3,786	2,134	5,920
4	Tyndale to Maclean	7,691	2,493	10,184	0	0	0	7,691	2,493	10,184
5	Maclean to Iluka interchange	9,724	2,797	12,521	3,283	560	3,843	6,441	2,237	8,678
6	Iluka interchange to Devil's Pulpit upgrade	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
	Devil's Pulpit upgrade	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
7	Devil's Pulpit upgrade to Trustums Hill	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
8	Trustums Hill to Broadwater National Park	6,730	2,572	9,302	2,310	452	2,762	4,420	2,120	6,540
9	Broadwater National Park to Richmond River	7,173	2,582	9,755	2,837	477	3,313	4,336	2,105	6,442
10	Richmond River to Coolgardie Road	7,946	2,574	10,520	3,507	384	3,891	4,439	2,190	6,629
11	Coolgardie Road to Ballina	20,162	3,184	23,346	0	0	0	20,162	3,184	23,346

Section	Location	2026 Base Model			2026 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	7,752	3,233	10,985	879	88	967	6,873	3,145	10,018
2	Halfway Creek upgrade to Glenugie upgrade	7,198	3,301	10,499	52	8	60	7,146	3,293	10,439
	Glenugie upgrade	7,125	3,299	10,424	20	0	20	7,105	3,299	10,404
3	Glenugie interchange to Tyndale	8,462	3,300	11,762	4,360	506	4,866	4,102	2,794	6,896
4	Tyndale to Maclean	8,337	3,264	11,601	0	0	0	8,337	3,264	11,601
5	Maclean to Iluka interchange	10,490	3,666	14,156	3,491	743	4,234	6,999	2,923	9,922
6	Iluka interchange to Devil's Pulpit upgrade	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
	Devil's Pulpit upgrade	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
7	Devil's Pulpit upgrade to Trustums Hill	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
8	Trustums Hill to Broadwater National Park	7,383	3,369	10,752	2,503	599	3,101	4,880	2,770	7,651
9	Broadwater National Park to Richmond River	7,881	3,380	11,261	3,068	631	3,700	4,813	2,749	7,561
10	Richmond River to Coolgardie Road	8,772	3,365	12,137	3,853	504	4,357	4,919	2,861	7,780
11	Coolgardie Road to Ballina	22,469	4,149	26,618	0	0	0	22,469	4,149	26,618

Section	Location	2036 Base Model			2036 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	8,449	4,205	12,654	979	115	1,094	7,470	4,090	11,560
2	Halfway Creek upgrade to Glenugie upgrade	7,813	4,296	12,109	55	11	66	7,758	4,285	12,043
	Glenugie upgrade	7,727	4,292	12,019	21	0	21	7,706	4,292	11,998
3	Glenugie interchange to Tyndale	9,081	4,294	13,375	4,698	673	5,371	4,383	3,621	8,004
4	Tyndale to Maclean	8,910	4,244	13,154	0	0	0	8,910	4,244	13,154
5	Maclean to Iluka interchange	11,151	4,773	15,924	3,667	981	4,648	7,484	3,792	11,276
6	Iluka interchange to Devil's Pulpit upgrade	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
	Devil's Pulpit upgrade	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
7	Devil's Pulpit upgrade to Trustums Hill	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
8	Trustums Hill to Broadwater National Park	7,958	4,363	12,321	2,668	778	3,446	5,290	3,585	8,875
9	Broadwater National Park to Richmond River	8,515	4,377	12,892	3,271	821	4,093	5,244	3,556	8,799
10	Richmond River to Coolgardie Road	9,517	4,359	13,876	4,168	656	4,824	5,349	3,703	9,052
11	Coolgardie Road to Ballina	24,580	5,353	29,933	0	0	0	24,580	5,353	29,933

Table 3-2 Travel characteristics (VKT and VHT)

Section	Location	2011 Base Model			
		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	47,353	192,496	493	2,005
2	Halfway Creek upgrade to Glenugie upgrade	26,160	99,492	273	1,036
	Glenugie upgrade	14,810	56,039	154	584
3	Glenugie interchange to Tyndale	97,139	426,153	1,012	4,439
4	Tyndale to Maclean	29,039	127,953	299	1,319
5	Maclean to Iluka interchange	33,782	163,954	356	1,726
6	Iluka interchange to Devil's Pulpit upgrade	17,470	62,266	188	670
	Devil's Pulpit upgrade	11,044	39,364	119	423
7	Devil's Pulpit upgrade to Trustums Hill	33,734	120,238	363	1,293
8	Trustums Hill to Broadwater National Park	25,599	99,004	275	1,065
9	Broadwater National Park to Richmond River	14,961	60,501	161	651
10	Richmond River to Coolgardie Road	26,231	114,873	282	1,235
11	Coolgardie Road to Ballina	18,203	143,563	196	1,544
	Total	**395,525**	**1,705,895**	**4,170**	**17,989**

Section	Location	2016 Base Model				2016 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	54,812	209,324	571	2,180	42,581	165,510	426	1,663
2	Halfway Creek upgrade to Glenugie upgrade	30,264	108,144	315	1,127	27,496	98,290	275	983
	Glenugie upgrade	17,122	60,867	178	634	15,108	53,722	151	537
3	Glenugie interchange to Tyndale	112,303	458,711	1,170	4,778	91,814	401,879	857	3,912
4	Tyndale to Maclean	33,656	137,484	347	1,417	33,406	136,466	304	1,241
5	Maclean to Iluka interchange	39,158	175,294	412	1,845	38,599	173,125	362	1,651
6	Iluka interchange to Devil's Pulpit upgrade	20,210	67,495	217	726	20,094	67,107	183	610
	Devil's Pulpit upgrade	12,777	42,669	137	459	12,544	41,893	114	381
7	Devil's Pulpit upgrade to Trustums Hill	39,026	130,334	420	1,401	38,562	128,783	351	1,171
8	Trustums Hill to Broadwater National Park	29,578	106,973	318	1,150	28,094	102,395	264	984
9	Broadwater National Park to Richmond River	17,299	65,359	186	703	19,194	71,156	180	684
10	Richmond River to Coolgardie Road	30,373	124,136	327	1,335	33,877	134,742	316	1,301
11	Coolgardie Road to Ballina	21,014	154,084	226	1,657	21,014	154,084	191	1,401
	Total	**457,593**	**1,840,873**	**4,824**	**19,412**	**422,384**	**1,729,151**	**3,973**	**16,518**

Section	Location	2026 Base Model				2026 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	71,773	243,867	748	2,540	55,736	192,775	558	1,937
2	Halfway Creek upgrade to Glenugie upgrade	39,612	125,988	413	1,312	35,990	114,505	360	1,145
	Glenugie upgrade	22,433	70,883	234	738	19,794	62,560	198	626
3	Glenugie interchange to Tyndale	147,180	524,585	1,533	5,464	120,357	458,388	1,124	4,455
4	Tyndale to Maclean	44,064	156,614	454	1,615	43,738	155,453	398	1,413
5	Maclean to Iluka interchange	51,324	198,184	540	2,086	50,593	195,704	475	1,864
6	Iluka interchange to Devil's Pulpit upgrade	26,431	78,344	284	842	26,279	77,893	239	708
	Devil's Pulpit upgrade	16,709	49,528	180	533	16,405	48,627	149	442
7	Devil's Pulpit upgrade to Trustums Hill	51,038	151,284	549	1,627	50,431	149,483	458	1,359
8	Trustums Hill to Broadwater National Park	38,744	123,648	417	1,330	36,804	118,293	346	1,135
9	Broadwater National Park to Richmond River	22,646	75,449	244	811	25,120	82,254	235	789
10	Richmond River to Coolgardie Road	39,707	143,217	427	1,540	44,285	155,665	412	1,501
11	Coolgardie Road to Ballina	27,383	175,679	294	1,889	27,383	175,679	249	1,597
	Total	**599,044**	**2,117,268**	**6,316**	**22,328**	**552,914**	**1,987,278**	**5,202**	**18,970**

Section	Location	2036 Base Model				2036 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	93,351	280,919	972	2,926	72,491	221,962	726	2,230
2	Halfway Creek upgrade to Glenugie upgrade	51,552	145,308	537	1,514	46,838	132,060	468	1,321
	Glenugie upgrade	29,186	81,729	304	851	25,752	72,131	258	721
3	Glenugie interchange to Tyndale	191,512	596,525	1,995	6,214	156,750	519,684	1,465	5,042
4	Tyndale to Maclean	57,294	177,579	591	1,831	56,870	176,264	517	1,602
5	Maclean to Iluka interchange	66,822	222,936	703	2,347	65,874	220,117	619	2,094
6	Iluka interchange to Devil's Pulpit upgrade	34,269	90,254	368	970	34,072	89,735	310	816
	Devil's Pulpit upgrade	21,665	57,057	233	614	21,271	56,020	193	509
7	Devil's Pulpit upgrade to Trustums Hill	66,175	174,283	712	1,874	65,387	172,208	594	1,566
8	Trustums Hill to Broadwater National Park	50,175	141,692	540	1,524	47,665	135,479	448	1,297
9	Broadwater National Park to Richmond River	29,326	86,376	315	929	32,526	94,296	305	903
10	Richmond River to Coolgardie Road	51,436	163,737	553	1,761	57,361	178,220	534	1,715
11	Coolgardie Road to Ballina	35,330	197,558	380	2,124	35,330	197,558	321	1,796
	Total	**778,092**	**2,415,953**	**8,203**	**25,478**	**718,187**	**2,265,734**	**6,758**	**21,612**

3.3 Road safety benefits

As has been identified in Section 2.10.3, the crash rate in the corridor varies across the study areas between 26.7 crashes/100 per million vehicle kilometres travelled of travel in Section 10 (Richmond River to Coolgardie Road) to 9.2 crashes/100 per million vehicle kilometres travelled between Coolgardie Road and Ballina, averaging 20.7 over the whole project.

The project objective of increasing travel safety is to achieve 15 crashes/100 per million vehicle kilometres travelled. On the basis that the crash rate on the existing alignment would continue despite reduced traffic, the project would reduce crash rates to the anticipated 15 crashes/100 per million vehicle kilometres travelled. It is forecast that there would be a 27 per cent reduction in crashes in the opening year (2016).

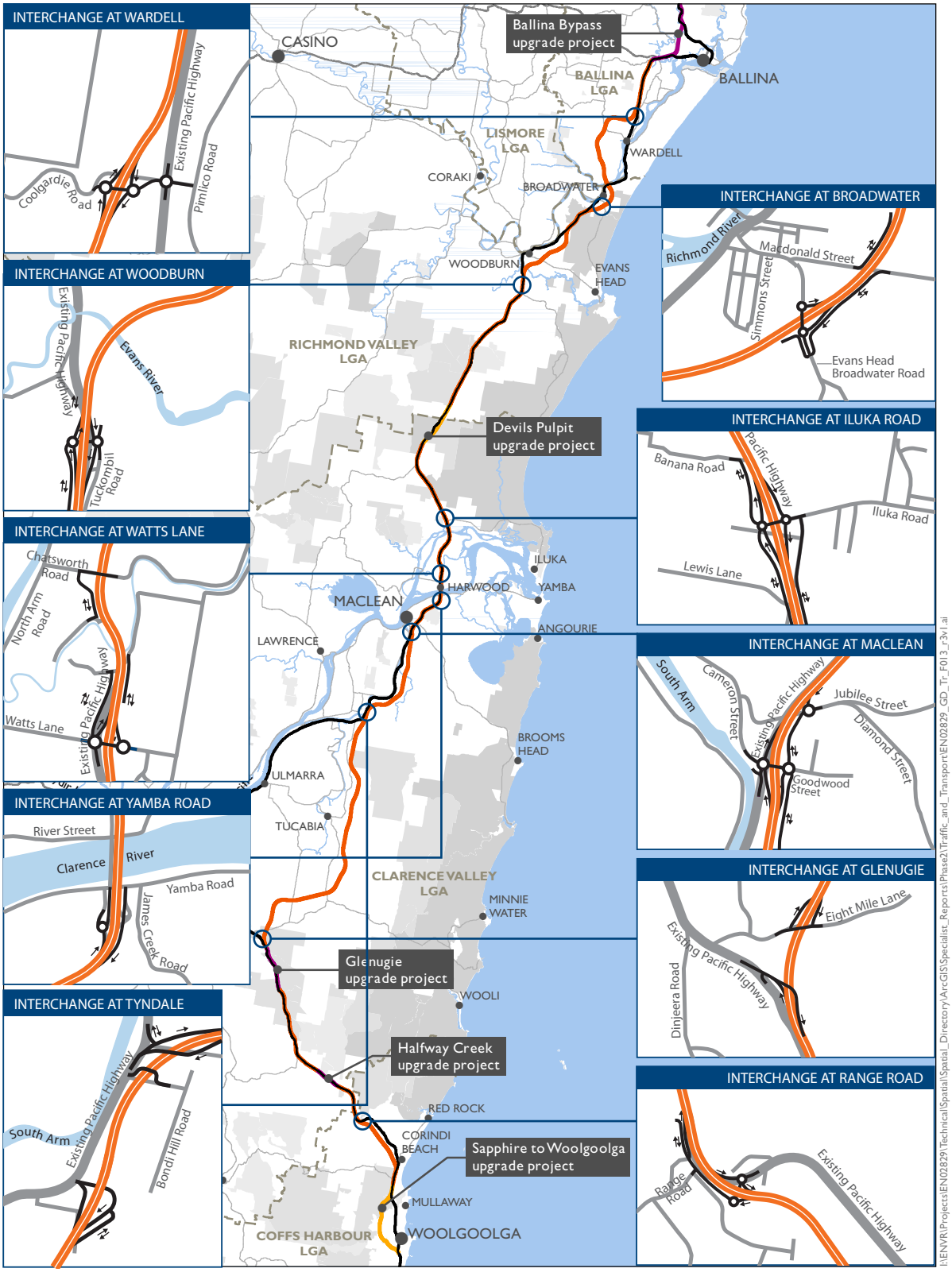
By 2036, it is forecast that the project would reduce the forecast 183 (if the project had not proceeded) to 132. The greatest crash saving would be between the Glenugie interchange and Tyndale, where the project would result in saving of 15 crashes, compared to 51 predicted without the project.

3.4 Impact of the project

3.4.1 Interchange performance

The location and geometric layout of the interchanges along the project are shown in Figure 3-3 to Figure 3-8.

Figure 3-3 Proposed interchanges



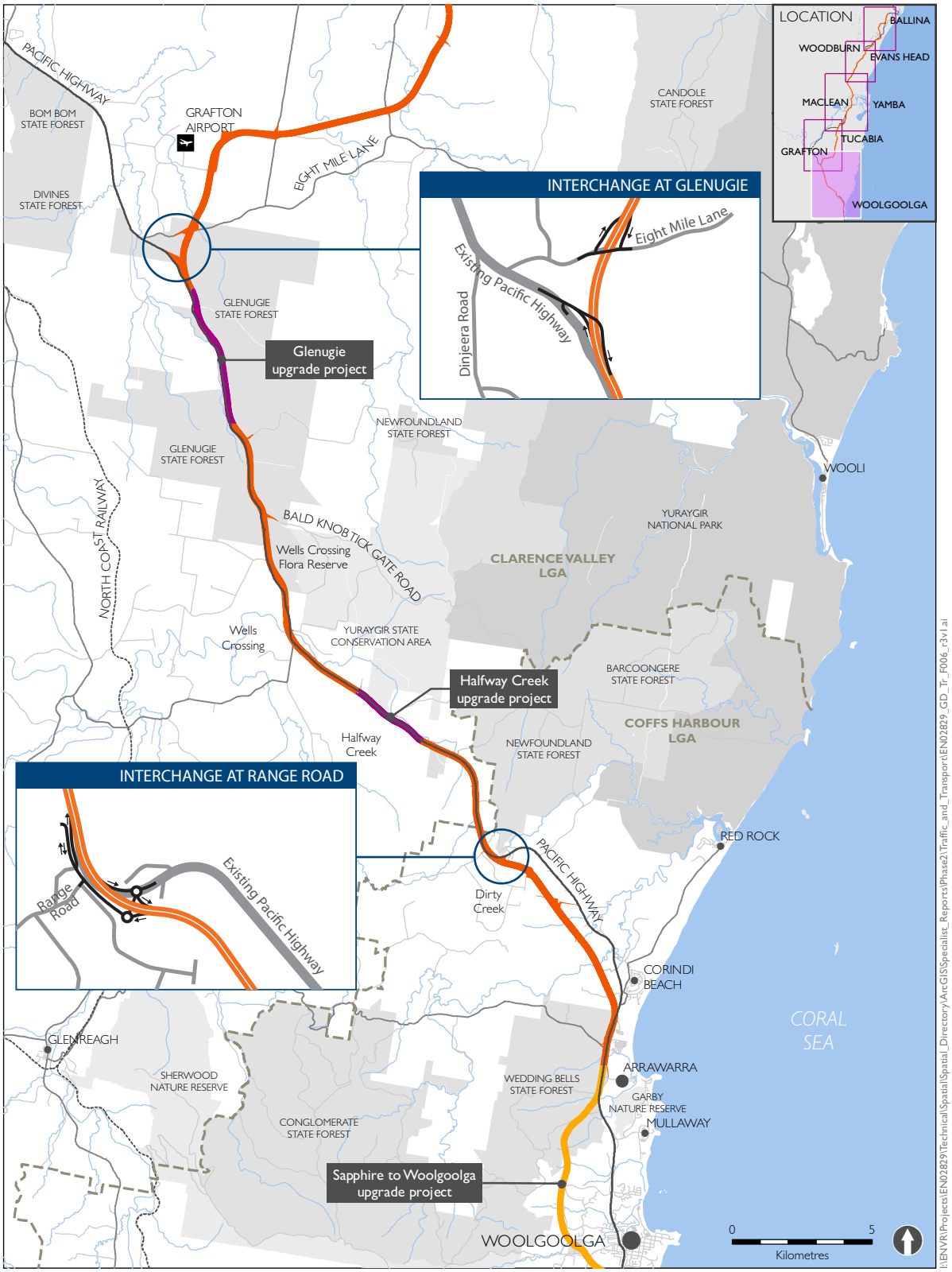
The project

Upgrade completed to dual carriageway

Upgrade under construction

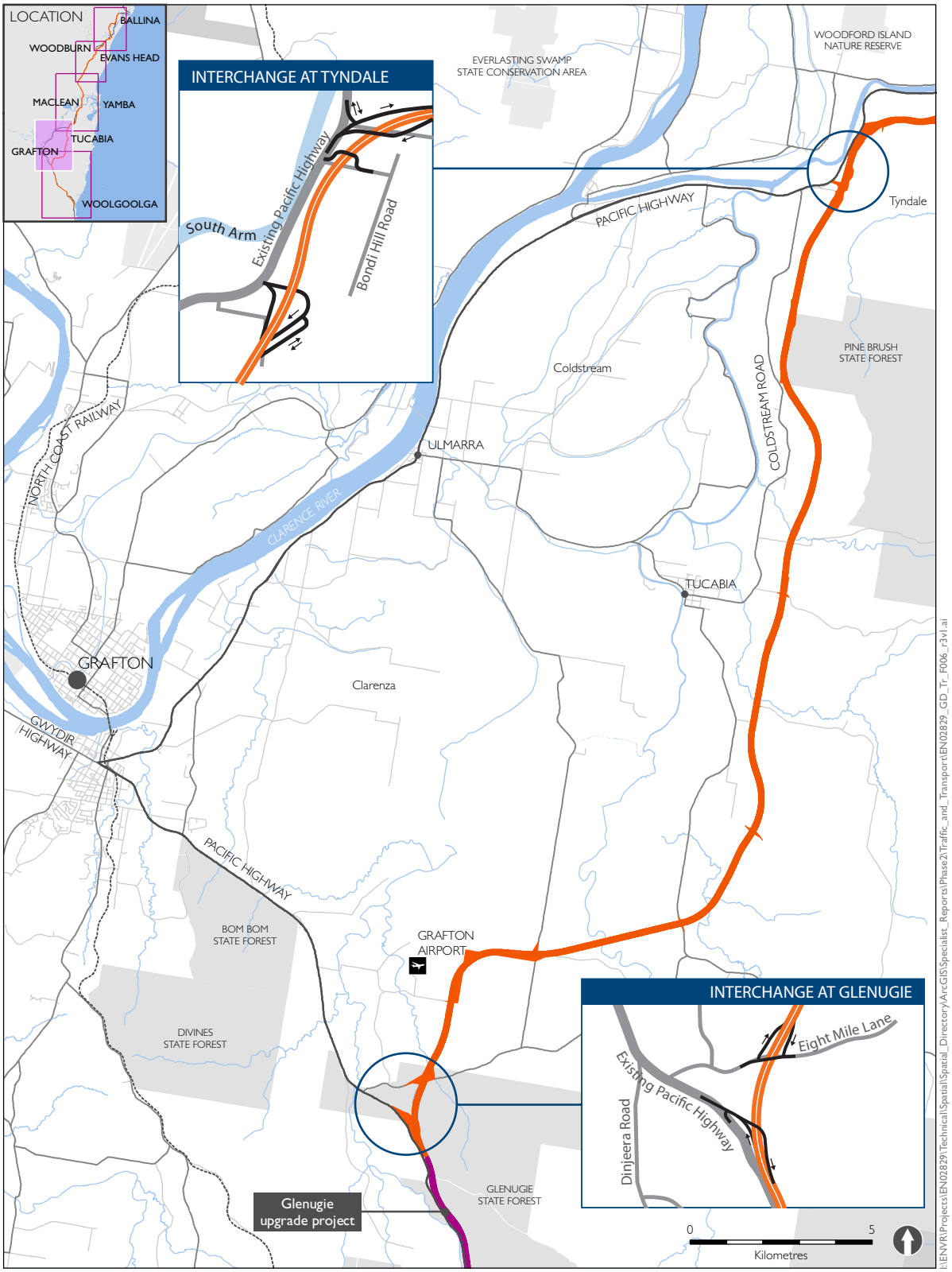
Existing Pacific Highway

Figure 3-4 Proposed interchanges - Arrawarra to Glenugie



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway

Figure 3-5 Proposed interchanges - Glenugie to Tyndale



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway

Figure 3-6 Proposed interchanges - Tyndale to Devils Pulpit

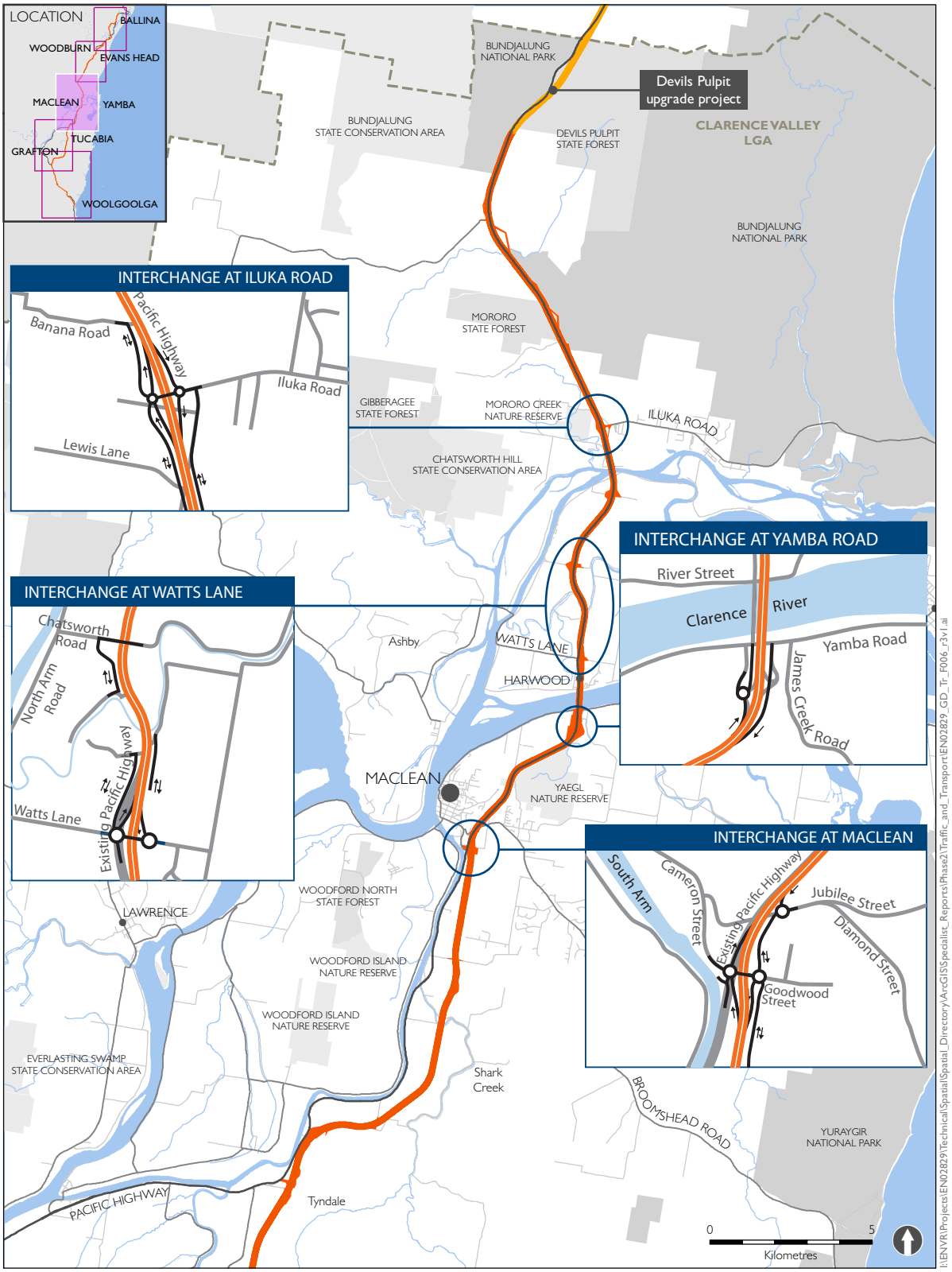
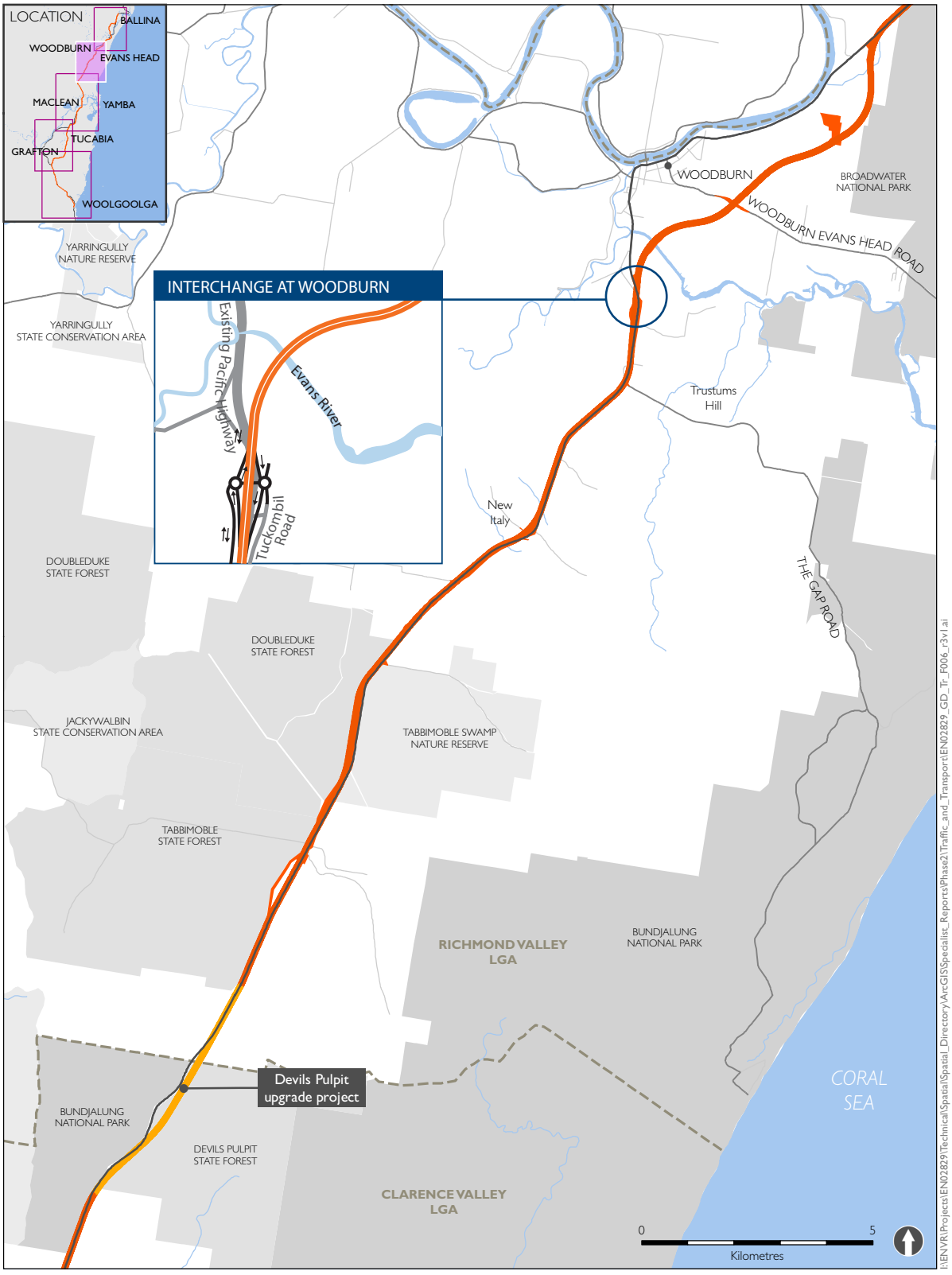
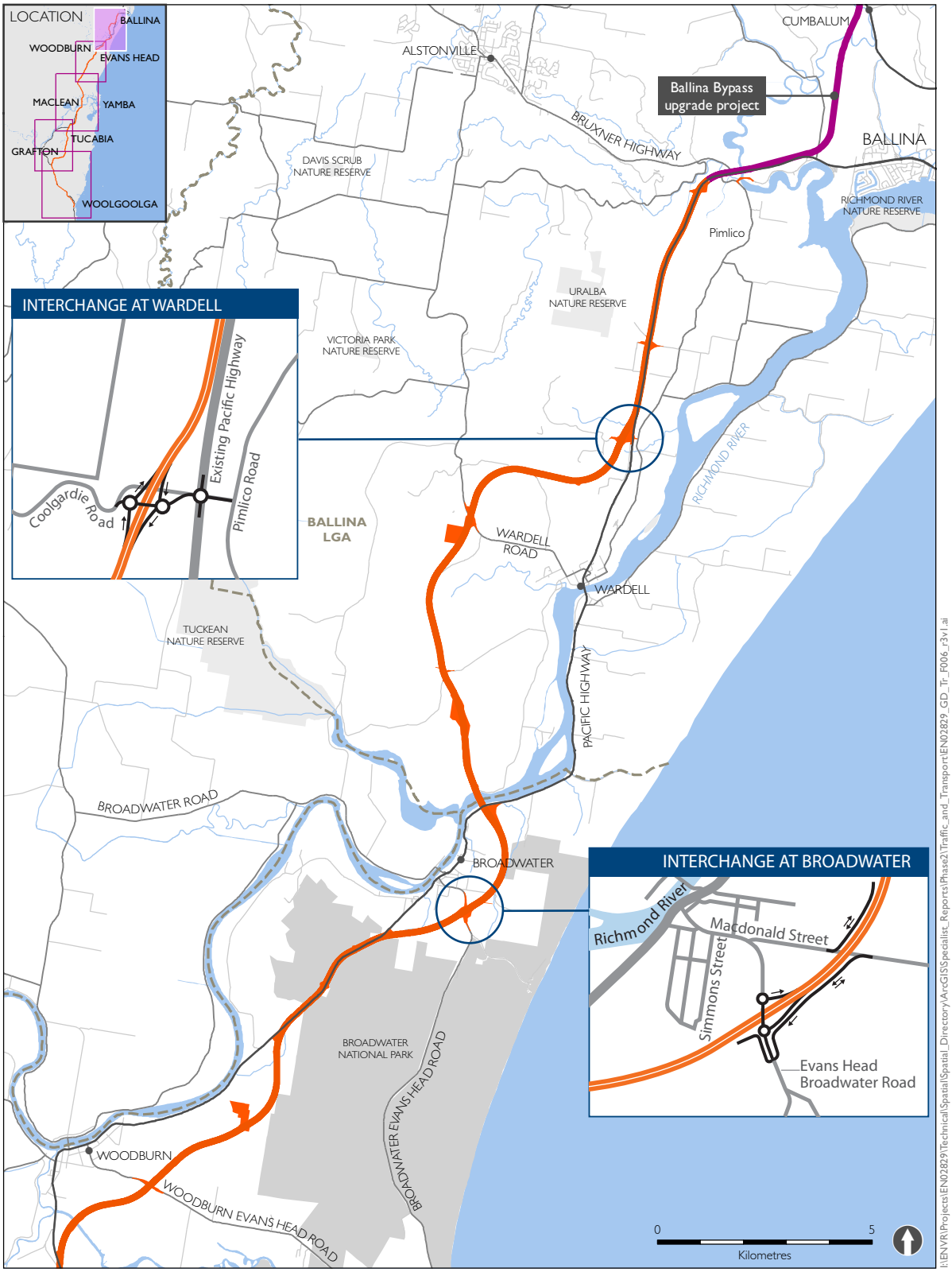


Figure 3-7 Proposed interchanges - Devils Pulpit to Woodburn



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway

Figure 3-8 Proposed interchanges - Woodburn to Ballina



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway

Traffic volumes at each of the interchanges along the project were extracted from the SATURN model for the 2016 (at opening when the project would initially be a mix of class A and class M sections) and 2036 (+20years, when the project has been assumed to be a class M highway in full).

Analysis of the interchanges was undertaken using the Sidra intersection analysis software (Version 5.1) to determine their operational level of service. Operating conditions can be compared to the performance criteria set out in Table 3-3.

Interchanges and intersections must be designed to provide a minimum Level of Service "C", in accordance with Austroads *Traffic Engineering Practice Series Part 2*, for the 100th highest hourly volume in the year 2036.

Table 3-3 Level of service criteria

Level of service	Average delay per Vehicle (sec/veh)	Traffic signals and roundabouts	Give way and stop signs
A	Less than 15	Good operation	Good operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near capacity and accident study required
E	57 to 70	At capacity; at signals incidents would cause delays Roundabouts require other control mode	At capacity, requires other control mode
F	Over 70	Extra capacity required	Extreme delay, traffic signal or other major treatment required.

Source: *Guide to Traffic Generating Developments*, (RTA, 2002, Version 2.2)

The levels of service for each interchange were used to gauge the adequacy of the concept design for the overall project. A summary of the results of the interchange analysis is shown in Table 3-4. All interchanges are expected to operate within the acceptable levels of service (C or better) both in 2016 (at opening – the initial scenario) and 2036 under the ultimate class M upgrade – the future scenario.

Table 3-4 Interchange level of service analyses (2016 and 2036)

			Opening 2016 Class A & M			+20years 2036 Class M		
Interchange	**Intersection**	**Approach**	**Average delay**	**Level of service**	**Degree of saturati**	**Average delay**	**Level of service**	**Degree of saturati**
Interchange at Wardell	Wardell interchange Eastern Roundabout	Southbound off-ramp	11	A	0.19	11	A	0.23
		Wardell interchange Link	13	A	0.01	13	A	0.26
		Service road	9	A	0.22	9	A	0.01
		All vehicles	10	A	0.22	10	A	0.26
	Wardell interchange Western Roundabout	Northbound off-ramp	13	A	0.03	13	A	0.29
		Wardell interchange Link	16	A	0.18	16	B	0.21
		Service road	11	A	0.04	12	A	0.04
		All vehicles	15	A	0.18	16	B	0.21
	Wardell interchange Link/ Service Road / Service Road East	Service road (existing Pacific Highway) south	11	A	0.25	11	A	0.29
		Service road east	14	A	0.05	14	A	0.05
		Service road (existing Pacific Highway) north	14	A	0.05	14	A	0.05
		Wardell interchange link	13	A	0.2	16	B	0.024
		All vehicles	13	A	0.25	13	A	0.29
Interchange at Broadwater	Broadwater interchange southern roundabout	Evans Head Broadwater Road	10	A	0.07	10	A	0.08
		Westbound off-ramp	12	A	0.05	12	A	0.06
		Broadwater interchange link	9	A	0.04	9	A	0.05
		All vehicles	10	A	0.07	10	A	0.08

			Opening 2016 Class A & M			+20years 2036 Class M		
Interchange	**Intersection**	**Approach**	**Average delay**	**Level of service**	**Degree of saturation**	**Average delay**	**Level of service**	**Degree of saturation**
	Broadwater interchange northern roundabout	Evans Head Broadwater Road	10	A	0.07	10	A	0.08
		Broadwater interchange link	9	A	0.05	9	A	0.06
		All vehicles	10	A	0.07	10	A	0.08
	Evans Head Broadwater Road/ service road	Service road south	9	A	0.03	9	A	0.03
		Evans Head Broadwater Road east	13	A	0.18	13	A	0.2
		Service road north	9	A	0.03	9	A	0.03
		Evans Head Broadwater Road west	13	A	0.18	13	A	0.2
		All vehicles	12	A	0.18	12	A	0.2
Interchange at Woodburn	Woodburn interchange eastern roundabout	Service road south	13	A	0.05	13	A	0.05
		Service road north	13	A	0.05	13	A	0.05
		Southbound off-ramp	13	A	0.06	13	A	0.06
		Woodburn interchange Link	15	B	0.11	15	B	0.12
		All vehicles	14	A	0.11	14	A	0.12
	Woodburn interchange western roundabout	Northbound off-ramp	11	A	0.16	11	A	0.18
		Wardell interchange Link	14	A	0.04	14	A	0.04
		Service road north	11	A	0.14	11	A	0.15
		Service road south	13	A	0.05	13	A	0.05
		All vehicles	12	A	0.16	12	A	0.18

			Opening 2016 Class A & M			+20years 2036 Class M		
Interchange	**Intersection**	**Approach**	**Average delay**	**Level of service**	**Degree of saturation**	**Average delay**	**Level of service**	**Degree of saturation**
Yamba Interchange	Yamba Interchange Western Roundabout	Yamba Rd Connection	10	A	0.08	10	A	0.11
		SB Off-ramp	14	A	0.16	14	A	0.19
		Service Road	15	B	0.13	15	B	0.15
		All Vehicles	**14**	**A**	**0.16**	**14**	**A**	**0.19**
Interchange at Iluka Road	Iluka interchange eastern roundabout	Middle Street	10	A	0.13	10	A	0.14
		Southbound off-ramp	12	A	0.05	12	A	0.05
		Iluka interchange Link	9	A	0.1	9	A	0.11
		All vehicles	10	A	0.13	10	A	0.14
	Iluka interchange Western Roundabout	Northbound off-ramp	15	B	0.16	16	B	0.17
		Iluka interchange Link	15	B	0.05	15	B	0.05
		Service road north	13	A	0.04	13	A	0.04
		Service road south	13	A	0.04	13	A	0.04
		All vehicles	15	B	0.16	15	B	0.17
	Middle Street/ service road	Service road	18	B	0.06	18	B	0.06
		Middle Street east	1	A	0.1	1	A	0.11
		Middle Street west	3	A	0.11	3	A	0.12
		All vehicles	3	A	0.11	3	A	0.12
Interchange at Watts Lane	Watts Lane interchange Eastern Roundabout	Watts Lane	9	A	0.26	9	A	0.29
		Southbound off-ramp	16	B	0.12	16	B	0.14

			Opening 2016 Class A & M			+20years 2036 Class M		
Interchange	**Intersection**	**Approach**	**Average delay**	**Level of service**	**Degree of saturati**	**Average delay**	**Level of service**	**Degree of saturati**
		Watts Lane interchange link	9	A	0.18	9	A	0.19
		All vehicles	10	A	0.26	10	A	0.29
	Watts Lane interchange Western roundabout	Wardell interchange Link	15	B	0.1	15	B	0.11
		Service road north	14	A	0.06	14	A	0.06
		Watts Lane west	13	A	0.06	13	A	0.06
		Service road south	12	A	0.06	12	A	0.06
		All vehicles	14	A	0.1	14	A	0.11
	Watts Lane/ service road	Watts Lane east	5	B	0.2	5	A	0.22
		Service road north	29	C	0.13	32	C	0.15
		Watts Lane West	1	A	0.2	1	A	0.21
		All vehicles	4	A	0.2	4	A	0.22
Interchange at Maclean	Maclean interchange eastern roundabout	Service road south	16	B	0.09	17	B	0.1
		Goodwood Road	11	A	0.46	11	A	0.5
		Service road north	17	B	0.09	18	B	0.1
		Maclean interchange link	11	A	0.44	11	A	0.48
		All vehicles	11	A	0.46	11	A	0.5
	Maclean interchange western roundabout	Northbound off-ramp	12	A	0.2	13	A	0.22
		Maclean interchange link	9	A	0.21	9	A	0.23
		Cameron Street	10	A	0.13	10	A	0.14

			Opening 2016 Class A & M			+20years 2036 Class M		
Interchange	**Intersection**	**Approach**	**Average delay**	**Level of service**	**Degree of saturati**	**Average delay**	**Level of service**	**Degree of saturati**
		service road south	14	A	0.05	14	A	0.06
		All vehicles	10	A	0.21	10	A	0.23
Interchange at Eight Mile Lane	Eight Mile Lane interchange east	Eight Mile Lane east	0	A	0.04	0	A	0.04
		Southbound off-ramp	14	A	0.04	15	B	0.04
		Eight Mile Lane west	0	A	0.04	0	A	0.05
		All vehicles	2	A	0.04	2	A	0.05
	Eight Mile Lane interchange West	Eight Mile Lane east	1	B	0.04	1	A	0.04
		Eight Mile Lane west	0	A	0.04	0	A	0.05
		All vehicles	0	A	0.04	1	A	0.05
Interchange at Range Road	Range Road Interchange northern roundabout	Service road	10	A	0.03	10	A	0.03
		Southbound off-ramp	11	A	0.04	11	A	0.04
		Range Road interchange link	13	A	0.02	13	A	0.02
		All vehicles	11	A	0.04	11	A	0.04
	Range Road interchange southern roundabout	Westbound off-ramp	13	A	0.02	13	A	0.02
		Range Road interchange Link	17	B	0.01	17	B	0.01
		All vehicles	14	A	0.02	14	A	0.02
Not Applicable	Eggins Drive/ Sherwood Creek Road	Eggins Drive south	6	A	0.02	6	A	0.02
		Eggins Drive north	7	A	0.02	7	A	0.02
		Sherwood Creek Road	13	B	0.03	13	A	0.03
		All vehicles	9	A	0.03	9	A	0.03

3.4.2 Impacts to heavy vehicle movements

With the anticipated growth in heavy vehicle activity and project objectives reflecting support for freight transport, the project provides travel time savings for both heavy and light vehicles alike, also reducing the impact of heavy vehicles on local communities along the project by providing the separate upgrade alignment. The travel time saving results from both the reduced length of the project over the existing highway and the increased speeds associated with the project to class M and class A, and then the ultimate class M configuration for sections upgraded to class A initially. This is planned to occur between opening in 2016 (the initial upgrade scenario) and 2036 (the future upgrade scenario).

In addition, the route bypasses four of the ten Higher Mass Limit (HML) deficient Pacific Highway bridges. A further HML deficient bridge is bypassed at Bulahdelah and the other four are in the section Port Macquarie to Urunga. When all are bypassed, the Pacific Highway would no longer be HML deficient and would provide a major HML freight route.

Due to the increased attractiveness of the project, the number of heavy vehicles using the existing highway, where it deviates from the project, is anticipated to drop significantly. Based on identified origin-destination patterns from the field surveys, it is expected that 91 per cent of heavy vehicle travel would use the project when it opens to traffic.

The inter-capital freight volume on the existing Pacific Highway in the study area was estimated to be around 2.9 million tonnes in the study area (BTRE, 2006). Road-based freight transport represents 76 per cent of the Sydney-Brisbane inter-capital freight, while rail represents 11 per cent, coastal shipping 12 per cent and air accounting for one per cent (Ernst and Young, 2006).

Any increase in the freight task is most likely to be absorbed predominantly by road. For the rail mode share to increase, significant investment in rail track and signalling infrastructure to improve travel times and access to Sydney ports is required. The continued upgrade of the Pacific Highway would improve travel times relative to the New England Highway, and provide a high-quality and safer route for road freight between Sydney and Brisbane.

From the freight movement forecasts, road would continue to be the dominant mode. Without the project this growth would be constrained by the current and predicted level of service experienced on the existing highway throughout the study area.

3.4.3 Impact on regional road connections

The impact on the project on other regional road connections in the study area, such as the Summerland Way and Bruxner Highway, are expected to be minimal. Slight increases may occur as a result of haulage, where these routes utilise these roads. However, the impacts would be temporary and short-term in nature.

The project would adopt a 5.6 metre vertical clearance envelope for all over bridges, this would obviously limit the movement of over height vehicles requiring a greater clearance. At the majority of locations such vehicles would be able to leave the main alignment at an upstream off-ramp and rejoin the main alignment at a point downstream of the obstruction.

3.4.4 Impacts on property access

This assessment assumes the project is constructed to full motorway standard (class M) either initially or in the future, with no direct access to properties provided off the main carriageway. As a result, there is the requirement for service roads to provide access from the highway to local

properties. The existing Pacific Highway would become a service road in locations where the construction of two new carriageways is required. In areas where the project bisects existing access routes, the realignment of local roads and accesses, along with the construction of new service roads would mitigate this impact.

In all cases local access to the motorway would be by the relevant service road, often the existing highway. Access northbound or southbound would be via an interchange for full class M upgrade. Access on sections to be initially class A would vary, but would permit north or south bound travel.

For some localities or properties additional travel distances or travel time would be necessary to reach destinations currently reached directly via the existing highway.

3.4.5 Rest areas

Rest areas would be provided at around 50 kilometre intervals for both northbound and southbound traffic. There would be five rest areas located along the project (two northbound, and three southbound) (refer to Figure 3-9). These would be consistent with rest area spacing elsewhere along the Pacific Highway. A rest area is also planned as part of the recently approved Devils Pulpit upgrade.

There is a rest area immediately adjacent to Arrawarra Beach Road and a service centre north of the tie in to the Ballina bypass. Additionally, the Mid-North Coast Regional Strategy allows highway service centres to be developed in the vicinity of the interchange at Maclean, in addition to those at Ballina and at Arrawarra. The list of rest areas on the Woolgoolga to Ballina upgrade project are:

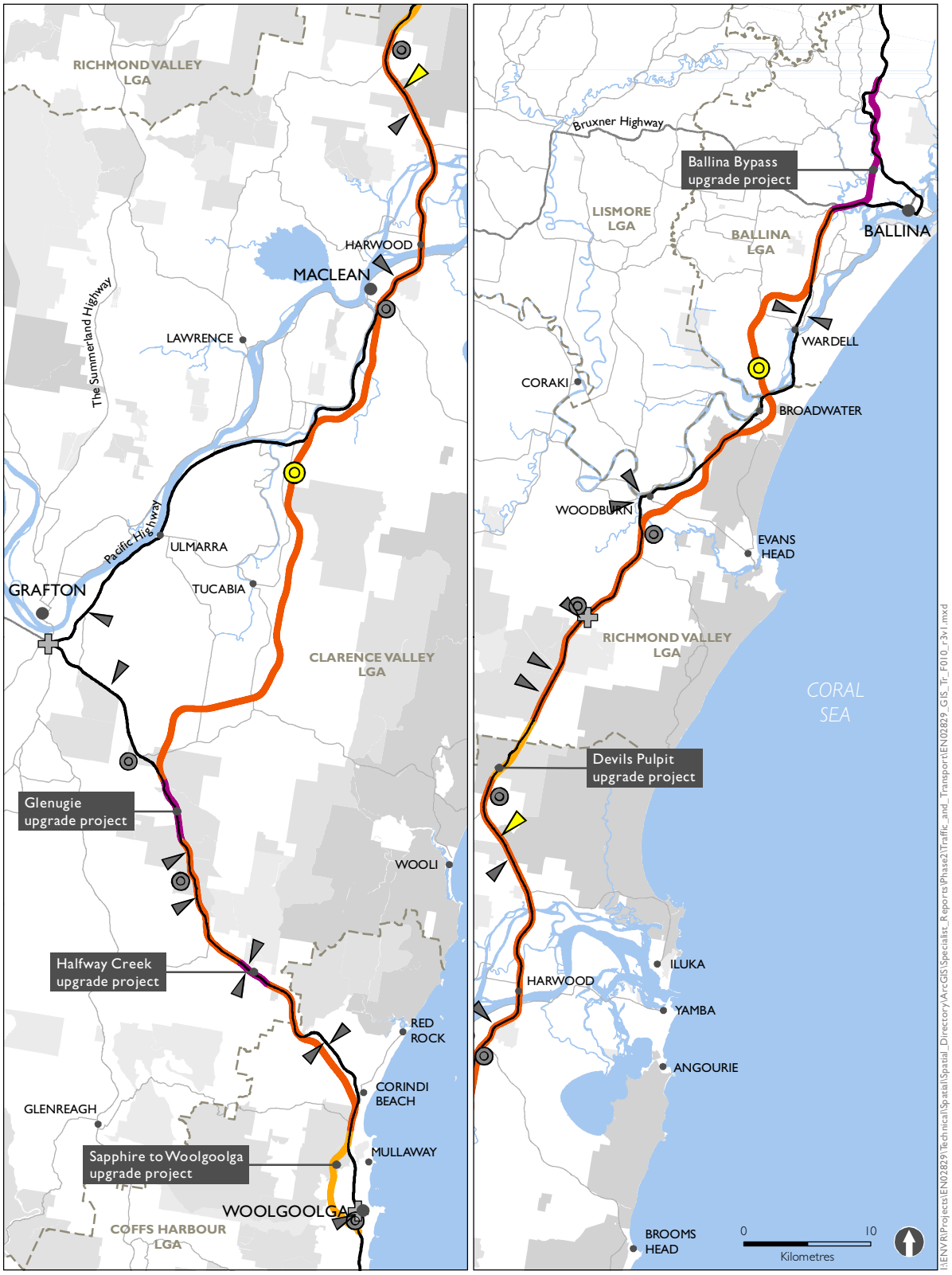
- Pine Brush, Tyndale (northbound, and southbound)
- Mororo Road (southbound only)
- Richmond River (northbound, and southbound).

Rest areas would generally be located on or near the crest of hills to enable easier and safer access, avoiding downhill sections locations where traffic would be accelerating.

Typical amenities provided at rest areas would include toilets and areas suitable for recreation and picnicking. Rain water tanks would be provided. However, many of the rest areas are remote from mains water supplies, and potable water cannot be readily provided. Rest areas would be divided into separate sections for commercial and general use. Specific parking provision would be made available for B-doubles, semi-trailers, light commercial vehicles, cars and trailers. It is recognised that lighting of the parking area and stray light from passing traffic is an important issue for long haul truck drivers. This would be addressed during detail design development.

Actual delivery of the rest areas may be staged depending on the timing of development of service centres as if these are developed first, then the need for a rest area may be deferred. Staging may also apply to the actual development of the rest area. Initial development would see spaces for 10 B-Doubles provided, with the capacity to expand to up to 20 truck spaces as required in future, while using the same entry and exit facilities.

Figure 3-9 Location of proposed rest areas along the Pacific Highway



3.4.6 Impacts on cyclists and pedestrians

The existing highway and local roads, with their associated pedestrian and cycle facilities where provided, would continue to be available once the project is constructed. For sections of redundant highway, the significant difference would be the reduction in the number of heavy vehicles using these sections of the existing highway. This has the potential to create a more attractive, and safe, cycle route through the study area than is currently available. Where existing pedestrian and cycle links are severed by the project, new facilities have been incorporated into the design.

No specific provision has been made for pedestrian access to the main carriageways of the project for safety reasons. However, cyclists would be able to use the 2.5 metre wide shoulders of the upgraded highway and some overbridges along the route.

Connectivity in the form of a three metre pathway would be provided for cycle use at key interchanges such as those at Yamba and Watts Lane for access to Yamba and Harwood. The bridge over the Clarence River would also retain shoulders that would allow safe passage of cyclists at Harwood. Pedestrian and cyclist access would be provided at the interchange at Maclean, with twin bridges at Jubilee Street maintaining connections to Townsend and Gulmarrad areas as this is an important pedestrian route, in particular for school pupils. Similar bicycle provision would be provided at the interchanges at Iluka Road, Woodburn and Broadwater - Evans Head Road.

Signposting and crossing points for cyclists would be provided at interchanges and traffic on/off ramps. The local road network in many places would be routed over the main carriageways. Pedestrian footways 1.5 metres wide would be provided on these bridges. Cyclists would also be able to use and benefit from the service road network where there are lower vehicle speeds and reduced traffic volumes.

Further opportunities such as the provision of an additional shoulder at Eggins Drive near Arrawarra (Section 1) to extend the cycle path network from Coffs Harbour, would be investigated at the detailed design stage in consultation with bicycle user groups in the North Coast region.

The project design includes a new bridge across Emigrant Creek at Smiths Drive which would enable the extension of the Ballina section of the NSW Coastline Cycleway Project towards Pimlico via Pimlico Road. This bridge would have a shared walkway in addition to shoulders on the road to cater for both leisure cycle users and road cycle users.

3.4.7 Impacts to local road network

Table 3-5 lists alterations required to the local road network in each section. In most cases, local access is maintained to the current route alignment, with negligible impact to traffic and surrounding properties. However, access distances would increase in a small number of cases. Furthermore, access is often enhanced where new service roads and interchanges are to be built.

Table 3-5 Summary of alterations to local roads

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Woolgoolga to Halfway Creek (1)	0	Arrawarra Beach Road.	Nil. Connection revised as part of Sapphire to Woolgoolga project	Arrawarra Interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	0.6	Sherwood Creek Road, Arrawarra.	Deviation to north and over upgraded highway to service road.	600 m south to Arrawarra Interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	0.1	Eggins Drive connection to Pacific Highway near Eggins Close.	Connection to be removed. Eggins Drive would form part of the service road, thus enable connection to interchanges at Arrawarra Beach Road and Range Road.	100 m south to Arrawarra Interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	2.5	Kangaroo Trail Road, Corindi Beach.	Local road over upgraded highway.	2.5 km south to Arrawarra Interchange, 6.5 km north to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Woolgoolga to Halfway Creek (1)	6.55	Paper Road, 600 m north of Post Office Lane, Corindi Beach.	To be formed and connect to Corindi access road which enables access to severed portions on the western side of the upgrade north of Corindi Creek.	3 km north to Range Road interchange, 6.5 km south to Arrawarra interchange.	Local access is maintained. Minimal traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	9.6	Range Road, Dirty Creek.	Will connect to service road. Access to upgrade via the nearby interchange.	600 m south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	9.8	New lookout road, Dirty Creek.	No change.	800 m south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	9.6	Range Road East, Dirty Creek.	Exiting terminal point relocated 100 m to east. No direct access to Pacific Highway as per existing scenario.	600 m south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	10.5	Dundoo Reach Road, Dirty Creek.	Connects to service road.	2 km south to Range Road interchange.	Southbound local access is maintained/enhanced via Range Rd interchange. Extra 500m travelling on service road required for northbound access.	Connection south via access road to Range Road Interchange.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Woolgoolga to Halfway Creek (1)	11.4	Dirty Creek Road, Milleara.	No change. Existing terminal point to remain.	2 km south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Woolgoolga to Halfway Creek (1)	11.95	Falconers Lane, Milleara.	Tie in to service road.	2 km south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Left-in, left-out arrangement and right turn lane from north. Access to south via u-turn bay to north.
Woolgoolga to Halfway Creek (1)	12	The Siding, Milleara.	Connects to service road.	2 km south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Tie in to Falconers Lane.
Woolgoolga to Halfway Creek (1)	13.2	McPhillips Road, Milleara.	Deviation to north and over upgraded highway to service road.	4 km south to Range Road interchange.	Local access is maintained. Negligible traffic impact.	Left-in, left-out arrangement and right turn lane from south. Access to north via u-turn bay to south
Woolgoolga to Halfway Creek (1)	14.3	Dunmar Lane, Milleara.	Connects to service road.	5 km south to Range Road interchange.	Local access is maintained. Minor traffic impact	Left-in, left-out arrangement
Woolgoolga to Halfway Creek (1)	15.65	Grays Road, Milleara.	Connects to service road via new over bridge.	6 km south to Range Road interchange, 21 km north Eight Mile	Local access is maintained. Minor traffic impact	No change to existing arrangement.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
				interchange.		
Woolgoolga to Halfway Creek (1)	15.75	Rediger Road, Milleara.	Connects to service road.	6 km south to Range Road interchange, 21 km north of Eight Mile interchange	Local access is maintained. Minor traffic impact	No change to existing arrangement.
Halfway Creek to Glenugie (2)	17.5	Lemon Tree Road, Halfway Creek.	Deviation to north and over upgraded highway to service road.	8 km south to Range Road interchange, 19 km north to Eight Mile interchange.	Local access is maintained. Minor traffic impact.	Left-in, left-out arrangement.
Halfway Creek to Glenugie (2)	20.3	Kungala Road, Halfway Creek.	Connects to service road.	12 km south to Range Road interchange, 15 km north to Eight Mile interchange.	Local access is maintained. Minor traffic impact.	Left-in, left-out arrangement and right turn lane from north. Access to south via u-turn bay to north.
Halfway Creek to Glenugie (2)	20.8	Luthers Road, Halfway Creek.	Deviation to north and over upgraded highway to service road.	12 km south to Range Road Interchange, 15 km north to Eight Mile interchange.	Local access is maintained. Extra 750m travelling on service road required.	Use of part of remnant Pacific Highway to north. Access to upgrade via Left-in, left-out arrangement and right turn lane from south. Access to

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
						north via u-turn bay to south.
Halfway Creek to Glenugie (2)	23.5	Parker Road, Wells Crossing.	Connects to proposed service road.	13 km north to Eight Mile Interchange, 14 km south to Range Road interchange.	Local access is maintained. Extra travel to nearest interchange (Range Road/ Eight Mile Road).	Left-in, left-out arrangement and right turn lane from north. Access to south via u-turn bay to north.
Halfway Creek to Glenugie (2)	25.1	Bald Knob Tick Gate Road, Wells Crossing.	Deviation to south and over upgraded highway to service road.	11 km north to Eight Mile Interchange, 16 km south to Range Road interchange.	Local access is maintained. Minor traffic impact.	Deviation to north and access to upgraded highway via left-in, left-out arrangement and right turn lane from south. Access to north via u-turn bay to south.
Halfway Creek to Glenugie (2)	28	Franklins Road, Glenugie.	Deviation to south and over upgraded highway to service road.	8 km north to Eight Mile interchange.	Local access is maintained. Minor traffic impact.	Deviation to north and access to upgraded highway via left-in, left-out arrangement and right turn lane from south. Access to north via u-turn bay to south.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Halfway Creek to Glenugie (2)	31.2	Old Pacific Highway (southern connection), Glenugie.	Forms part of local service road. Connection to upgrade removed at this point.	4 km north to Eight Mile interchange.	Local access is maintained. Extra travel to nearest interchange (Eight Mile Road).	Access to north unchanged, access to south at Parker Road.
Glenugie to Tyndale (3)	36	Eight Mile Lane, Glenugie.	Local road over upgraded highway.	New interchange.	Connectivity of the local area is enhanced with an interchange at Eight Mile Lane.	Not applicable.
Glenugie to Tyndale (3)	39.1	Old Six Mile Lane, Lavadia.	Local road over upgraded highway and realignment to south, Duplication of Old Six Mile Lane to the north of the upgrade to Chavalley Lane and existing Old Six Mile Lane.	3 km south to Eight Mile interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Glenugie to Tyndale (3)	41.45	Avenue Road, Lavadia.	Local road over upgraded highway.	6 km south to Eight Mile interchange, 25 km north to Tyndale interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Glenugie to Tyndale (3)	41.9	Wants Lane, Lavadia.	Realignment to south connecting to Avenue Road.	6 km south to Eight Mile interchange, 25 km north to	Local access is maintained. Minor traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
				Tyndale interchange.		
Glenugie to Tyndale (3)	45.5	Wooli Road, Pillar Valley.	Local road over upgraded highway.	11 km south to Eight Mile interchange, 20 km north to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	48.8	Mitchell Road, Pillar Valley.	Local road under upgraded highway, minor realignment to south.	13 km south to Eight Mile interchange, 18 km north to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	51.9	Firth Heinz Road, Tucabia.	Local road over upgraded highway, minor realignment to east.	15 km north to Tyndale interchange, 16 km south to Eight Mile interchange.	New service road provided. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	55.5	Bostock Road, Tucabia.	Local road over upgraded highway.	11 km north to Tyndale interchange, 21 km south to Eight Mile interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Glenugie to Tyndale (3)	56.9	Somervale Road, Tucabia.	Local road under upgraded highway.	12 km north to Tyndale interchange, 20 km south to Eight Mile interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	63.6	No Name - From Coldstream Road, Tyndale.	Local road over upgraded highway.	4 km north to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	64.9	Crowley Road, Tyndale.	Local government owned road over upgraded highway with minor realignment.	2 km north to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Glenugie to Tyndale (3)	66.6	Benson Lane, Tyndale.	New connection to existing pacific highway at Tyndale using new interchange layout.	500 m north to Tyndale interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Glenugie to Tyndale (3)	67.2	Sheeys Lane, Tyndale.	To be terminated at Benson Lane intersection. Access to Tyndale unchanged.	100 m north to Tyndale interchange.	Local access is maintained. Extra travel to Tyndale Interchange.	Not applicable.
Tyndale To Maclean (4)	69.4	Connection to Bondi Hill Road, Tyndale - Access	Local road over upgraded highway,	2 km south to Tyndale interchange, 11	Local access is maintained. Minor traffic	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
		road over main alignment.	deviation to north.	km north to Maclean interchange.	impact.	
Tyndale To Maclean (4)	69.4	Bondi Hill Road, Tyndale.	New Connection to Byrons Lane south of upgraded highway.	2 km south to Tyndale interchange, 11 km north to Maclean Interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Tyndale To Maclean (4)	71.2	Byrons Lane, Tyndale.	Local road over upgraded highway.	4 km south to Tyndale interchange, 9 km north to Maclean interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Tyndale To Maclean (4)	74.05	Norleys Lane, Shark Creek.	Terminated either side of upgraded highway. West side has direct access to existing Pacific Highway, east side would connect to existing Pacific Highway via new access road to north connecting to Gallaghers Lane.	6 km north to Maclean interchange, 7 km south to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Tyndale To Maclean (4)	75.1	Gallaghers Lane, Shark Creek.	No change, passes under upgraded highway.	5 km north to Maclean interchange, 8 km south to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Tyndale To Maclean (4)	75.2	Shark Creek Road, Shark Creek.	No change, passes under upgraded highway.	5 km north to Maclean interchange, 8 km south to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Tyndale To Maclean (4)	75.4	Stokes Road, Shark Creek.	Terminated at highway upgrade. Would connect to Shark Creek Road only.	5 km north to Maclean interchange, 8 km south to Tyndale interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Tyndale To Maclean (4)	77	McIntyres Lane, Gulmarrad.	Local access restricted across the project.	3 km north to Maclean interchange, 10 km south to Tyndale interchange.	Access to project via eastern service road to interchange at Maclean. Extra travel to Maclean interchange.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Tyndale To Maclean (4)	77.8	Clyde Essex Drive, Gulmarrad.	Paper road terminated at highway upgrade. Existing access to east remain unchanged.	2.5 km north to Maclean interchange.	Local access is maintained. Extra travel to Maclean interchange.	Not applicable.
Tyndale To Maclean (4)	78.4	Causeleys Lane, Gulmarrad.	Terminated at highway upgrade. Western side connects to existing Pacific Highway. Eastern side connection to new access road connecting to McIntyres Lane and Maclean interchange.	2 km north to Maclean interchange.	Local access is maintained. Extra travel to Maclean interchange.	Not applicable.
Tyndale To Maclean (4)	80.45	Cameron Street, Maclean.	Connection to new interchange.	Maclean interchange.	Connectivity of the local area is enhanced with an interchange at Maclean.	Not applicable.
Tyndale To Maclean (4)	80.55	Goodwood Street, Maclean.	Connection to new interchange.	Maclean Interchange.	Connectivity of the local area is enhanced with an interchange at Maclean.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Tyndale To Maclean (4)	81.2	Jubilee Street, Maclean.	Terminated for vehicular traffic either side of upgraded highway. Western side access to Maclean is unchanged but eastern side connects to new Maclean interchange. Pedestrian and cycle traffic is provided under upgraded highway.	1 km south to Maclean Interchange.	Extra 1.6 km travelling required to access between western and eastern side of Jubilee Street. Connectivity to other local areas such as Yamba is enhanced.	Not applicable.
Tyndale To Maclean (4)	81.5	Schwonberg Street, Maclean.	Exiting terminal point relocated 100 m to south. No direct access to Pacific Highway as per existing scenario.	1 km south to Maclean interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Maclean to Iluka (5)	83.1	Koala Drive/Farlows Lane, Maclean.	Local road under upgraded highway.	3 km north to Harwood interchange, 3 km south to Maclean interchange.	Local access is maintained. Negligible traffic impact.	Not applicable
Maclean to Iluka (5)	86.2	Yamba Road, Maclean.	Connection to interchanges to south	1 km north to Harwood	Connectivity of the local area is enhanced with an	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
			and to the north via existing bridge crossing at Harwood.	interchange.	interchange at Yamba Road.	
Maclean to Iluka (5)	86.9	River Street, Harwood.	Local road under upgraded highway, access to service road via Morpeth Street.	1 km north to Harwood interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Maclean to Iluka (5)	87	Petticoat Lane, Harwood.	Terminated at highway upgrade. Access to road network via existing Church Street connection.	1 km north to Harwood interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Maclean to Iluka (5)	87.8	Watt Lane, Harwood.	Local road over upgraded highway and connection to new interchange.	New interchange.	Connectivity of the local area is enhanced with a grade separated interchange at Watts Lane.	Not applicable.
Maclean to Iluka (5)	89.064	Anderson Lane, Harwood.	Connects to service road.	1 km south to Harwood interchange, 6 km north to Iluka interchange.	Local access is maintained. Minor traffic impact.	Connection south via access road to Harwood Interchange.
Maclean to Iluka (5)	89.3	Serpentine Channel Road South, Harwood.	Connects to Harwood Interchange via access road.	1 km south to Harwood interchange, 6 km north to Iluka	Local access is maintained. Minor traffic impact.	Left-in, left-out arrangement.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
				interchange.		
Maclean to Iluka (5)	90	Ryans Lane, Chatsworth.	Connects to service road.	2 km south to Harwood interchange, 5 km north to Iluka interchange.	Local access is maintained. Minor traffic impact.	Connection north to Chatsworth road.
Maclean to Iluka (5)	90.8	Chatsworth Road/Serpentine Channel Road North, Chatsworth.	Local road over upgraded highway. Connects to service road.	2 km south to Harwood interchange, 5 km north to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Direct connection to upgraded highway via left-in, left -out arrangements for both carriageways.
Maclean to Iluka (5)	93.3	Carrols Lane, Chatsworth.	Local road over upgraded highway. Connects to service road.	2 km north to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Direct connection to upgraded highway via left-in, left -out arrangements for both carriageways.
Maclean to Iluka (5)	93.85	Chatsworth Road, Chatsworth.	Connects to service road.	2 km north to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Maclean to Iluka (5)	93.85	Fischers Road, Chatsworth.	Deviation to south connecting to Carrols Lane.	2 km north to Iluka interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Maclean to Iluka (5)	94.5	Garretts Lane East, Wombah.	Deviation to north connecting to Iluka	1 km north to Iluka	Local access is maintained. Minor traffic	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
			Road.	interchange.	impact.	
Maclean to Iluka (5)	94.7	Garretts Lane/Lewis Lane, Mororo.	Connects to service road.	500 m north to Iluka interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Maclean to Iluka (5)	95.45	Iluka Road, Wombah.	Local road over upgraded highway and connection to new interchange.	New interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Maclean to Iluka (5)	96.05	Banana Road, Mororo.	Connects to service road.	500m south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Connection south via access road to Iluka Road Interchange.
Iluka to Devils Pulpit (6)	98.4	Mororo Road, Mororo.	Connects to service road.	3 km south to Iluka interchange, 29km north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Left-in, left-out arrangement, Access south via u-turn bay, access from north u-turn bay to south.
Iluka to Devils Pulpit (6)	103.4	Old Pacific Highway, Mororo.	Connects to access road over upgraded highway to service road.	7 km south to Iluka interchange, 26 km north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Left-in left-out arrangement.
Devils Pulpit to Trustums	102.75	Tullymorgan-Jacky	Connects to service	7 km south to Iluka	Local access is maintained. Minor traffic	Seagull intersection with access in all

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Hill (7)		Bulbin Road.	road.	interchange, 26 km north to Woodburn interchange.	impact.	directions.
Devils Pulpit to Trustums Hill (7)	114.3	Serendipity Road, Tabbimoble.	Deviation over upgraded highway to service road.	14 km north to Woodburn interchange, 19 km south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Seagull intersection with access in all directions.
Devils Pulpit to Trustums Hill (7)	114.5	Glencoe Road, Tabbimoble.	Connects to service road to south.	14 km north to Woodburn interchange, 19 km south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Left-in left-out arrangement.
Devils Pulpit to Trustums Hill (7)	118.8	Minyumai Road, New Italy.	Connects to service road.	9 km north to Woodburn interchange, 23 km south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Connects to eastern access road with left-in, left-out access to highway north of Cypress road.
Devils Pulpit to Trustums Hill (7)	119.5	Cypress Road, New Italy.	Connects to western access road which connects to service road at New Italy to the north.	9 km north to Woodburn interchange, 23 km south to Iluka	Local access is maintained. Minor traffic impact.	Left-in, left-out arrangement and right turn lane from north. Access to south via u-turn bay

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
				interchange.		to north.
Devils Pulpit to Trustums Hill (7)	121.1	Swan Bay - New Italy Road, New Italy.	Connects to service road.	7 km north to Woodburn interchange, 25 km south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Seagull intersection with access in all directions.
Devils Pulpit to Trustums Hill (7)	123.05	Whites Road, New Italy.	Connects to western access road which connects to service road at New Italy to the south.	6 km north to Woodburn interchange, 26.5 km south to Iluka interchange.	Local access is maintained. Minor traffic impact.	Left-in, left-out arrangement and right turn lane from north. Access to south via u-turn bay to north.
Devils Pulpit to Trustums Hill (7)	122.9	Red Gates Road/Turners Road, New Italy.	Connects to service road.	6 km north to Woodburn interchange, 26.5 km south to Iluka interchange.	Local access is maintained. Negligible traffic impact.	Left-in, left-out arrangement, Access south via u-turn bay, access from north u-turn bay to south.
Devils Pulpit to Trustums Hill (7)	124.8	Nortons road, New Italy.	Connects to service road.	4 km north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Left-in, left-out arrangement.
Trustums Hill to Broadwater National	127	The Gap Road, Woodburn.	Connects to .service road.	1.5 km north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Connects to Woodburn Interchange via

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Park (8)						Tuckombil Road.
Trustums Hill to Broadwater National Park (8)	127.5	Wondawee Way, Woodburn.	Connects to western access road to Woodburn interchange.	800 m north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Trustums Hill to Broadwater National Park (8)	127.5	Sharpe Road, Woodburn.	No change.	1 km north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Trustums Hill to Broadwater National Park (8)	128.2	Brickella Road.	No change.	300 m north to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Trustums Hill to Broadwater National Park (8)	128.3	Tuckombil Road, The Gap.	Minor horizontal shift.	100 m north to Woodburn interchange.	New service road is provided. Extra 1.5km travelling required between Tuckombil Road and Turners Road.	Not applicable.
Trustums Hill to Broadwater National	129	Trustums Hill Road, Woodburn.	Exiting terminal point relocated 100m to north. No direct access to Pacific	1 km south to Woodburn interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Park (8)			Highway as per existing scenario.			
Trustums Hill to Broadwater National Park (8)	129.3	Pacific Highway, Trustums Hill, Woodburn.	New connection to Woodburn interchange.	1 km south to Woodburn interchange.	Connectivity of the local area is enhanced with a interchange at Woodburn.	Not applicable.
Trustums Hill to Broadwater National Park (8)	131.1	Watsons Road, Woodburn.	No change, passes under upgraded highway.	3 km south to Woodburn interchange, 11 km north to Broadwater interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Trustums Hill to Broadwater National Park (8)	132.1	Woodburn - Evans Head road, Woodburn.	Deviation to north and over upgraded highway.	4 km south to Woodburn interchange, 10 km north to Broadwater interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Broadwater National Park to Richmond River (9)	140.7	Pacific Highway, Woodburn, Rileys Hill and Broadwater (through Broadwater National Park).	Deviation to north of existing Pacific Highway to form the service road.	2 km north to Broadwater interchange, 12 km south to Woodburn interchange.	Local access is maintained. Minor traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Broadwater National Park to Richmond River (9)	142.7	Broadwater - Evans Head road, Broadwater.	Local road over upgraded highway and connection to new interchange.	1.5 km south to Broadwater interchange, 14.5 km north to Coolgardie interchange.	Connectivity between Broadwater and Wardell is enhanced with an interchange at Broadwater.	Not applicable.
Broadwater National Park to Richmond River (9)	143.8	Broadwater Quarry Road, Broadwater.	Termination at upgraded highway.	2 km south to Broadwater interchange, 14 km north to Coolgardie interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Broadwater National Park to Richmond River (9)	143.6	Fisher Street, Broadwater.	Termination at upgraded highway.	2 km south to Broadwater interchange, 14 km north to Coolgardie interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Broadwater National Park to Richmond River (9)	144.1	Byrnes Street, Broadwater.	Termination at upgraded highway.	2 km south to Broadwater interchange, 14 km north to Coolgardie interchange.	Minor traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Broadwater National Park to Richmond River (9)	145.6	Pacific Highway, Broadwater.	No change, passes under upgraded highway.	4 km south to Broadwater interchange, 11 km north to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie Road (10)	146	Back Channel Road, Wardell.	Deviation to south and under upgraded highway.	4 km south to Broadwater interchange, 11 km north to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie Road (10)	148.9	Old Bagotville Road.	Deviation to north and over upgraded highway.	6 km north to Coolgardie interchange 7 km south to Broadwater interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie Road (10)	149	Montis Road.	Deviation to connect to Old Bagotville Road.	6 km north to Coolgardie interchange 7 km south to Broadwater interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie	151.25	Thurgates Lane.	Deviation on western side to connect to Hillside Lane and	6 km north to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Road (10)			Wardell Road.			
Richmond River to Coolgardie Road (10)	152.8	Hillside Lane.	Connects to realigned Thurgates Lane.	3 km north to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie Road (10)	152.9	Wardell Road.	Deviation to the north and over upgraded highway.	3 km north to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie Road (10)	154.35	Lumleys Lane.	Terminated either side of upgraded highway. New connection for western side to Wardell Road, Connection to Wardell from eastern side to remain.	2 km north to Coolgardie interchange.	Extra 1km travelling required between western and eastern side of Lumley Lane. Local access is maintained.	Not applicable.
Richmond River to Coolgardie Road (10)	157.5	Kays Road.	Local road connects to upgraded highway through Coolgardie interchange.	100 m to Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Richmond River to Coolgardie	157.5	Coolgardie Road, Wardell.	Local road over upgraded highway and connection to	100 m to Coolgardie	Connectivity of the local area is enhanced with a grade separated	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Road (10)			new interchange.	Interchange.	interchange at Wardell.	
Coolgardie Road to Ballina Bypass (11)	159.15	Laws Road.	No change.	2 km south at Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Coolgardie Road to Ballina Bypass (11)	159.83	Whytes Lane, Pimlico.	Deviation to south and connecting to Interchange at Coolgardie Road to form the new service road.	3 km south at Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Coolgardie Road to Ballina Bypass (11)	159.8	McAndrews Lane, Pimlico.	Local road over upgraded highway connecting to Whytes Lane.	3 km south at Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.
Coolgardie Road to Ballina Bypass (11)	160	Whytes Lane West, Pimlico.	Deviation to connect to McAndrews Lane.	3 km south at Coolgardie interchange.	Local access is maintained. Minor traffic impact.	Not applicable.
Coolgardie Road to Ballina Bypass (11)	164.3	Pimlico Road, Pimlico.	Termination at Smiths Drive bridge.	7 km south at Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

Project Section	Station (km from Woolgoolga)	Road and location	Alteration and local access required for class "M" ultimate design	Location of nearest interchange	Access and traffic impact	Alterations and local access required for initial design (opening)
Coolgardie Road to Ballina Bypass (11)	164.7	Smiths Drive.	New connection over Emigrant Creek to Pimlico Road to form service road.	7 km south at Coolgardie interchange.	Local access is maintained. Negligible traffic impact.	Not applicable.

3.4.8 Impacts on public transport

Individual bus operators may modify services, including changing routes or adding services to use the project highway. However, local bus routes would continue to service the local community and run along the existing Pacific Highway where it deviates from the project, as this would service the greatest number of potential passengers. Where the Highway is being upgraded in its current alignment, local access would be provided by service roads. Similarly, the current long-distance coaches are expected to continue to make stops within the study area.

There would be minimal disruption to the existing school bus routes during construction as the existing highway would be retained for local access and would be available throughout the construction period.

3.4.9 Interaction with rail infrastructure

There would be no obstruction to the functioning of the north coast railway during the construction or operation of the project.

3.4.10 Impact on emergency services

During consultation for this assessment, issues were raised by emergency services providers about potential restrictions on U-turn movements along the highway due to physical barriers between the northbound and southbound lanes. Ongoing consultation with emergency services providers would be required during the detailed design phase to ensure that potential impacts on emergency vehicle access are appropriately mitigated. This would be particularly important at for the Halfway Creek rural fire brigade at Lemon Tree Road, Halfway Creek.

The project has been designed to include a shoulder width of 2.5 metres and a one metre clearance to the gutter. This would allow for vehicles to pull over at any location in the event of a sudden breakdown or other incident, while retaining clearance to through-traffic. Across bridges, the shoulder width would be 2.5 metres between kerbs. This would be adequate for most vehicles to be able to stop clear of through traffic. Stopping bays are also provided about every 5 kilometres.

Emergency u-turn bays would be provided about every 2.5 kilometres, except adjacent to full interchanges. These would provide for emergency vehicles to conduct U-turns, and contra-flow arrangements would be put in place as required.

These U-turn opportunities also provide local residents access in the class A upgrade. However, under a class M upgrade the use of U-turn bays by the public would be prohibited. Across the flood plains, the location of wire rope safety barriers would determine location of U-turns and crossovers.

In sections that are separated from service roads (Section 3 and Sections 8, 9 and 10), emergency services would have access to a locked gate for emergency access onto the controlled road corridor. Access would also be provided to water quality control ponds for the Rural Fire Services and the NSW Fire and Rescue crews in case of fire along the project.

Incident management plans would be prepared in consultation with emergency services for both the construction and operation phase during the detailed design stage of the project. Plans would require sign-off from the emergency services and would involve identification of alternative access arrangements to manage different levels of incident. This may involve contra flow and /or use of the existing highway and appropriate temporary signage. These would include the system of contra flow in the event that highway carriageways become flooded in a 100 year ARI event.

Speed enforcement bays are not currently included as part of the Pacific Highway Design Guidelines (RTA, 2009b).

These facilities are required to manage safe and responsible driving, provide visibility of the police services on the highway network and provide safer working condition for enforcement officers. RMS is currently reviewing the potential for providing speed enforcement bays along the Pacific Highway.

Emergency vehicles needing to access properties and community facilities would not be impeded by the project.

The Halfway Creek rural fire brigade is located at Lemon Tree Road, Halfway Creek (Section 2). Access to the highway from the rural fire brigade would be maintained via Lemon Tree Road under the class A arrangement. Under the class M arrangement, access from Lemon Tree Road to the highway would be restricted and would be via the interchange at either Range Road or Glenugie.

3.4.11 Impacts on State Forest road network

Access to State Forests has been maintained through the local road network and the provision of the service road along Class M sections of the project. In many cases, forest roads run along the current boundary of the forests.

At some locations, small parcels of land would need to be acquired for the project, and adjacent forest roads would need to be reconstructed. During construction, potential impacts on areas of State forest may result from the temporary use of land for construction activities such as ancillary facilities or temporary sedimentation basins. Any areas used would be rehabilitated in consultation with the Department of Primary Industries.

State forests are managed for multiple uses including timber harvesting, recreation, bee keeping and conservation and are occasionally leased for grazing

Access to State forests has been maintained through the local road network and the provision of the service road along motorway sections of the project. In many cases, forest roads run along the current boundary of the forests.

At some locations, forest roads would be affected. Roads, access tracks and fire trails in State forests likely to be affected by the project include:

- Section 1: Arrawarra Beach Road, Sherwood Creek Road (Wedding Bells State Forest), Dunmar Lane (Newfoundland State Forest)
- Section 2: Bald Knob Tick Gate Road, No 2 Fire Road, Lookout Road (Glenugie State Forest)
- Section 3: Dungel Road, Eight Mile Lane, No 1 Fire Road, Shields Road (Glenugie State Forest)
- Section 6: Mororo Fire Trail (Mororo State Forest)
- Section 7: Cypress Road, Darkys Road, South Pacific Trail, North Pacific Trail, (Doubleduke State Forest), Glencoe Road, McFayden Road, Serendipity Road, (Tabbimoble State Forest).

Further unnamed access tracks and trails are also expected to be affected during construction of the project. However, the detail of this impact is only likely to emerge during detailed design. These details will need to be addressed with Forests NSW at that time through appropriate consultation and planning. Providing alternative access arrangements would be required, and will depend on construction details.

Figures 3-10 to 3-15 indicate where alterations to the State forest road and access track network might be required. Impacts would be particularly apparent through Wedding Bells, Newfoundland, Glenugie and Tabbimoble State forests in Sections 1, 2, 3 and 7 of the project. Appropriate access arrangements would need to be agreed with Forests NSW prior to construction to provide alternative means of access and egress, in particular for timber trucks and other State forest traffic. Arrangements would be finalised in conjunction with Forests NSW following detailed design.

Figure 3-10 State forest road network - overview

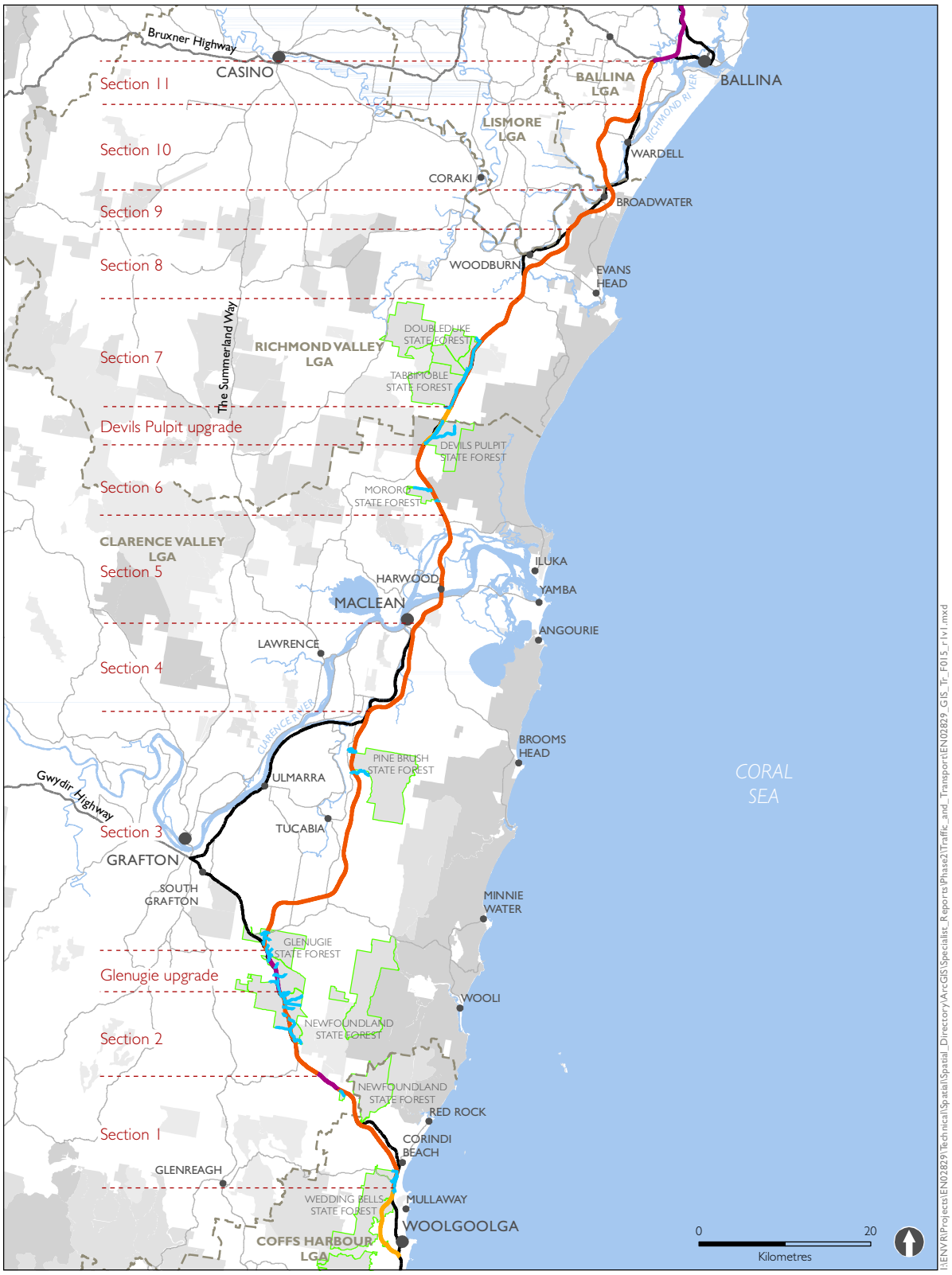


Figure 3-11 State forest road network alterations: Section 1 - Woolgoolga to Halfway Creek

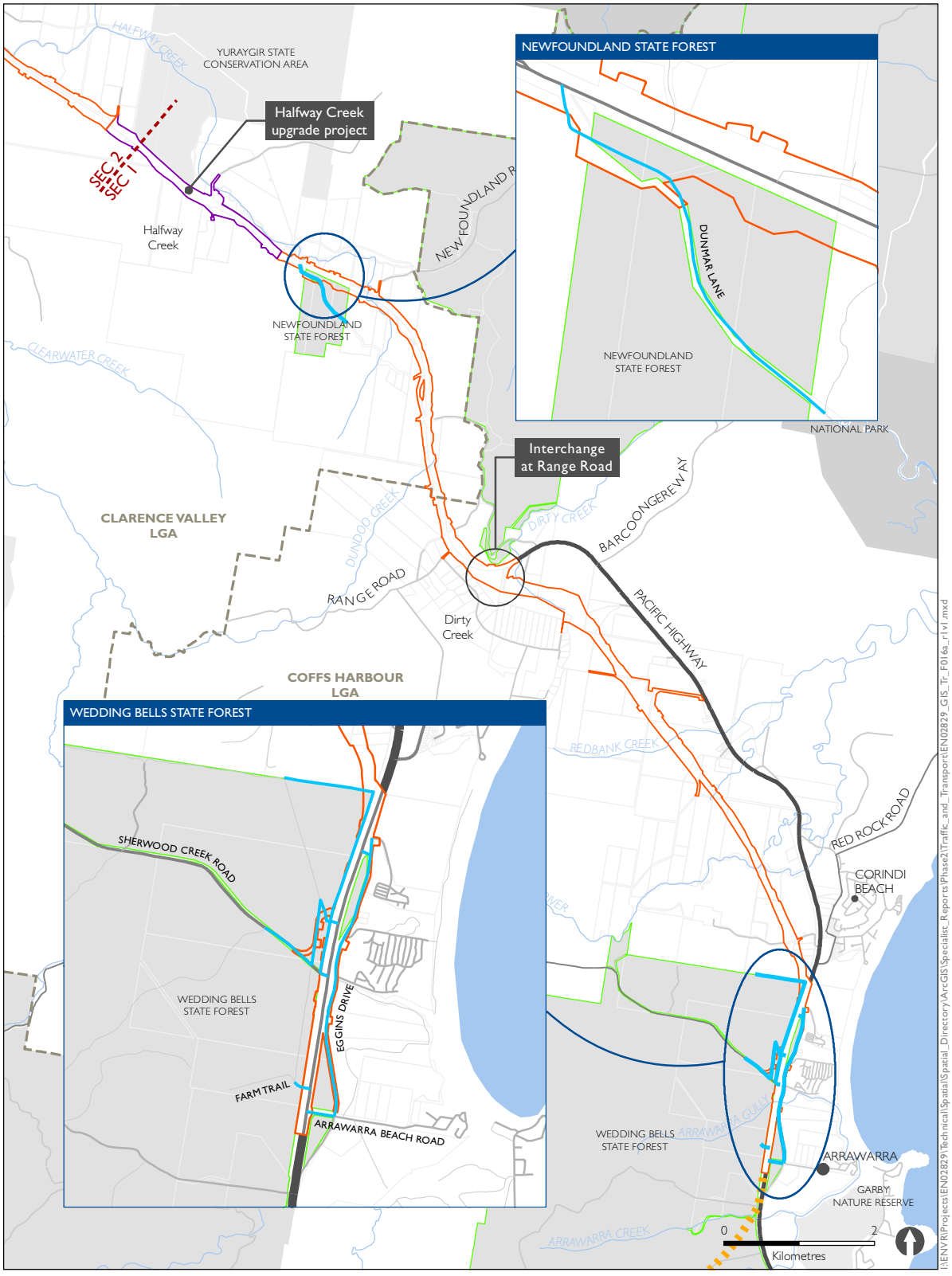


Figure 3-12 State forest road network alterations: Section 2 - Halfway Creek to Glenugie upgrade

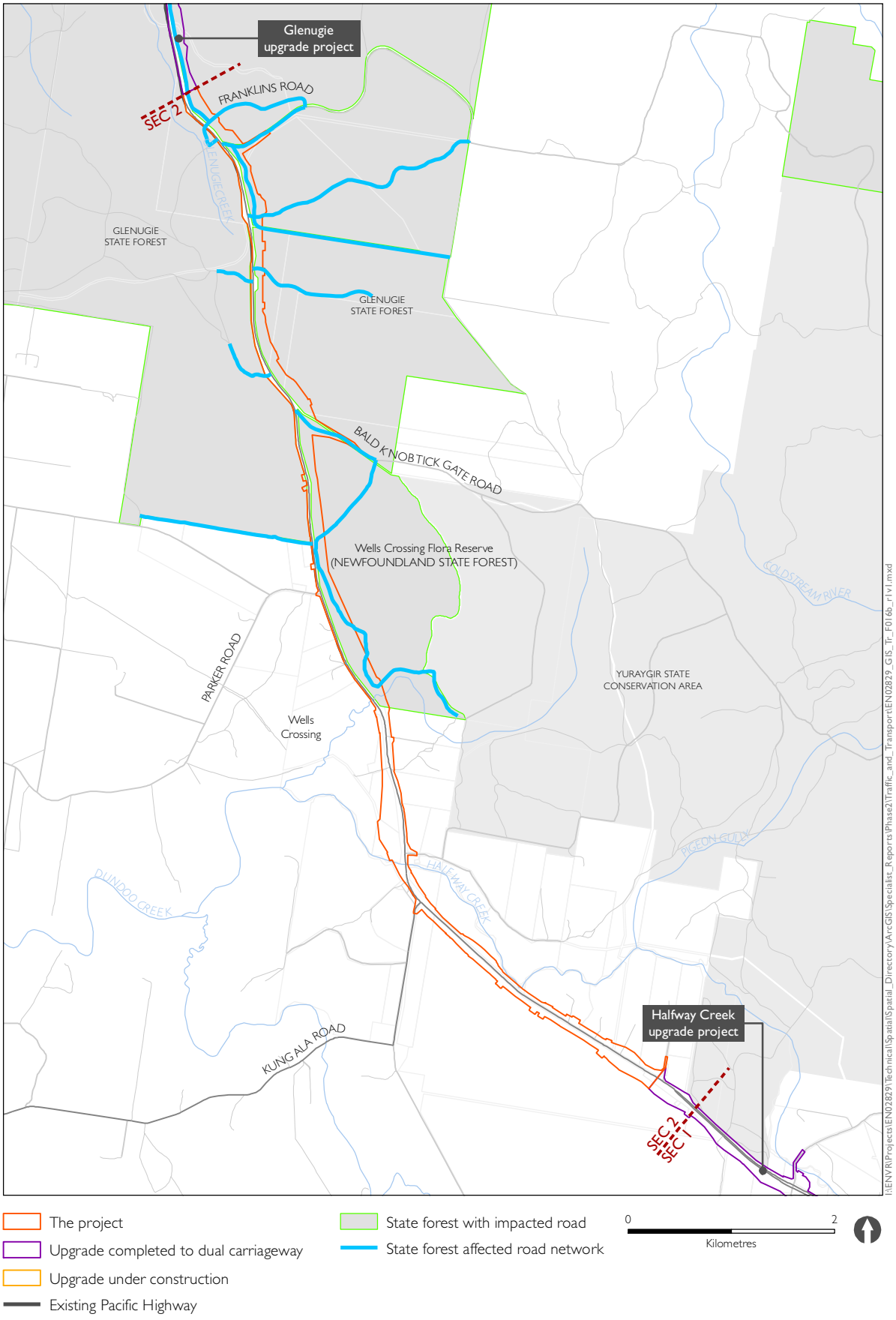


Figure 3-13 State forest road network alterations: Section 3 - Glenugie upgrade to Tyndale

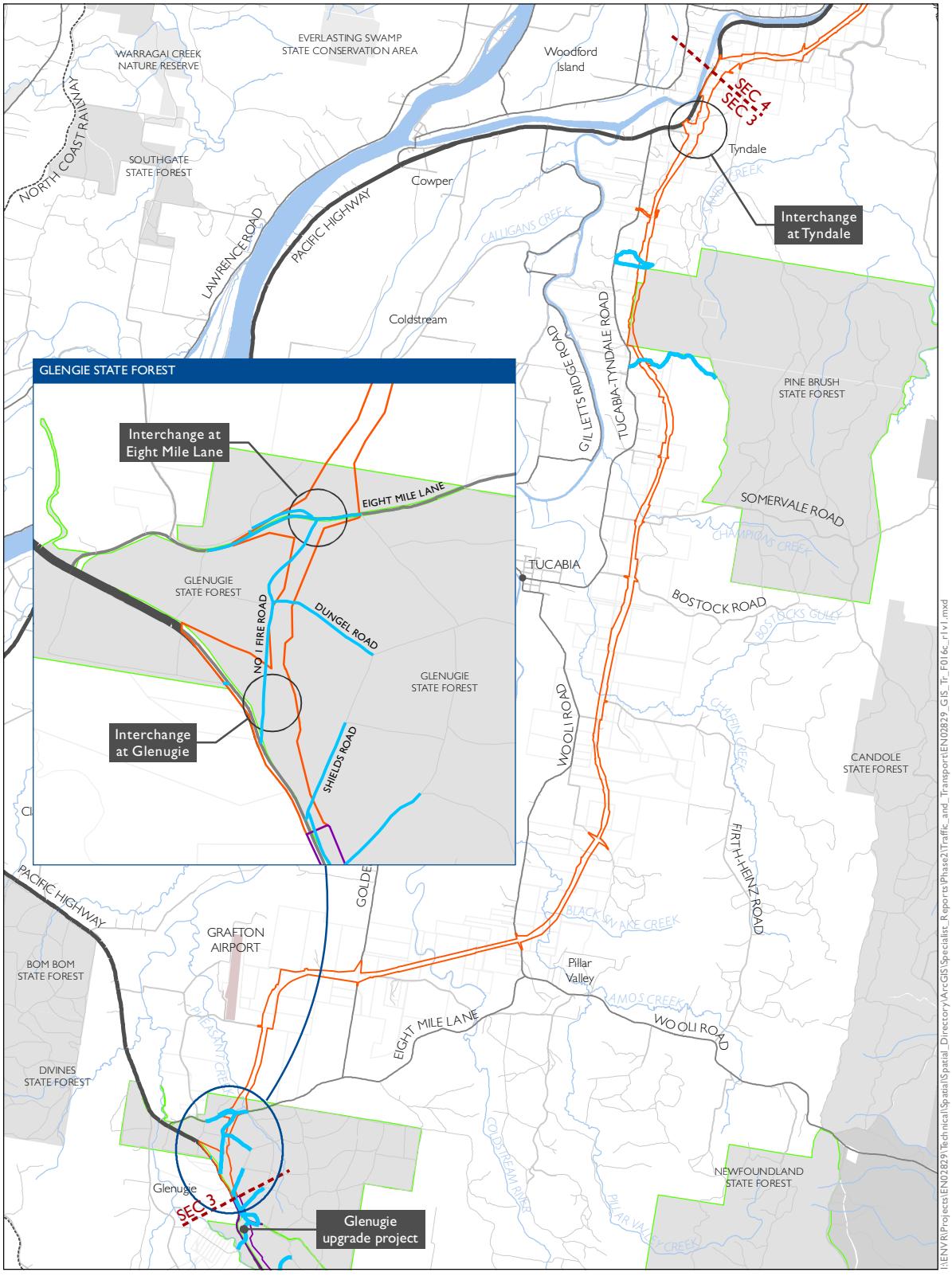


Figure 3-14 State forest road network alterations: Section 6 - Iluka Road to Devils Pulpit upgrade

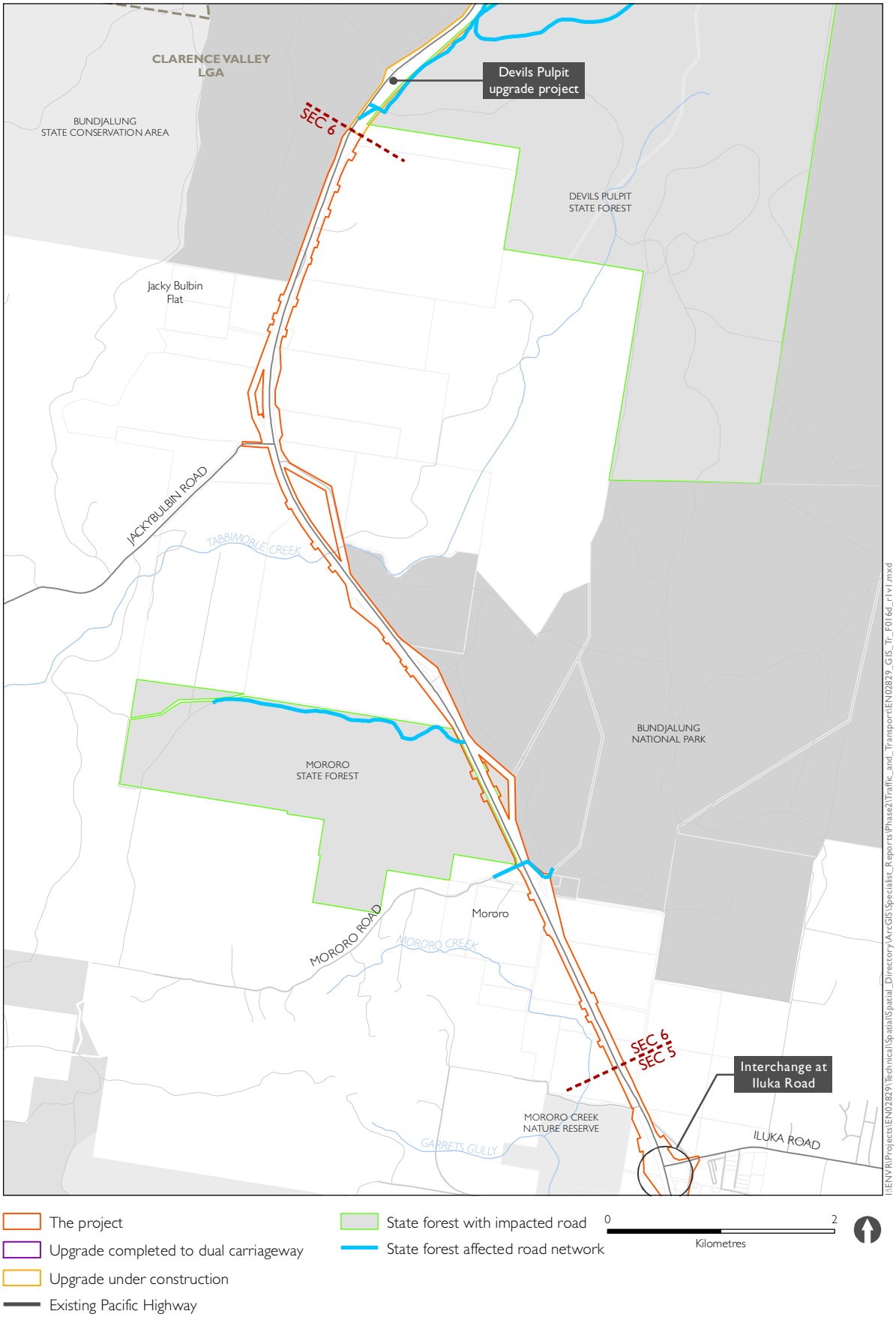
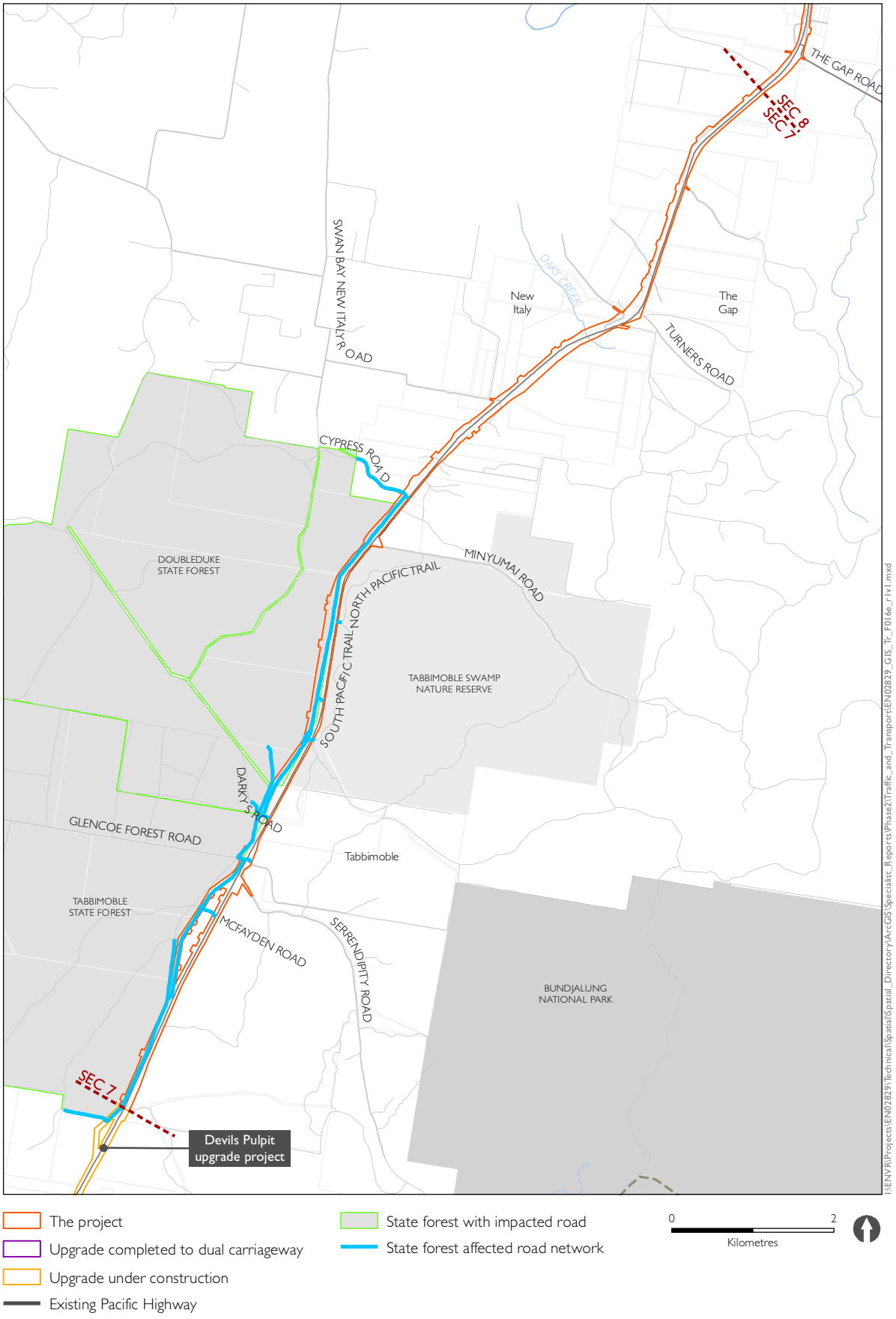


Figure 3-15 State forest road network alterations: Section 7 - Devils Pulpit upgrade to Trustums Hill



3.4.12 Impacts on maritime use

Low level bridges exist across the Richmond and the Clarence Rivers. Opening for maritime traffic is relatively rare; the bridge at Harwood is only opening some 13 times/month. The existing bridges would be retained and continue to be opened as necessary.

The intention is to not obstruct the navigational channel during operation. The bridge design over the Richmond and the Clarence Rivers would allow for continued use of the rivers by maritime traffic once built. They are both high level bridges, and would not be opening. The Richmond River bridge would have 15 metres clearance to road deck, while the Clarence River bridge would have 30 metres clearance to road deck.

Bridge design would be advertised to the maritime community (under the Roads Act) so they are aware of design developments and can provide comment on the proposals. This would be prior to project approval being granted, but post environmental impact statement submission and exhibition.

4 Construction traffic

4.1 Project staging

In November 2011, the NSW Government made a submission to Infrastructure Australia stating that the completion of the Pacific Highway Upgrade Program by 2016 was one of its top three key transport infrastructure priorities and "*will bring a range of economic, travel time and safety benefits to this important national corridor".*

The submission noted the approach being taken with the class A (arterial highway) to class M (motorway) staging strategy and that flexibility exists in how the construction would be packaged and procured to suit the funding profile and priority.

The submission included staging for the completion of a dual carriageway upgrade between Woolgoolga and Ballina by the end of 2016 based around the estimated construction period to complete the various project sections.

The grouping of the eleven project sections within the overall construction staging strategy is based on the advised durations in the submission, and would be as shown in Table 4-1.

Table 4-1 Delivery stages based on the Infrastructure Australia submission

Priority	Construction period (estimated)	Project sections
Stage 1	3.5 years	Section 4 - Tyndale to Maclean
		Section 5 - Maclean to Iluka Road
		Section 6 - Iluka Road to Devil's Pulpit
Stage 2	3 years	Section 3 - Glenugie to Tyndale
		Section 8 - Trustums Hill to Broadwater National Park
		Section 9 - Broadwater National Park to Richmond River
		Section 10 - Richmond River to Coolgardie Road
		Section 11 - Coolgardie to Ballina Bypass
Stage 3	2 years	Section 1 - Woolgoolga to Halfway Creek
		Section 2 - Halfway Creek to Glenugie
		Section 7 - Devil's Pulpit to Trustums Hill

Within the overall framework shown in Table 4-1, a high degree of flexibility would be required to effectively respond to changing circumstances as they arise, particularly variations in the available funding.

Earthworks management would be given a high priority to ensure that the best use is made of the materials available from the cuttings within the project to reduce the need to obtain materials from sources outside the project. This would involve the transfer of large quantities of earthworks materials between project sections, given the imbalance of available material along the project.

While the completion of the project sections would generally follow the staging shown in Table 4-1, it is likely that earthworks construction would be carried out within the stage 2 projects (Sections 8, 9, 10 and 11) concurrently with the construction of Section 3 to maximise the use of the material available from the large cuttings at the northern end of this section, reducing the need for stockpiling and / or double handling of the large quantities involved.

4.2 Haulage vehicle activity

Construction of the project would require substantial quantities of materials including:

- Earthworks materials, such as topsoil, general fill material, select fill for use in the Selected Material Zone (SMZ) and verge, bridging layers and drainage layers
- Aggregates for drainage construction, concrete and asphalt production and spray seals
- Sand for drainage construction and concrete and asphalt production
- Concrete for drainage construction, pavement construction, bridgeworks and miscellaneous works such as barrier kerbs, kerbs and gutters, paving and signpost footings
- Bitumen for spray seals and asphalt production
- Cement and fly ash for concrete production
- Road base for the construction of flexible pavements
- Precast concrete elements for drainage construction (culverts, pits and headwalls), bridge construction (bridge piles, girders and parapets) and miscellaneous works
- Steel for bridge girders, barrier railings and reinforcement in concrete.

The expected haulage vehicle activity for each of the eleven sections has been developed in detail and is summarised below in Table 4-2, and presented in further detail in Section 4.6.

Indicative haulage routes have been identified and are presented in Figure 4-1.

Substantial quantities of earthworks materials would be hauled along the existing highway to maximise the use of the material from the cuttings for the construction of embankments and to minimise the need for imported materials from local quarry resources. Some earthworks materials would also be hauled along existing roads due to access constraints along the road formation or for safety reasons (see Table 4-2).

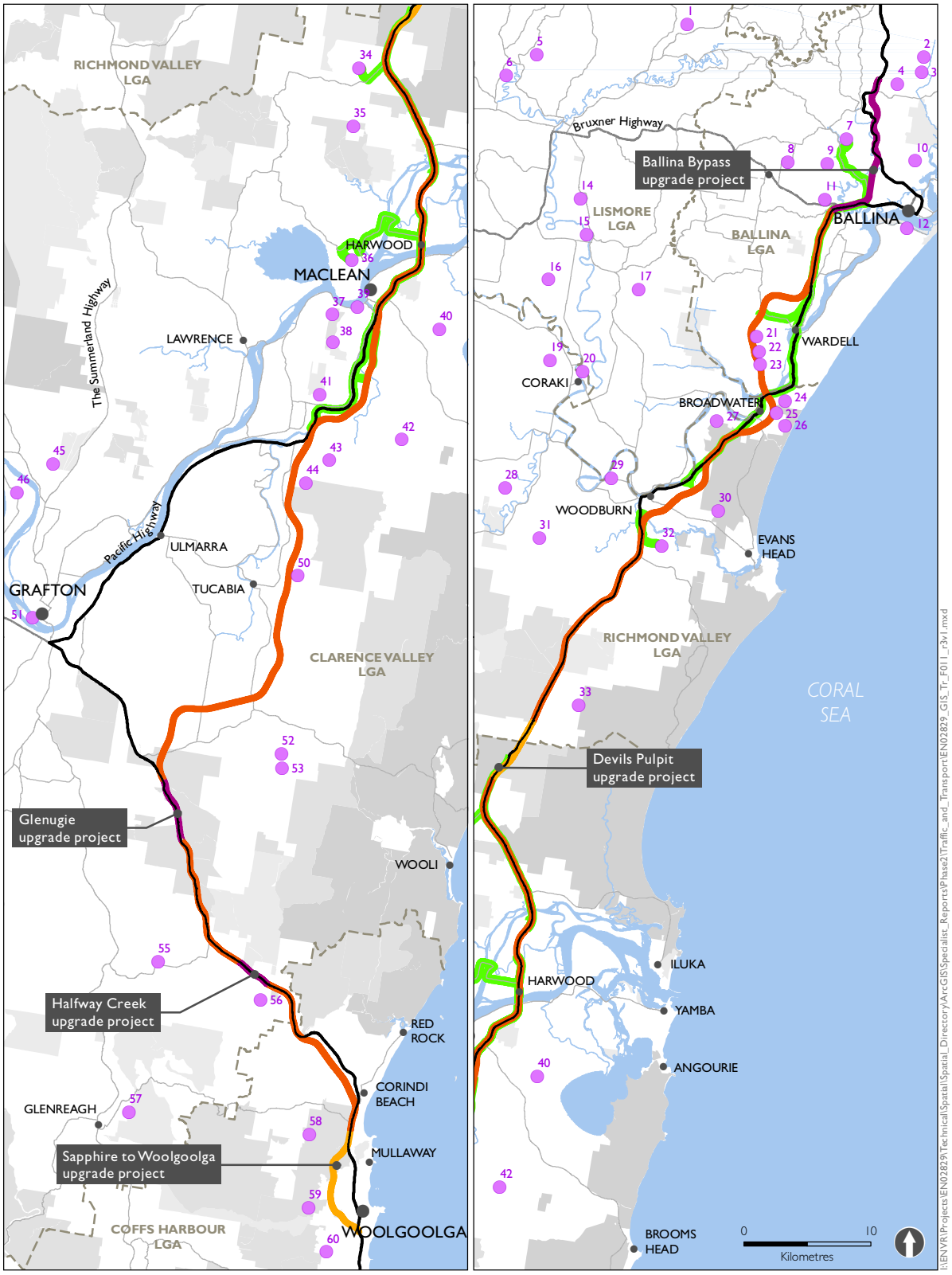
Table 4-2 Haulage of earthworks materials on local roads

Estimated quantity (m3#)		Haulage details		Local road used / Truck trips #
(bank)	(loose)	From	To	
Section 1				
65,000	70,000	Dirty Creek Range	South of Corindi Creek	Corindi Access Road / 5,800
Section 8				
80,000	100,000	South of Woodburn interchange	North of Tuckombil Canal	Local access road north of Tuckombil Canal / 8,300
Section 9				
30,000	35,000	Section 3	Section 9	Broadwater Evans Head Road / 2,900

#: The quantities are rounded to the nearest 5,000 metres[3].

In addition to earthworks materials sourced from within the project, substantial quantities of materials would need to be imported from local quarries. These materials would be hauled along local roads from the quarries and along the existing highway to the various construction sites and batch plants along the length of the project.

Figure 4-1 Indicative haulage routes



The project
Upgrade completed to dual carriageway
Upgrade under construction
Existing Pacific Highway
Indicative haulage routes
Quarry locations

Earthworks haulage along the above local roads would be required for the following reasons:

- In Section 1 haulage along the road formation would not be available across Corindi Creek until the new bridge is constructed, but the rock fill material would need to be placed before the construction of the southern bridge abutment could start
- In Section 8 haulage along the road formation would not be available across the Tuckombil Canal until the new bridge is constructed, but the rock fill material would need to be placed for the soft soil treatment prior before the construction of the northern bridge abutment could start
- In Section 9 haulage of earthworks material into the construction site directly from the existing highway immediately north of the Richmond River crossing would not be safe and access would need to be by the existing intersection with Broadwater Evans Head Road.

The overall shortfall in earthworks materials across the project, estimated at 315,000 metres^3, would also need to be imported from local quarries unless a substantial new borrow area is identified within the project as the source for this material.

The construction of the initial class A and class M upgrade by the end of 2016 would require construction activities to be underway on all project sections concurrently. This would significantly increase the demand on local quarries, particularly during 2015 and 2016 when pavement construction would be in progress across all project sections, and the demand could exceed the capacity to supply.

The earthworks management approach would limit the demand on local quarries to supply general fill and select fill materials. The demand for the supply of road base materials would be reduced by recycling existing pavement materials wherever practicable.

4.2.1 Haulage of materials along existing roads

Indications from the 2011 traffic surveys and growth forecasts to opening (2016) indicate that the Pacific Highway has adequate capacity to absorb construction traffic without any deterioration in Level of Service.

Construction haulage along local roads is minimal, and whilst it will create a substantial relative increase, it is off a negligible base. This might trigger some community concern but will be not impact Levels of Service. Safety issues will need to be monitored. As part of detailed construction management, condition surveys will need to be undertaken once detailed routing is determined. These will need to monitor road, asset and traffic conditions, and be repeated during the construction period, as well as at completion to ensure that the roads are returned to their pre-construction condition.

Haulage of earthworks materials along the existing highway

Based on the earthworks management strategy detailed in Section 4.2, there would be no haulage of earthworks materials through the various towns along the project other than along the existing highway, except for the quantity of material hauled along Broadwater Evans Head Road.

The haulage of earthworks materials outside the road formation is summarised in Table 4-3.

Table 4-3 Haulage of earthworks materials outside the road formation

Estimated quantity (m3 #)		Haulage details		Approximate distance / Truck trips #
(bank)	(loose)	From	To	
65,000	70,000	Section 1 (Dirty Creek Range)	Section 1 (south of Corindi Creek)	10 km to 15 km along the road formation, Corindi Access Road and highway / 5,800
90,000	100,000	Section 1	Section 2	10 km to 15 km / 8,400
30,000	35,000	Glenugie	Section 2	15 km / 2,900
145,000	160,000	Section 3	Section 2	20 km / 13,400
10,000	10,000	Section 3	Glenugie	10 km / 800
695,000	810,000	Section 3	Section 5	35 km to 45 km / 67,500
715,000	840,000	Section 4	Section 5	10 km to 15 km for General Fill Material and up to 45 km for Select Material and Verge Material / 70,000
275,000	325,000	Section 3	Section 6	35 km to 45 km / 27,200
25,000	30,000	Devils Pulpit	Section 6	40 km / 2,500
30,000	35,000	Devils Pulpit	Section 7	5 km to 10 km / 2,900
125,000	150,000	Section 3	Section 7	50 km to 60 km / 12,500
15,000	20,000	Section 8	Devils Pulpit	30 km / 1,700
80,000	100,000	Section 8 (south of Woodburn interchange)	Section 8 (north of Tuckombil Canal)	4 km along road formation, existing highway and access road north of canal / 8,300
70,000	80,000	Section 8 (south of Woodburn interchange)	Section 8 (north of Macdonalds Creek)	10 km along road formation and existing highway / 6,700
790,000	960,000	Section 3	Section 9	70 km to 85 km / 80,200
245,000	295,000	Section 3	Section 10	80 km to 95 km / 24,600
80,000m^3	95,000	Section 10	Section 11	10 km / 7,900

#: The quantities are rounded to the nearest 5,000 metres ^{3}. *: The number of truck trips is based on road trucks of 12 metres^3 capacity and rounded to the nearest 100 trips. These estimates may be subject to change through further refinement of the vertical alignment, and from shorter hauls (<20 kilometres).

As noted in Section 4.2 and Table 4-3, a large quantity of earthworks materials would need to be hauled along the existing highway from the cuttings in the northern part of Section 3 for the construction of the embankments, Select Material and verge in the project sections north of Maclean.

To minimise the impact of the haulage operation on existing highway traffic, the overall net shortfall in earthworks material across the project, estimated at 315,000 metres^3 (bank), would be imported from local quarries around Ballina and Wardell for use in Section 11.

The total estimated quantity of earthworks materials (general fill , Select Material and verge material) to be hauled north along the existing highway from Section 3 for use in Sections 5, 6, 7, 9

and 10 would be 2,130,000 metres^3 (bank), about 2,540,000 metres^3 (loose), involving about 212,000 truck movements.

Based on the project staging outlined in Table 4-1, the indicative start dates, duration of haulage operations and average number of truck trips per day for the movement of the material from Section 3 to Sections 5, 6, 7, 9 and 10 are shown in Table 4-4.

Table 4-4 Estimated timing of haulage operations north along highway from Section 3

Haulage details #		Indicative haulage duration	Average truck trips/day (estimated)
From	To		
Section 3	Section 5	12 month	280
Section 3	Section 6	6 months	230
Section 3	Section 7	3 months	210
Section 3	Section 9	18 months	230
Section 3	Section 10	9 months	170

#: Based on the details in Table 4-4, 20 haulage days per month and rounded to the nearest 10 trips.

This would result in increased truck volumes on the existing highway during approved working hours. The estimated number and duration of additional truck movements along the highway at the townships of Harwood, Woodburn and Wardell are shown in Table 4-5.

Table 4-5 Estimated increase in average daily truck volumes on existing highway (indicative only)

Traffic levels (vehicles/day)	Harwood (Section 5)	Woodburn (Section 8)	Broadwater (Section 9)	Wardell (Section 10)
Current (all vehicles)	11,711	8609	9030	9735
Current (heavy vehicles)	2413	2226	2233	2223
Predicted maximums, subject to timing and routing	910	400	160	170

#: Based on Table 4-4, 20 haulage days per month and rounded to the nearest 10 trips.
**: Interpolated modelled forecast*

The actual timing and duration of the haulage operations from Section 3 would depend on the actual construction staging strategy adopted for the northern project sections, the availability of road trucks to move the quantities involved and the timing of the embankment construction operations in Sections 5, 6, 7, 9 and 10.

The impact of construction haulage vehicles will be apparent, but overall volumes will not be such as to deteriorate from entirely acceptable Levels of Service.

Haulage of quarry sourced materials along the existing highway

An estimated 3.46 million tonnes of road base, sand and aggregates would need to be sourced from local quarries for the construction of the project in addition to an estimated shortfall of 315,000 metres^3, about 0.58 million tonnes, of earthworks materials.

These materials would need to be brought from the source quarries to the various construction sites and batching plants by road trucks along the existing highway.

Based on delivery by semi-trailers and / or trucks with dog trailers with an average capacity of 25 tonnes, the movement of these materials would involve an estimated 162,000 truck movements, although the actual number of additional truck movements at any given location would be substantially lower than this, depending on the locations of the source quarries.

Haulage of cement and fly ash along the existing highway

An estimated 0.36 million tonnes of cement and fly ash would be required for the production of concrete for the pavement, drainage and bridge construction for the project.

These materials would need to site by road tankers along various section of the existing highway to the site batch plants. Based on delivery by tankers with an average capacity of 25 tonnes, the movement of these materials would involve an estimated 14,400 truck movements.

Haulage of materials to site batch plants along local roads

While the majority of site asphalt and concrete batching plants for the production of concrete and asphalt for pavement construction can be accessed directly from the existing highway, the sites listed in Table 4-6 would involve the delivery of materials to the site batch plants along local roads. This list is indicative and could be subject to change in response to detailed design, and traffic routing arrangements agreed via community consultation.

Table 4-6 Delivery of materials to site batch plants via local roads

Project section	Site No. #	Local road used for material deliveries – potential route option
Section 1	Site 1a	Kangaroo Trail Road
Section 1	Site 2	Post Office Lane and local access track
Section 2	Site 1b	Lemon Tree Road
Section 2	Site 5	Parker Road
Section 3	Site 1	Local access road
Section 3	Site 3a	Eight Mile Lane and Avenue Road
Section 3	Site 4	Eight Mile Lane and Wooli Road
Section 3	Site 8	Tucabia Road and a local access road
Section 3	Site 9	Coldstream Road (Tucabia Road)
Section 3	Site 10	Sheeys Lane
Section 4	Site 3	Shark Creek Road and access track
Section 4	Site 4c	McIntyres Lane
Section 5	Site 1	Farlows Lane
Section 5	Site 3b	Watts Lane
Section 8	Site 2b	Alfred Street, Wagner Street and Woodburn Evans Head Road, or Norman Street and Woodburn Evans Head Road
Section 9	Site 3	Evans Head Broadwater Road

Project section	Site No. #	Local road used for material deliveries – potential route option
Section 10	Site 3a	Wardell Road, Hillside Lane and local access road
Section 10	Site 5	Coolgardie Road
Section 10	Site 6	Local property access
Section 11	Site 1a	McAndrews Lane and Sartories Road
Section 11	Site 2	Pimlico Road

Batching plants would be established on site to produce concrete for pavement construction in all project sections except Section 11 which has only flexible pavements.

For typical concrete pavement construction rates of between 1,000 metres^3 and 1,500 metres^3 per day, between 2,500 tonnes and 3,500 tonnes of aggregate, sand, cement and flyash would need to be delivered to the site concrete batch plant daily to maintain these production rates. This would require between 100 and 150 trucks per day assuming the delivery trucks (sand and aggregates) and tankers (cement and flyash) have an average 25 tonne capacity.

Batching plants would also be established on site in Sections 3, 4, 5 and 8 (and possible also Sections 10 and 11) to produce asphalt for pavement construction.

For typical asphalt placing rates of between 500 tonnes and 1,000 tonnes per day, up to 40 trucks (comprising bitumen tankers and sand and aggregate delivery trucks) would be needed to deliver the required materials to the site asphalt plant to maintain the daily production rates, based on trucks and tankers with an average 25 tonne capacity.

4.3 Construction workforce

The full-time site-based construction workforce would comprise professional staff, administration staff, supervisors, tradesmen, plant operators, truck drivers, unskilled labour and subcontractors, with the number and composition being dependent on the size of the section under construction and the activities underway at any given time.

Apart from a core workforce comprising a range professional staff, supervisors, tradesmen and plant operators that would typically be sourced from within the constructor's own organisation, much of the construction workforce would be expected to be sourced from within the local area. This would include a wide range of subcontractors and suppliers, although specialist subcontractors and materials suppliers would typically be sourced from outside the local area.

The total full time workforce is anticipated to peak at around 4300 in the third quarter of 2015 The actual construction workforce numbers would vary over time and be influenced by the nature and combination of construction activities underway and the construction staging strategy adopted for the project.

4.4 Impacts during construction

4.4.1 Impacts of construction work vehicles and haulage vehicles

Details of haulage vehicle movements and the estimated construction workforce for each section of the project are provided in Sections 4.2 and 4.3 respectively. Existing traffic is most likely to be impacted where haulage routes/construction site accesses intersect with existing roads. Where volumes of construction work vehicles/haulage vehicles entering and exiting the road network are expected to have an impact on traffic flows, temporary intersections with appropriate auxiliary turning lanes would need to be provided. Through traffic would be able to deviate around vehicles waiting to turn, thus maintaining traffic flow, and safety would be improved by removing stationary turning vehicles from the through traffic lane.

4.4.2 Impacts on local roads & fire trails

The overall impact of construction activity is anticipated to be minor, as construction would generally be undertaken clear of existing traffic. Temporary traffic management arrangements would be in place to maintain traffic operation on the sections that are in use as local roads. Details of construction activities and road user delay in respect of specific construction routing and local network are provided in Section 4.6.

4.4.3 Impacts on property access

Access to properties and local roads would be maintained throughout the construction of the project, although interruptions to access would be required at various times. Any such interruptions would be for short periods and by agreement with the affected property owners and / or relevant agencies.

4.4.4 Impacts on cyclists and pedestrians

The construction activity would require the narrowing of the road shoulder which may impact on cyclists passing through the work site. Cyclists would need to move into the traffic lane as they travel through the work site. Given the rural nature of the road, it is expected that cyclist volumes would be low and the overall delay is anticipated to be relatively minor. No remedial measures are proposed.

Pedestrians travelling through the worksite would be guided to cross the road at designated locations where required. This may cause minor delays but given the very low pedestrian volumes using the Pacific Highway, this is not considered to be a significant issue. No remedial measures are proposed.

4.4.5 Impacts on bus operations

There would be minimal disruption to existing passenger and school bus routes during construction as the existing highway would be retained for local access and would be available throughout the construction period.

4.4.6 Impacts on emergency vehicles

The construction activity would have only minor impact on emergency vehicles, as vehicular access along the Pacific Highway would be maintained. Access to State forests and other

important assets has been retained. No remedial measures are proposed, however, emergency services would be kept fully informed of changes to traffic arrangements throughout the various construction stages of the project.

4.5 Mitigation and management

4.5.1 Overall mitigation measures

Risks associated with traffic management during construction are typically managed by ensuring that no activity commences on site that has an effect on traffic without an approved road occupancy licence. In addition, it should be ensured that all work on site occurs in accordance with the relevant construction traffic management plan, traffic control plan and associated road occupancy licence. Safeguards in place at work sites typically include barriers, signage, beacons and traffic controllers.

Traffic control plans

Preparation and implementation of traffic control plans

All traffic control plans to be used during the construction activity would be developed in accordance with Australian Standard 1742.3 and RMS's Guide to Traffic Control at Work Sites by a suitably qualified person.

A traffic control plan can only be prepared by a person who has undertaken and successfully passed RMS's Traffic Control at Work Sites Manual training course and holds current certification.

Relevant reference documents include:

- Australian Standard AS1742.3 – 2009, Manual of uniform traffic control devices – Traffic control for works on roads
- RMS, Guide to Traffic Control at Work Sites, Version 4 (2010)
- RMS, QA Specification G10 Control of Traffic, Edition 4/Revision 2 (2005)
- Austroads, Guide to Traffic Management Part 3: Traffic Studies and Analysis (2009).

All work sites and traffic control plans would be implemented as per the authorised traffic control plan for the appropriate stage of works by suitably qualified personnel.

Inspection of roadwork traffic schemes

The requirement to inspect traffic control schemes is stipulated in Section 6 of the RTA's Guide to Traffic Control at Work Sites and Appendix A of Australian Standard 1742.3. There are three main types of inspection:

- Pre-start and pre-closedown inspections of short-term traffic control
- Weekly inspections of long-term traffic control
- Night inspections of long-term traffic control.

The checklist provided in RMS's Guide to Traffic Control at Work Sites is generic and can be used for all three types of inspection.

The responsibility and frequency of inspections is included in Section 6.1 of the RMS's Guide to Traffic Control at Work Sites and is summarised in Table 4-7.

Table 4-7 Traffic control plan inspections

Inspection type	Responsibility	Frequency
Pre-start and pre-finish	Works supervisor	Daily
Weekly audit	Site supervisor	Twice a week
Night audit	Site supervisor	Once a week
Pre-opening	Traffic engineer	Prior to opening any new temporary roadwork site or major adjustment

Vehicle movement plans

In accordance with G10, vehicle movement plans (VMPs)and appropriate haulage routes would be developed:

- Drivers would be inducted to VMPs to ensure that they keep to nominated routes
- Deliveries would be timed to occur outside peak traffic periods
- Queuing on the highway would be avoided by the use of two-way radios to call up haulage trucks from layover areas on a 'just in time' basis.

Road occupancy licence

Applicants are required to prepare submissions for a road occupancy licence and complete the RMS's application form.

Applications for a road occupancy licence should be submitted to the RMS and the relevant local government area(s) at least ten working days prior to the proposed occupancy. The RMS and / or councils would grant or reject the application within this period.

Traffic control arrangements must provide sufficient capacity to accommodate the expected traffic volumes during the period of occupancy. The RMS and / or councils would not grant approval for those activities that would not satisfy this requirement.

4.5.2 Road user delay management

Objectives

The main objective of a road user delay management study is to ensure that throughout the project lifecycle (including construction and ongoing maintenance phases), due consideration is given to minimising road user delays.

Definition of delay and road occupancy

RMS's Pacific Highway Office has developed guidelines for road user delay management[6][7][8] for road projects along the Pacific Highway. The guidelines identify specific methods to minimise road user delays throughout the construction and maintenance phases of a project.

Work site delay

The definition of work site delay adopted for this project is:

"The difference between a driver's travel time through a section of road under normal conditions, and the travel time experienced when roadworks are in progress".

Delays involve an economic cost, which is reflected in the amount people are prepared to pay to avoid the delay. Costs may be determined from standard rates published in the RMS's *Economic Analysis Manual* (1999a).

Road occupancy licence

Road user delays are caused when there is some occupation of the Pacific Highway that would normally be available to general traffic. A road occupancy licence is required for any proposed construction or maintenance work that would affect general traffic flow in the following manner:

- Slowing or stopping of traffic along the Pacific Highway
- Diverting Pacific Highway traffic away from its normal course along the road carriageway, including lane closures, turning restrictions, detours and diversions
- Occupation of any portion of the Pacific Highway that is normally available for traffic, including road shoulders.

Protocols for the application and issuance of a road occupancy licence are detailed in Section 4.5.1.

Evaluation of road user delays

RMS Guidelines on the evaluation of road user delays detail several key elements that should be addressed when undertaking any study.

No specific estimates or calculations in regards to travel delay and delay cost have been undertaken in this study.

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[6] Requirements for Project Development and Detailed Design Work Briefs: Pacific Highway Road User Delay Management, Pacific Highway Development Office, RTA, May 1999.
[7] Road Occupancy Licensing Guidelines: Pacific Highway Road User Delay Management, Pacific Highway Development Office (RTA, 1999b).
[8] Pacific Highway - Managing the Impact of Delay, (RTA, 1997).

Each of the eleven sections within the project have been analysed separately in regard to any expected delay issues.

Work site considerations

Safe provision for traffic must be made at all work sites:

- Delays to traffic at each work site would be minimised
- Works would be coordinated to ensure that road users do not encounter several delays in quick succession
- A well-informed driver is likely to be more successful in avoiding delays and be more tolerant of unavoidable delays. Road users would therefore be kept informed, through a comprehensive communications strategy utilising Variable Message Signs, the media, brochures placed in service centres etc, about:
    - The locations of works
    - The delays they are likely to encounter
    - Any alternative routes which might be suitable, to allow them to make informed decisions about whether to travel, when to travel, and which route to use.

Pavement considerations

Current pavement design policy for the upgrading of the Pacific Highway specifies that a high-strength 10m wide pavement (consisting of a 2.5m shoulder, 2 x 3.5m travel lanes and 0.5m median shoulder) would be constructed. The pavement design requires that the same pavement is used under the road shoulders as on the trafficable lanes. As such, the wider shoulders can accommodate future traffic loading during maintenance activities.

When pavement design parameters are being established, the likely delay costs during future routine maintenance must be identified and estimated. This ensures project decisions consider the cost impact of future maintenance as well as those expected during the construction phase.

Design considerations

Consideration would be given to minimising the need to occupy any areas of the existing trafficked roadway during the lifecycle of the road asset. This ensures thought is given to avoid unnecessary traffic delay not only during the construction phase, but also considers the future impact of maintenance activities. To address these issues, the RMS Guidelines for road user delay management specify all briefs for detailed design work would contain the following:

- Whenever economically feasible, the final alignment is to avoid encroaching on existing trafficked roadway
- Construction staging plans must be developed, where necessary to ensure the capacity of the roadway is maximised
- Consideration must be given to the future maintenance of traffic control devices and roadside furniture to ensure the potential road occupancy and road user delays are minimised.

These Guidelines would provide input at the time the project is progressed to the detailed design stage.

Bridge considerations

Narrow clearances associated with bridge structures have the potential to present a serious impediment to diverted traffic during maintenance activities, and to cause significant additional future costs when road widening is required.

RMS has recommended that during the final design of any bridge structures, the costs associated with providing sufficient width on a highway bridge or sufficient lateral clearance of an overbridge to accommodate vehicular access during future maintenance activities and possible future widening must be estimated.

It has been assumed that all new bridges constructed for the project would adhere to the standards established by RMS for Pacific Highway Upgrade projects. Stringent quality management during both the concept and final design stages of the project would ensure continual compliance with RMS standards.

Road user delay conclusion

The overall travel delay expected by the project is likely to be minimal due to the isolation of the majority of works. Where possible, the preferred route is either at a distance from the current highway alignment or duplicated adjacent to the existing roadway.

Delay may be experienced at the various tie-in points along the length of the works where interchanges between the project and the existing Pacific Highway would be constructed. Construction staging would be developed to ensure the existing number of trafficable lanes is maintained at all times. Newly constructed work and / or temporary pavement would be used to provide suitable sidetracks and detours with an appropriate design speed to minimise delays to road users. Motorists using local roads interfacing with the existing highway and/or the new alignment could also experience possible delays.

Traffic management plans and staging would be progressively developed, refined, audited and amended as required during the progression of the works to facilitate the safe and efficient movement of traffic through and around all intersections, construction zones and local road networks impacted by the work.

The passage of trucks servicing the project is not expected to adversely affect existing road networks or the access of other vehicles to the network. Regular review of the usage of local roads by construction vehicles would be carried out by personnel supervising the works, and adjustments made to traffic control plans as required. This would include locations associated with vehicle passage, manoeuvring of vehicles and site access points. These areas are expected to have the most impact.

4.5.3 Maritime delay management

The bridge design over the Richmond and the Clarence Rivers would allow for continued use of the rivers by maritime traffic once built. They are both high level bridges, and would not be opening. The Richmond River bridge would have 15 metres clearance to road deck, while the Clarence River bridge would have 30 metres clearance to road deck.

Bridge design would be advertised to the maritime community (under the Roads Act) so they are aware of design developments and can provide comment on the proposals. This would be prior to project approval being granted, though post environmental impact statement submission and exhibition.

Delays to maritime users will depend on detail construction planning and maritime traffic management that would in turn be dependent on detail design. A number of bridge options are available, and once determined in conjunction with the maritime community, construction planning can be developed. The key commitment is that river navigation will be maintained. (see also Section 3.4.12.)

4.6 Construction activity and road user delay

This Section combines construction activity and road user delay for each section of the project.

Individual construction traffic levels will be dependent on final detail design, whole-of-project scheduling, and final works programming for each section of the project. Construction traffic is identified below, however daily volumes reflect construction timing. These characteristics would need to be refined in conjunction with detailed design development as part of construction management specific for each Section.

4.6.1 Section 1 – Woolgoolga to Halfway Creek

The alignment for this section of the project would be as follows:

- Between Arrawarra Beach Road and Eggins Close, the alignment would follow the existing highway alignment. A northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway
- Between Eggins Close and Range Road, the alignment would deviate to the west of the existing highway, bypassing the village of Corindi. The alignment would re-join the existing highway alignment immediately prior to Range Road
- Between Range Road and Halfway Creek, the alignment would follow the existing highway alignment. A northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway.

Construction

- Haulage of materials would generally be along the new formation, with some haulage along the Pacific Highway and local roads. The use of local roads for the haulage of earthworks and plant would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site
- About 65,000 metres^3 of general fill material would need to be hauled from the cuts north of the Corindi River for the construction of the embankments south of Corindi Creek (assuming fill material for the construction of the embankment between Corindi Creek and Corindi River is

hauled along the new alignment from the north). This quantity would reduce to 15,000 metres^3 if 50,000 metres^3 of drainage blanket material was imported from external quarry sources for the construction of the embankment foundations across the Corindi River flood plain

- The adopted haulage route would depend on the source of the fill material as follows:
  - Range Road cuts (130,000 metres^3 available): Trucks would exit the construction site at the Range Road interchange area, travel south along the existing highway, turn at the Arrawarra interchange and enter the construction site from the northbound carriageway. This route would involve a round trip of around 20 kilometres and would avoid the use of local roads
  - Dirty Creek cut (1,200,000 metres^3 available): Trucks would travel south along the new formation, exit the construction site via the new Corindi Access Road to the existing Pacific Highway, travel south along the highway and enter the site via Kangaroo Trail Road. This route would involve a round trip of around 13 kilometres with travel along parts of two local roads
- Drainage blanket material sourced from external quarries (or from the cuttings in other sections of the project) would be hauled along the existing highway with the point of entry to the construction site as follows:
  - Via Kangaroo Trail Road for material to be used south of the Corindi River (25,000 metres^3)
  - Via the new Corindi Access Road for material to be used north of the Corindi River (25,000 metres^3)
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. It is proposed that haulage of materials would be:
  - From the existing highway via Kangaroo Trail Road
  - From the existing highway and via Post Office Lane and a local road
  - Directly from the existing highway.

Road user delay

Due to separation of the duplication between Arrawarra Beach and Eggins Close, and between Range Road and Halfway Creek, it is expected that construction works associated with these parts of Section 1 would not impose significant delays to Pacific Highway motorists. On other parts of Section 1, it is envisaged that delay points would occur at the two tie-in locations between the existing highway and the new alignment (Eggins Close and Range Road). It has been assumed that 'construction speed zones', which would be a reduction to the existing speed limit, would be introduced at the two tie-in locations. Works would be staged to enable traffic to be routed around the work site using temporary pavement and/or new pavement. Temporary traffic arrangements would be designed so that the maximum safe speed zoning can be retained. Speed zone restrictions and all other traffic control measures would need to comply with RMS's Traffic Control at Worksites Manual.

In order to reduce the expected delay to motorists during construction, these two identified tie-in points would be carried out at different stages of the project, thereby having only one 'construction speed zone' in operation at any one time throughout the project lifecycle.

Temporary traffic arrangements would be required for the haulage of material from north of Corindi River to the embankments south of Corindi River as access along the new formation would not be available until the bridges have been constructed. Based on the identified haulage routes (see Section 4.2), the following works may be required:

- Temporary traffic management for access to the existing highway at the Range Road interchange area
- Temporary traffic management and / or improvements to the Corindi Access Road / existing highway intersection
- Temporary traffic management and / or improvements to the Kangaroo Trail Road / existing highway intersection.

Impacts on local roads in Section 1 that are to be altered as part of the project and may experience some delays are detailed below:

- Kangaroo Trail Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor and cross the new formation near the cut / fill line either north or south of the cutting. The side track would be to a similar standard to the existing road
- The realignments of both Sherwood and Corindi Access Road would be constructed clear of traffic with temporary traffic measures required for the construction of the connections to the existing alignments
- Other local roads, including the upgrade of Eggins Drive would be constructed under local traffic with appropriate traffic management arrangements in place
- The construction of the overpass at Grays Road as part of the full upgrade to class M would require the new bridge to be constructed over the operating highway. This would require lane closures during construction and short term closures of each carriageway during the erection of bridge girders and for some deck construction activities. Traffic flow would be maintained during the closure of one carriageway by diverting traffic to the other carriageway in a contra-flow arrangement.

4.6.2 Section 2 – Halfway Creek to Glenugie

The alignment for this section of the project would be as follows:

- From Lemon Tree Road to Kungala Road, the upgrade would follow the existing highway alignment. A new northbound carriageway would be constructed on the western side of the existing highway, and the existing highway would become the new southbound carriageway
- From Kungala Road to Newfoundland State Forest, northbound and southbound carriageways would be constructed, with the new carriageways closely following the existing highway alignment
- From Newfoundland State Forest to Franklins Road, the upgrade would deviate to the east of the existing alignment.

Construction

- Haulage of materials would generally be along the new formation, with some haulage along the Pacific Highway and local roads. The use of local roads for the haulage of earthworks and plant would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site or via the existing highway
- The haulage of material from the large cuttings at the northern end of Section 2 for embankment construction south of Wells Crossing would be along the formation if the haulage occurs after the construction of one of the twin bridges, or along the existing highway using road trucks if haulage occurs prior to the bridge construction
- The haulage of material from adjoining sections or external quarry sources to make up the shortfall in general fill, Select Material and verge material would be along the existing highway using road trucks
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - Directly from the existing highway
    - From the existing highway via Lemon Tree Road
    - From the existing highway via Parker Road.

Road user delay

Construction of Section 2 would pose no major delays to motorists due to separation of the duplication from the existing highway. It is envisaged that some delays would occur at the one tie-in location (Kungala Road). Traffic management procedures and protocols that would be adopted at the tie-in locations in Section 1 would apply to the tie-in location in Section 2.

Temporary traffic arrangements would be required for the haulage of material from the cuttings at the northern end of Section 2 along the existing highway for use in embankment construction south of Wells Crossing at the entry and exit points from the construction site.

The construction of the overpasses at Lemon Tree Access Road (station 17.8), Bald Knob Tick Road (station 25.1) and Franklins Road (station 2.8) as part of the full upgrade to class M would require the new bridge to be constructed over the operating highway. This would require lane closures during construction and short term closures of each carriageway during the erection of bridge girders and for some deck construction activities. Traffic flow would be maintained during the closure of one carriageway by diverting traffic to the other carriageway in a contra-flow arrangement.

Local roads in Section 2 that are to be altered as part of the project and may experience some delays include:

- Lemon Tree Road, Halfway Creek
- Kungala Road, Halfway Creek

- Luthers Road, Halfway Creek
- Bald Knob Tick Gate Road, Wells Crossing
- Franklins Road, Glenugie.

It is expected that these local roads would remain open as construction would be undertaken in isolation to the existing roadway in most cases. Some delays may occur at tie-in locations between existing local roads and the service road/realignments to existing local roads.

4.6.3 Section 3 – Glenugie to Tyndale

This section of the project would follow a new alignment to the east of the existing highway, bypassing the towns from South Grafton to Tyndale and passing through a mix of open grazing land and remnant bushland on the eastern side of Coldstream River. No major delays to motorists are envisaged due to the isolation of Section 3 from the existing highway.

Construction

- Haulage of materials would generally be along the new formation, with some haulage along local roads required because of the deviated alignment of the project in Section 3. The use of local roads for the haulage of earthworks and other construction materials would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site
- An estimated 145,000 metres^3 of earthworks material (general fill and Select Material) would need to be hauled from Section 3 to make up a shortfall in Section 2. This material would come from the southern end of Section 3 and be transported in road trucks along the existing highway, probably for use south of Wells Crossing
- An estimated surplus of 2,615,000 metres^3 (bank) of earthworks material (including general fill, Select Material and verge material) would be available from the northern half of Section 3 (north of Chaffin Creek) for use in other parts of the project. The haul routes adopted for this very large quantity of material would depend on its use and would be driven by the construction staging strategy adopted by RMS for the overall project delivery. Two probable options would be:
    - Material from the northern cuttings in Section 3 that is used in Section 4 south of Shark Creek (comprising drainage blanket material, general fill and Select Material) would be hauled along the new alignment by dump trucks and / or scrapers. The quantity involved could be up to 505,000 metres^3 (bank)
    - The remaining surplus, estimated at 2,110,000 metres^3 (bank), or about 2,300,000 metres^3 (loose), would be hauled via a construction access track from the northern end of Section 3 to the existing highway for use in other sections of the project
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - Directly from the existing highway
    - From the existing highway via Eight Mile Lane and Avenue Road

- From the existing highway via Eight Mile Lane and Wooli Road
- From the existing highway via Tucabia Road (Coldstream Road) and an existing access road
- From the existing highway from the existing highway via Tucabia Road (Coldstream Road).

Road user delay

Temporary traffic arrangements would be required for the haulage of material from the southern end of Section 3 while trucks are entering the existing highway to head south and turning across the existing highway to re-enter the construction site. In addition, a temporary intersection would need to be provided where the construction access road from the northern end of Section 3 connects to the existing highway. Given the volume of material that would potentially be hauled along the access road, the intersection may require turning lanes to be constructed to allow the haulage trucks and other construction delivery vehicles to enter and leave the existing highway safely.

Impacts on local roads in Section 3 that are to be altered as part of the project and may experience some delays are detailed below:

- Eight Mile Lane would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor, probably to the south of the existing road and the new overpass alignments and be of a similar standard to the existing road
- Old Six Mile Lane crosses the alignment of the project at three locations with a new overpass and two connecting roads (east and west of the road corridor) provided to maintain existing traffic access. Traffic access would be maintained along Old Six Mile Road during the construction with the actual provisions being dependent on the construction staging adopted. Options to achieve this would include:
    - Construction and opening to traffic of the connecting road on the western side of the project while maintaining the other existing crossings in operation. This would allow the construction of the new overpass at station 38.3 to proceed with Old Six Mile Lane closed either side of the bridge site
    - Construction and opening to traffic of the connecting road on the eastern side of the project while maintaining the existing crossing at station 40.0. This would allow cut excavation to proceed south of the remaining crossing
    - Construction of a side track to the north of the remaining crossing at station 40.0 to allow continuous excavation of the cutting at this location. The side track would be constructed within the road corridor and would be to a similar standard to the existing road
- Avenue Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the south of the existing road and the new overpass alignments to a similar standard to the existing road
- Wants Lane would need to be diverted clear of the Avenue Road overpass site. This would be achieved by construction of the connecting road and a connection to the Avenue Road side track
- Wooli Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the north of the

existing road and the new overpass alignments and cross the new formation near the cut / fill line. The side track would be to a similar standard to the existing road

- The Mitchell Road diversion would be constructed and opened to traffic before construction of the highway embankment started. Temporary traffic management arrangements would be implemented to allow construction traffic to cross the road during working hours. A short term full closure of Mitchell Road would be required during the erection of the bridge girders and for some deck construction activities
- Firth Heinz Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor along the western side of the formation before connecting into the existing road before it leaves the road corridor to the east. The side track would be to a similar standard to the existing road
- Bostock Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the south of the existing road and cross the new formation near the cut / fill line. The side track would be to a similar standard to the existing road
- Somervale Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the south of the existing road and be to a similar standard to the existing road
- Campbells Road (a private access road) would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the south of the existing road and cross the new formation near the cut / fill line. The side track would be to a similar standard to the existing road
- A private property access road at station 63.6 would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the south of the existing road and be to a similar standard to the existing road
- Crowleys Road would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor to the north of the existing road and be to a similar standard to the existing road
- Benson Lane would be retained in operation until the alternate access through Tyndale interchange is constructed. Benson Lane would then be closed and the cul-de-sac constructed at the end of Sheeys Lane.

4.6.4 Section 4 – Tyndale to Maclean

This section of the project would follow a new alignment to the east of the existing highway for nearly the entire length, returning to the existing highway alignment at Maclean. No major delays to motorists are envisaged due to the isolation of Section 4 from the existing highway.

Construction

- Haulage of earthworks materials would generally be along the new formation as far as possible
- Haulage of materials to stockpile sites would generally be directly from the construction site. However, local roads including McIntyres Lane and Causeleys Lane would be used to access some stockpile sites
- If drainage blanket and fill material for use in the embankment for the soft soil area north of Shark Creek (SS-02) was sourced from external quarries or from the cuttings at the northern end of Section 3, this material would be hauled along the existing highway and into the construction site via Shark Creek Road by road trucks, probably by semi-trailers or trucks with dog trailers (with a capacity of about 12 metres^3). An estimated 25,000 metres^3 (bank) of rock drainage blanket material and 60,000 metres^3 (bank) of embankment material would be required for SS-02, requiring about 8,000 truck movements for the 95,000 metres^3 (loose) of material
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - Directly from the existing highway
    - From the existing highway along Shark Creek Road
    - From the existing highway along McIntyres Lane.

Road user delay

Construction of the new connections to the existing highway at both the southern and northern ends of Section 4 would be carried out under temporary traffic arrangements, including lane closures at various times. Some works would require the complete closure of either the northbound or southbound lanes and would be done at night to minimise disruptions to traffic on the existing highway. In addition, temporary traffic arrangements would be required at the intersection of the existing highway and Shark Creek Road during the haulage of materials to the construction site along Shark Creek Road.

Impacts on local roads in Section 4 that are to be altered as part of the project and may experience some delays are detailed below:

- Byrons Lane would need to be diverted onto a temporary side track for the construction of the new overpass. The side track would be constructed within the road corridor and adjacent to the new overpass alignment, probably on the northern side. The side track would be to a similar standard to the existing road
- Norleys Lane would be retained in operation during the construction of the highway embankment and overpass bridges. Temporary traffic management arrangements would be implemented to allow construction traffic to cross the road during working hours. One or more short term full closures of Norleys Lane would be required during the erection of the bridge girders and for some deck construction activities

- Gallaghers Lane and Shark Creek Road would be retained in operation throughout the construction of the Shark Creek bridge and approach embankments, with any upgrade works carried out under local traffic with appropriate traffic management arrangements in place
- Stokes Road would be closed at the Road Reserve boundary to allow construction activities to proceed
- Temporary traffic arrangements would be required at the intersection of the existing highway and McIntyres Lane during the haulage of materials to the construction site along Shark Creek Road
- McIntyres Lane would be retained in operation until the new local road connection along the eastern side of the new highway has been constructed and opened to traffic to connect McIntyres Lane to Goodwood Road east of the new Maclean interchange. McIntyres Lane would need to be diverted onto a temporary side track to the north of the existing road to allow the excavation of the cutting to proceed. The side track would be constructed within the road corridor to a similar standard to the existing road and cross the new formation near the cut / fill line
- Goodwood Road would need to be diverted onto a temporary side track to the south of the existing new overpass embankment to allow the construction of the overpass bridge and approach embankments to proceed. The side track would be constructed within the road corridor to a similar standard to the existing road
- Jubilee Street would be retained in operation until the new local road connection along the eastern side of the new highway has been constructed and opened to traffic to connect Jubilee Street to Goodwood Road east of the new Maclean interchange. Pedestrian access would be retained throughout the construction.

4.6.5 Section 5 – Maclean to Iluka Road

The project would involve constructing either a new northbound or new southbound carriageway that would generally follow the existing highway alignment.

The alignment would cross the Clarence River via the Harwood Bridge and require construction of an additional bridge to provide the dual carriageway arrangement (in the project, this is called the Harwood Bridge duplication).

Construction

- Haulage of materials would generally be along the new formation, with some haulage along the Pacific Highway and local roads. The use of local roads for the haulage of earthworks and plant would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site. However, local roads including the connecting road off Yamba Road, Watts Lane, Chatsworth Road and Carrolls Lane would be used to access some stockpile sites

- Due to access constraints along the new alignment imposed by the Clarence River, Serpentine Channel and the Clarence River North Arm, the haulage of earthworks and other construction materials would need to be along the existing highway across these waterways until the new bridges have been constructed
- Given the large surplus of earthworks materials in Section 3 and Section 4, it is likely that the large net shortfall in this section of the project would be made up with material from these sections as follows:
    - The estimated shortfall of 265,000 metres^3 south of the Clarence River would probably be made up with material hauled from the cuttings north of Shark Creek in Section 4, with haulage along the new formation using scrapers and / or dump trucks
    - An estimated 450,000 metres^3 (bank), about 500,000 metres^3 (loose), would also be hauled from the cuttings north of Shark Creek in Section 4 along the new alignment and then along the existing highway for the construction of the embankments between the Clarence River and the Serpentine Channel (about 430,000 metres^3 (bank) shortfall) , with the balance used north of the Serpentine Channel. The haulage of this material would involve about 42,000 truck movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3)
    - The balance of the shortfall (estimated at 695,000 metres^3 (bank), about 770,000 metres^3 (loose) would be hauled along the existing highway from Section 3 for the construction of the embankments north of the Serpentine Channel. The haulage of this material would involve about 64,000 truck movements based on haulage by road trucks (with a capacity of about 12 metres^3)
- For safety reasons, the haulage of imported earthworks materials for the construction of the embankments between the Clarence River and Anderson Lane would probably enter the construction site from the existing highway via Watts Lane, rather than directly from the highway north of the river. The quantity involved would be up to 300,000 metres^3 (bank), or 330,000 metres^3 (loose), requiring around 27,000 truck movements based on haulage by road trucks (with a capacity of about 12 metres^3 loose)
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - From the existing highway along Farlows Lane
    - From the existing highway along Yamba Road
    - From the existing highway along Watts Lane
    - From the existing highway along Carrolls Lane.

Road user delay

Construction of Section 5 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants. In addition, temporary traffic improvement works may

be required at the intersection of the existing highway and Watts Road in Harwood to facilitate the haulage of earthworks materials into the construction site.

The construction of the main carriageways and ramp connections between the project and the existing highway at the Yamba interchange would involve staged construction with some works carried out under traffic using partial road closures and / or diversions at various times.

Impacts on local roads in Section 4 that are to be altered as part of the project and may experience some delays are detailed below:

- Watts Lane would need to be diverted onto a temporary side track for the construction of the new overpass and approach roundabouts. The side track would be constructed within the road corridor to a similar standard to the existing road
- The construction of the Harwood interchange would be largely done clear of existing highway traffic. However, some works for the construction of the ramp connections to the existing highway would need to be carried out under traffic using partial road closures and / or diversions at various times
- While the new service road on the western side of the project north of Watts Lane would largely be done clear of traffic, the connection to the new roundabout would need to be staged, to maintain traffic flows on the existing highway and Watts Lane
- Partial or full road closures may be required on Yamba Road, River Street and Petticoat Lane during the construction of the Harwood Bridge. The number, type and duration of these closures would depend on the construction method adopted for the new bridge. Where full road closures are required these would be done at night to minimise disruptions to traffic. Detours for local traffic during the full road closures would be considered where alternative routes exist
- Chatsworth Road / Serpentine Channel Road North would need to be diverted onto a temporary side track for the construction of the new overpass and approach roads. The side track would be constructed within the road corridor to a similar standard to the existing road
- The local road connections between Ryans Lane and Carrolls Lane, between Carrolls Lane and Fischers Road and between Garretts Lane and the Old Pacific Highway would be constructed clear of traffic, as would the realignment of the connection between Carrolls Lane and the upgraded highway
- The construction of the Iluka Road interchange would need to be staged to maintain traffic flows. Iluka Road would be diverted onto a side track to allow the construction of the overpass bridge and approaches, although the interchange ramps would largely be constructed clear of existing traffic.

4.6.6 Section 6 – Iluka Road to Devil's Pulpit

The project would involve constructing either new northbound or new southbound carriageways closely following the existing highway alignment, with minor deviations to meet design standards for road gradient and curvature.

A bridge would be built where the project crosses the Clarence River North Arm at Mororo to provide the dual carriageway arrangement for the crossing (in the project, this is called the Mororo Bridge duplication).

Construction

- Haulage of materials would generally be along the new formation, with some haulage of materials along the Pacific Highway
- Haulage of materials to stockpile sites would be directly from the construction site and the existing highway
- Due to access constraints along the project imposed by the Tabbimobil Creek and Tabbimobil Overflow channel, the haulage of earthworks and other construction materials would need to be along the existing highway across these waterways until the new bridges have been constructed
- Given the large surplus of earthworks materials in Section 3, it is likely that the net shortfall in this section of the project would be made up with material hauled from Section 3 along the existing highway. An estimated 300,000 metres^3 (bank), about 330,000 metres^3 (loose), would need to be hauled from Section 3 for the construction of the embankments, Select Material and verge in this section. The haulage of this material would involve about 27,000 movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3)
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be directly from the existing highway.

Road user delay

Construction of Section 6 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants.

The construction of the overpass connecting the eastern and western service roads (station 103.4) as part of the full upgrade to class M would involve construction of the new bridge over the operating highway and construction of the approach embankments next to the highway. This would require lane closures during construction and short term closures of each carriageway during the erection of bridge girders and for some deck construction activities. Traffic flow would be maintained during the closure of one carriageway by diverting traffic to the other carriageway in a contra-flow arrangement.

No local roads in Section 6 are to be altered as part of the project.

4.6.7 Section 7 – Devil's Pulpit to Trustrums Hill

The alignment would generally follow the existing highway with minor deviations to the west to straighten the alignment to meet design standards. Where the alignment deviates to the west, northbound and southbound carriageways would be constructed.

For the remainder of the section, a carriageway would be constructed adjacent to the existing highway, and the existing highway would be used for the other carriageway.

Construction

- Haulage of materials would generally be along the new formation, with some haulage of materials along the Pacific Highway
- Haulage of materials to stockpile sites would be directly from the construction site and the existing highway
- Due to access constraints along the new alignment imposed by the Tabbimobil Floodway No.1, the haulage of earthworks and other construction materials would need to be along the existing highway at this location until the new bridges has been constructed
- Given the large surplus of earthworks materials in Section 3, it is likely that the net shortfall in this section of the project would be made up with material hauled from Section 3 along the existing highway, with some material coming from the adjoining Devils Pulpit section (estimated at about 40,000 metres^3). An estimated 280,000 metres^3 (bank), about 310,000 metres^3 (loose), would need to be hauled from Section 3 and the Devils Pulpit section for the construction of the embankments, Select Material and verge in this section. The haulage of this material would involve about 26,000 truck movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3), with the majority of this material being required north of Tabbimobil Floodway No.1
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
  - Directly from the existing highway
  - From the existing highway via an access track along the southern edge of the site.

Road user delay

Construction of Section 7 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants.

Impacts on local roads in Section 7 that are to be altered as part of the project and may experience some delays are detailed below:

- The construction of the realignment of Serendipity Road and the construction of the new connections to Minyumai Road , Whytes Road and the existing highway (at station 123.4) would largely be done free of traffic, except for the tie-ins where temporary traffic management measures would be required
- Construction of the new service roads would generally be done clear of existing traffic, with temporary traffic management arrangements in place to maintain traffic operation on the sections that are in use as local roads
- The construction of the overpass connecting the western service road to Serendipity Road (station 114.3) as part of the full upgrade to class M would involve construction of the new bridge over the operating highway and construction of the approach embankments next to the highway. This would require lane closures during construction and short term closures of each carriageway during the erection of bridge girders and for some deck construction activities. Traffic flow would be maintained during the closure of one carriageway by diverting traffic to the other carriageway in a contra-flow arrangement
- The construction of the overpass connecting the eastern service road to Swan Bay New Italy Road (station 121.1) as part of the full upgrade to class M would require similar traffic management arrangements as outlined in 9 above, with a temporary side track also constructed to divert Swan Bay New Italy Road clear of the construction area.

4.6.8 Section 8 – Trustrums Hill to Broadwater National Park

The alignment would initially follow the existing highway alignment before deviating to the west at Woodburn interchange between Gap Road and Trustrums Hill Road. North of the interchange, the alignment would cross back over the existing highway alignment and follow a new alignment to the east, bypassing Woodburn and re-joining the existing highway alignment at the end of the section.

The upgrade of this section would involve constructing northbound and southbound carriageways.

Construction

- Haulage of earthworks materials would generally be along the new formation as far as possible
- Haulage of materials to stockpile sites would generally be directly from the construction site, although Woodburn Evans Head Road would also be used
- Haulage of material from the large cutting at the Woodburn interchange area to make up the shortfall in earthworks materials south of the Tuckombil Canal would be along the new formation, probably using scrapers and / or dump trucks
- To minimise the impact on streets within Woodburn, the haulage of earthworks material into the site for the treatment of the soft spoil area north of the Tuckombil Canal and to make up the shortfall in embankment materials, Select Material and verge material between the canal and Woodburn would be from the existing highway via the existing access road along the northern side of the canal. Including material for the treatment of the soft soil area north of the canal, an estimated quantity of 80,000 metres^3 (bank), or about 90,000 metres^3 (loose) would be

required. Haulage of this material would involve about 8,000 truck movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3)

- Haulage of material from the large cutting at the Woodburn interchange area to make up the shortfall in earthworks materials north of McDonald Creek would be along the existing highway. Based on the estimated shortfall of 70,000 metres^3 (Bank), or about 78,000 metres^3 (loose), Haulage of this material would involve about 6,500 truck movements using road trucks (with a capacity of about 12 metres^3)
- Haulage of the earthworks material obtained from the Lang Hill cutting for the construction of the embankments between the Tuckombil Canal and McDonald Creek would be along the new formation using scrapers and dump trucks. Should the Lang Hill borrow area not be available, there would be an estimated 500,000 metres^3 (bank), or about 550,000 metres^3 (loose), shortage of embankment material within this part of the project. This material would need to be imported using road trucks and would involve about 46,000 additional truck movements into the construction site from the existing highway (based on trucks with a capacity of 12 metres^3). The majority of this material would need to access the site via Woodburn Evans Head Road
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
  - Directly from the existing highway
  - From the existing highway at Woodburn via Alfred Street, Wagner Street and Woodburn Evans Head Road, or via Norman Street and Woodburn Evans Head Road
  - From the existing highway via an access road.

Road user delay

Construction of Section 8 north of the Woodburn interchange would pose no major delays to motorists due to isolation from the existing highway. Similarly, between Trustrums Hill and the Woodburn interchange, minimal delays to motorists are envisaged due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants. In addition, temporary traffic improvement works may be required at the intersection of the existing highway and the existing road north of the Tuckombil Canal to facilitate the haulage of earthworks materials into the site.

While the construction of the Woodburn interchange would be largely clear of the existing highway, the tie-ins to the highway would involve staged construction with some works carried out under traffic using partial road closures and / or diversions at various times. It is probable that the construction of the new service road north of the interchange would be done after highway traffic has been diverted onto the project highway alignment.

Woodburn Evans Head Road would need to be diverted onto a temporary side track for the construction of the new overpass and approach roundabouts. The side track would be constructed within the road corridor to a similar standard to the existing road.

4.6.9 Section 9 – Broadwater National Park to Richmond River

Around the first 3 kilometres of this section would follow the existing highway alignment through Broadwater National Park with the construction of northbound and southbound carriageways using the existing road reserve to the greatest extent possible, although some acquisition from Broadwater National Park would be required on the western side of the project.

Between the northern boundary of Broadwater National Park and the Richmond River, the project would deviate to the east of the existing highway alignment, bypassing the town of Broadwater.

Construction

- Haulage of materials would generally be along the new formation, with some haulage along the Pacific Highway and local roads. The use of local roads for the haulage of earthworks and plant would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site
- Given the large surplus of earthworks materials in Section 3, it is likely that the large net shortfall in this section of the project would be made up with material hauled from Section 3 along the existing highway as follows:
    - The estimated net shortfall in embankment material of 400,000 metres^3 (bank),or about 440,000 metres^3 (loose) in the section that follows the existing highway alignment would enter the construction site directly from the existing highway at controlled locations. The haulage of this material would involve about 37,000 truck movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3)
    - To minimise the impact on traffic using Broadwater Evans Head, the estimated shortfall in embankment material of 270,000 metres^3 (bank),or about 300,000 metres^3 (loose) in the section of deviated alignment south of the Broadwater interchange would enter the construction site from the existing highway and travel along the new formation rather than via Broadwater Evans Head Road. The haulage of this material would involve about 25,000 truck movements based on haulage by road trucks (semi-trailers or trucks and dog trailers with a capacity of about 12 metres^3)
    - The estimated net shortfall in embankment material of 30,000 metres^3 (bank),or about 33,000 metres^3 (loose) in the section north of the Broadwater interchange would enter the construction site from the existing highway via Broadwater Evans Head Road. The haulage operation would involve about 2,800 truck movements using road trucks (based on a capacity of 12 metres^3)
- The haulage of imported Select Material and verge material would generally be along the new formation, entering the construction site from the existing highway at controlled locations
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - Directly from the existing highway

- From the existing highway via Broadwater Evans Head Broadwater Road.

Road user delay

Construction of Section 9 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants. In addition, temporary traffic improvement works may be required at the intersection of the existing highway and Broadwater Evans Head Road to facilitate the haulage of earthworks materials into the construction site.

Some delays may occur on Evans Head Road in Broadwater to accommodate its deviation over the dual carriageways and interchange. However, it is expected that it would remain open for the majority of the duration of construction as construction would be undertaken in isolation to the existing roadway.

4.6.10 Section 10 – Richmond River to Coolgardie Road

The project in this section of the project would cross the Richmond River and follow a new alignment to the west of the existing highway, bypassing the town of Wardell, before re-joining the existing alignment at Coolgardie Road.

Construction

- Haulage of materials would generally be along the new formation, with some haulage along the Pacific Highway and local roads. The use of local roads for the haulage of earthworks and plant would be minimised
- Haulage of materials to stockpile sites would generally be directly from the construction site
- Haulage of imported earthworks materials to make up the estimated shortfall of 165,000 metres^3 (bank) within this section would be as follows:
    - 60,000 metres^3 (bank), or about 65,000 metres^3 (loose) of general fill material would be imported from local quarries (around Wardell or Ballina) for use in the construction of the embankments at the northern end of the project (which has an estimated shortfall of 150,000 metres^3). Haulage of this material would be by road trucks and involve about 5,500 truck movements based on haulage by semi-trailers or trucks with dog trailers with a capacity of about 12 metres^3. The point of access to the construction site would be from the existing highway north of Coolgardie Road
    - 105,000 metres^3 (bank), or about 115,000 metres^3 (loose) of general fill material would be imported from the large cuttings at the northern end of Section 3. An estimated 50,000 metres^3 (bank), or 55,000 metres^3 (loose) would be used for the construction of the embankment south of the Richmond River, requiring about 4,600 truck movements. The balance of 55,000 metres^3 (bank), or about 60,000 metres^3 (loose) would be used for the construction of the embankments at the northern end of the project, requiring about 5,000 truck movements. Access to the construction site at both locations would be directly from the existing highway

- The haulage of imported Select Material and verge material would generally be along the new formation, entering the construction site from the existing highway at controlled locations
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - Directly from the existing highway
    - From the existing highway via Wardell Road, Hillside Lane and a local access road
    - From the existing highway via Coolgardie Road
    - From the existing highway via a local property access.

Road user delay

Overall, construction of Section 10 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Some delays may occur at the interface between the Wardell interchange and the existing highway as well as at Coolgardie Road where the alignment merges back with the existing highway. It has been assumed that 'construction speed zones' would be introduced at tie-in points and effective traffic management procures would be adopted.

Partial or full road closures may be required on the existing highway south of the Richmond river and on Back Channel Road north of the Richmond River during the construction of the new bridge across the river. The number, type and duration of these closures would depend on the construction method adopted for the bridge. Where full road closures are required these would be done at night to minimise disruptions to traffic.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants.

Impacts on local roads in Section 10 that are to be altered as part of the project and may experience some delays are detailed below:

- The connection from Montis Road would need to be constructed together with a diversion of Old Bagotville Road onto a temporary side track to allow the construction of the new overpass at station 148.9 to proceed. The side track would be constructed within the road corridor, probably south of the new overpass, and to a similar standard to the existing road
- Wardell Road would need to be diverted onto a temporary side track to allow the construction of the new overpass bridge and approaches to proceed. The side track would be constructed within the road corridor, probably north of the new overpass, and to a similar standard to the existing road
- The local access road along the western side of the new alignment between station 150.6 and Wardell Road, and between Wardell Road and station 155.4 would need to be constructed before the construction of the project severed the existing property accesses in this section of the project.

4.6.11 Section 11 – Coolgardie to Ballina Bypass

The alignment for this section of the project would be as follows:

- Between Coolgardie Road and about 150 metres north of Whytes Lane, northbound and southbound carriageways would be constructed immediately west of the existing highway. The southbound lanes of the existing highway would become a local service road and the single northbound lane would be decommissioned
- About 150 metres north of Whytes Lane, the alignment would re-join the existing highway alignment. The existing highway would be incorporated into the southbound carriageway of the project and a northbound carriageway would be constructed to the west
- At the end of this section a new 220 metre single carriageway bridge would connect Pimlico Road to Smiths Drive.

Construction

- Haulage of materials would generally be along the project formation and the existing highway
- Haulage of imported earthworks materials to make up the estimated shortfall of 395,000 metres^3 (bank) within this section would be from local quarries (in the Wardell and Ballina areas) with access into the construction site directly from the existing highway at controlled locations
- Haulage of materials to stockpile sites would generally be directly from the construction site, although McAndrews lane, Sartories Road, Whytes Lane and Pimlico Road would also be used
- The haulage route for the delivery of materials for the site batching of concrete and asphalt would depend on the locations adopted for the site batch plants. Haulage of materials would be:
    - From the existing highway via McAndrews Lane and Sartories Road
    - From the existing highway via Pimlico Road.

Road user delay

Construction of Section 11 would pose no major delays to motorists due to separation of the duplication from the existing highway.

Temporary traffic arrangements would be required for the haulage of material along the existing highway at the locations where the trucks enter and leave the construction site, including for the delivery of materials to the site batch plants.

Local roads in Section 11 that are to be altered as part of the project and may experience some delays include:

- McAndrews Lane, Pimlico
- Whytes Lane, Pimlico.

Some delays may occur on these roads to accommodate their deviation/ passing over the dual carriageways. However, it is expected that they would remain open for the majority of the duration of construction as construction would be undertaken in isolation to the existing roadways.

5 Conclusion

5.1 Key findings of the assessment

Daily travel along the Pacific Highway through the study area is forecast to grow by some 42 per cent from 2012 to 2036. This growth would be derived from general economic activity and population growth, as well as increases in the economy and tourism in the study area driven by the improved access that the project would provide. While heavy vehicle traffic represents a high proportion of traffic at night, it is relatively constant throughout the day. By 2036, an annual average daily traffic volume of around 14,000 vehicles is expected between Woolgoolga and Ballina. Currently, on average, a peak of around 9800 vehicles uses the existing Pacific Highway each day.

By implementing the project, it is anticipated that daily travel in 2036 would be reduced by 150,200 kilometres of travel or 6 per cent, with a savings in time of around 3,850 hours or 15 per cent.

Traffic forecasts indicate a Level of Service of “A” on opening and at the design threshold of the 100th highest hourly volume after 20 years.

Heavy vehicle travel is expected to double over the same period, and the project would provide a 17.5 per cent saving in heavy vehicle travel time.

Crash profiling indicates that with reduced travel on the existing highway, crash savings of some 27 per cent would be realised from improved safety standards associated with the project.

Access to properties along the existing Pacific Highway corridor would be retained via access of the remaining sections of the Pacific Highway, or off service roads that would parallel the new alignment.

The project would accommodate cyclists along the alignment, providing wayfinding to and complementing the NSW Coastal Cycleway. In the urbanised area adjacent to the south of the project, cycle facilities would be provided consistent with those provided in the Sapphire to Woolgoolga Pacific Highway upgrade.

Maritime use of the Clarence and Richmond Rivers would not be impeded during operation. A high level bridge would be provided at Harwood across the Clarence River which would not require opening.

Construction activity would involve substantial movement of cut and fill. This would be effected largely along the project alignment, minimising impact on Pacific Highway traffic.

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Appendix A SATURN Model

A network model was developed for this study using SATURN traffic modelling software to synthesise available traffic data, and forecast the daily traffic volumes on the existing and proposed Pacific Highway. The model is a simple assignment tool with traffic demand estimated from observed origin-destination vehicle surveys. The base model was calibrated to replicate 2011 observed vehicle volumes, counted in November 2011. Future demands for 2016, 2026 and 2036 were calculated using a growth factor generally based on growth in demographics.

A.1 Base model

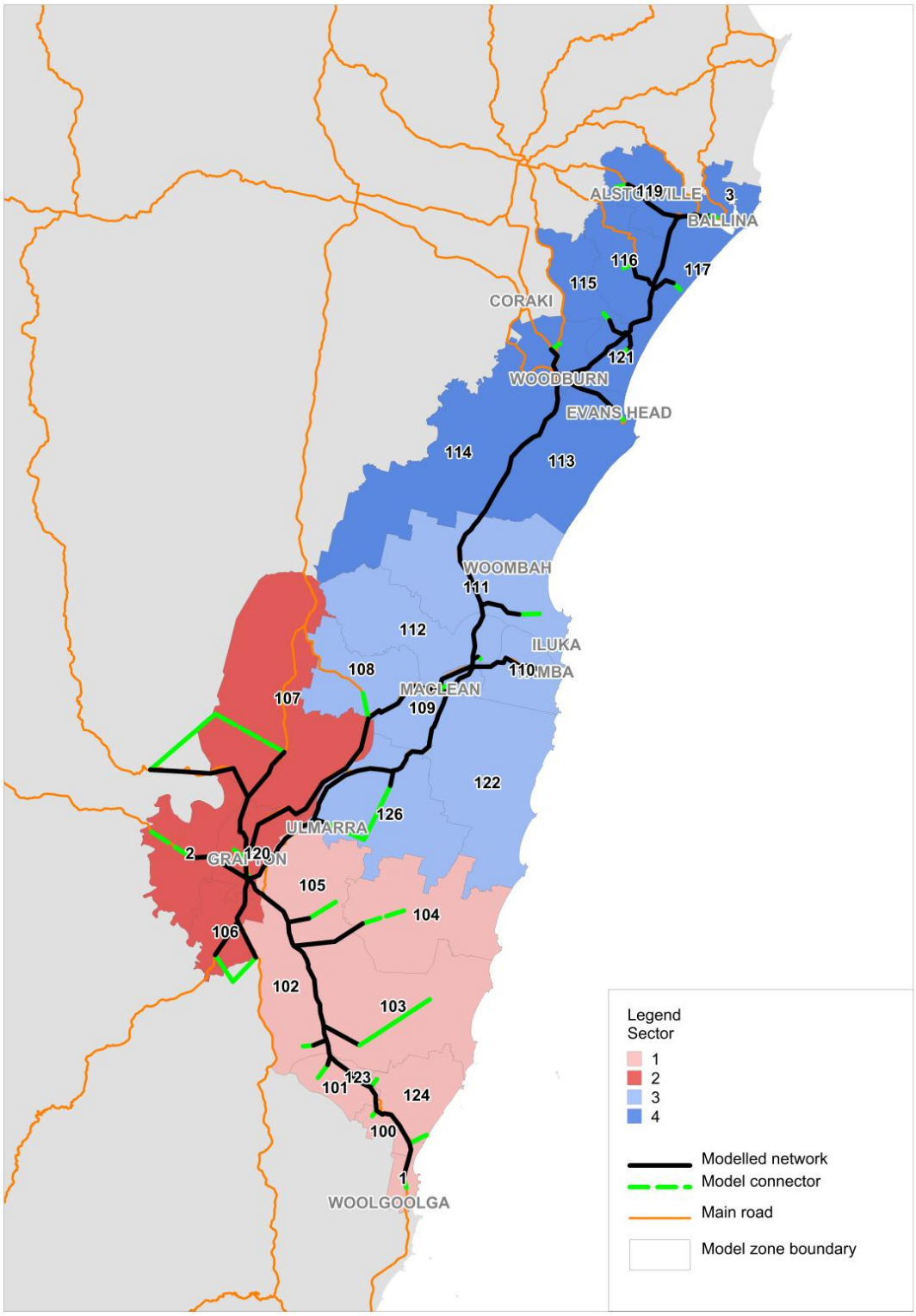
A.1.1 Model coding

The model only contains major road connections. These included the Pacific Highway (between Woolgoolga to Ballina) and road connections to major towns along it. A total of 29 zones, representing major towns and/or catchments, were coded. Figure A-1 shows the locations of the zones and their connectivity to the modelled road network.

The zones were then aggregated into four sectors, allowing comparison of recently observed traffic demand (2011) with previous data (2004) and development of modelled origin-destination tables to be input into the model as matrices. The sectors are shown in Figure A-1.

The existing Pacific Highway was coded as a two-lane, two-way link with a posted speed of 100 kilometres per hour on most sections. Around major town centres, the posted speed would drop to 80 kilometres per hour (or even further to 60 kilometres per hour). The base model reflects these changes in speed.

Figure A-1 Modelled network and zones



A.1.2 Model calibration and validation statistics

The following criteria are used for both model calibration and goodness-of-fit criteria:

- At least 95 per cent of individual link volumes should have a GEH9 value ≤ 5.0
- All individual link volumes should have a GEH value ≤ 10.0
- The Root Mean Square Error[10] for all counts should be 30.0 or lower.

The GEH statistic is a formula to compare two sets of hourly traffic volumes. It is a form of Chi-squared statistic designed to be tolerant of larger errors in low flows. The reason for introducing such a statistic is the inability of either the absolute difference or the relative difference to cope over a wide range of flows. The formula for the GEH statistic is:

$$GEH = \sqrt{\frac{(V_o - V_m)^2}{0.5\,(V_o + V_m)}}$$

where V_o and V_m are the observed and modelled flows (in vehicles per hour) respectively.

The Root Mean Square Error (RMSE) and R-Square (R^2) are statistical measures of the correlation between the entire count data set and the predicted model volumes. Unlike the GEH statistic (which applies to individual flows and screenlines), the RMSE statistic applies to the entire comparison data set and is expressed as a single value. The formula for RMSE is:

$$RMSE = \frac{\sqrt{\frac{\sum (V_o - V_m)^2}{C - 1}}}{\frac{\sum V_o}{C}} \times 100$$

where V_o and V_m are the observed and modelled flows (in vehicles per hour) respectively. C is the number of count locations in the dataset.

A.1.3 Assumptions

The assumptions used in the development of the model used in this assessment are as follows:

- The peak hour volume to be used in assessing the GEH statistic is assumed to be 10 per cent of the daily volume. This indicative value was calculated from survey data collected in November 2011

[9] GEH statistic: Traffic Appraisal Manual, Department of Transport UK, May 1996.
[10] Ibid.

- The 2011 survey classified count data (which were classified based on Austroads vehicle classification) showed the axle pair to vehicle conversion factors were around 0.64 and 0.90 along the Pacific Highway and other roads respectively. The conversion factors indicate the Pacific Highway is heavily used by large heavy vehicles compared to other roads. This assumption is required to convert RMS daily traffic volumes (AADT) from axle pairs into vehicles for comparison of permanent traffic counts
- Linear growth rates from 2004 were calculated for the RMS annual average daily traffic volumes, and used in model validation. This was necessary for validation count data collected before 2011. For a valid comparison during validation, the RMS annual average daily traffic volumes were factored into representative 2011 annual average daily traffic volumes. For count stations that did not have multiple years of annual average daily traffic volumes, the average linear growth rates (based on 18 count stations with multiple records) were used, which was about 3.1 per cent per annum
- Some trips were added to the base model matrices to account for the trips not captured by origin-destination survey (near the fringes of modelled network – Grafton and Woolgoolga areas). The heavy vehicle proportion of the added trips was assumed to be 7 per cent. This was estimated based on the origin-destination and traffic survey data (recorded on Tuesday 8 November 2011).

A.1.4 Traffic data

The data used for model calibration were:

- 2011 origin-destination survey
- 2011 traffic count survey undertaken between 4 November 2011 and 13 November 2011.

The validation datasets were independent of the calibration datasets and were:

- 2004 and 2007 RMS count data
- 2004 origin-destination survey.

The 2011 origin-destination survey of traffic movements was conducted along the Pacific Highway corridor between north of Woolgoolga and just south of Ballina. The survey hours were from 1.00am on 8 November 2011 through till 3.00am on 9 November 2011.

The field method involved the recording of vehicles and their number plates using video techniques and then transcribing number plates in a controlled environment. This occurred at 15 stations, all of which were two-way, yielding a total of 30 observation streams. The 15 stations are mapped in Figure A-2 along with the locations of the used RMS and surveyed count data. The corresponding survey zones are shown in Figure A-3. For comparison, the 2004 origin-destination survey stations are shown in Figure A-4.

Figure A-2 Traffic data locations

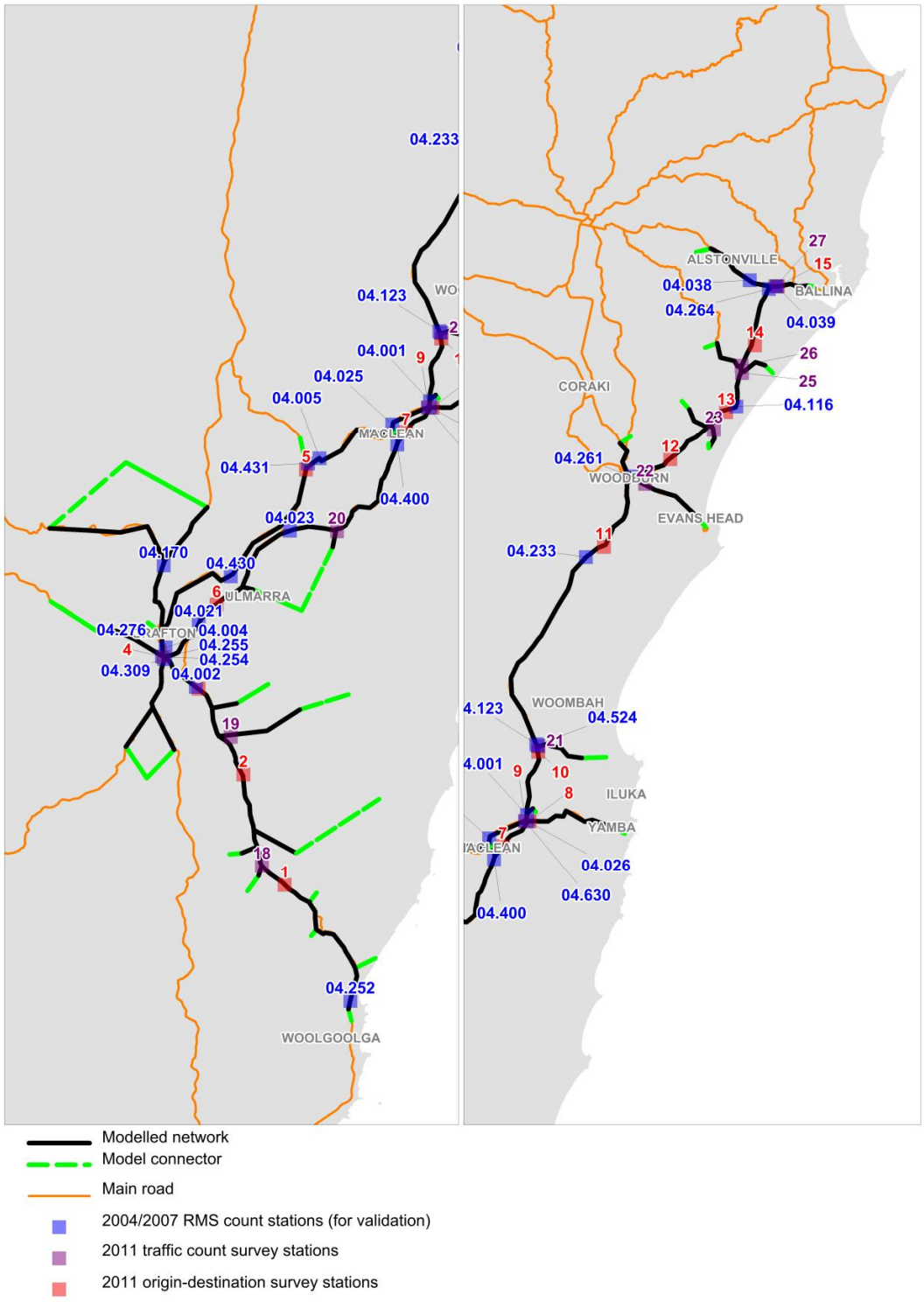


Figure A-3 2011 origin-destination survey zones

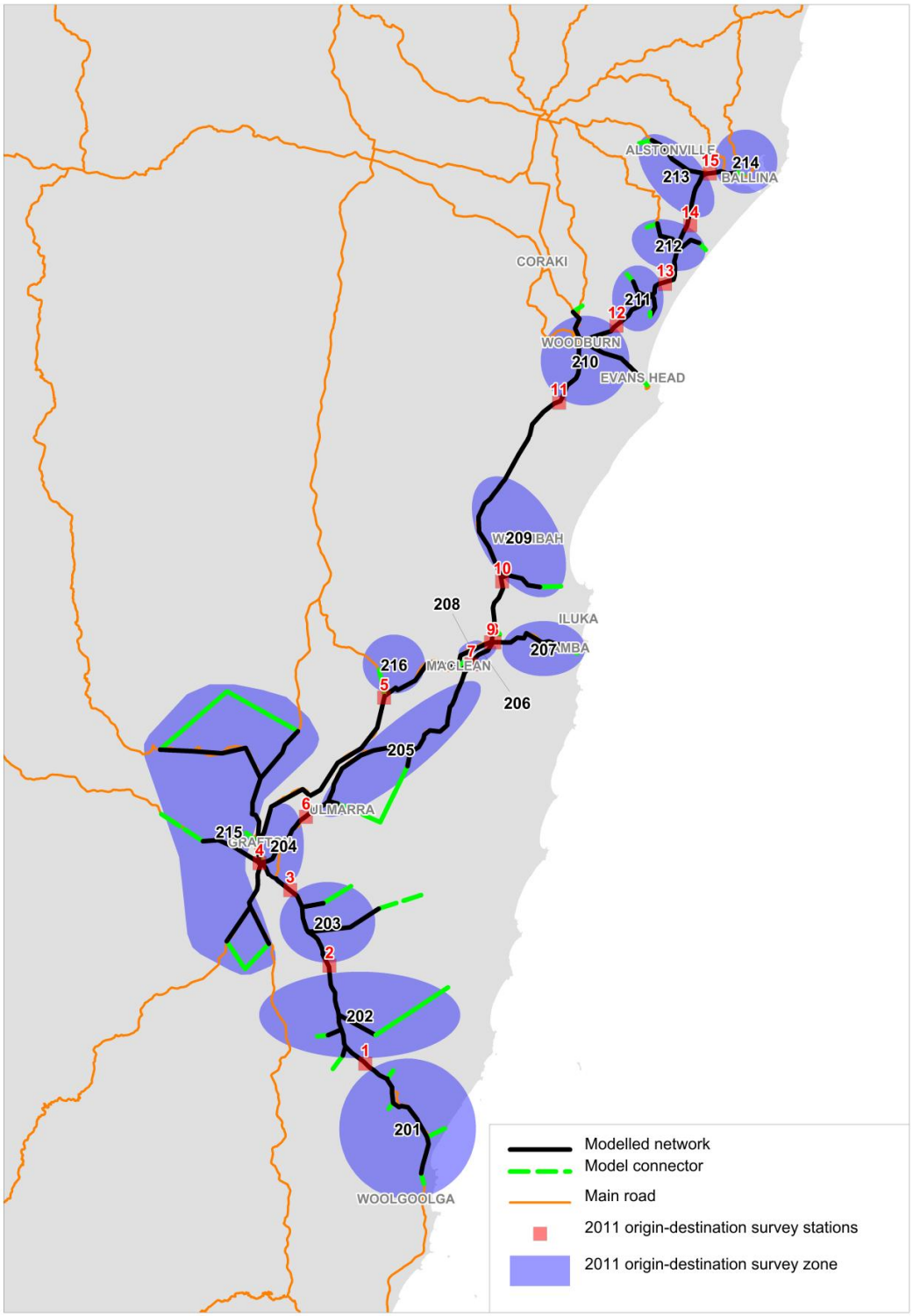
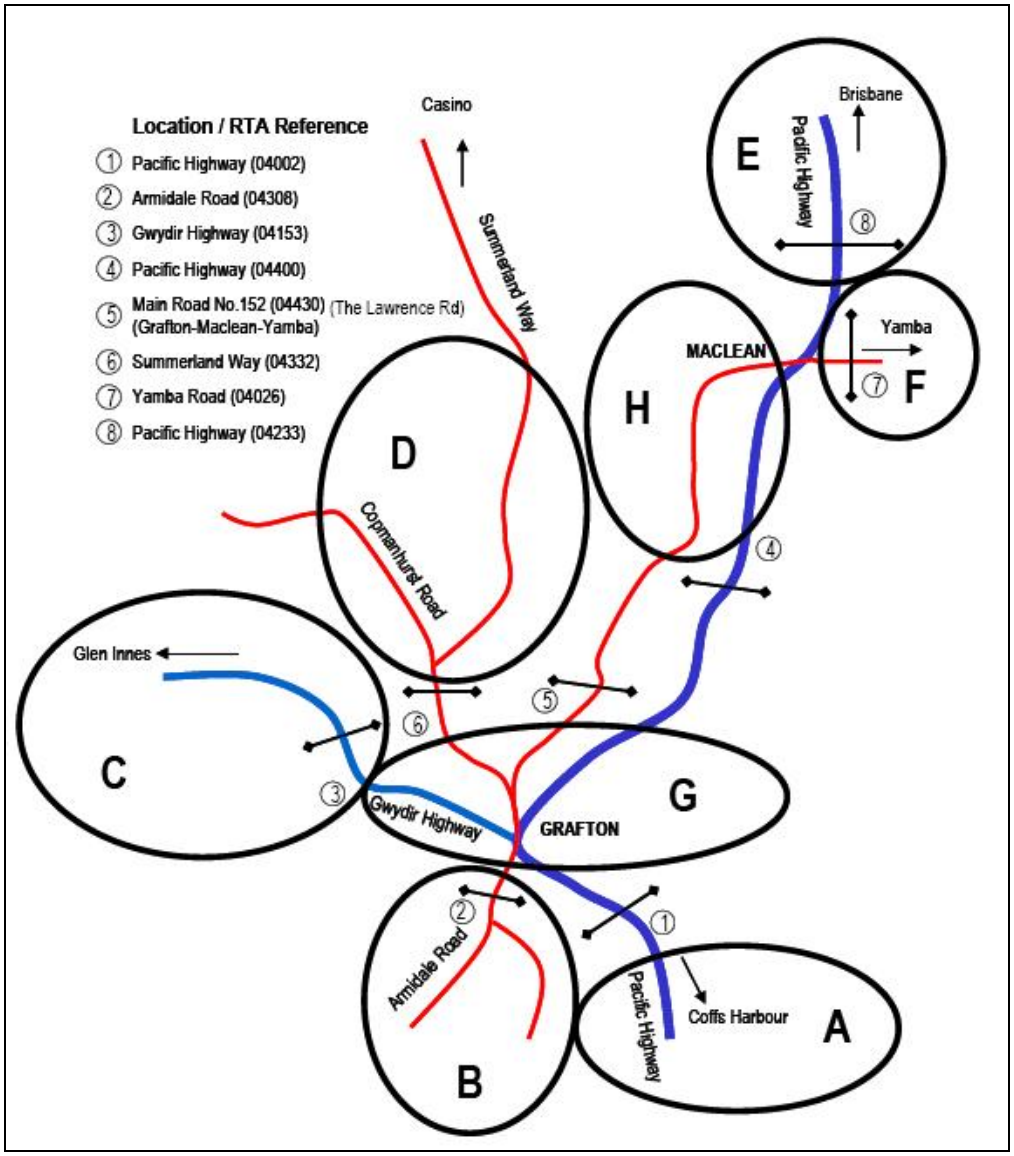


Figure A-4 2004 origin-destination survey



A.1.5 Model calibration

The traffic demands within the model are represented as a table of total vehicle movements from traffic *origin* (O) zone to traffic *destination* (D) zone. This is often referred to as an OD vehicle trip matrix. In the case of this model, the OD trip matrix was estimated from observed vehicle movements captured using an extensive number plate survey. The term *calibration* refers to this estimation of the base year OD vehicle trip matrix from the number plate and vehicle count survey data using a trip matrix estimation technique.

Daily light and heavy vehicle matrices were developed with the SATURN Matrix Estimation module using the surveyed origin-destination matrices and traffic counts as inputs. Both OD and count surveys were undertaken simultaneously on Tuesday 8 November 2011. Figure A-2 shows the

locations of the survey sites as well as the RMS count sites used in validating the model. The origin-destination survey zones are shown in Figure A-3.

The OD surveys were undertaken by recording vehicle number plates and time of passage of all vehicles past observation points. The matrices were produced by using a maximum travel time threshold between vehicle observations in an attempt to break a single trip into a reasonable number of separate trips should the vehicle stop for a significantly long period. The maximum travel time threshold was estimated using the following formulae:

- For trip distance less than or equal to 50kilometres,
  maximum travel time threshold (in minutes) = 1.35 × [posted speed] × [trip distance] + 15
- For trip distance greater than 50kilometres,
  maximum travel time threshold (in minutes) = 1.20 × [posted speed] × [trip distance] + 15.

The details on the derivation of the trips (identified as “Case A”) origin-destination matrices and origin-destination zoning system are reported in the Woolgoolga to Ballina Origin-Destination Survey Data Analysis report prepared by High Range Analytics Pty Ltd on 16 December 2011. The equivalence between origin-destination and model zones, for obtaining light and heavy vehicles’ prior matrices as inputs into SATURN Matrix Estimation module, is provided in the Table A-1.

Some minor adjustments were made to the origin-destination surveyed matrices before the calibration process to correct data recording errors. In addition, some corrections were made during the calibration process to account for trips not captured by origin-destination survey (near the fringes of modelled network – Grafton and Woolgoolga areas).

The calibration statistics with the estimated OD matrices (separate OD matrices for light and heavy vehicles) are summarised in Table A-1. Scatter plots of modelled versus observed daily volumes are shown in Figure A-5 and Figure A-6. In addition, the detailed statistics are provided in Table A-3. As can be seen, the model is considered calibrated based on the calibration criteria.

Table A-1 Origin-destination survey zone to model zone equivalence for creating prior matrices

Origin-destination survey zone	Model zone	Proportion		Origin-destination survey zone	Model zone	Proportion
201	1	95%		206	112	100%
201	100	1%		207	110	100%
201	123	1%		208	108	25%
201	124	3%		208	109	75%
202	101	80%		209	111	100%
202	102	10%		210	113	50%
202	103	10%		210	114	50%
203	104	50%		211	115	30%
203	105	50%		211	121	70%
204	2	10%		212	116	50%
204	106	10%		212	117	50%
204	107	10%		213	119	100%
204	120	70%		214	3	100%
204	127	0%		215	2	10%
205	108	10%		215	106	10%
205	109	70%		215	107	10%
205	122	10%		215	120	70%
205	126	10%		216	108	100%

Table A-2 Calibration statistics

Criteria description	Value	Satisfy criteria?
At least 95 per cent of individual link volumes should have a GEH value ≤ 5.0	100 per cent of link volumes have a GEH value ≤ 5.0 for light and heavy vehicles	Yes.
All individual link volumes should have a GEH value ≤ 10.0	100 per cent of link volumes have a GEH value ≤ 10.0 for light and heavy vehicles	Yes.
All counts RMSE should be 30.0 or lower	4.9 for light vehicles; 8.3 for heavy vehicles	Yes. RMSEs lower than 30.0

Figure A-5 Modelled versus observed daily volumes for light vehicles

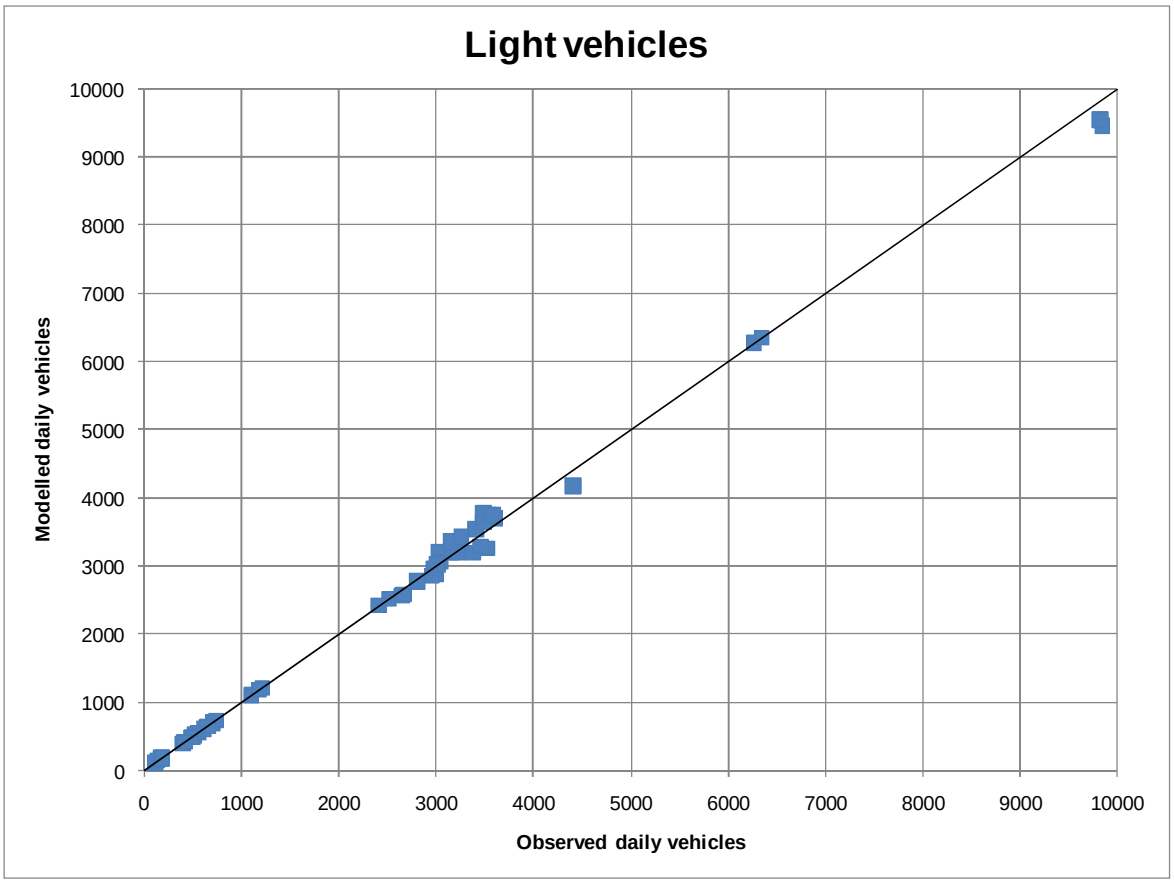


Figure A-6 Modelled versus observed daily volumes for heavy vehicles

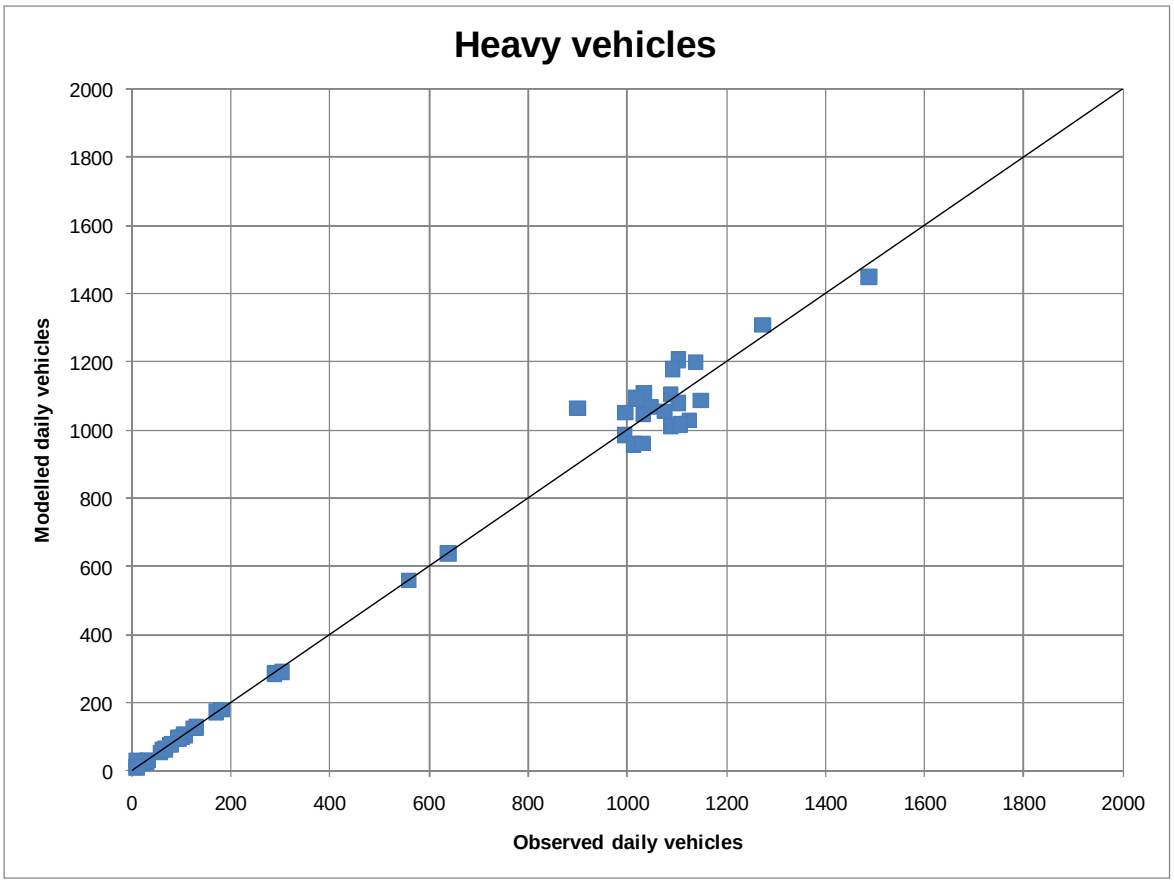


Table A-3 Detailed calibration statistics

Survey Site	Survey site description	Travel direction	Observed daily light vehicle	Modelled daily light vehicle	Observed daily heavy vehicle	Modelled daily heavy vehicle	GEH (for light vehicle)	GEH (for heavy vehicle)
2011 origin-destination								
1	Pacific Hwy (3.5 km south of Kungara Rd)	Northbound	2,999	2,882	1,048	1,070	0.7	0.2
		Southbound	3,234	3,229	900	1,063	0.0	1.6
2	Pacific Hwy (5 km south of Eight Mile Ln)	Northbound	2,960	2,859	1,048	1,068	0.6	0.2
		Southbound	3,029	3,204	1,033	1,110	1.0	0.7
3	Pacific Hwy (50 m south of Four Mile Ln)	Northbound	3,374	3,191	1,075	1,055	1.0	0.2
		Southbound	3,490	3,768	1,088	1,106	1.5	0.2
4	Gwydir Hwy (east of Bent St)	Westbound	3,598	3,699	288	286	0.5	0.0
		Eastbound	4,407	4,178	303	290	1.1	0.2
5	Grafton Lawrence Rd (south of River Bank Rd)	Northbound	556	556	31	31	0.0	0.0
		Southbound	519	518	23	23	0.0	0.0
6	Pacific Hwy (north of McLaclans Ln)	Northbound	3,410	3,546	1,031	1,047	0.7	0.2
		Southbound	3,486	3,644	1,018	1,094	0.8	0.7
7	Pacific Hwy (1.65 km north of Cameron St)	Northbound	2,808	2,777	1,087	1,012	0.2	0.7
		Southbound	2,983	2,974	1,149	1,088	0.1	0.6
8	Yamba Rd (east of James Ck Rd)	Westbound	3,054	3,053	170	173	0.0	0.1
		Eastbound	3,014	3,027	181	180	0.1	0.0
9	Yamba Rd (west of Western ramp at Pacific Hwy interchange)	Westbound	2,413	2,423	106	106	0.1	0.0
		Eastbound	2,516	2,518	94	94	0.0	0.0
10	Pacific Hwy (south of Lewis Ln)	Northbound	3,527	3,257	994	985	1.5	0.1
		Southbound	3,458	3,279	1,104	1,080	1.0	0.2
11	Pacific Hwy (south of Turners Rd)	Northbound	2,648	2,561	1,013	958	0.5	0.6
		Southbound	2,663	2,588	996	1,050	0.5	0.5
12	Pacific Hwy (1.25 km north of Richmond Rd)	Northbound	3,164	3,191	1,126	1,027	0.2	1.0
		Southbound	3,220	3,192	1,137	1,199	0.2	0.6
13	Pacific Hwy (50 m south of Walshs Ln)	Northbound	3,150	3,366	1,107	1,017	1.2	0.9
		Southbound	3,259	3,431	1,104	1,206	0.9	0.9
14	Pacific Hwy (200 m south of Coolgardie Rd)	Northbound	3,546	3,750	1,030	960	1.1	0.7
		Southbound	3,580	3,762	1,090	1,179	0.9	0.8
15	Pacific Hwy (300 m east of Bruxner Hwy)	Eastbound	9,839	9,454	1,273	1,308	1.2	0.3
		Westbound	9,823	9,540	1,488	1,450	0.9	0.3
2011 traffic count								
18	Kungara Rd (50 m west of Pacific Hwy)	Eastbound	144	143	10	10	0.0	0.0
		Westbound	115	115	8	31	0.0	1.6

Survey Site	Survey site description	Travel direction	Observed daily light vehicle	Modelled daily light vehicle	Observed daily heavy vehicle	Modelled daily heavy vehicle	GEH (for light vehicle)	GEH (for heavy vehicle)
19	Eight Mile Ln (50 m east of Airport Rd)	Eastbound	493	492	30	29	0.0	0.1
		Westbound	488	488	24	25	0.0	0.1
20	Tucaba-Tyndale Rd (200 m south of Pacific Hwy)	Southbound	180	181	8	10	0.0	0.2
		Northbound	185	182	12	13	0.1	0.1
21	Iluka Rd (east of Pacific Hwy)	Eastbound	1,108	1,108	124	125	0.0	0.0
		Westbound	1,101	1,103	129	128	0.0	0.0
22	Evans Head Rd (south of Wagner St)	Westbound	1,215	1,215	101	100	0.0	0.0
		Eastbound	1,184	1,188	98	99	0.0	0.0
23	Evans Head Broadwater Rd (south of Macdonald St)	Northbound	707	704	57	54	0.0	0.1
		Southbound	738	731	62	64	0.1	0.1
25	River Drv (east of Pacific Hwy)	Eastbound	401	400	94	96	0.0	0.1
		Westbound	414	412	68	65	0.0	0.1
26	Carlisle St (west of Pacific Hwy)	Westbound	613	609	76	77	0.1	0.0
		Eastbound	654	650	79	78	0.0	0.0
27	Bruxner Hwy (north of Pacific Hwy)	Eastbound	6,270	6,271	638	637	0.0	0.0
		Westbound	6,345	6,345	558	560	0.0	0.0

A.1.6 Model validation

The calibrated model is validated using the following data:

- Linearly projected 2011 annual average daily traffic volumes from older RMS annual average daily traffic volumes
- 2004 origin-destination survey matrix from the previous development project - Wells Crossing to Iluka Road.

It would have been preferred to have actual 2011 RMS annual average daily traffic volumes for validating the model. However, they were not available. Therefore, older annual average daily traffic volumes (in years 2004, 2007, 2008 and 2009) were projected forward to give estimated 2011 annual average daily traffic volumes. The validation statistics are shown Table A-4 below. For more details, please see Table A-5.

Table A-5

Table A-4 Validation statistics

Criteria description	Value	Satisfy criteria?	Comment if criteria are not satisfied
At least 95 per cent of individual link volumes should have a GEH value ≤ 5.0.	88 per cent of link volumes have a GEH value ≤ 5.0 for light and heavy vehicles.	No (although significant variation in the counts used for validation is likely).	The model does not validate well around the Bruxner Highway and Pacific Highway intersection, and at Pacific Highway, south of Maclean.
All individual link volumes should have a GEH value ≤ 10.0.	100 per cent of link volumes have a GEH value ≤ 10.0 for light and heavy vehicles.	Yes.	-
All counts RMSE should be 30.0 or lower.	15.3 for total vehicles.	Yes. RMSEs lower than 30.0.	-

Table A-5 Detailed validation statistics

RMS Count Site	Road name	Location	2011 projected daily volume	2011 modelled daily volume	GEH
04.001	Pacific Highway	On Harwood Bridge, Harwood	11,904	11,711	0.6
04.002	Pacific Highway	South of Charles Street, Grafton	10,555	9,120	4.6
04.004	Bent Street	At Clarence River Bridge, Grafton	24,513	22,783	3.6
04.005	Merton Street	At Clarence River Ferry, Lawrence	1,164	1,162	0.0
04.021	Pacific Highway	South of Greens Lane, Swan Creek	9,761	9,331	1.4
04.023	Pacific Highway	East of Wilson St, Cowper	8,535	9,092	1.9
04.025	River St	North of Union Street, Maclean	6,327	5,141	5.0
04.026	Yamba Road	East of Pacific Highway, Harwood	5,544	6,433	3.6
04.038	Bruxner Highway	West of Pacific Highway, Ballina	10,699	13,813	8.9
04.039	Pacific Highway	East of Bruxner Highway, Ballina	25,738	21,752	8.2
04.116	Pacific Highway	North of Boundary Creek Road, Broadwater	10,151	9,020	3.7
04.123	Pacific Highway	North of Iluka Road, Mororo	6,969	7,157	0.7
04.170	Summerland Way	North of Boneyard Lane, Koolkhan	2,593	2,401	1.2
04.233	Pacific Highway	South of Swan Bay New Italy Road, Woodburn	7,203	7,157	0.2
04.252	Pacific Highway	North of Arrawarra Beach Road, Arrawarra	8,436	8,634	0.7
04.254	Pacific Highway	North of Schwinghammer St, Grafton	10,334	9,120	3.9
04.255	Pacific Highway	East of Gwydir Highway, Grafton	8,391	9,331	3.2
04.261	Pacific Highway	West of Duke St, Woodburn	8,435	8,609	0.6

04.264	Pacific Highway	South of Bruxner Highway, Ballina	9,321	9,651	1.1
04.276	Gwydir Highway	West of Bent Street, Grafton	9,267	10,601	4.2
04.309	Armidale St	South of Ryan St, South Grafton	7,342	7,401	0.2
04.400	Pacific Highway	South of Cameron Street, Maclean	7,843	9,478	5.6
04.430	Grafton Lawrence St	North of Clarence River Ferry Rd, Southgate	1,060	1,128	0.7
04.431	Richmond St	North of River Bank Rd, Lawrence	979	1,128	1.5
04.524	Illuka Rd	East of Pacific Highway, Mororo	2,163	2,464	2.0
04.630	Yamba Road	West of Pacific Highway, Harwood	4,885	5,141	1.1

In addition, the 2011 base model trip distribution was compared to the 2004 surveyed trip distribution at a sector level. The 2011 modelled and 2004 surveyed sector matrices are shown in Table A-6 and Table A-7 respectively. They are also used to plot the trip length distributions shown in Figure A-7. Please note the following trips were deliberately left out during the comparison because they were not captured by the previous 2004 origin-destination survey and the trips made within Grafton sector (which did not use Pacific Highway) were not the aim of this study:

- Sector 1 to Sector 1 trips (i.e. trips within Pacific Highway South sector)
- Sector 2 to Sector 2 trips (i.e. trips within Grafton sector)
- Sector 4 to Sector 4 trips (i.e. trips within Pacific Highway North sector).

For completeness, the full 2011 modelled sector matrix is summarised in Table A-8.

The trips travelling within Sector 3 have increased significantly by 88%, from 4180 trips in 2004 to 7859 trips in 2011.

Table A-6 2011 modelled daily trips (vehicles)

Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South		1,850	488	1,903	4,242
2	Grafton	2,248		2,296	497	5,042
3	Maclean, Yamba, Harwood, Iluka	404	2,183	7,859	1,122	11,538
4	Pacific Highway North	2,219	476	944		3,639
Total		**4,842**	**4,509**	**11,587**	**3,523**	**24,461**

Table A-7 2004 surveyed daily trips (vehicles)

Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South		2,680	290	1,160	4,130
2	Grafton	2,740		1,470	1,270	5,480
3	Maclean, Yamba, Harwood, Iluka	290	2,260	4,180	990	7,720
4	Pacific Highway North	1,060	760	1,720		3,540
Total		**4,090**	**5,700**	**7,660**	**3,420**	**20,870**

Table A-8 2011 modelled daily trips (vehicles) without removing any trips

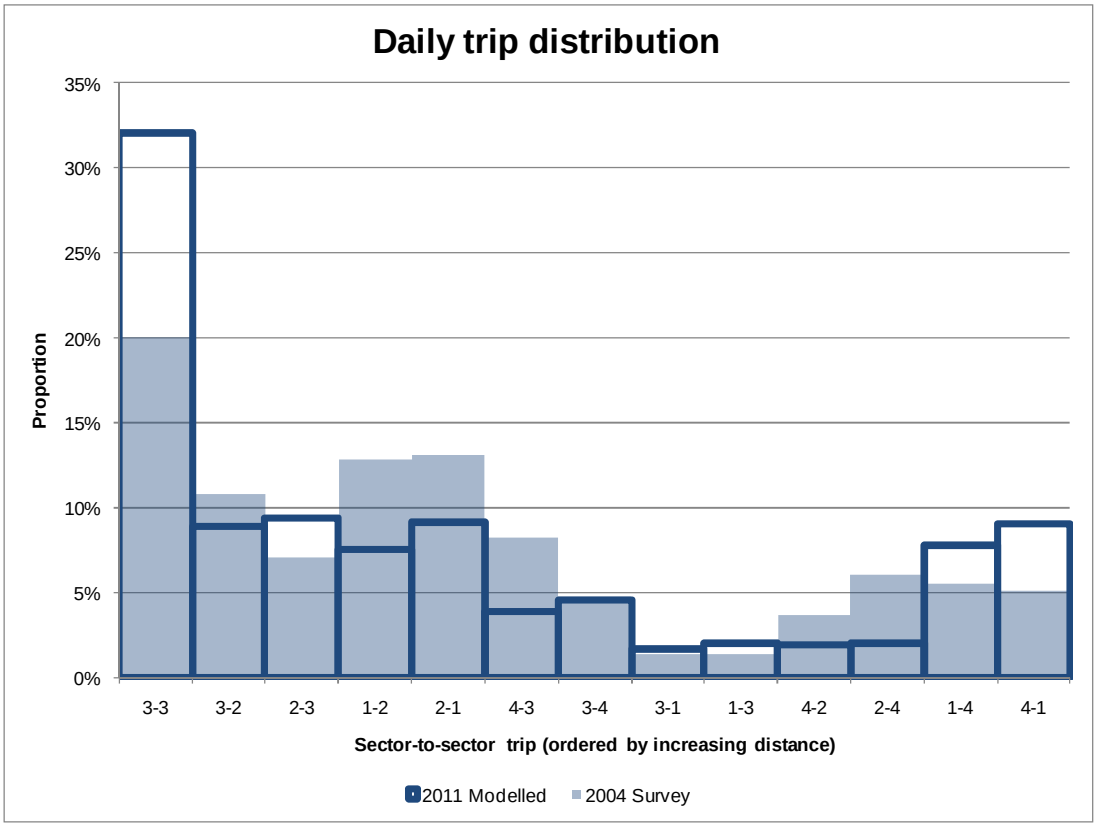
Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South	1,633	1,850	488	1,903	5,875
2	Grafton	2,248	17,076	2,296	497	22,118
3	Maclean, Yamba, Harwood, Iluka	404	2,183	7,859	1,122	11,568
4	Pacific Highway North	2,219	476	944	18,588	22,227
Total		**6,504**	**21,585**	**11,587**	**22,111**	**61,788**

The modelled and surveyed trip distributions (shown in Figure A-7) have a similar pattern i.e. a high number of short trips, a reasonable amount of medium and very long trips, and low numbers of long trips. However, there is a large increase (around 60 per cent compared to previous OD data) in trips made within Sector 3 - Maclean, Yamba, Harwood and Iluka (i.e. trips travelling from Sector 3 to Sector 3 itself).

Even though the model does not satisfy all validation criteria and its trip distribution is significantly different for short trips, it can be considered reasonably validated for studying traffic along Pacific Highway given that:

- The modelled volumes validate well with most count data (88 per cent with a GEH value less than or equal to 5.0 and 100 per cent with a GEH value no greater than 10.0)
- The modelled trip distribution (at sector level) did capture the main characteristic of 2004 surveyed trip distribution. It is reasonable to expect some increase in trips within Sector 3 (Maclean, Yamba, Harwood and Iluka) because the 2011 origin-destination survey is much more refined than the 2004 data around Sector 3 (i.e. more origin-destination sites)
- The validation data calculated from RMS counter records is likely to have an elevated level of error given they were projected from earlier years' data to give a 2011 base set for comparison.

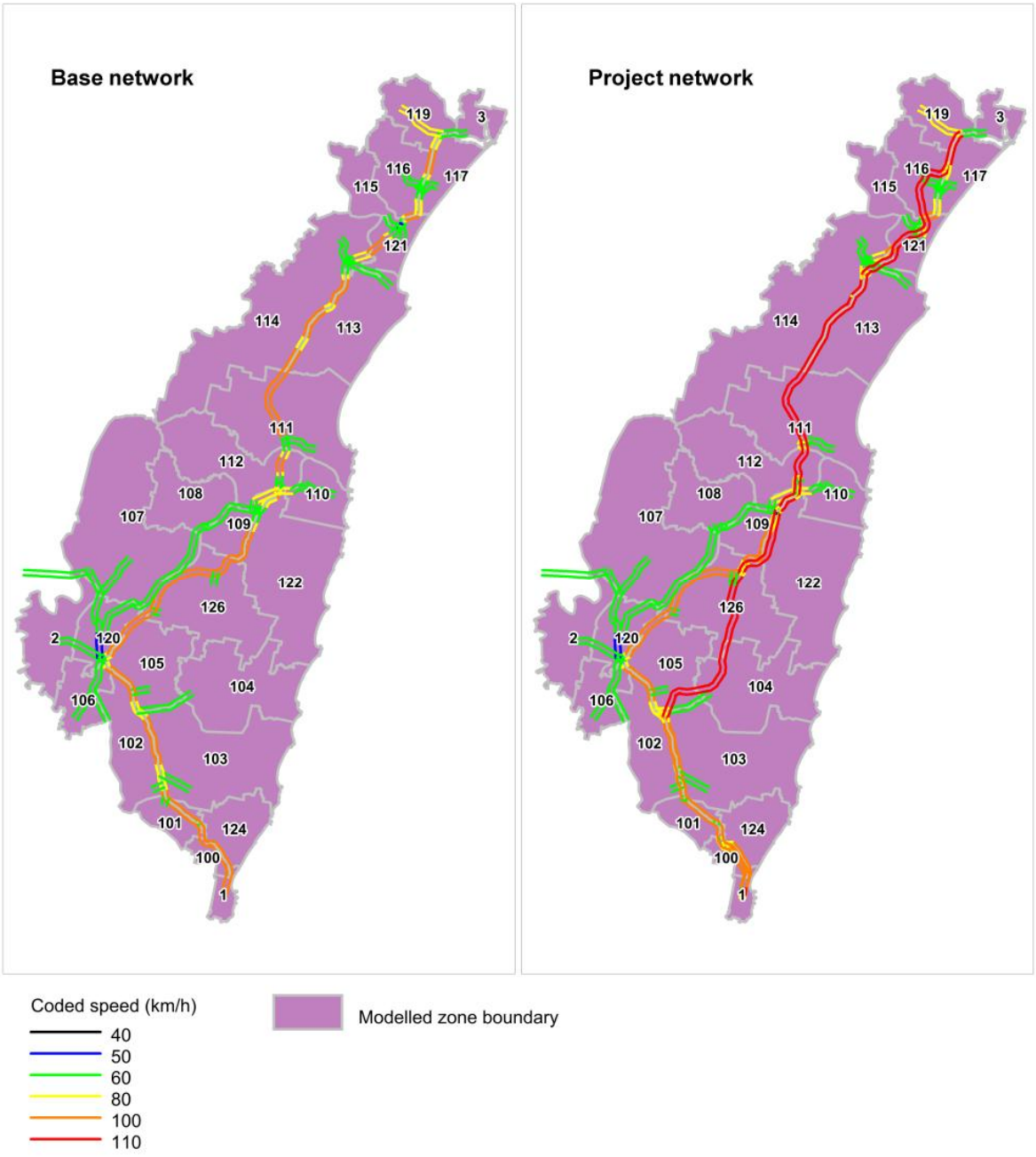
Figure A-7 Daily trip distribution comparison



A.2 Future model

The future model including the project is referred as the project network. The project has been coded in the project network as a two-lane, two-way link with a posted speed of 110 kilometres per hour. Figure A-8 compares the base and project networks side-by-side.

Figure A-8 Base and project network



The future vehicle demand matrices for year 2016, 2026 and 2036 were developed from the calibrated base demand matrices using a growth factor approach. The car demand growths were

calculated from the Local Government Areas (LGA) population and visitor estimates and heavy vehicle growths were based on freight growth rates reported by the NSW Government[11].

Table A 9 summarises the growth rates by for trips between various Local Government Authorities (LGA). The equivalence between model zones and LGAs is shown in Figure A-9.

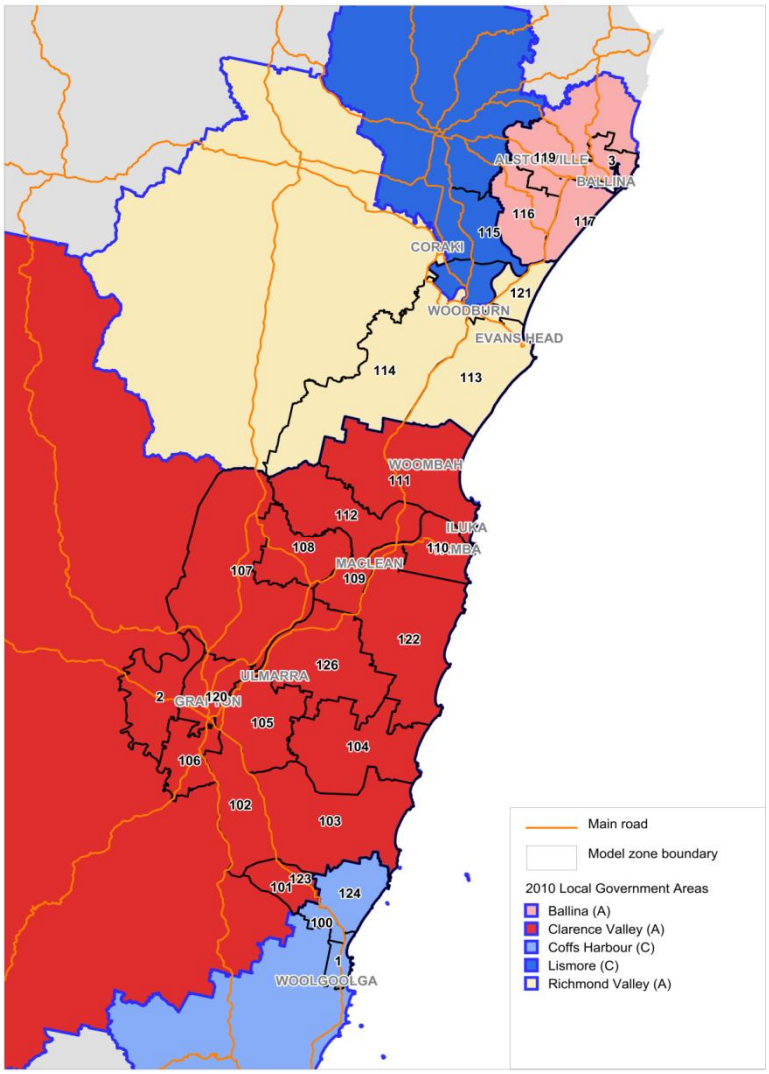
Table A 9 Light and heavy vehicles' growth rates

LGA to LGA OD pair		Light vehicle			Heavy vehicle		
		2011-2016	2016-2026	2026-2036	2011-2016	2016-2026	2026-2036
Ballina (A)	Ballina (A)	1.2%	1.1%	1.0%	2.8%	2.6%	2.5%
Ballina (A)	Clarence Valley (A)	0.9%	0.8%	0.7%	3.0%	2.8%	2.7%
Ballina (A)	Coffs Harbour (C)	1.4%	1.2%	1.0%	2.9%	2.7%	2.6%
Ballina (A)	Lismore (C)	0.8%	0.8%	0.7%	3.0%	2.8%	2.7%
Ballina (A)	Richmond Valley (A)	0.9%	0.8%	0.7%	3.0%	2.8%	2.7%
Clarence Valley (A)	Ballina (A)	0.9%	0.8%	0.7%	3.0%	2.8%	2.7%
Clarence Valley (A)	Clarence Valley (A)	0.6%	0.5%	0.4%	3.1%	2.9%	2.8%
Clarence Valley (A)	Coffs Harbour (C)	1.1%	0.9%	0.7%	3.1%	2.9%	2.8%
Clarence Valley (A)	Lismore (C)	0.5%	0.5%	0.4%	3.1%	2.9%	2.8%
Clarence Valley (A)	Richmond Valley (A)	0.6%	0.5%	0.4%	3.1%	2.9%	2.8%
Coffs Harbour (C)	Ballina (A)	1.4%	1.2%	1.0%	2.9%	2.7%	2.6%
Coffs Harbour (C)	Clarence Valley (A)	1.1%	0.9%	0.7%	3.1%	2.9%	2.8%
Coffs Harbour (C)	Coffs Harbour (C)	1.6%	1.4%	1.1%	3.0%	2.8%	2.7%
Coffs Harbour (C)	Lismore (C)	1.0%	0.9%	0.7%	3.1%	2.9%	2.8%
Coffs Harbour (C)	Richmond Valley (A)	1.1%	0.9%	0.7%	3.1%	2.9%	2.8%
Lismore (C)	Ballina (A)	0.8%	0.8%	0.7%	3.0%	2.8%	2.7%
Lismore (C)	Clarence Valley (A)	0.5%	0.5%	0.4%	3.1%	2.9%	2.8%
Lismore (C)	Coffs Harbour (C)	1.0%	0.9%	0.7%	3.1%	2.9%	2.8%
Lismore (C)	Lismore (C)	0.4%	0.4%	0.4%	3.1%	2.9%	2.8%
Lismore (C)	Richmond Valley (A)	0.5%	0.5%	0.4%	3.1%	2.9%	2.8%
Richmond Valley (A)	Ballina (A)	0.9%	0.8%	0.7%	3.0%	2.8%	2.7%
Richmond Valley (A)	Clarence Valley (A)	0.6%	0.5%	0.4%	3.1%	2.9%	2.8%
Richmond Valley (A)	Coffs Harbour (C)	1.1%	0.9%	0.7%	3.1%	2.9%	2.8%

[11] NSW Government Submission to Infrastructure Australia on the Pacific Highway Upgrade Program Economic Appraisal Report (PwC, 2011).

LGA to LGA OD pair		Light vehicle			Heavy vehicle		
		2011-2016	2016-2026	2026-2036	2011-2016	2016-2026	2026-2036
Richmond Valley (A)	Lismore (C)	0.5%	0.5%	0.4%	3.1%	2.9%	2.8%
Richmond Valley (A)	Richmond Valley (A)	0.6%	0.5%	0.4%	3.1%	2.9%	2.8%
Growth rate range		**0.4% - 1.6%**	**0.4% - 1.4%**	**0.4% - 1.1%**	**2.8% - 3.1%**	**2.6% - 2.9%**	**2.5% - 2.8%**

Figure A-9 Local Government Areas and modelled zones



The future matrices developed are summarised by sector movements in Table A-10, Table A-11 and Table A-12. The total daily trips growth is around 700 vehicles per annum. This equates to about 1.1 per cent linear growth every year from 2011. The daily trip length distributions across the

modelled years are shown in Figure A-10. The distributions show that there is an increase in long distance trips.

Table A-10 2016 modelled daily trips (vehicles)

Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South	1,757	1,957	529	2,100	6,343
2	Grafton	2,371	17,792	2,387	527	23,078
3	Maclean, Yamba, Harwood, Iluka	434	2,267	8,193	1,181	12,075
4	Pacific Highway North	2,448	505	993	19,830	23,775
Total		**7,010**	**22,520**	**12,102**	**23,638**	**65,271**

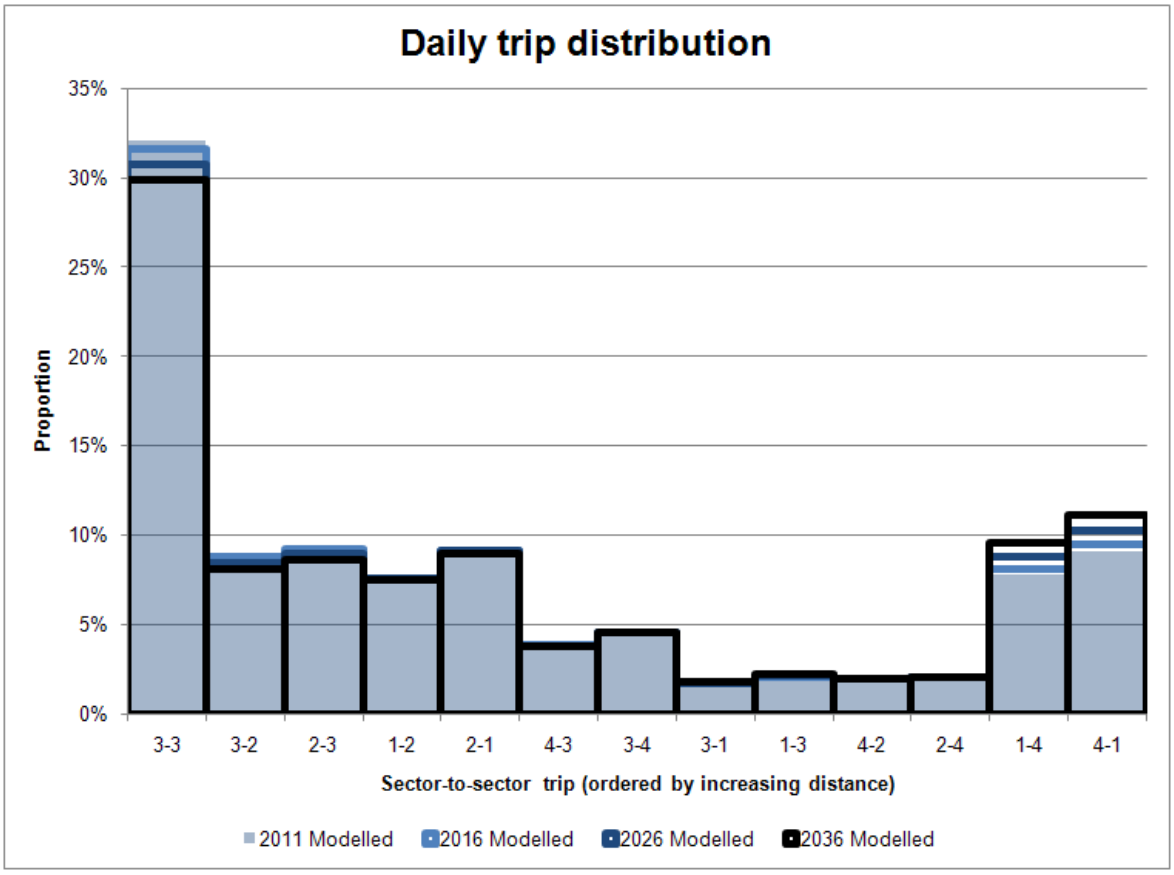
Table A-11 2026 modelled daily trips (vehicles)

Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South	2,003	2,162	615	2,526	7,306
2	Grafton	2,606	19,138	2,556	588	24,888
3	Maclean, Yamba, Harwood, Iluka	496	2,420	8,823	1,300	13,039
4	Pacific Highway North	2,942	563	1,091	22,374	26,971
Total		**8,047**	**24,284**	**13,085**	**26,788**	**72,204**

Table A-12 2036 modelled daily trips (vehicles)

Sector	Sector description	1	2	3	4	Total
1	Pacific Highway South	2,242	2,361	709	3,006	8,317
2	Grafton	2,827	20,422	2,711	650	26,610
3	Maclean, Yamba, Harwood, Iluka	561	2,559	9,429	1,419	13,968
4	Pacific Highway North	3,498	622	1,189	24,878	30,188
Total		**9,128**	**25,964**	**14,038**	**29,952**	**79,082**

Figure A-10 Daily trip distribution comparison (including future years)



A.3 Model outputs

The modelled daily volumes from base and future models are used to assess the impact of upgrading the Pacific Highway. They are used to calculate vehicle kilometres travelled (VKT) and vehicle hours travelled (VHT). The maximum volumes, vehicle kilometres travelled and vehicle hours travelled for each project section are summarised Table A-15 and Table A-16. The speed and section length used are summarised in Table A-14, where the speeds on the existing highway are estimated from current posted speed and those on the proposed highway are the design posted speeds. The modelled scenarios are listed in Table A-13.

Table A-15 shows that the existing highway carries zero trips in project model. In reality, it would carry some local traffic. However, they are not modelled.

Table A-13 Modelled scenarios

Model scenario	Network	Demand matrix
2011 Base Model	Base (or existing)	2011
2011 Project Model	Project	2011
2016 Base Model	Base	2016
2016 Project Model	Project	2016
2026 Base Model	Base	2026
2026 Project Model	Project	2026
2036 Base Model	Base	2036
2036 Project Model	Project	2036

Table A-14 Assumed speed and section length

Stage	Location	Existing highway		Proposed highway	
		Average speed (km/hr)[12]	Distance (km)	Average speed (km/hr)	Distance (km)
1	Woolgoolga to Halfway Creek upgrade	96	22.20	100	17.10
2	Halfway Creek upgrade to Glenugie upgrade	96	12.00	100	10.90
	Glenugie upgrade	96	6.80	100	6.00
3	Glenugie interchange to Tyndale	97	44.60	110	35.00
4	Tyndale to Maclean	97	13.50	110	13.40
5	Maclean to Iluka interchange	95	14.00	110	13.75
6	Iluka interchange to Devil's Pulpit upgrade	93	8.70	110	8.65
	Devil's Pulpit upgrade	93	5.50	110	5.40
7	Devil's Pulpit upgrade to Trustums Hill	93	16.80	110	16.60
8	Trustums Hill to Broadwater National Park	93	11.50	110	10.80
9	Broadwater National Park to Richmond River	93	6.70	110	7.60
10	Richmond River to Coolgardie Road	93	11.80	110	13.40
11	Coolgardie Road to Ballina	93	6.60	110	6.60

[12] Existing speed profiles were derived from measured travel speeds in the NRMA Pacific Highway Route Performance Final Report (November 2006).

Table A-15 2011 to 2036 maximum modelled volumes on each section

Section	Location	2011 Base Model			2011 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	6,538	2,133	8,671	710	57	767	5,828	2,076	7,904
2	Halfway Creek upgrade to Glenugie upgrade	6,111	2,180	8,291	46	5	51	6,065	2,175	8,240
	Glenugie upgrade	6,063	2,178	8,241	20	0	20	6,043	2,178	8,221
3	Glenugie interchange to Tyndale	7,377	2,178	9,555	3,771	326	4,097	3,606	1,852	5,458
4	Tyndale to Maclean	7,327	2,151	9,478	0	0	0	7,327	2,151	9,478
5	Maclean to Iluka interchange	9,298	2,413	11,711	3,161	482	3,643	6,137	1,931	8,068
6	Iluka interchange to Devil's Pulpit upgrade	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
	Devil's Pulpit upgrade	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
7	Devil's Pulpit upgrade to Trustums Hill	5,149	2,008	7,157	0	0	0	5,149	2,008	7,157
8	Trustums Hill to Broadwater National Park	6,383	2,226	8,609	2,210	391	2,601	4,173	1,835	6,008
9	Broadwater National Park to Richmond River	6,797	2,233	9,030	2,710	411	3,121	4,087	1,822	5,909
10	Richmond River to Coolgardie Road	7,512	2,223	9,735	3,329	328	3,657	4,183	1,895	6,078
11	Coolgardie Road to Ballina	18,994	2,758	21,752	0	0	0	18,994	2,758	21,752

Section	Location	2016 Base Model			2016 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	6,960	2,469	9,429	767	71	838	6,193	2,398	8,591
2	Halfway Creek upgrade to Glenugie upgrade	6,490	2,522	9,012	48	6	54	6,442	2,516	8,958
	Glenugie upgrade	6,433	2,518	8,951	20	0	20	6,413	2,518	8,931
3	Glenugie interchange to Tyndale	7,767	2,518	10,285	3,980	384	4,364	3,787	2,134	5,921
4	Tyndale to Maclean	7,691	2,493	10,184	0	0	0	7,691	2,493	10,184
5	Maclean to Iluka interchange	9,724	2,797	12,521	3,278	561	3,839	6,446	2,236	8,682
6	Iluka interchange to Devil's Pulpit upgrade	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
	Devil's Pulpit upgrade	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
7	Devil's Pulpit upgrade to Trustums Hill	5,435	2,323	7,758	0	0	0	5,435	2,323	7,758
8	Trustums Hill to Broadwater National Park	6,730	2,572	9,302	2,311	452	2,763	4,419	2,120	6,539
9	Broadwater National Park to Richmond River	7,173	2,582	9,755	2,831	476	3,307	4,342	2,106	6,448
10	Richmond River to Coolgardie Road	7,946	2,574	10,520	3,507	384	3,891	4,439	2,190	6,629
11	Coolgardie Road to Ballina	20,162	3,184	23,346	0	0	0	20,162	3,184	23,346

Section	Location	2026 Base Model			2026 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	7,752	3,233	10,985	879	88	967	6,873	3,145	10,018
2	Halfway Creek upgrade to Glenugie upgrade	7,198	3,301	10,499	52	8	60	7,146	3,293	10,439
	Glenugie upgrade	7,125	3,299	10,424	20	0	20	7,105	3,299	10,404
3	Glenugie interchange to Tyndale	8,462	3,300	11,762	4,358	506	4,864	4,104	2,794	6,898
4	Tyndale to Maclean	8,337	3,264	11,601	0	0	0	8,337	3,264	11,601
5	Maclean to Iluka interchange	10,490	3,666	14,156	3,486	744	4,230	7,004	2,922	9,926
6	Iluka interchange to Devil's Pulpit upgrade	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
	Devil's Pulpit upgrade	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
7	Devil's Pulpit upgrade to Trustums Hill	5,967	3,038	9,005	0	0	0	5,967	3,038	9,005
8	Trustums Hill to Broadwater National Park	7,383	3,369	10,752	2,503	598	3,102	4,880	2,771	7,650
9	Broadwater National Park to Richmond River	7,881	3,380	11,261	3,063	630	3,693	4,818	2,750	7,568
10	Richmond River to Coolgardie Road	8,772	3,365	12,137	3,853	504	4,357	4,919	2,861	7,780
11	Coolgardie Road to Ballina	22,469	4,149	26,618	0	0	0	22,469	4,149	26,618

Section	Location	2036 Base Model			2036 Project Model					
		Existing highway			Existing highway			Proposed highway		
		Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume	Light veh (daily volume)	Heavy veh (daily volume)	Total daily volume
1	Woolgoolga to Halfway Creek upgrade	8,449	4,205	12,654	979	115	1,094	7,470	4,090	11,560
2	Halfway Creek upgrade to Glenugie upgrade	7,813	4,296	12,109	55	11	66	7,758	4,285	12,043
	Glenugie upgrade	7,727	4,292	12,019	21	0	21	7,706	4,292	11,998
3	Glenugie interchange to Tyndale	9,081	4,294	13,375	4,695	673	5,368	4,386	3,621	8,007
4	Tyndale to Maclean	8,910	4,244	13,154	0	0	0	8,910	4,244	13,154
5	Maclean to Iluka interchange	11,151	4,773	15,924	3,662	982	4,644	7,489	3,791	11,280
6	Iluka interchange to Devil's Pulpit upgrade	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
	Devil's Pulpit upgrade	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
7	Devil's Pulpit upgrade to Trustums Hill	6,435	3,939	10,374	0	0	0	6,435	3,939	10,374
8	Trustums Hill to Broadwater National Park	7,958	4,363	12,321	2,669	777	3,446	5,289	3,586	8,875
9	Broadwater National Park to Richmond River	8,515	4,377	12,892	3,266	820	4,086	5,249	3,557	8,806
10	Richmond River to Coolgardie Road	9,517	4,359	13,876	4,168	656	4,824	5,349	3,703	9,052
11	Coolgardie Road to Ballina	24,580	5,353	29,933	0	0	0	24,580	5,353	29,933

Table A-16 2011 to 2036 modelled VKT and VHT (calculated using maximum modelled volumes on each section)

Section	Location	2011 Base Model				2011 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	47,353	192,496	493	2,005	36,767	152,186	368	1,529
2	Halfway Creek upgrade to Glenugie upgrade	26,160	99,492	273	1,036	23,767	90,428	238	905
	Glenugie upgrade	14,810	56,039	154	584	13,068	49,462	131	495
3	Glenugie interchange to Tyndale	97,139	426,153	1,012	4,439	79,361	373,761	741	3,640
4	Tyndale to Maclean	29,039	127,953	299	1,319	28,823	127,005	262	1,155
5	Maclean to Iluka interchange	33,782	163,954	356	1,726	33,299	161,937	312	1,545
6	Iluka interchange to Devil's Pulpit upgrade	17,470	62,266	188	670	17,369	61,908	158	563
	Devil's Pulpit upgrade	11,044	39,364	119	423	10,843	38,648	99	351
7	Devil's Pulpit upgrade to Trustums Hill	33,734	120,238	363	1,293	33,333	118,806	303	1,080
8	Trustums Hill to Broadwater National Park	25,599	99,004	275	1,065	24,315	94,798	229	911
9	Broadwater National Park to Richmond River	14,961	60,501	161	651	16,601	65,819	155	633
10	Richmond River to Coolgardie Road	26,231	114,873	282	1,235	29,263	124,598	272	1,204
11	Coolgardie Road to Ballina	18,203	143,563	196	1,544	18,203	143,563	165	1,305
	Total	**395,525**	**1,705,895**	**4,170**	**17,989**	**365,012**	**1,602,919**	**3,433**	**15,317**

Section	Location	2016 Base Model				2016 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	54,812	209,324	571	2,180	42,582	165,510	426	1,663
2	Halfway Creek upgrade to Glenugie upgrade	30,264	108,144	315	1,127	27,496	98,290	275	983
	Glenugie upgrade	17,122	60,867	178	634	15,108	53,722	151	537
3	Glenugie interchange to Tyndale	112,303	458,711	1,170	4,778	91,814	401,866	857	3,911
4	Tyndale to Maclean	33,656	137,484	347	1,417	33,406	136,466	304	1,241
5	Maclean to Iluka interchange	39,158	175,294	412	1,845	38,599	173,124	362	1,651
6	Iluka interchange to Devil's Pulpit upgrade	20,210	67,495	217	726	20,094	67,107	183	610
	Devil's Pulpit upgrade	12,777	42,669	137	459	12,544	41,893	114	381
7	Devil's Pulpit upgrade to Trustums Hill	39,026	130,334	420	1,401	38,562	128,783	351	1,171
8	Trustums Hill to Broadwater National Park	29,578	106,973	318	1,150	28,094	102,395	264	984
9	Broadwater National Park to Richmond River	17,299	65,359	186	703	19,195	71,161	180	684
10	Richmond River to Coolgardie Road	30,373	124,136	327	1,335	33,877	134,742	316	1,301
11	Coolgardie Road to Ballina	21,014	154,084	226	1,657	21,014	154,084	191	1,401
	Total	**457,593**	**1,840,873**	**4,824**	**19,412**	**422,386**	**1,729,143**	**3,973**	**16,517**

Section	Location	2026 Base Model				2026 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	71,773	243,867	748	2,540	55,736	192,775	558	1,937
2	Halfway Creek upgrade to Glenugie upgrade	39,612	125,988	413	1,312	35,990	114,505	360	1,145
	Glenugie upgrade	22,433	70,883	234	738	19,794	62,560	198	626
3	Glenugie interchange to Tyndale	147,180	524,585	1,533	5,464	120,358	458,368	1,124	4,455
4	Tyndale to Maclean	44,064	156,614	454	1,615	43,738	155,453	398	1,413
5	Maclean to Iluka interchange	51,324	198,184	540	2,086	50,594	195,703	475	1,864
6	Iluka interchange to Devil's Pulpit upgrade	26,431	78,344	284	842	26,279	77,893	239	708
	Devil's Pulpit upgrade	16,709	49,528	180	533	16,405	48,627	149	442
7	Devil's Pulpit upgrade to Trustums Hill	51,038	151,284	549	1,627	50,431	149,483	458	1,359
8	Trustums Hill to Broadwater National Park	38,744	123,648	417	1,330	36,804	118,293	346	1,135
9	Broadwater National Park to Richmond River	22,646	75,449	244	811	25,121	82,260	235	789
10	Richmond River to Coolgardie Road	39,707	143,217	427	1,540	44,285	155,665	412	1,501
11	Coolgardie Road to Ballina	27,383	175,679	294	1,889	27,383	175,679	249	1,597
	Total	**599,044**	**2,117,268**	**6,316**	**22,328**	**552,915**	**1,987,263**	**5,202**	**18,970**

Section	Location	2036 Base Model				2036 Project Model			
		VKT (km)		VHT (hour)		VKT (km)		VHT (hour)	
		Heavy veh	Total	Heavy veh	Total	Heavy veh	Total	Heavy veh	Total
1	Woolgoolga to Halfway Creek upgrade	93,351	280,919	972	2,926	72,491	221,962	726	2,230
2	Halfway Creek upgrade to Glenugie upgrade	51,552	145,308	537	1,514	46,838	132,061	468	1,321
	Glenugie upgrade	29,186	81,729	304	851	25,752	72,131	258	721
3	Glenugie interchange to Tyndale	191,512	596,525	1,995	6,214	156,751	519,656	1,465	5,042
4	Tyndale to Maclean	57,294	177,579	591	1,831	56,870	176,264	517	1,602
5	Maclean to Iluka interchange	66,822	222,936	703	2,347	65,874	220,116	619	2,094
6	Iluka interchange to Devil's Pulpit upgrade	34,269	90,254	368	970	34,072	89,735	310	816
	Devil's Pulpit upgrade	21,665	57,057	233	614	21,271	56,020	193	509
7	Devil's Pulpit upgrade to Trustums Hill	66,175	174,283	712	1,874	65,387	172,208	594	1,566
8	Trustums Hill to Broadwater National Park	50,175	141,692	540	1,524	47,665	135,479	448	1,297
9	Broadwater National Park to Richmond River	29,326	86,376	315	929	32,527	94,302	305	903
10	Richmond River to Coolgardie Road	51,436	163,737	553	1,761	57,361	178,220	534	1,715
11	Coolgardie Road to Ballina	35,330	197,558	380	2,124	35,330	197,558	321	1,796
	Total	**778,092**	**2,415,953**	**8,203**	**25,478**	**718,189**	**2,265,711**	**6,758**	**21,612**

Appendix B Traffic profiles for noise and air quality determination

B.1 Night and peak 1hour profile for noise and air quality assessment

The following tables have been based on identified daily traffic profiles at the survey sites identified in Section 2.3.1. These actual profiles have been applied to the average daily traffic (ADT) forecast in the SATURN network model. Note that these have not been annualised to annual average daily traffic due to limited availability of adequate whole-of-year profiles.

Table B-1 Section 1 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	6,193	2,398	8,591	767	71	838	6,960	2,469	9,429
	Night	744	765	1,509	92	22	115	836	787	1,623
	Leq(9hr)	12%	32%	18%	12%	32%	14%	12%	32%	17%
	Peak1hr	487	113	622	60	3	61	547	116	683
	%	8%	5%	7%	8%	5%	7%	8%	5%	7%
2026	ADT	6,873	3,145	10,018	879	88	967	7,752	3,233	10,985
	Night	825	1,003	1,828	106	28	134	931	1,031	1,962
	Leq(9hr)	12%	32%	18%	12%	32%	14%	12%	32%	18%
	Peak1hr	540	148	726	69	4	70	610	152	796
	%ADT	8%	5%	7%	8%	5%	7%	8%	5%	7%

Table B-2 Section 2 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	6,442	2,516	8,958	48	6	54	6,490	2,522	9,012
	Night	491	850	1,341	4	2	6	494	852	1,347
	Leq(9hr)	8%	34%	15%	8%	40%	11%	8%	34%	15%
	Peak 1hr	548	120	689	4	0	4	552	121	693
	%ADT	9%	5%	8%	8%	4%	8%	9%	5%	8%
2026	ADT	7,146	3,293	10,439	52	8	60	7,198	3,301	10,499
	Night	544	1,113	1,657	4	3	7	548	1,116	1,664
	Leq(9hr)	8%	34%	16%	8%	40%	12%	8%	34%	16%
	Peak 1hr	608	158	803	4	0	5	612	158	808
	%ADT	9%	5%	8%	8%	4%	8%	9%	5%	8%

Table B-3 Section 3 – day day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	3,786	2,134	5,920	3,981	384	4,365	7,767	2,518	10,285
	Night	316	718	1,034	332	132	464	648	851	1,498
	Leq(9hr)	8%	34%	17%	8%	34%	11%	8%	34%	15%
	Peak 1hr	320	94	453	336	17	334	657	111	786
	%ADT	8%	4%	8%	8%	4%	8%	8%	4%	8%
2026	ADT	4,102	2,794	6,896	4,360	506	4,866	8,462	3,300	11,762
	Night	342	941	1,283	364	174	538	706	1,115	1,821
	Leq(9hr)	8%	34%	19%	8%	34%	11%	8%	34%	15%
	Peak 1hr	347	123	527	368	22	372	715	146	899
	%ADT	8%	4%	8%	8%	4%	8%	8%	4%	8%

Table B-4 Section 4 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	7,691	2,493	10,184	-	-	-	7,691	2,493	10,184
	Night	668	839	1,507	-	-	-	668	839	1,507
	Leq(9hr)	9%	34%	15%				9%	34%	15%
	Peak 1hr	679	112	795	-	-	-	679	112	795
	%ADT	9%	5%	8%				9%	5%	8%
2026	ADT	8,337	3,264	11,601	-	-	-	8,337	3,264	11,601
	Night	724	1,098	1,822	-	-	-	724	1,098	1,822
	Leq(9hr)	9%	34%	16%				9%	34%	16%
	Peak 1hr	736	147	905	-	-	-	736	147	905
	%ADT	9%	5%	8%				9%	5%	8%

Table B-5 Section 5 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	6,441	2,237	8,678	3,283	560	3,843	9,724	2,797	12,521
	Night	529	704	1,233	270	178	448	798	882	1,680
	Leq(9hr)	8%	31%	14%	8%	32%	12%	8%	32%	13%
	Peak 1hr	579	95	690	295	24	306	874	119	996
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%
2026	ADT	6,999	2,923	9,922	3,491	743	4,234	10,490	3,666	14,156
	Night	574	920	1,495	287	235	522	861	1,156	2,017
	Leq(9hr)	8%	31%	15%	8%	32%	12%	8%	32%	14%
	Peak 1hr	629	124	789	314	32	337	943	156	1,127
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%

Table B-6 Section 6 - day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	5,435	2,323	7,758	-	-	-	5,435	2,323	7,758
	Night	427	733	1,160	-	-	-	427	733	1,160
	Leq(9hr)	8%	32%	15%				8%	32%	15%
	Peak 1hr	495	99	623	-	-	-	495	99	623
	%ADT	9%	4%	8%				9%	4%	8%
2026	ADT	5,967	3,038	9,005	-	-	-	5,967	3,038	9,005
	Night	469	959	1,428	-	-	-	469	959	1,428
	Leq(9hr)	8%	32%	16%				8%	32%	16%
	Peak 1hr	543	129	723	-	-	-	543	129	723
	%ADT	9%	4%	8%				9%	4%	8%

Table B-7 Section 7 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	5,435	2,323	7,758	-	-	-	5,435	2,323	7,758
	Night	402	736	1,138	-	-	-	402	736	1,138
	Leq(9hr)	7%	32%	15%				7%	32%	15%
	Peak 1hr	503	99	630	-	-	-	503	99	630
	%ADT	9%	4%	8%				9%	4%	8%
2026	ADT	5,967	3,038	9,005	-	-	-	5,967	3,038	9,005
	Night	442	963	1,405	-	-	-	442	963	1,405
	Leq(9hr)	7%	32%	16%				7%	32%	16%
	Peak 1hr	552	130	731	-	-	-	552	130	731
	%ADT	9%	4%	8%				9%	4%	8%

Table B-8 Section 8 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	4,420	2,120	6,540	2,310	452	2,762	6,730	2,572	9,302
	Night	387	662	1,049	202	140	342	589	803	1,391
	Leq(9hr)	9%	31%	16%	9%	31%	12%	9%	31%	15%
	Peak 1hr	383	92	502	200	20	212	583	111	714
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%
2026	ADT	4,880	2,770	7,651	2,503	599	3,101	7,383	3,369	10,752
	Night	427	866	1,293	219	186	404	646	1,051	1,697
	Leq(9hr)	9%	31%	17%	9%	31%	13%	9%	31%	16%
	Peak 1hr	423	120	587	217	26	238	639	146	825
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%

Table B-9 Section 9 - day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	4,336	2,105	6,442	2,837	477	3,313	7,173	2,582	9,755
	Night	394	659	1,053	257	148	405	651	807	1,458
	Leq(9hr)	9%	31%	16%	9%	31%	12%	9%	31%	15%
	Peak 1hr	370	91	490	242	20	252	612	111	743
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%
2026	ADT	4,813	2,749	7,561	3,068	631	3,700	7,881	3,380	11,261
	Night	437	860	1,298	278	196	474	715	1,056	1,771
	Leq(9hr)	9%	31%	17%	9%	31%	13%	9%	31%	16%
	Peak 1hr	411	118	576	262	27	282	673	145	857
	%ADT	9%	4%	8%	9%	4%	8%	9%	4%	8%

Table B-10 Section 10 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	4,439	2,190	6,629	3,507	384	3,891	7,946	2,574	10,520
	Night	417	694	1,111	329	113	442	746	807	1,553
	Leq(9hr)	9%	32%	17%	9%	29%	11%	9%	31%	15%
	Peak 1hr	377	102	510	298	18	299	675	121	809
	%ADT	8%	5%	8%	9%	5%	8%	8%	5%	8%
2026	ADT	4,919	2,861	7,780	3,853	504	4,357	8,772	3,365	12,137
	Night	463	907	1,369	361	148	509	824	1,055	1,878
	Leq(9hr)	9%	32%	18%	9%	29%	12%	9%	31%	15%
	Peak 1hr	418	134	599	328	24	335	746	158	934
	%ADT	8%	5%	8%	9%	5%	8%	8%	5%	8%

Table B-11 Section 11 – day/night and peak 1hour traffic profiles – 2016 and 2026

		Without project			With project					
		Existing Highway			Existing Highway			Proposed Highway		
		Light	Heavy	TOTAL	Light	Heavy	TOTAL	Light	Heavy	TOTAL
2016	ADT	20,162	3,184	23,346	-	-	-	20,162	3,184	23,346
	Night	1,567	721	2,288	-	-	-	1,567	721	2,288
	Leq(9hr)	8%	23%	10%				8%	23%	10%
	Peak 1hr	1,712	215	1,927	-	-	-	1,712	215	1,927
	%ADT	8%	7%	8%				8%	7%	8%
2026	ADT	22,469	4,149	26,618	-	-	-	22,469	4,149	26,618
	Night	1,746	939	2,686	-	-	-	1,746	939	2,686
	Leq(9hr)	8%	23%	10%				8%	23%	10%
	Peak 1hr	1,908	280	2,197	-	-	-	1,908	280	2,197
	%ADT	8%	7%	8%				8%	7%	8%