

Roads and Traffic Authority

Lane Cove Tunnel Post
Opening Traffic Evaluation

Before and After Study

ARUP

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I Introduction

The Roads and Traffic Authority (RTA) commissioned Arup on the 17th November 2008 to undertake a Post-Opening traffic evaluation for the Lane Cove Tunnel project in Sydney. The evaluation is to include a before and after Study, comparing volumes gathered in 2008 to volumes gathered in 2004 by Sinclair Knight Merz (SKM) in their Before Opening Traffic Study.

The study area includes roads within Hunter's Hill, Ku-ring-gai, Lane Cove, North Sydney, Ryde and Willoughby Council areas. The first stage of the Lane Cove Tunnel (LCT) project was opened to traffic in March 2007, whilst the second stage of the project that included the adjustments to Epping Road, was completed in March 2008.

As part of the Planning Minister's Conditions of Approval for the Lane Cove Tunnel Project, the RTA is required to monitor traffic levels for a period of one week, 12 months after the opening of the tunnel. To achieve this task, the following tasks have been completed and are described and discussed in this report:

- Large scale surveys in the November/December period, including vehicle classification counts, obtaining SCATS data and intersection counts
- Comparison of newly collected survey data against data previously surveyed in the Before Opening Traffic Study and the predicted data from the LCT Environmental Impact Statement and assessing degree of diversions, identifying any improvements needed

The data used in this report was sourced from:

- Vehicle Classification Surveys undertaken by CFE Information Technologies (CFEIT) at 84 locations
- Intersection Manual counts undertaken by ROAR Data at 24 locations
- Sydney Coordinated Adaptive Traffic Signal System (SCATS) intersection counts from the RTA
- Permanent Vehicle Counts from the RTA
- The counts conducted in 2004 by SKM in their Before Opening Traffic Study

2 Methodology

As the intention of this project is to make comparisons to the 2004 data collected by SKM, it was necessary to replicate the same surveys as closely as possible, to assess changes in traffic volume and movements in the study area as a result of the Lane Cove Tunnel project opening to traffic.

The RTA provided the SCATS counts and Permanent Counts, while Arup engaged the specified subcontractors to undertake vehicle classification surveys (CFEIT) and manual counts (ROAR Data). The surveys and counts were taken during November and December 2008, with some supplementary vehicle classification counts occurring in February 2008. The methodology of these counts is described in this section.

2.1 Vehicle Classification Surveys

Vehicle Classification Surveys, otherwise known as Tube Counts, determine the volume of vehicles traversing a section on a road some distance from an intersection.

The definition for the classification of vehicles uses the Austroads Standard of 12 Vehicle Classes ranging from light vehicles to articulated heavy vehicles. For easier comparison to the 2004 report by SKM on traffic before the opening of the Lane Cove Tunnel, this study has also grouped the 12 classes into three main categories: light vehicles; rigid vehicles; and articulated vehicles. Classes 1 and 2 were grouped as light vehicles; classes 3 to 5 were grouped into rigid heavy vehicles, and classes 6 to 12 were grouped into articulated vehicles.

The vehicle classification surveys were undertaken at 84 locations in the study area collecting data for a one week period during November and December 2004. The locations of the vehicle classification surveys are shown in **Figure 1**. The data has been analysed into average weekday, average weekend and average weekly counts. To complete the comparative analysis with the SKM report, the daily counts have been split into the following periods:

- Early morning (EM) average hourly counts for the period 12:00 am – 6:59 am
- Morning peak (AM) average hourly counts for the period 7:00 am – 8:59 am
- Business hours (BH) average hourly counts for the period 9:00 am – 15:59 pm
- Evening peak (PM) average hourly counts for the period 16:00 pm – 17:59 pm
- Night time (NT) average hourly counts for the period 18:00 pm – 23:59 pm

2.2 Manual Turning Movement Count Surveys

Manual Turning Movement Count Surveys are designed to distinguish turning movements at intersections and their vehicle classifications. 24 locations were surveyed between 7:00 am – 9:00 am and 4:00 pm – 6:00 pm periods, from Tuesday 25th November 2008 to Thursday 27th November 2008. The volumes counted were divided into light vehicles and heavy vehicles. The locations of Manual Turning Movement Count Surveys are shown in **Figure 2**.

2.3 SCATS Intersection Counts

The SCATS traffic count system is managed by the RTA and has the ability to record the lane volumes of vehicles at intersections, giving the vehicle volumes on roads approaching the signalized intersections. Data for 42 SCATS locations within the vicinity of the Lane Cove Tunnel were collected from RTA and these locations can be seen in **Figure 3**. The RTA has provided the SCATS traffic counts for the period 24 November 2007 - 7 December 2007.

The SCATS data was analysed in terms of average weekday, average weekend and average weekly counts. The daily counts were broken down into peak and off-peak periods and the peak periods to enable the comparison between two sets of data:

- Early morning (EM) average hourly counts for the period 12:00 am – 6:59 am
- Morning peak (AM) average hourly counts for the period 7:00 am – 8:59 am
- Business hours (BH) average hourly counts for the period 9:00 am – 15:59 pm
- Evening peak (PM) average hourly counts for the period 16:00 pm – 17:59 pm
- Night time (NT) average hourly counts for the period 18:00 pm – 23:59 pm

2.4 Permanent Counts

The RTA provided 8 permanent traffic count locations and data for a three week period during November and December 2008. The data was used to verify tube counts and other surveys and to compare with similar counts that took place in 2004. The locations of the permanent counts are shown in **Figure 4**.

2.5 Data Accuracy

To ensure the accuracy of the data received, the permanent counts, SCATS counts and the vehicle classification counts were compared with each other at locations where they coincided. There were no public holidays during these periods to affect the data.

2.5.1 Vehicle Classification Survey Data Accuracy

The Vehicle Classification Surveys were conducted at 84 locations in this project. The data accuracy relied upon the tube counters to distinguish the classification of vehicles. To reduce errors the following precautions were taken:

- Tube counters were located away from signalised intersections
- Each lane was installed with one tube counter to avoid mistakes between different lanes

Errors may have been caused due to the following:

- A vehicle parked directly on a tube counter
- A slow-moving queue of vehicles over a tube counter
- Extensive lane changing due to unexpected traffic conditions
- Damage and vandalism on a tube counter

While analysing the 2008 data, Arup identified missing data due to faulty or damaged tubes at two locations.

- Willoughby Road (B30) was missing data in the Northern direction, due to faulty tubes. This location was resurveyed in both directions during the week starting the 9 February 2009
- Eastern Loop Road (B75), data was considered faulty due to tubes being damaged upon inspection of tubes after the survey. The location was resurveyed during the week starting the 9 February 2009

When compared to 2008 data at similar locations, the counts matched data obtained using other methods; hence the resurveyed 2009 data was considered valid and applicable.

2.5.2 Manual Turning Movement Count Data Accuracy

The Manual Turning Movement Count Surveys were conducted at the 24 locations indicated in the 2004 report. ROAR Data were the sub contractors who were assigned to undertake the Manual Turning Movement Count Surveys in the specified 24 locations.

During the data comparison between the 2004 and 2008 data, Arup noticed some incomplete 2004 data on the Kurri Street and Parklands Avenue intersection in the “west through” and “travelling north turning left” directions.

During the Manual counts, ROAR Data noticed that during 7 to 9am Moore Street was closed. There were vehicles waiting for the gate to open and it took a little time to clear them when it did.

ROAR Data mentioned that the figures along Cox's Road between Badajoz Road and Blenheim Road and data from surrounding roads may be misleading as the data was surveyed on Tuesday and vehicles were accessing the petrol station for cheap petrol especially in the afternoon.

2.5.3 SCATS Data Accuracy

The RTA provided the SCATS data in 15-minute intervals for each of the 42 SCATS locations. A comparison of average weekly volume per day between the SCATS counts and nearby vehicle classification data was conducted to determine the degree of consistency between data sources. The data comparison can be seen in Appendix C, which shows that there is an average of 8% difference, with a few exceptions which are noted below.

A number of SCATS detectors had faults for the entire survey period while there were others that were missing data over a few 15 minutes intervals. The faults were mainly caused by road works or loss of electrical signals. Using the

same practices applied by SKM for the 2004 before opening data assessment, Arup has followed a similar process to recover the missing data, by taking the average of the values immediately before and after the faulty periods.

- On Sunday 7 December 2008 between 12:15pm – 2:45pm there was faulty SCATS survey data on several SCATS locations as follows: TCS 138, TCS 163, TCS 715, TCS 219, TCS 371, TCS 410, TCS 550, TCS 806, TCS 882, TCS 1044, TCS 1336, TCS 1337, TCS 1362, TCS 2209, TCS 2861, TCS 2819 and TCS 3556
- TCS 452 counter 4 for the 2 week period
- TCS 765 12:30pm Thursday 4 December 2008 to 1pm Friday 5 December 2008. *This was corrected by using the data from the previous week*
- TCS 1359 on 3 December 2008 from 12am – 4am. Also Thursday 4 December 2:45pm – 3:00
- TCS 1878 on 7 December 2008 from 9am – 10:30am
- TCS 2819 counter 4 from 6am on 30 November 2008 to 8:30pm 1 December 2008. *This was corrected by using the data from the previous week*
- TCS 2993 counters 9, 10, 11, 14 for the 2 week period
- TCS 3556 counter 8 from 8am to 9am on 30 November 2008. Also Counter 3 and 4 from 6 am on 6 December 2008 to 12am on 7 December 2008. *This was corrected by using the data from the previous week*
- TCS 3622 counter 8 from 11am – 7:15pm on 24 November 2008 and counter 8 during 1pm – 7:15pm on the 25 November 2008

2.5.4 Permanent Count Survey Data Accuracy

The RTA provided hourly data counts from 24 November 2008 to 14 December 2008 for the 8 permanent locations which was compared to the 2004 data.

The permanent count loops on Epping Road west of Longueville Road were removed as a result of the recent Epping Road reconfiguration work and they had not been reinstated. Consequently there is not 2008 data for comparison with the 2004 counts at this location.

Figure I: Vehicle Classification Count Locations

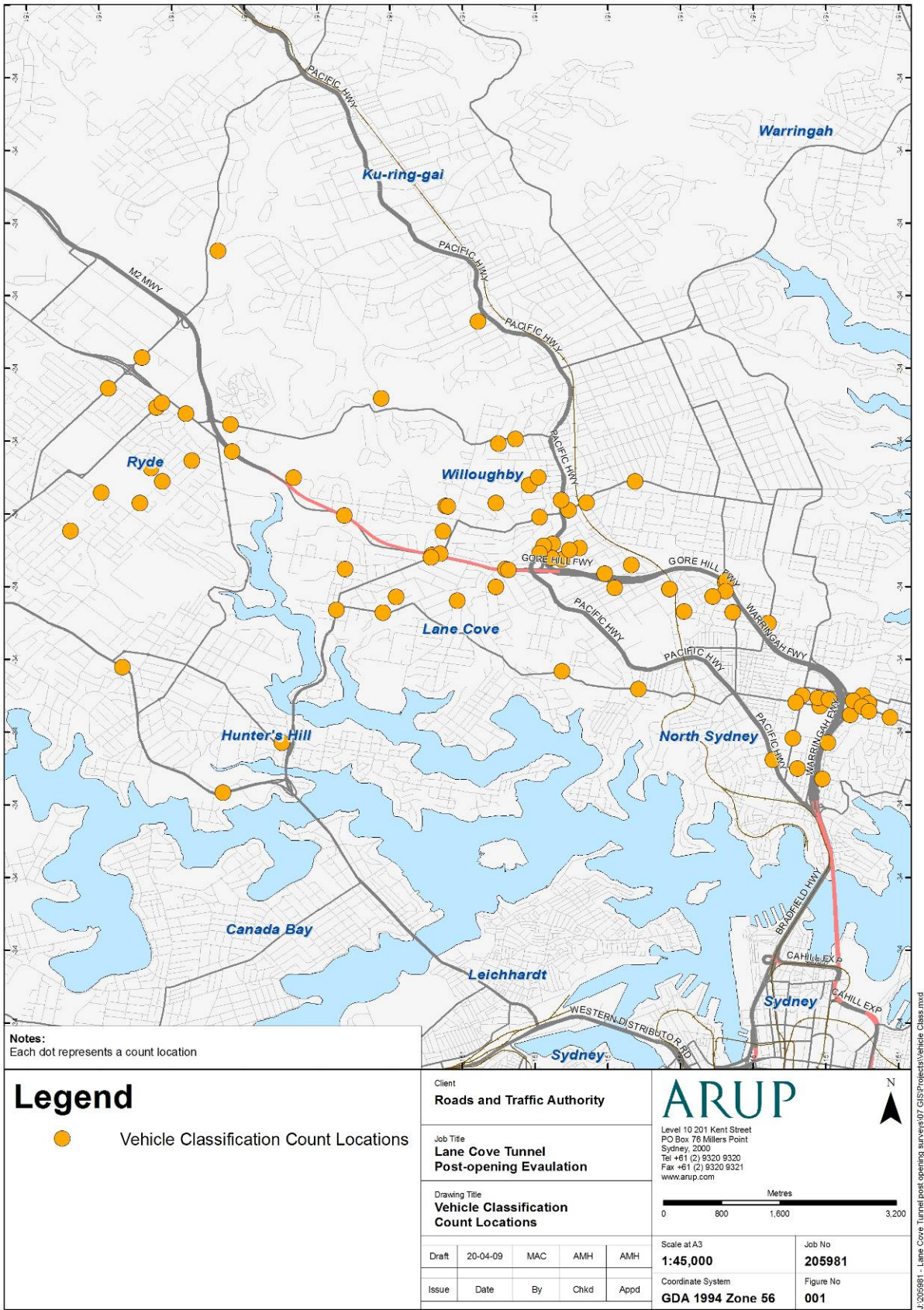


Figure 2: Turning Movement Count Locations

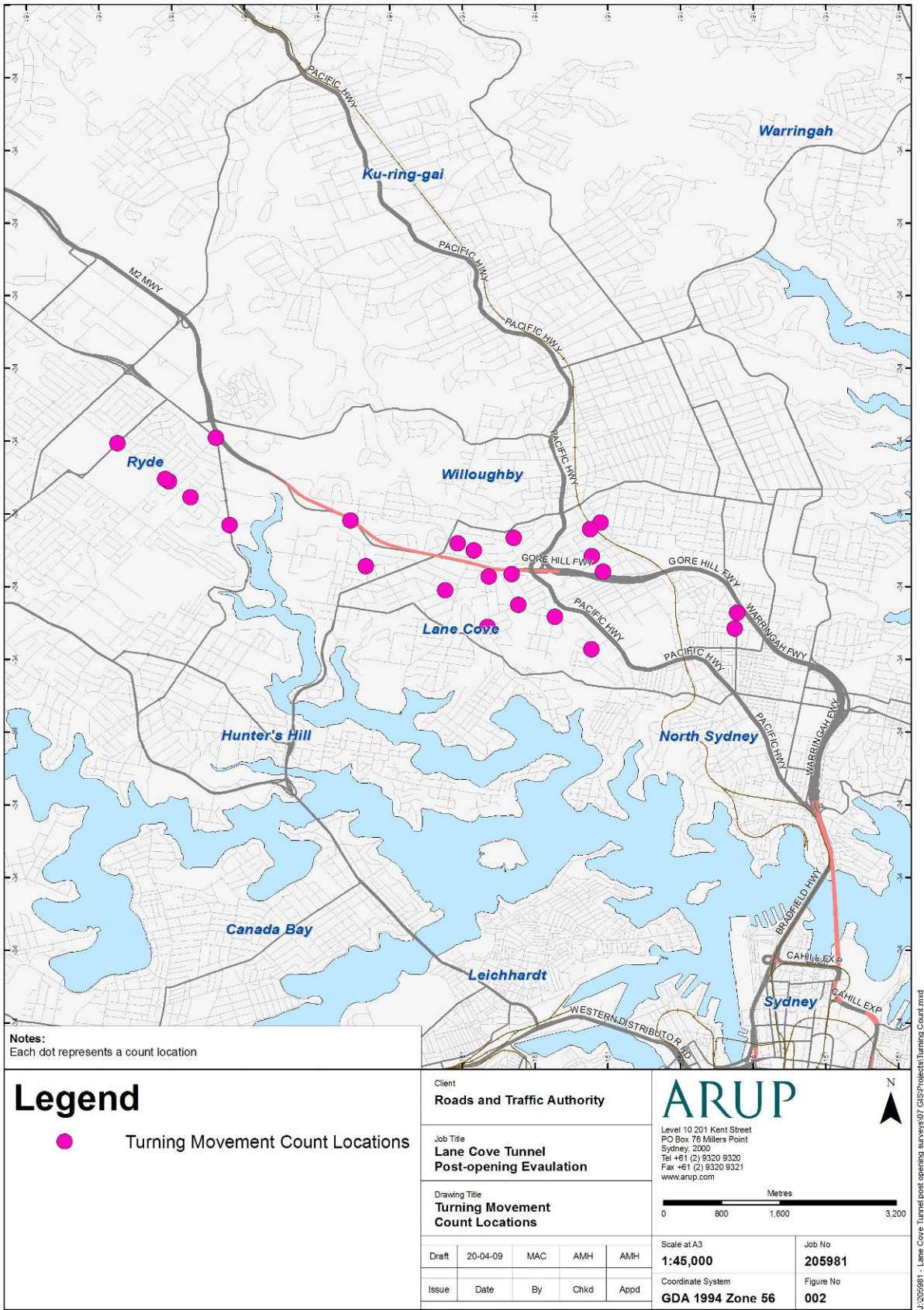


Figure 3: SCATS Traffic Signal Count Locations

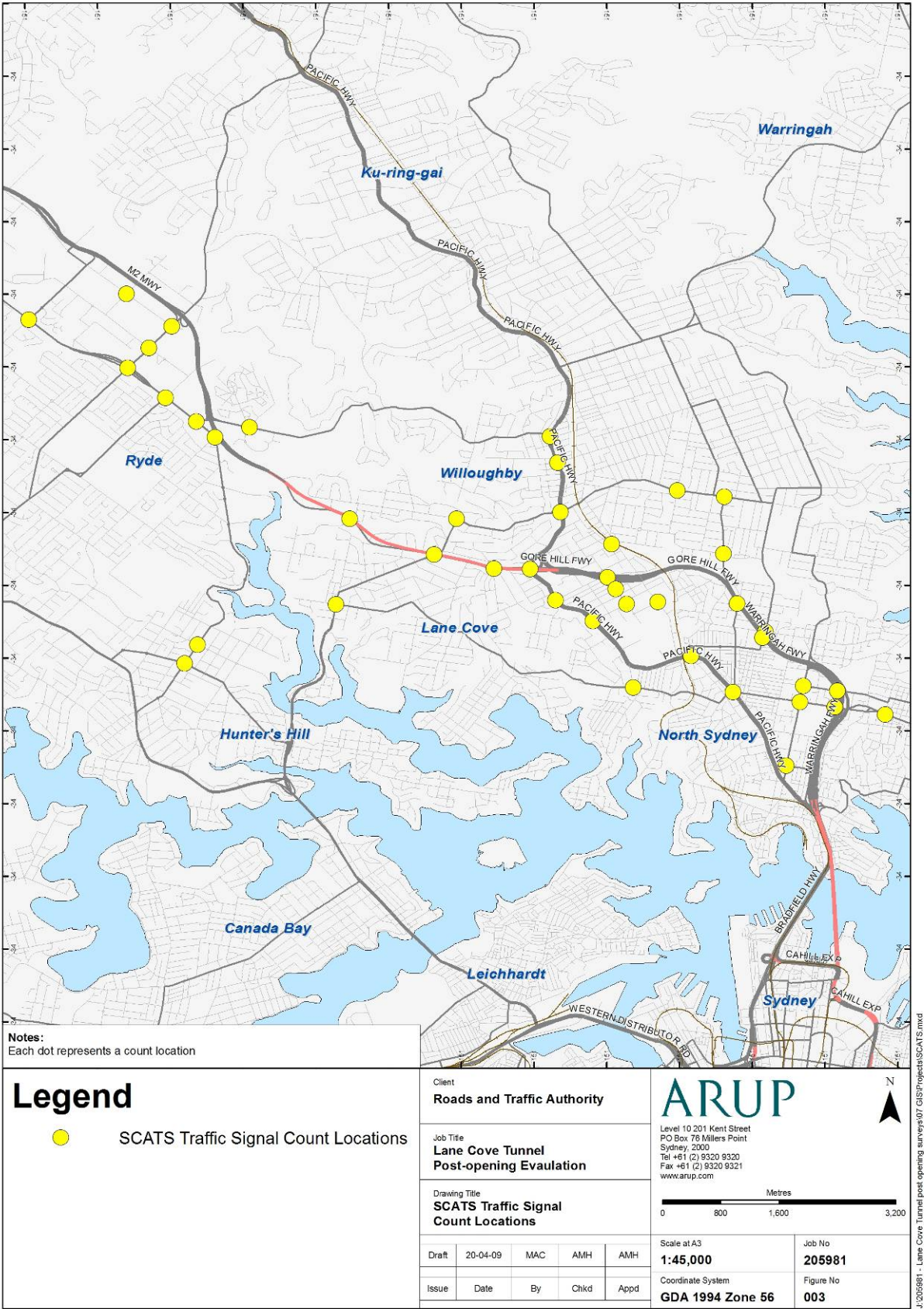
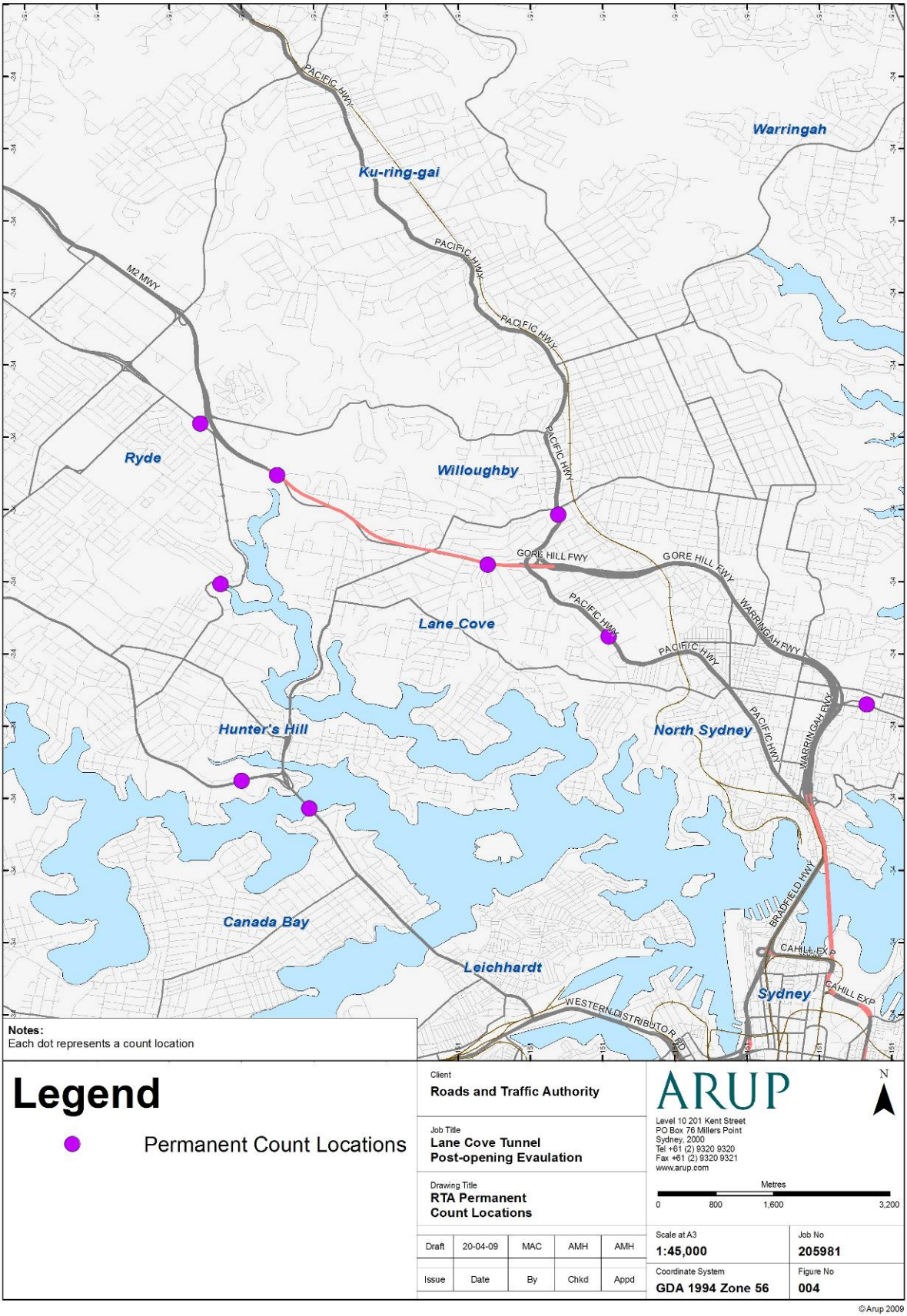




Figure 4: RTA Permanent Count Locations



3 Predicted post-opening volumes comparison

Prior to initiation of the LCT, Masson Wilson Twiney, (MWT) developed a traffic model to assess the effects of the LCT and prepared post-opening predicted traffic volumes based upon an opening year of 2006. These numbers were also used in the Environmental Impact Statement (EIS) dated October 2001. The predictions from these two reports are compared to actual 2008 post-opening volumes in this section.

A colour coding system is used on the maps and in the tables to identify the percentage change. These ranges have been chosen to simplify the presentation of results indicating a minimal change in the middle band or a reasonable change up or down.

	-100% to -10%
	-10% to +10%
	+10% to +100%

3.1 Working Paper No. 4 Predicted traffic volumes

Working paper 4 by MWT predicted traffic generated by the introduction of the LCT and presented predicted values for the volumes expected at opening. These values were presented to the four Councils (Ryde, Lane Cove, North Sydney and Willoughby) and became an important part of the approval for initiation of the project. The following section shows how the predicted values of 2006 differ to the actual 2008 one year post opening volumes recorded and collated by Arup.

Table 1: Predicted Volumes comparison from Working Paper 4 Morning Peak

Volume based on weekly data	Morning Peak Hour (Both Directions)						
Location	2004 Actual	2006 Predicted	2008 Actual	04-08 Change	04-08 % Change	06-08 Difference	06-08 % Difference
M2 S of Delhi Rd	2,228	3,663	2,113	-115	-5%	-1,550	-42%
Epping Rd E of Pittwater Rd	2,962	5,455	4,593	1631	55%	-862	-16%
Mowbray Road West N of Epping Rd	1,550	636	1,324	-226	-15%	688	108%
Centennial Ave S of Epping Rd	1,029	1,637	1,355	326	32%	-282	-17%
Longueville Rd E of Parklands Rd	4,759	2,538	2,836	-1923	-40%	298	12%
LCT	N/A	6,809	5076	-	-	-1733	-25%
Fullers Rd W of Pacific Hwy	1,732	2,049	1,926	194	11%	-123	-6%
Mowbray Road West W of Pacific Hwy	1,286	1,825	1,470	184	14%	-355	-19%
River Rd E of Northwood Rd	2,092	3,162	1,876	-216	-10%	-1286	-41%
Pacific Hwy N of Gore Hill Fwy	3,490	3,530	3,384	-106	-3%	-146	-4%
Gore Hill Fwy at Willoughby Rd O/Pass	5,110	9,095	6,289	1179	23%	-2806	-31%
Falcon St E of Miller St	1,524	1,950	1,296	-228	-15%	-654	-34%
Military Rd W of Ben Boyd Rd	3,730	4,499	3,301	-429	-11%	-1198	-27%
Falcon St North-facing Ramps	N/A	2,031	858	-	-	-1173	-58%
Epping Rd at Stringy Bark Ck	4,202	1,670	2,327	-1875	-45%	657	39%
Epping Rd W of Sam Johnson Way	4,179	1,873	2,643	-1536	-37%	770	41%
Pacific Hwy N of Greenwich Rd	1,936	2,666	1,753	-183	-9%	-913	-34%
Pacific Hwy E of Christie St	1,936	2,568	1,753	-183	-9%	-815	-32%

Table 1 above, which refers to the morning peak, indicates that there are some variations between the predicted post-opening values on certain roads to the actual post-opening volumes. In particular, the large difference for Mowbray Road West, north of Epping Road. The predicted volume for this road post-opening was significantly less than recorded in 2008 (+108%), although there has been a reduction in traffic volumes from 2004 to 2008 (-15%).

Other large differences in predicted values occur at the LCT itself, with slightly more than half the predicted traffic and the Falcon Street ramps, with less than half the predicted traffic. River Road, east of Northwood Road did not experience the expected increase in traffic, with the 2008 volumes approximately 60% of the predicted volumes. The eastern end of Epping Road had reduced traffic predicted due to the LCT. While the traffic volume did reduce by approximately 40%, it did not experience the predicted reduction in traffic volume. The western end of Epping Road had increased traffic predicted due to the LCT. While it experienced an increase of 55% over 2004 levels, this volume was also less than the predicted increase in traffic volume.

Table 2: Predicted Volumes comparison from Working Paper 4 Afternoon Peak

Volume based on weekly data	Afternoon Peak Hour (Both Directions)						
Location	2004 Actual	2006 Predicted	2008 Actual	04-08 Change	04-08 % Change	06-08 Difference	06-08 % Difference
M2 S of Delhi Rd	2,763	4,492	2612	-151	-5%	-1,880	-42%
Epping Rd E of Pittwater Rd	3,688	7,885	5356	1668	45%	-2529	-32%
Mowbray Road West N of Epping Rd	1,505	543	1199	-306	-20%	656	121%
Centennial Ave S of Epping Rd	1,336	1386	1361	25	2%	-25	-2%
Longueville Rd E of Parklands Rd	5659	3,084	3,342	-2317	-41%	258	8%
LCT	N/A	9,381	5,102	-	-	-4279	-46%
Fullers Rd W of Pacific Hwy	2235	2,299	2166	-69	-3%	-133	-6%
Mowbray Road West W of Pacific Hwy	1554	1165	1445	-109	-7%	280	24%
River Rd E of Northwood Rd	2,150	3,497	1932	-218	-10%	-1565	-45%
Pacific Hwy N of Gore Hill Fwy	4,578	2,981	4,280	-298	-7%	1299	44%
Gore Hill Fwy at Willoughby Rd O/Pass	6,092	9,573	7188	1096	18%	-2385	-25%
Falcon St E of Miller St	1,752	2,560	1587	-165	-9%	-973	-38%
Military Rd W of Ben Boyd Rd	4,010	4,741	4010	0	0%	-731	-15%
Falcon St North-facing Ramps	N/A	2099	913	-	-	-1186	-57%
Epping Rd at Stringy Bark Ck	5076	2,201	2,958	-2118	-42%	757	34%
Epping Rd W of Sam Johnson Way	5457	2505	3,026	-2431	-45%	521	21%
Pacific Hwy N of Greenwich Rd	2,176	3,460	1794	-382	-18%	-1666	-48%
Pacific Hwy E of Christie St	2,176	3,093	1794	-382	-18%	-1299	-42%

Table 2 above shows the afternoon peak traffic volumes, both 2004 and 2008 and the predicted post-opening volumes. There are some differences between the predicted values and the actual post-opening values. Of particular note is Mowbray Road West not experiencing the predicted reduction in traffic, although there was a 20% reduction in traffic from 2004 to 2008.

Other large differences in predicted volumes include Epping Road before the tunnel, increasing traffic by 45%, but not to the levels predicted,

3.2 Environment Impact Statement (2001) Predicted traffic volumes

The Environmental Impact Statement (EIS) completed by SKM gave future traffic numbers on several roads that would be affected by the LCT. These predictions have been compared to the recently recorded numbers, with the differences highlighted in Table 3.

Table 3: Environmental Impact Statement predicted values compared to actual volumes

Road	Morning Peak Hour				Evening Peak Hour			
	2004 (Actual)	2006 (Predicted)	2008 (Actual)	Difference 2008-2006	2004 (Actual)	2006 (Predicted)	2008 (Actual)	Difference 2008- 2006
Longueville Road	5689	2538	3403	865	5921	3084	3494	410
Lane Cove Tunnel	N/A	6809	5076	-1733	N/A	9381	5102	-4279
Gore Hill Freeway	6046	9095	7607	-1488	6399	9573	7727	-1846
M2/Epping Road	4894	9118	6706	-2412	5897	12377	7972	-4405

4 Before and After Analysis

This section summarises the effect of the LCT on the surrounding road network highlighting the changes in traffic volumes experienced. The complete before and after comparison values for each location surveyed is presented in the Appendices.

The analysis is broken into nine areas within the study area, for ease of viewing only, as due to the nature of the borders of the Local Councils involved, a LGA specific map for each is not appropriate for the report format.

In this section, the traffic volumes are split into light vehicles such as cars, trailers and motorcycles, rigid vehicles such as delivery and garbage trucks and articulated vehicles such as semi-trailers and b-doubles. This classification is based upon the number of axles recorded for each vehicle, two for light vehicles, 3 or 4 for rigid vehicles and 5 or more for articulated vehicles. In the tables below, Cars refers to light vehicles, Rigid refers to rigid heavy vehicles and Artic refers to articulated vehicles.

Each direction of travel is shown on each street section. The direction of travel is indicated as follows:

N – Northbound

S – Southbound

E – Eastbound

W - Westbound

4.1 Lane Cove

Figure 5: Vehicle Classification count results - Lane Cove

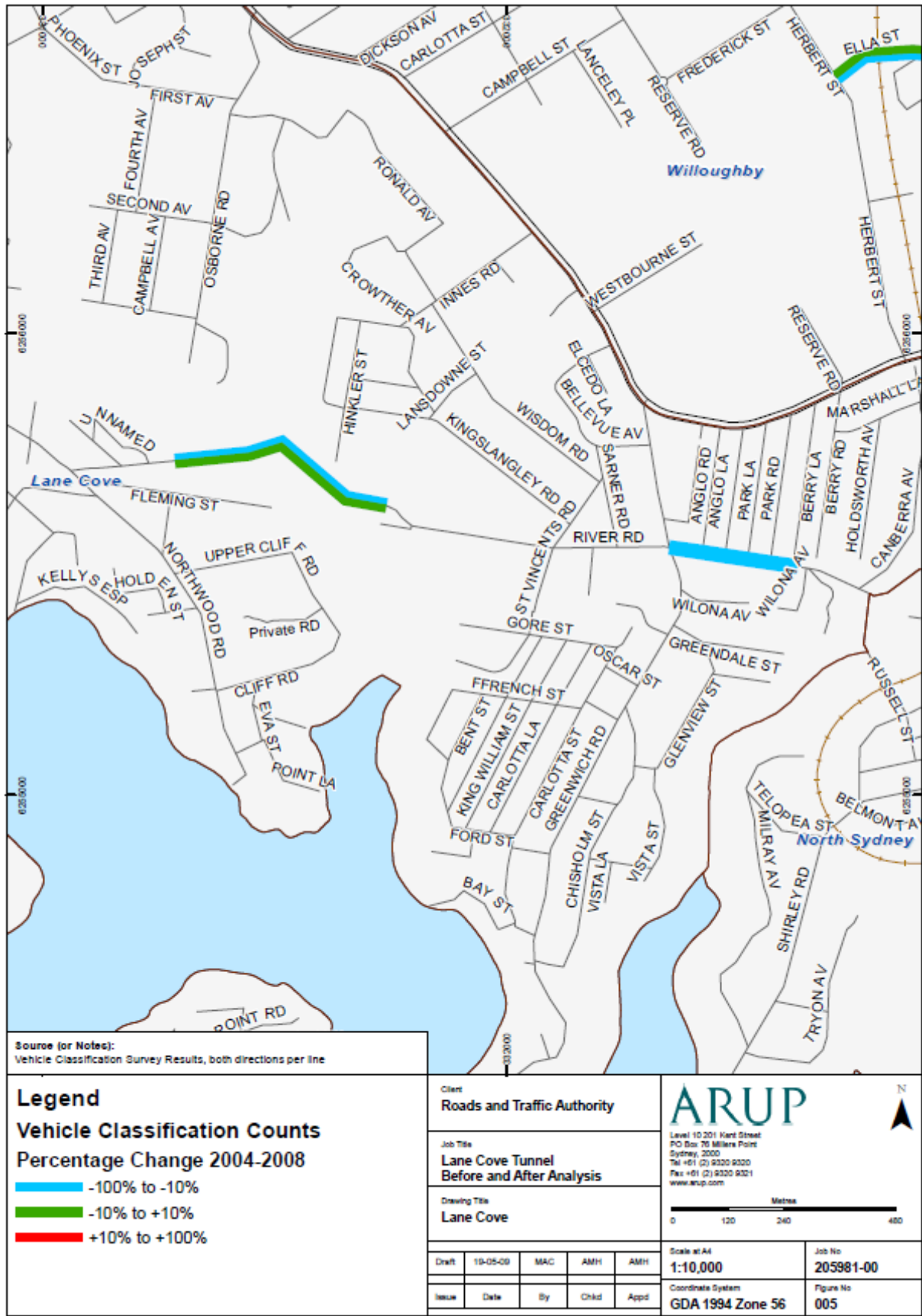


Table 4: Changes in Volumes - Lane Cove

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
River Road East E	9818	239	10	10067	6346	204	7	6557	-3510	-35%
River Road East W	10059	245	12	10316	8603	286	19	8908	-1408	-14%
River Road West E	12078	364	11	12453	11298	352	7	11657	-796	-6%
River Road West W	13860	349	18	14227	12147	374	10	12531	-1696	-12%

As can be seen in Figure 5, there has been a reduction in traffic using River Road. Although there is a reduced amount of total traffic using this road, heavy rigid vehicle usage in 2008 remained consistent with 2004 volumes.

The major reduction in traffic on this road occurred at the count location east of Greenwich Road, with most of the reduction in the eastbound direction.

4.2 Lane Cove North

Figure 6: Vehicle Classification count results - Lane Cove North

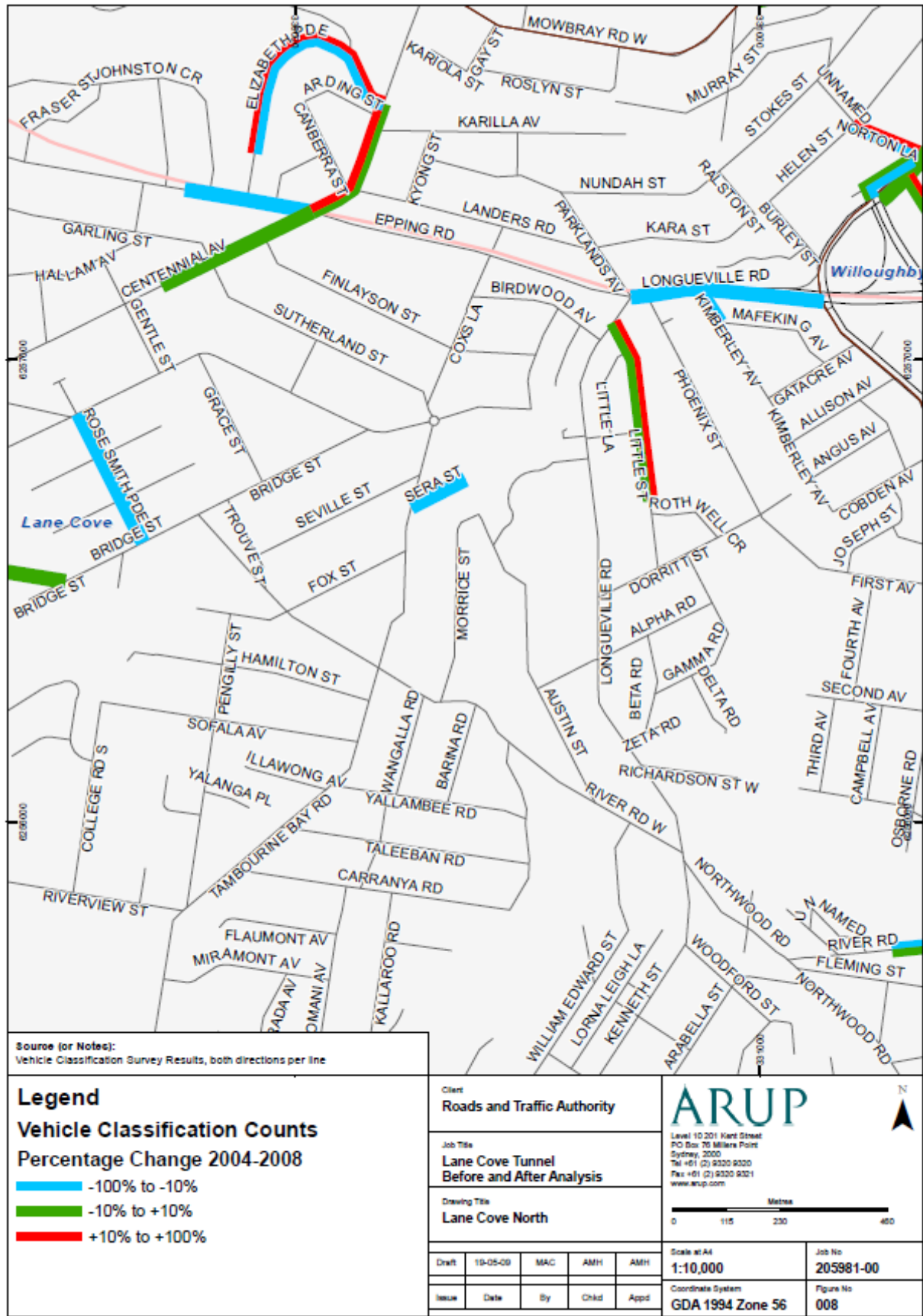


Table 5: Changes in Volumes - Lane Cove North

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Centennial Ave N, N	4945	156	14	5115	5717	165	8	5890	775	15%
Centennial Ave N, S	5967	152	9	6128	6041	154	6	6201	73	1%
Centennial Ave S, E	8141	294	27	8462	8521	362	42	8925	463	5%
Centennial Ave S, W	10010	386	32	10428	9855	354	21	10230	-198	-2%
Elizabeth Parade E	586	6	0	592	508	5	0	513	-79	-13%
Elizabeth Parade W	336	7	0	343	378	5	0	383	40	12%
Epping Road E	30332	2344	284	32960	14867	856	61	15784	-17176	-52%
Epping Road W	38857	1928	267	41052	18961	923	69	19953	-21099	-51%
Howarth Road	2114	101	7	2222	1522	57	18	1597	-625	-28%
Little Street N	1271	61	164	1496	1456	81	14	1551	55	4%
Little Street S	1252	89	37	1378	1409	110	29	1548	170	12%
Longueville Road E	38754	1787	182	40723	21186	1098	63	22347	-18376	-45%
Longueville Road W	41778	2861	304	44943	25753	1327	87	27167	-17776	-40%
Norton Lane	915	8	3	926	1106	19	3	1128	202	22%
Ross Smith Parade E	1233	64	8	1305	1003	68	4	1075	-230	-18%
Ross Smith Parade W	1515	65	9	1589	1334	66	4	1404	-185	-12%
Sera Street E	1136	17	1	1154	856	25	4	885	-269	-23%
Sera Street W	1606	14	0	1620	1250	29	4	1283	-337	-21%

There was a reduction in the amount of traffic using Longueville Road from Lane Cove to the Pacific Highway, which stems from the reduction in traffic on Epping Road. Norton Lane shows an increase of 22%, however, Norton Lane is now one-way. Centennial Avenue northbound experienced an increase of 15%, north from Epping Road, otherwise there was little change.

Heavy Vehicle usage on Centennial Avenue South, eastbound has increased by approximately 70 vehicles, however the total traffic increase on the road was negligible.

Figure 7: Vehicle Classification count results - Lane Cove West



Table 6: Changes in Volumes - Lane Cove West

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Burns Bay Road N	20030	757	49	20836	18835	707	54	19596	-1240	-6%
Burns Bay Road S	22765	968	67	23800	21186	731	36	21953	-1847	-8%
Cullen Street N	977	16	3	996	829	16	1	846	-150	-15%
Cullen Street S	570	8	2	580	500	7	0	507	-73	-13%
Epping Road E	37440	2086	274	39800	18039	901	62	19002	-20798	-52%
Epping Road W	37183	6855	1074	45112	21536	970	73	22579	-22533	-50%
Mowbray Road E	7752	317	45	8114	6864	311	32	7207	-907	-11%
Mowbray Road W	7313	310	49	7672	6619	314	30	6963	-709	-9%
Penrose Street E	10190	405	20	10615	9545	328	15	9888	-727	-7%
Penrose Street W	12063	384	17	12464	11007	307	20	11334	-1130	-9%

All traffic volumes in this section recorded reduced traffic volumes when compared to 2004 volumes. Epping Road experienced the largest drop, with sub-arterial roads such as Mowbray Road, Burns Bay Road and Penrose Street recording reductions in traffic up to 11%. Cullen Street, a local road, also experienced a reduction in traffic.

Heavy vehicle usage is very similar to the 2004 for all streets in this section with the exception of Epping Road which recorded a large reduction in heavy vehicle traffic.

4.4 Gladesville

Figure 8: Vehicle Classification count results - Gladesville

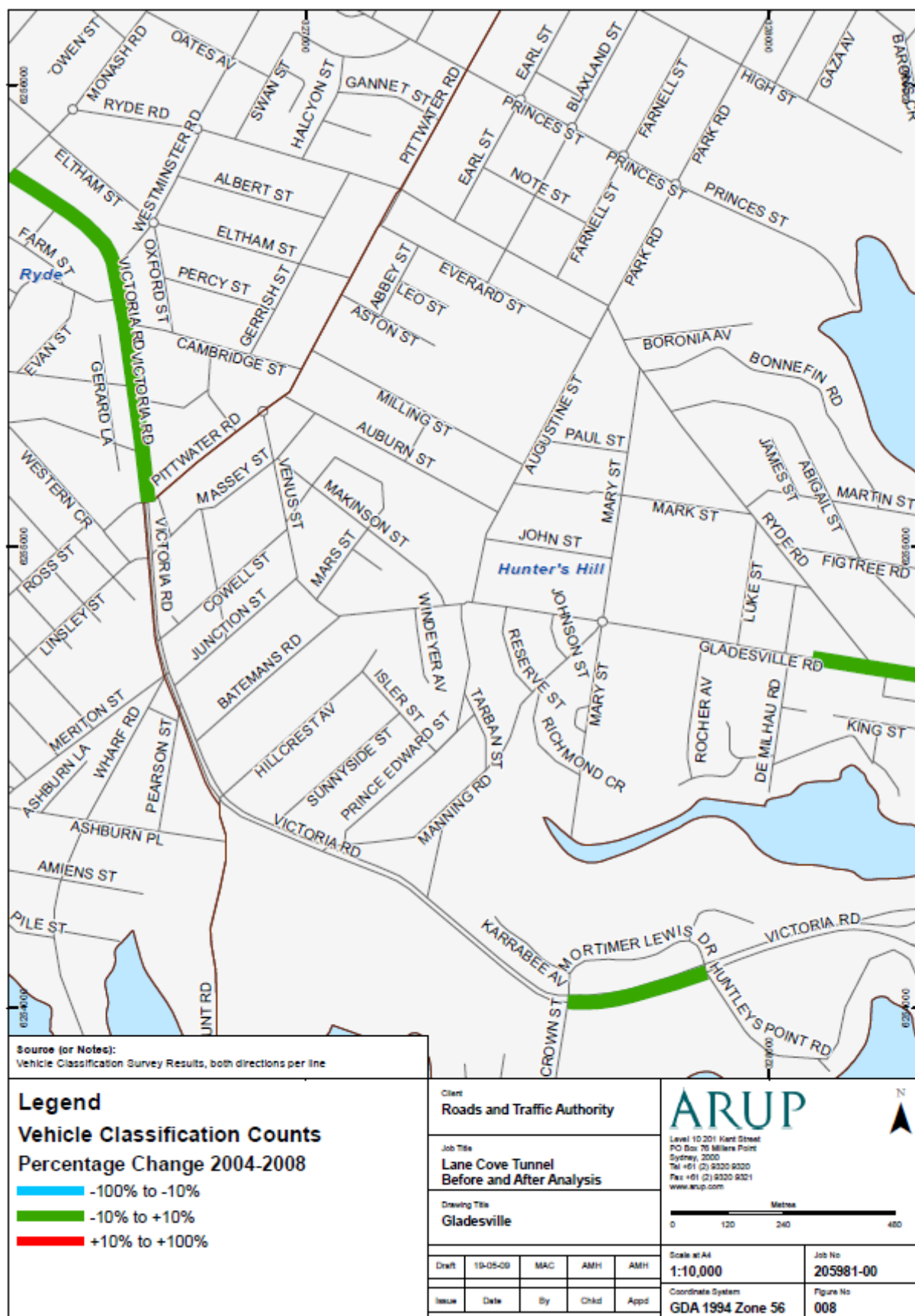


Table 7: Changes in Volumes - Gladesville

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Ryde Road E	13218	504	19	13741	12467	428	17	12912	-829	-6%
Ryde Road W	13142	442	10	13594	12632	468	12	13112	-482	-4%
Victoria Road East E	29042	1145	80	30267	28083	1235	103	29421	-846	-3%
Victoria Road East W	27288	1422	111	28821	25050	1257	92	26399	-2422	-8%
Victoria Road West E	25145	1141	81	26367	23372	1237	90	24699	-1668	-6%
Victoria Road West W	21647	1336	90	23073	20670	1051	60	21781	-1292	-6%

Traffic volumes on Victoria Road in Gladesville have reduced at all count locations. Traffic volumes on Ryde Road have also reduced in both directions.

Heavy vehicle usage on Victoria Road has not changed significantly from 2004 to 2008 (approx. 6%).

4.5 Lindfield

Figure 9: Vehicle Classification count results - Lindfield

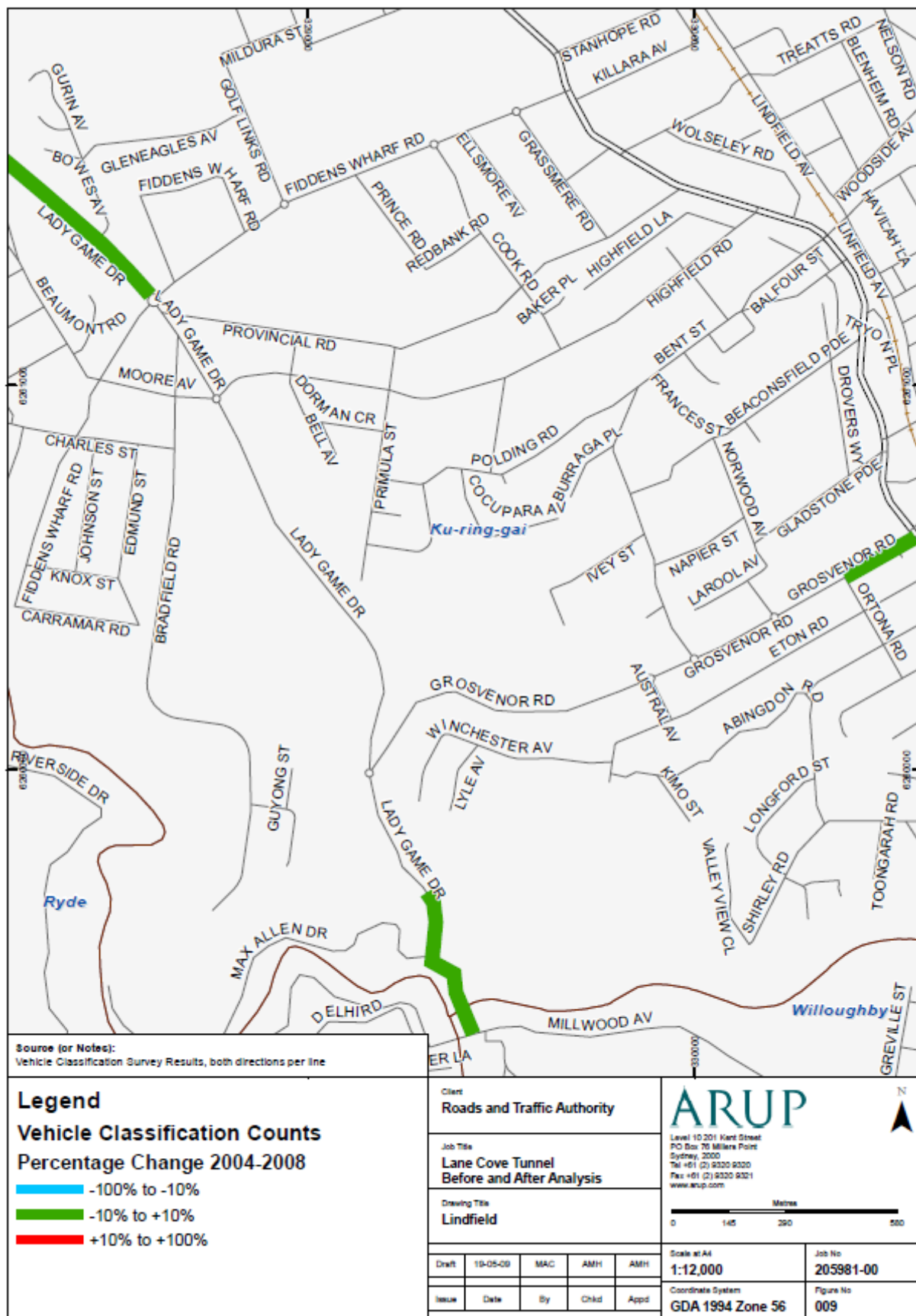


Table 8: Changes in Volumes - Lindfield

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Grosvenor Road E	3743	92	4	3839	3595	128	4	3727	-112	-3%
Grosvenor Road W	3898	80	1	3979	3597	103	6	3706	-273	-7%
Lady Game Dr East E	9034	96	2	9132	8435	146	6	8587	-545	-6%
Lady Game Dr East W	9495	102	3	9600	9036	122	6	9164	-436	-5%
Lady Game Dr West E	4584	51	3	4638	4633	79	4	4716	78	2%
Lady Game Dr West W	4637	54	3	4694	4615	102	4	4721	27	1%

Lady Game Drive shows a slight increase in heavy vehicle usage, however total traffic volumes have remained similar to 2004 levels.

4.6 Ryde

Figure 10: Vehicle Classification count results - Ryde

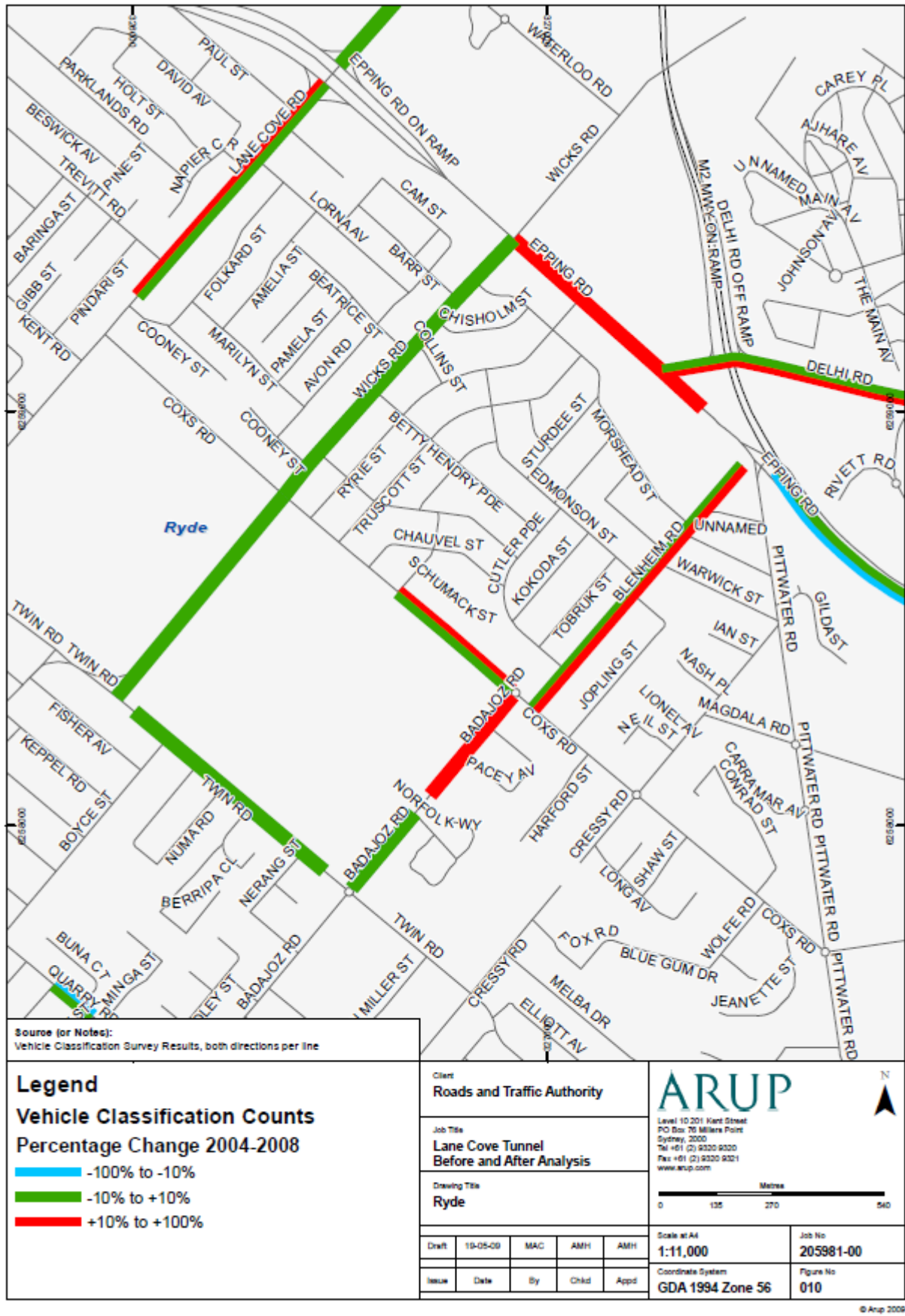


Table 9: Changes in Volumes - Ryde

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Badajoz Road N, N	2936	136	1	3073	4238	171	4	4413	1340	44%
Badajoz Road N, S	3140	139	0	3279	4198	192	7	4397	1118	34%
Badajoz Road S, N	4071	125	2	4198	4238	171	4	4413	215	5%
Badajoz Road S, S	3978	102	2	4082	4198	192	7	4397	315	8%
Blenheim Road N	2528	132	2	2662	3086	182	3	3271	609	23%
Blenheim Road S	2665	136	1	2802	2833	172	5	3010	208	7%
Coxs Road E	3989	194	3	4186	3706	198	7	3911	-275	-7%
Coxs Road W	3621	186	2	3809	4427	181	4	4612	803	21%
Delhi Road E	12875	516	33	13424	13752	809	78	14639	1215	9%
Delhi Road W	14437	542	45	15024	15866	1162	131	17159	2135	14%
Epping Road E	25328	1744	214	27286	32559	1741	138	34438	7152	26%
Epping Road W	27203	1795	199	29197	33874	1817	198	35889	6692	23%
Lane Cove Road N, N	33610	2049	330	35989	30806	1904	300	33010	-2979	-8%
Lane Cove Road N, S	33559	1788	323	35670	30789	1715	294	32798	-2872	-8%
Lane Cove Road S, N	27683	1734	375	29792	26070	1609	253	27932	-1860	-6%
Lane Cove Road S, S	24034	915	71	25020	27399	1468	243	29110	4090	16%
M2 Motorway E	16508	736	166	17410	14805	753	168	15726	-1684	-10%
M2 Motorway W	17186	782	246	18214	15310	758	176	16244	-1970	-11%
Twin Road N	2835	86	4	2925	2956	79	4	3039	114	4%
Twin Road S	2417	70	3	2490	2452	68	5	2525	35	1%
Wicks Road N, N	8618	323	24	8965	9170	526	41	9737	772	9%
Wicks Road N, S	10348	455	31	10834	10588	681	47	11316	482	4%
Wicks Road S, N	8902	401	35	9338	8912	471	26	9409	71	1%
Wicks Road S, S	10626	456	38	11120	10632	575	33	11240	120	1%

A number of roads in Ryde recorded increased traffic in 2008. Epping Road recorded a 23% increase in traffic. Delhi Road also recorded increased traffic of over 9% in both directions. Badajoz and Blenheim Roads recorded increases of up to 44% in the case of Badajoz Road Northbound.

Volumes of heavy vehicles have increased on Blenheim, Wicks and Badajoz Roads, with the largest increase of 63% on Wicks Road Northbound, north of Coxs Road. On Delhi Road, heavy vehicle usage has increased in both directions, doubling in the westbound direction. Lane Cove Road in the southbound direction, south of Epping Road recorded a volume increase of 500 heavy vehicles.

4.7 North Sydney

Figure 11: Vehicle Classification count results - North Sydney

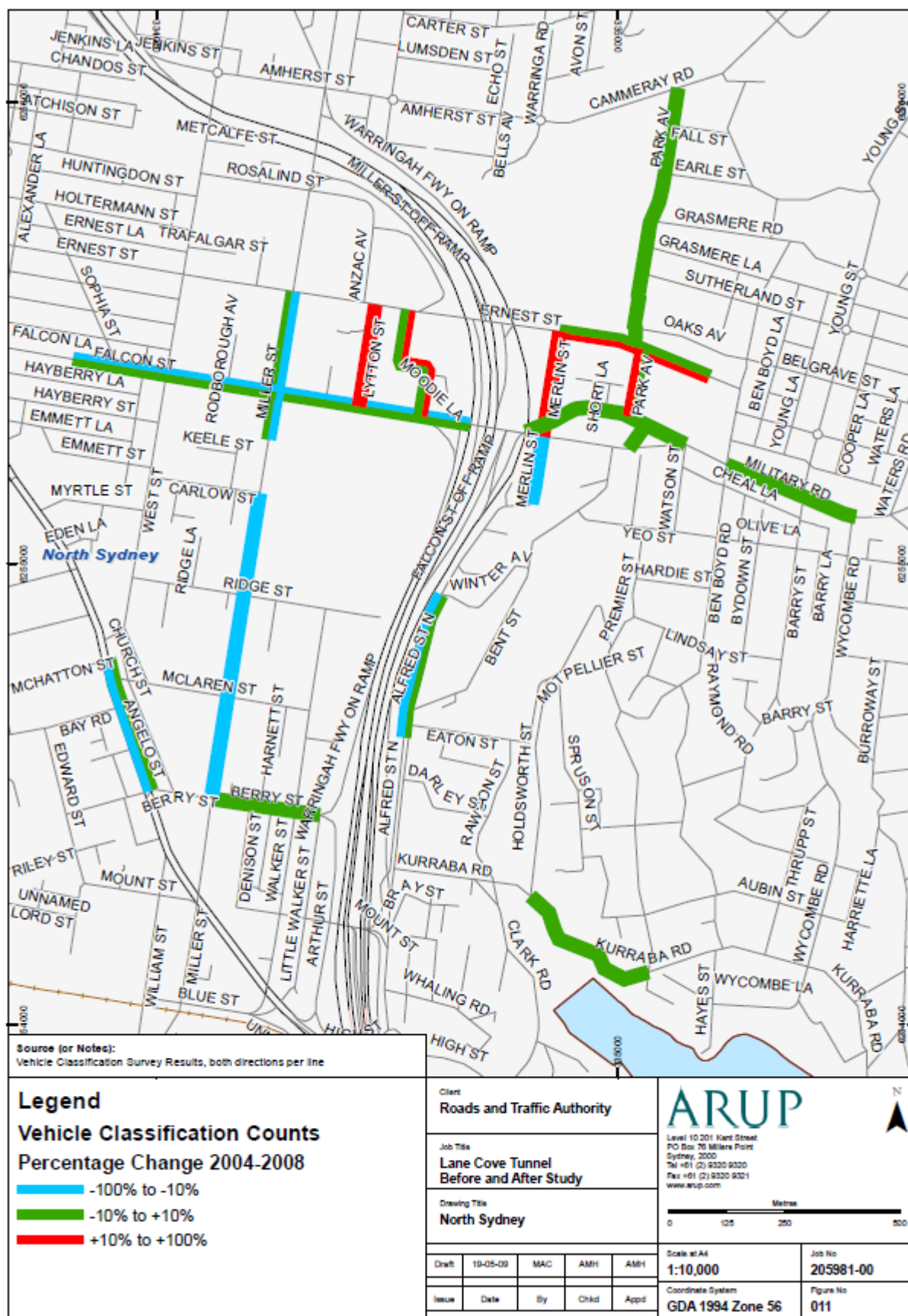


Table 10: Changes in Volumes - North Sydney

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Alfred Street N	2236	30	12	2278	1314	22	6	1342	-936	-41%
Berry Street E	14757	510	37	15304	15299	904	109	16312	1008	7%
Ernest Street E	10800	287	10	11097	11973	275	11	12259	1162	10%
Ernest Street W	15343	457	34	15834	17492	408	36	17936	2102	13%
Falcon Street East E	16413	970	54	17437	15165	963	50	16178	-1259	-7%
Falcon Street East W	16708	1199	232	18139	8899	498	20	9417	-8722	-48%
Falcon Street West E	11989	717	40	12746	12022	611	32	12665	-81	-1%
Falcon Street West W	13584	747	39	14370	10955	608	31	11594	-2776	-19%
Kurraba Road E	10539	179	155	10873	9764	171	7	9942	-931	-9%
Kurraba Road W	8634	110	56	8800	8260	123	2	8385	-415	-5%
Lytton Street N	313	13	3	329	373	16	1	390	61	18%
Lytton Street S	467	8	3	478	713	14	2	729	251	52%
Merlin Street North N	420	22	1	443	624	39	7	670	227	51%
Merlin Street North S	1768	66	1	1835	2025	87	4	2116	281	15%
Merlin Street South N	2559	47	57	2663	1781	29	1	1811	-852	-32%
Merlin Street South S	250	7	5	262	186	5	0	191	-71	-27%
Military Road East E	30996	1804	210	33010	30414	2753	434	33601	591	2%
Military Road East W	30515	1974	215	32704	28910	2548	215	31673	-1031	-3%
Military Road West E	38555	3173	348	42076	37980	2704	260	40944	-1132	-3%
Miller Street North N	7685	346	15	8046	5873	277	9	6159	-1887	-23%
Miller Street North S	5602	268	9	5879	5559	274	15	5848	-31	-1%
Miller Street South N	6279	422	12	6713	4590	367	10	4967	-1746	-26%
Miller Street South S	9328	545	22	9895	6262	441	26	6729	-3166	-32%
Moodie Street N	276	5	8	289	293	8	1	302	13	4%
Moodie Street S	160	2	0	162	176	6	0	182	20	12%
Pacific Highway N	16915	919	41	17875	12571	627	22	13220	-4655	-26%
Pacific Highway S	12946	775	43	13764	12722	859	75	13656	-108	-1%
Park Avenue North N	1170	15	0	1185	1293	16	0	1309	124	10%
Park Avenue North S	2573	31	0	2604	2791	52	1	2844	240	9%
Park Avenue South N	423	2	0	425	473	7	0	480	55	13%
Slip Lane	843	31	1	875	826	38	2	866	-9	-1%

The traffic increases in North Sydney occurred on Berry Street, Lytton Street, Moodie Street, Merlin Street and Ernest Street.

Heavy Vehicle Volumes on Military Road at Ben Boyd Road have increased by over 50% eastbound and 25% westbound. Berry Street recorded almost a 100% increase in heavy vehicle usage from 2004 to 2008.

4.8 Chatswood

Figure 12: Vehicle Classification count results - Chatswood

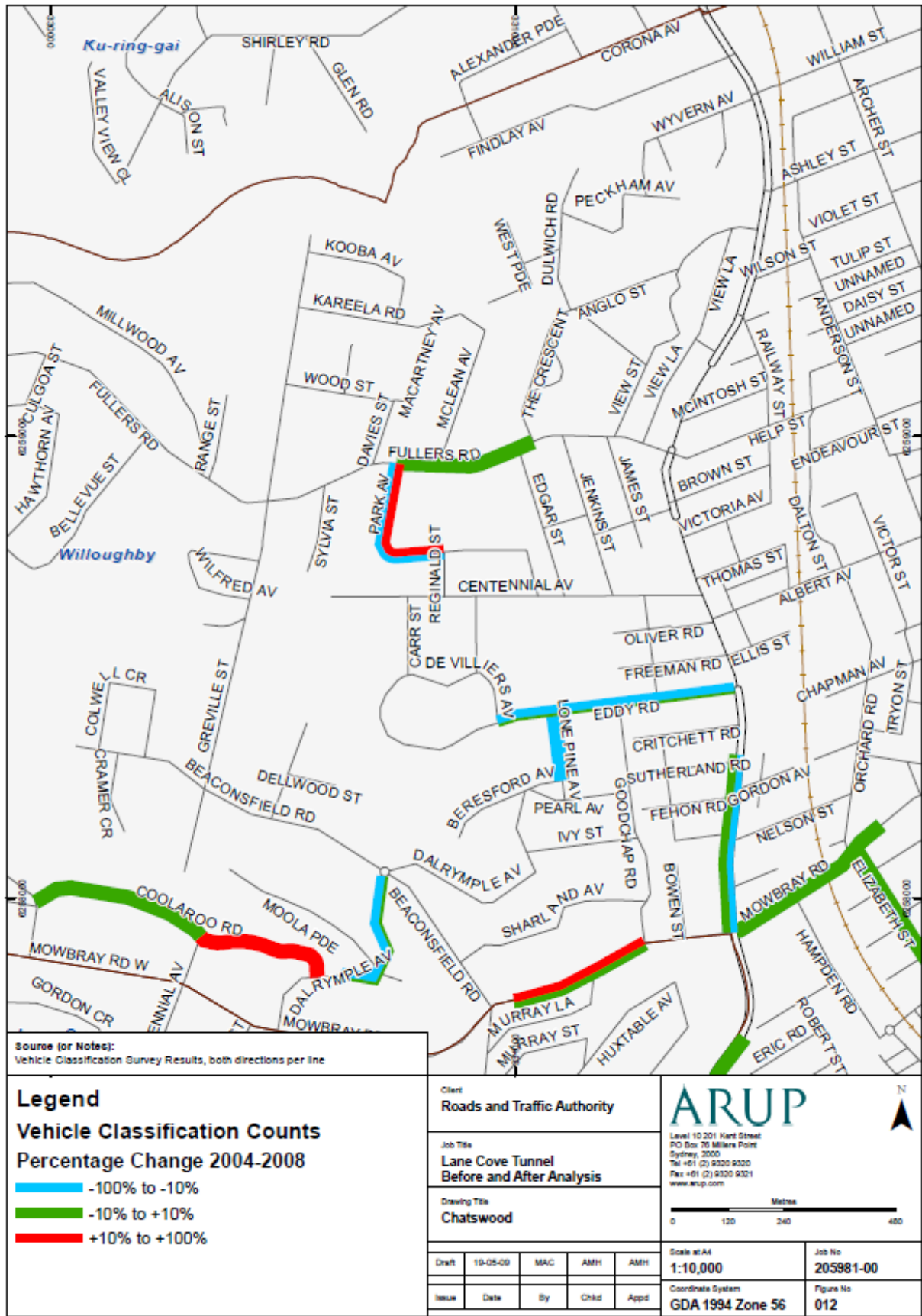


Table 11: Changes in Volumes - Chatswood

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Coolaroo Road East E	658	7	1	666	922	10	19	951	285	42%
Coolaroo Road East W	323	3	0	326	516	8	6	530	204	62%
Coolaroo Road West E	634	2	0	636	561	6	5	572	-64	-10%
Coolaroo Road West W	321	7	0	328	286	7	2	295	-33	-10%
Dalrymple Avenue N	1032	8	0	1040	896	22	0	918	-122	-12%
Dalrymple Avenue S	1059	14	0	1073	1030	15	0	1045	-28	-3%
Eddy Road E	531	9	8	548	457	8	2	467	-81	-15%
Eddy Road W	200	5	17	222	224	7	1	232	10	4%
Elizabeth Street N	586	6	0	592	508	5	0	513	-79	-13%
Elizabeth Street S	336	7	0	343	378	5	0	383	40	12%
Fullers Road E	12458	630	39	13127	13219	598	53	13870	743	6%
Fullers Road W	16164	677	37	16878	15052	680	54	15786	-1092	-6%
Lone Pine Avenue N	807	22	9	838	677	28	4	709	-129	-15%
Lone Pine Avenue S	977	17	11	1005	840	17	3	860	-145	-14%
Mowbray Road East E	9984	446	54	10484	10848	582	55	11485	1001	10%
Mowbray Road East W	11415	733	63	12211	11359	529	59	11947	-264	-2%
Pacific Highway N	28847	1148	194	30189	29394	1228	180	30802	613	2%
Pacific Highway S	32370	2132	453	34955	27090	1367	198	28655	-6300	-18%
Park Avenue N	593	13	7	613	717	10	2	729	116	19%
Park Avenue S	1116	18	21	1155	939	10	2	951	-204	-18%

The traffic increase on Coolaroo Road east of Centennial Avenue east of Greenlands Road is over 50% but volumes are still at local road levels. Traffic on Elizabeth Street southbound and Park Avenue northbound are also still at local road volumes despite large percentage increases.

Heavy Vehicle traffic volumes on the Pacific Highway, southbound have decreased by 60%. All other heavy vehicle volumes show little change from 2004 to 2008.

4.9 Naremburn

Figure 13: Vehicle Classification count results - Naremburn

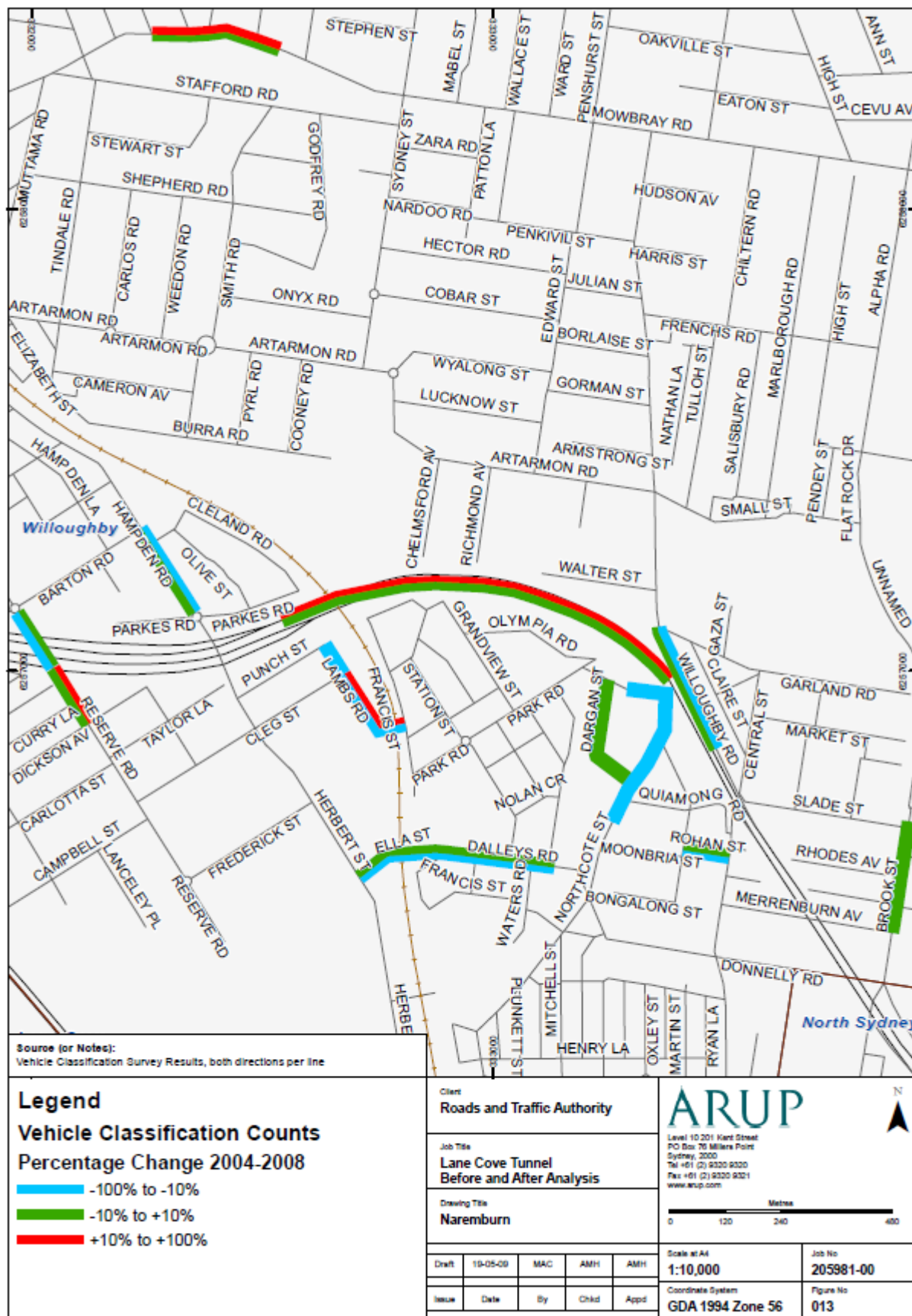


Table 12: Changes in Volumes - Naremburn

Street	2004 Volume				2008 Volume				Change	
	Cars	Rigid	Artic.	Total	Cars	Rigid	Artic.	Total	Volume	%
Brook Street N	14114	608	13	14735	14488	620	27	15135	400	3%
Brook Street S	14736	605	15	15356	14903	702	43	15648	292	2%
Dalleys Road E	2818	51	0	2869	2731	59	2	2792	-77	-3%
Dalleys Road W	2586	46	0	2632	2115	66	3	2184	-448	-17%
Dargan Street N	210	5	0	215	213	3	0	216	1	0%
Dargan Street S	167	4	0	171	162	4	0	166	-5	-3%
Gore Hill Freeway E	42834	1675	353	44862	50225	2271	378	52874	8012	18%
Gore Hill Freeway W	41333	1651	345	43329	45404	2286	394	48084	4755	11%
Hampden Rd N	5743	156	3	5902	6090	252	6	6348	446	8%
Hampden Rd S	6305	135	3	6443	5388	230	6	5624	-819	-13%
Lambs Rd North N	1407	31	1	1439	172	14	3	189	-1250	-87%
Lambs Rd North S	1229	26	1	1256	273	7	4	284	-972	-77%
Lambs Rd South N	1350	29	15	1394	1120	47	12	1179	-215	-15%
Lambs Rd South S	1119	27	13	1159	1297	31	19	1347	188	16%
Mowbray Road East E	3737	1246	136	5119	No 2008 data recorded				-	-
Mowbray Road East W	9819	430	45	10294	10211	479	38	10728	434	4%
Northcote Street N	703	18	0	721	520	12	1	533	-188	-26%
Northcote Street S	607	7	0	614	435	7	1	443	-171	-28%
Rohan Street E	1587	28	1	1616	1454	31	20	1505	-111	-7%
Rohan Street W	1887	311	1	2199	1550	21	28	1599	-600	-27%
Willoughby Rd N	18045	591	34	18670	15589	597	42	16228	-2442	-13%
Willoughby Rd S	17469	557	30	18056	16639	533	56	17228	-828	-5%
Reserve Rd North N	4464	198	403	5065	4030	144	9	4183	-882	-17%
Reserve Rd North S	6028	159	52	6239	5789	153	3	5945	-294	-5%
Reserve Rd South N	9474	587	123	10184	8263	745	116	9124	-1060	-10%
Reserve Rd South S	7662	516	84	8262	9032	653	92	9777	1515	18%

Traffic Volumes on the Gore Hill Freeway have increased in both directions by up to 18%. Most of the other roads in this area show reduced traffic volumes when compared to 2004 data.

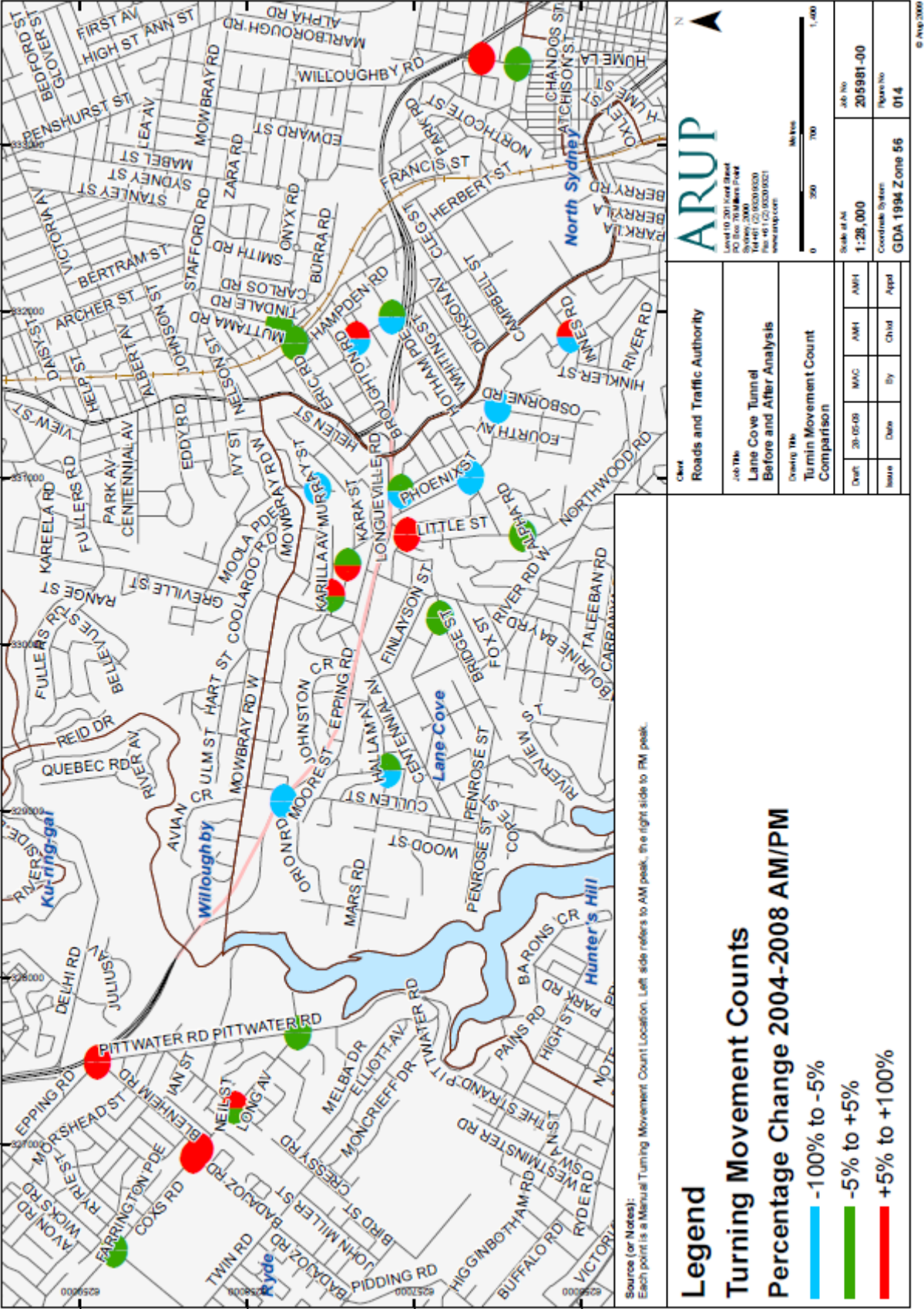
Heavy vehicle volumes on Hampden road have increased by approximately 100 vehicles since 2004. Data from Rohan Street in the westbound direction shows a large reduction of more than 200 heavy vehicles from 2004 to 2008.

Reserve Road south of the Gore Hill Freeway recorded higher volumes of heavy vehicles in both directions in 2008.

4.10 Comparison of Manual Turning Movement Counts at Intersections

The percentage change in traffic volume in each of the peak periods for the 24 manual turning movement counts undertaken at intersections across the study area are shown in Figure 14.

Figure 14: Turning Movement Counts - Total intersection changes AM/PM



The total volume of traffic entering an intersection has been compared for the AM and PM peak periods surveyed as shown in Table 13.

Table 13: Turning Movement Counts - Total intersection changes AM/PM

Intersection	2004 Volume		2008 Volume		Number Change		% Change	
	AM	PM	AM	PM	AM	PM	AM	PM
Coxs Road and Wicks Road	2657	2648	2816	2910	159	262	6%	10%
Coxs Road and Cressy Road	856	690	925	959	69	269	8%	39%
Pittwater Road and Epping Road	4810	6562	7945	7543	3135	981	65%	15%
Epping Road at Sam Johnson Way	5037	7231	3460	3903	-1577	-3328	-31%	-46%
Barwon Road and Hallam Avenue	246	671	218	614	-28	-57	-11%	-8%
Kimberley Avenue and Mafeking Avenue	184	79	77	79	-107	0	-58%	0%
Burns Bay Road and Tambourine Bay Road	1526	1350	1424	1355	-102	5	-7%	0%
Longueville Road and Alpha Road	840	800	800	769	-40	-31	-5%	-4%
Dorritt Street and Phoenix Street	946	767	618	593	-328	-174	-35%	-23%
Osbourne Road and First Avenue	600	657	531	517	-69	-140	-12%	-21%
Innes Road and Ronald Avenue	202	163	176	190	-26	27	-13%	17%
Kyong Street and Karilla Avenue	130	133	126	148	-4	15	-3%	11%
Parklands Avenue and Kurri Street	129	149	153	154	24	5	19%	3%
Ralston Street and Murray Street	277	238	222	186	-55	-52	-20%	-22%
Elizabeth Street and Brand Street	1757	1652	1675	1648	-82	-4	-5%	0%
Hampden Road and Brand Street	1770	1444	2149	1922	379	478	21%	33%
Longueville Road and Birdwood Avenue	1130	1398	1580	1759	450	361	40%	26%
Coxs Road and Blenheim Road	1463	1290	1676	1472	213	182	15%	14%
Coxs Road and Badajoz Road	1521	1303	1728	1741	207	438	14%	34%
Pittwater Road and Coxs Road	1636	1899	1640	1917	4	18	0%	1%
Reserve Road and Jersey Road	1051	812	880	910	-171	98	-16%	12%
Reserve Road and Barton Road	1204	1032	1069	1029	-135	-3	-11%	0%
Dalleys Road and Willoughby Road	1726	1823	1571	1818	-155	-5	-9%	0%
Rohan Road and Willoughby Road	1014	1178	1282	1472	268	294	26%	25%
Longueville Road and Alpha Road	2657	2648	2816	2910	159	262	6%	10%