Annex A – Interim Assessment of Traffic Movements at Castlecary Junction Slip Roads

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M80 Stepps to Haggs DBFO

Interim Assessment of Traffic Movements at Castlecary Junction Slip Roads

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Contents

1 Introduction

1.1 Introduction

The purpose of this report is to summarise the monitoring of traffic movements using the recently upgraded Castlecary Westbound Diverge Slip Road and Castlecary Eastbound Merge Slip Road, which form part of the works for the M80 Stepps to Haggs DBFO Contract. In particular, on the east side of Castlecary Junction a number of vehicles from the Castlecary Westbound Diverge Slip Road have been observed performing U-turns on the B816 at Allandale, at Dundas Cottages and at Access Track 11. On the west side of Castlecary Junction a number of vehicles accessing the Castlecary Eastbound Merge Slip have been observed as vehicles coming from the Castlecary direction, either performing U-turns at Walton Road or making an illegal right turn manoeuvre from the B816 .

1.2 Traffic Monitoring

On the east side of Castlecary Junction, traffic surveys have been undertaken at Dundas Cottages, Access Track 11 and along the B816 between April 2009 and November 2011. This traffic data was collected during both the construction period for the M80 and post-construction.

On the west side of Castlecary Junction, traffic surveys have been undertaken at Walton Road and at the recently installed Bus Gates. The surveys at these locations were undertaken in the last week of November 2011. Traffic data therefore relates to post-construction only.

1.3 Report Structure

This report structure is as follows:

- ***Section 2 – Background, details the scheme background and movements observed;***
- ***Section 3 – Traffic Flow Information, details the data collected and provides commentary relating to the U-turn manoeuvres;***
- ***Section 4 – Traffic Monitoring, details the proposed next steps in the traffic monitoring; and***
- ***Section 5 – Data Assessment, provides a summary of the data assessment to date.***

2 Background

2.1 Introduction

Castlecary Junction is situated adjacent to the Castlecary Viaduct on the M80 scheme. As a part of the upgrading of the A80 between Stepps and Haggs to motorway standard, the layout of Castlecary Junction was altered and reconfigured.

To reduce traffic volumes in Castlecary village, the right turn movement from the B816 to the M80 eastbound carriageway and the right turn movement from the M80 westbound diverge onto the B816 were prohibited to all vehicles, except buses, as part of the scheme. Bus gates were introduced at these junctions to permit scheduled bus services only. Vehicles prohibited from making right turn manoeuvres at the Castlecary Slip Roads are intended to access or egress the M80 via the new Old Inns Junction, thereby reducing through traffic in Castlecary.

In addition to the above, the existing westbound merge slip road onto the A80 at Castlecary Junction was closed on safety grounds as part of the scheme.

2.2 Construction Phase

2.2.1 Temporary Traffic Management Scheme

In March 2009, a temporary traffic management scheme was implemented at Castlecary Junction. The temporary traffic management scheme effectively managed the traffic in the same way as the new permanent layout, with the exception that the physical bus gate was not installed. Right turn manoeuvres to and from the slip roads were prohibited under a Temporary Traffic Regulation Order and relevant signage erected.

2.2.2 Traffic Movements during the Temporary Traffic Management Scheme

Castlecary Westbound Diverge Slip Road:
During the construction phase, with the temporary traffic management measures in place, a number of cars and heavy goods vehicles (HGVs) circumvented the right turn prohibition by turning left from the Westbound Diverge Slip Road and travelling eastbound along the B816 before making a U-turn manoeuvre to gain access to the westbound B816.

Initially, a high proportion of these cars and HGVs made the U-turn manoeuvre at the Dundas Cottages access, approximately 1km east of the Westbound Diverge Slip Road. Following the distribution of a letter notifying employers of the issue to all Industrial Estates in the Castlecary/Wardpark area the number of HGVs performing the U-turn manoeuvre reduced significantly. As a consequence of this process only cars/light vans, with a very limited number of HGVs, were observed to continue to perform a U-turn manoeuvre; at Dundas Cottages and at other locations on the B816.

Castlecary Eastbound Merge Slip Road:
During the construction phase, with the temporary traffic management measures in place, some cars/light vans and HGVs disregarded the right turn prohibition and made an illegal right turn to access the Eastbound Merge Slip Road by crossing the continuous double white line (see Figure 6). Other drivers travelled to Walton Road

and made a U-turn manoeuvre to access the Castlecary Eastbound Merge Slip Road from the westbound B816.

2.3 Post Construction

2.3.1 Post Construction Permanent Layout

In August 2011, the final layouts of the bus gates were introduced on the Castlecary Westbound Diverge Slip Road and Castlecary Eastbound Diverge Slip Road. On the east side the bus gates were installed on the right hand lane of the Westbound Diverge Slip Road allowing only buses to turn right onto the B816. On the west side the bus gates were installed on the Eastbound Merge Slip Road allowing only buses to access the merge. The physical barriers installed as part of the final layout are operated manually by bus drivers, travelling to and from Castlecary, entering a code using a keypad.

On the east side, the illegal right turn movement by vehicles onto the B816 from the diverge slip road is further prevented by a raised central median, consisting of a kerbed island, on the B816 at this location.

As part of the motorway upgrade, Access Track 11 was constructed to provide access, for maintenance purposes, to a drainage pond. The location of Access Track 11 is between the Castlecary Diverge Slip Road and Dundas Cottages.

2.3.2 Post Construction Traffic Movements

Castlecary Westbound Diverge Slip Road:

Since the completion of Access Track 11, a significant change in traffic movements was observed, with the number of vehicles making the U-turn manoeuvre at Dundas Cottages reducing and at Access Track 11 increasing.

Castlecary Eastbound Merge Slip Road:
With the Bus Gates in operation, some cars/light vans and HGVs were observed to either make a U-turn at Walton Road or perform an illegal right turn to access the Castlecary Eastbound Merge Slip Road. (Refer to Figure 6 in Appendix A)

3 Traffic Flow information

3.1 Data Collection

Traffic flow data has been collected from the following locations:

Castlecary Westbound Diverge Slip Road:

- Castlecary Westbound Diverge Slip Road;
- B816 Castlecary Road;
- Access Track 11;and
- Dundas Cottages.

Castlecary Eastbound Merge Slip Road:

- Castlecary Eastbound Merge Slip Road (Bus Gates Access);and
- Walton Road.

For the data collection, the AM peak is defined as the time period between the hours of 7am and 9am and the PM peak is defined as the time period between the hours of 4pm and 6pm.

Manual counting of U-turn movements at Dundas Cottages was undertaken once a week during the AM peak and PM peak from April 2009 to November 2011. To validate the weekly manual U-turn counts as being representative of the whole week, a 12 hour video survey was undertaken for a full week from 12 September 2011 to 16 September 2011. September is recognised to be an ideal month for traffic surveys as this is a period less affected by holidays and weather.

Similarly, manual counting of U-turn movements at Access Track 11 was undertaken once a week during the AM peak and PM peak from August 2011 to November 2011. This location was also included in the 12 hours video survey over the period of 12 September to 16 September 2011 for validation of the manual survey results as sufficiently representative.

3.1.1 Castlecary Westbound Diverge Slip Road

At the Castlecary Westbound Diverge Slip Road, data was collected from an Automated Traffic Counter (ATC) between the period September 2011 and October 2011. This data presents the total number of vehicles using the Castlecary Westbound Diverge Slip Road.

The traffic information collected from this ATC confirmed that on average approximately 850 vehicles per day use this slip road, of which 20 percent is HGVs.

3.1.2 B816 Castlecary Road

For the B816 Castlecary Road, data was collected from an ATC located on the Castlecary side for the period between September 2011 and October 2011.

The average 24 hour two-way traffic flow on B816 as taken from this ATC counter is 5,500 vehicles per day.

ATC data was also collected for the B816 Castlecary Road prior to construction of the new M80 for the months of September 2007 and October 2007. The average 24 hour two-way traffic flow on B816 at this time was approximately 10,000 vehicles per day.

Comparison of the above data indicates an average reduction of 4,500 vehicles per day using this route.

3.1.3 Access Track 11

For Access Track 11(refer to Figure 4 in Appendix A), data was collected during the period 31 August 2011 to 24 November 2011. This data records the number of vehicles performing the U-turn manoeuvre at this location. The surveys at this location were undertaken on a Wednesday between the hours of 4pm and 6pm and on a Thursday morning between the hours of 7am and 9am. Surveys on a Wednesday evening and Thursday morning are considered to provide data for typical morning and evening peak periods during the week.

In addition, a 12 hour video survey of Access Track 11 was undertaken from 12 September 2011 to 16 September 2011 to establish a record of the total number of vehicles making the U-turn manoeuvre between the hours of 7am and 7pm for a full Monday to Friday five day period.

The 12hour (7am-7pm) traffic counts from the video surveys are shown in Table 3-A and the peak period traffic counts from the video surveys are shown in Table 3-B and 3-C.

Date	Cars	HGVs
12/09/2011	313	0
13/09/2011	356	1
14/09/2011	328	2
15/09/2011	382	2
16/09/2011	350	2

Table 3-A 12 hour (7am – 7pm) U-turn Counts from the video survey

Date	Cars	HGVs
12/09/2011	98	0
13/09/2011	107	0
14/09/2011	114	1
15/09/2011	90	0
16/09/2011	104	0

Table 3-B AM Peak (7am-9am) U-turn Counts from the video survey

Date	Cars	HGVs
12/09/2011	60	0
13/09/2011	87	0
14/09/2011	53	0
15/09/2011	69	0
16/09/2011	54	0

Table 3-C PM Peak (4pm-6pm) U-turn Counts from the video survey

Table 3-D and 3-E show the number of U-turns performed at Access Track 11, based on surveys undertaken on Wednesday (PM peak) and Thursday (AM peak) between 31 August 2011 and 24 November 2011.

Date	Cars	HGVs
01/09/2011	82	0
08/09/2011	91	0
15/09/2011	90	0
22/09/2011	105	1
29/09/2011	94	2
06/10/2011	121	2
13/10/2011	89	0
20/10/2011	80	0
27/10/2011	88	0
10/11/2011	88	0
17/11/2011	90	1
24/11/2011	104	0

Table 3-D AM Peak (7am-9am) U-turn Counts

Date	Cars	HGVs
31/08/2011	46	1
07/09/2011	99	1
14/09/2011	53	0
21/09/2011	75	3
28/09/2011	55	1
05/10/2011	63	0
12/10/2011	70	0
19/10/2011	70	0
26/10/2011	72	1
09/11/2011	78	0
16/11/2011	50	3
23/11/2011	71	0

Table 3-E PM Peak (4pm-6pm) U-turn Counts

3.1.4 Dundas Cottages

For the Dundas Cottages access (refer to Figure 3 in Appendix A), data was collected for the period 1 April 2009 to 24 November 2011. This data presents the number of vehicles performing the U-turn manoeuvre at this location. The surveys at Dundas Cottages were undertaken on a Wednesday between the hours of 4pm and 6pm and on Thursday morning between the hours of 7am and 9am.

During the period 1 April 2009 and 15 May 2009, surveys were undertaken between the hours of 6am and 8am in the morning. Based on initial observations, the period between 6am and 7am had a low volume of traffic performing the U-turn manoeuvre, therefore it was decided from 16 May 2009 onwards that the traffic should be monitored between 7am and 9am.

Further to the above data, a 12 hour video survey of Dundas Cottages Access was undertaken from the 12 September 2011 to 16 September 2011 between the hours of 7am and 7pm. The 12hour (7am-7pm) traffic counts from the video surveys are

shown in Table 3-F. The corresponding peak period U-turns from the video surveys are shown in Tables 3-G and 3-H.

Date	Cars	HGVs
12/09/2011	39	0
13/09/2011	45	0
14/09/2011	50	0
15/09/2011	36	0
16/09/2011	32	0

Table 3-F 12 hour (7am – 7pm) Counts from the video survey

Date	Cars	HGVs
12/09/2011	5	0
13/09/2011	3	0
14/09/2011	5	0
15/09/2011	8	1
16/09/2011	6	0

Table 3-G AM Peak (7am-9am) U-turn Counts from the video survey

Date	Cars	HGVs
12/09/2011	8	0
13/09/2011	11	0
14/09/2011	17	1
15/09/2011	7	0
16/09/2011	6	0

Table 3-H PM Peak (4pm-6pm) U-turn Counts from the video survey

In addition to the video surveys detailed in the above tables, Tables 3-I and 3-J show the U-turn manoeuvres for the period 31 August 2011 to 24 November 2011. The data collected from the 1 April 2011 to 31 August 2011 is presented in Appendix B.

Date	Cars	HGVs
01/09/2011	10	0
08/09/2011	4	0
15/09/2011	8	1
22/09/2011	10	0
29/09/2011	7	0
06/10/2011	11	0
13/10/2011	12	0
20/10/2011	4	0
27/10/2011	5	0
10/11/2011	5	0
17/11/2011	8	0
24/11/2011	18	0

Table 3-I AM Peak (7am-9am) U-turn Counts

Date	Cars	HGVs
31/08/2011	6	0

Date	Cars	HGVs
07/09/2011	26	0
14/09/2011	17	1
21/09/2011	7	0
28/09/2011	12	0
05/10/2011	4	0
12/10/2011	13	0
19/10/2011	12	0
26/10/2011	7	0
09/11/2011	12	0
16/11/2011	8	2
23/11/2011	21	0

Table 3-J PM Peak (4pm-6pm) U-turn Counts

Site observations confirm that following the opening of Access Track 11, U-turns decreased at the Dundas Cottages.

3.1.5 Castlecary Eastbound Merge Slip Road (Bus Gates Access)

After the Bus Gates operation was reinstated at this location, following a period of non-operation due to damaged equipment, a traffic video survey was undertaken in the last week of November 2011 to monitor the number of cars/light vans and HGVs accessing the Castlecary Eastbound Merge Slip Road by performing an illegal right turn manoeuvre.

The survey indicated on an average 180 vehicles between the hours of 7am and 7pm perform the illegal manoeuvre to access the eastbound slip road from Castlecary.

The recorded number of illegal right turn manoeuvres from the video survey at this location between the hours of 7am and 7pm is presented in Table 3-K. For the AM peak and PM peak it is shown in Table 3-L and 3-M:

Date	Cars	HGVs
29/11/2011	179	3
01/12/2011	187	0
02/12/2011	169	0

Table 3-K 12 hour (7am – 7pm) Counts from the video survey

Date	Cars	HGVs
29/11/2011	65	2
01/12/2011	49	0
02/12/2011	51	0

Table 3-L AM Peak (7am-9am) Counts from the video survey

Date	Cars	HGVs
29/11/2011	33	0
01/12/2011	45	0
02/12/2011	30	0

Table 3-M PM Peak (4pm-6pm) Counts from the video survey

3.1.6 Walton Road

In addition to the traffic video surveys at the Bus Gates, video surveys were undertaken at Walton Road (refer to Figure 5 in Appendix A) in the last week of November 2011 to monitor the number of vehicles performing a U-turn manoeuvre to access the Eastbound Merge Slip Road.

The survey analysis found that on an average 200 vehicles between the hours of 7am and 7pm make a U-turn manoeuvre at Walton Road, to access the Eastbound Merge Slip Road from Castlecary.

The total number of U-turn manoeuvres from the video survey at this location between the hours of 7am and 7pm is presented in Table 3-N. For the AM peak and PM peak it is shown in Table 3-O and 3-P:

Date	Cars	HGVs
29/11/2011	203	1
01/12/2011	205	0
02/12/2011	179	1

Table 3-N 12 hour (7am – 7pm) U-turn Counts from the video survey

Date	Cars	HGVs
29/11/2011	40	0
01/12/2011	52	0
02/12/2011	22	0

Table 3-O AM Peak (7am-9am) Counts from the video survey

Date	Cars	HGVs
29/11/2011	82	0
01/12/2011	48	0
02/12/2011	27	0

Table 3-P PM Peak (4pm-6pm) Counts from the video survey

3.2 Analysis summary

3.2.1 Castlecary Road B816

From the survey analysis it is established that there is a significant reduction in the number of vehicles passing through Castlecary after the completion of the M80 Stepps to Haggs DBFO Contract, which was one of the objectives of the scheme. The data indicates there is approximately up to a 45% reduction in through traffic in Castlecary (B816) in comparison to 2007 flows.

3.2.2 Castlecary Westbound Diverge Slip Road

From the traffic data collected to date it is evident that the number of vehicles performing the U-turn manoeuvre at Dundas Cottages has reduced over the course of the monitoring; particularly following the opening of Access Track 11 and there is an increase in U-turns observed at this location.

Furthermore, the traffic data collected confirms the total number of vehicles currently using the Castlecary Westbound Diverge Slip Road is 850 vehicles; of which 450 vehicles on average perform a U-turn manoeuvre on the B816 between the Castlecary Westbound Diverge Slip Road and the environs of Allandale.

3.2.3 Castlecary Eastbound Merge Slip Road

From the survey analysis it is evident that on average 400 vehicles coming from the Castlecary direction, between the hours of 7am and 7pm, access the Eastbound Merge Slip Road either by performing an illegal right turn manoeuvre or by performing a U-turn at Walton Road.

4 Traffic Monitoring

4.1 Further Monitoring

Traffic movements at the Castlecary Slip roads will be subject to further monitoring to assess the numbers of vehicles that continue to perform U-turn manoeuvres or illegal right turns on the B816, as opposed to using Old Inns Junction to access and egress the M80 as intended.

Further monitoring is required to build on the data presented in this interim report and allow a fully informed assessment to be undertaken of the traffic movements at this junction on the new M80 for the following reasons:

- Insufficient time has elapsed since completion of the scheme to confirm traffic patterns have stabilised;
- Drivers need to become aware of the new road layouts and the benefits of using Old Inns Junction;
- The bus gates barriers have only recently come fully into operation;
- A period of 6 months is considered reasonable to allow traffic patterns to stabilise for any new road layout; and
- This period will allow a further more detailed traffic survey to be undertaken in the Spring, which is considered in addition to a September period, as being an optimum period for such traffic surveys.

5 Data Assessment

5.1 Conclusion

5.1.1 Castlecary Road (B816)

Monitoring of traffic movements at Castlecary Slip Road and the traffic data gathered as part of this assessment has confirmed the objective of reducing through traffic in Castlecary, as part of the M80 Stepps to Haggs scheme, has been achieved, with a reduction of approximately up to 45% in such traffic being recorded in comparison to 2007 traffic flows.

5.1.1 Castlecary Westbound Diverge Slip Road

Analysis of the data collected from April 2009 to November 2011 confirms that some of the traffic using the Castlecary Westbound Diverge Slip Road is performing a U-turn manoeuvre on B816. The recent video survey indicates that approximately 50 percent of traffic using the Castlecary Westbound Diverge Slip Road performs a U-turn manoeuvre on B816.

It is evident from the data analysis that the U-turn manoeuvre at Dundas Cottages is continuing. However, the number of vehicles performing this manoeuvre at this location has significantly reduced from April 2009 to July 2011 levels, following the opening of Access Track 11.

5.1.2 Castlecary Eastbound Merge Slip Road

Analysis of the video survey data collected from November 2011 to December 2011 indicates that some of the traffic coming from the Castlecary direction continues to use the M80 Eastbound Merge Slip Road either by making a U-turn at Walton Road or by making an illegal right turn manoeuvre from the B816 to merge with the slip road.

5.1.3 Traffic Monitoring

Monitoring of traffic flows will continue for a further 3 months or thereby to ensure that the data collected is representative of traffic behaviour once traffic patterns have stabilised on the new road layout and at the new Castlecary junction layout with the bus gates fully operational. This will allow further surveys to be undertaken in the optimum Spring period.

During this further monitoring period, consideration will also be given to the following:

- how to protect the achieved objective of the significant reduction in through traffic in Castlecary;
- how driver behaviour can be altered to encourage greater use of Old Inns junction to reduce the number of U-turns and illegal manoeuvres associated with Castlecary junction;

and, as possible contingencies should the outcome of above determine further consideration, other measures will be investigated.

Appendix A Locations

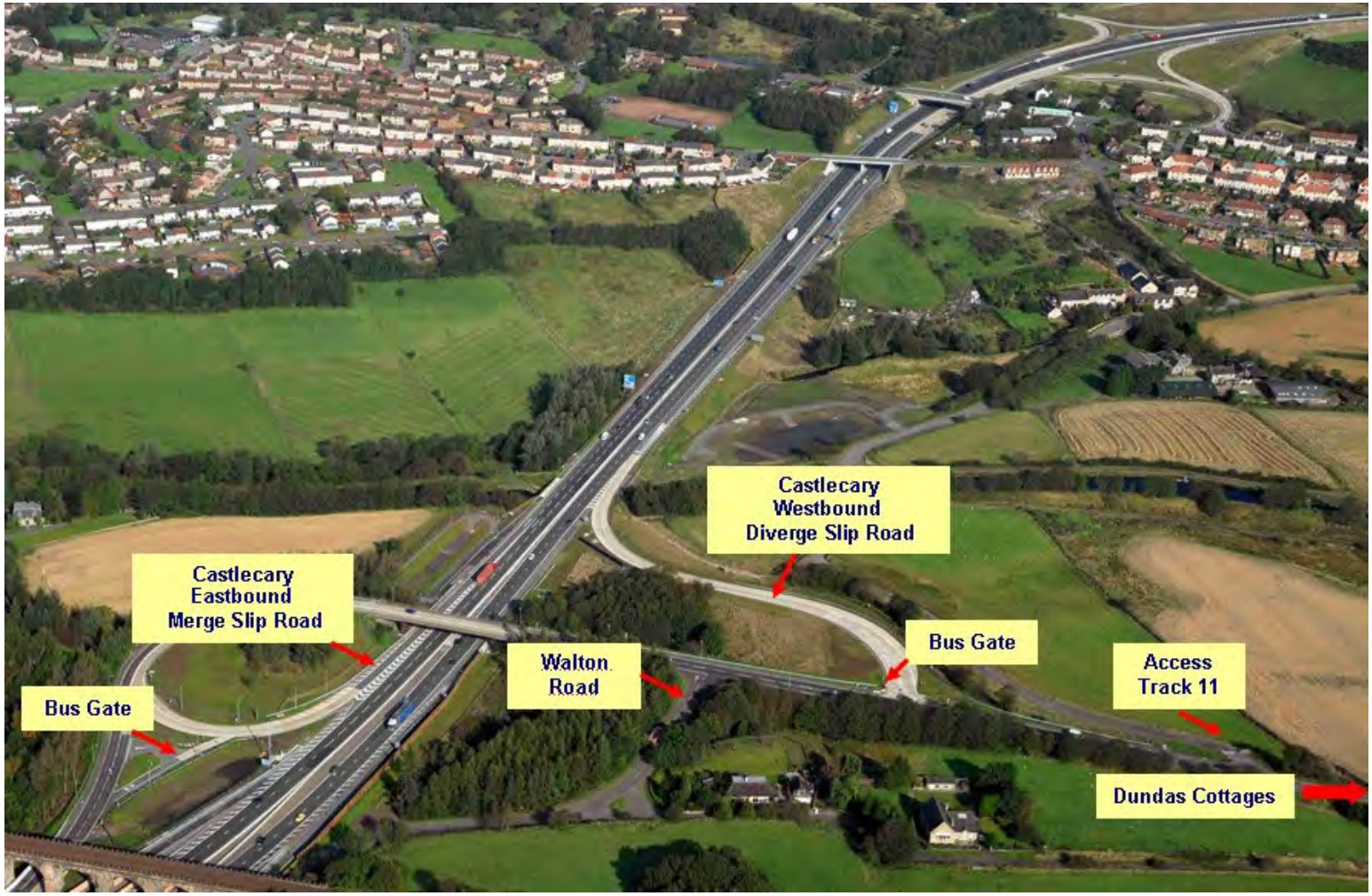

Figure 1: Location Plan

Figure 2: Castlecary Junction prior to Construction

Figure 3: Location of Dundas Cottages

Figure 4: Location of Access Track 11(Post Construction)

Figure 5: Location of Walton Road

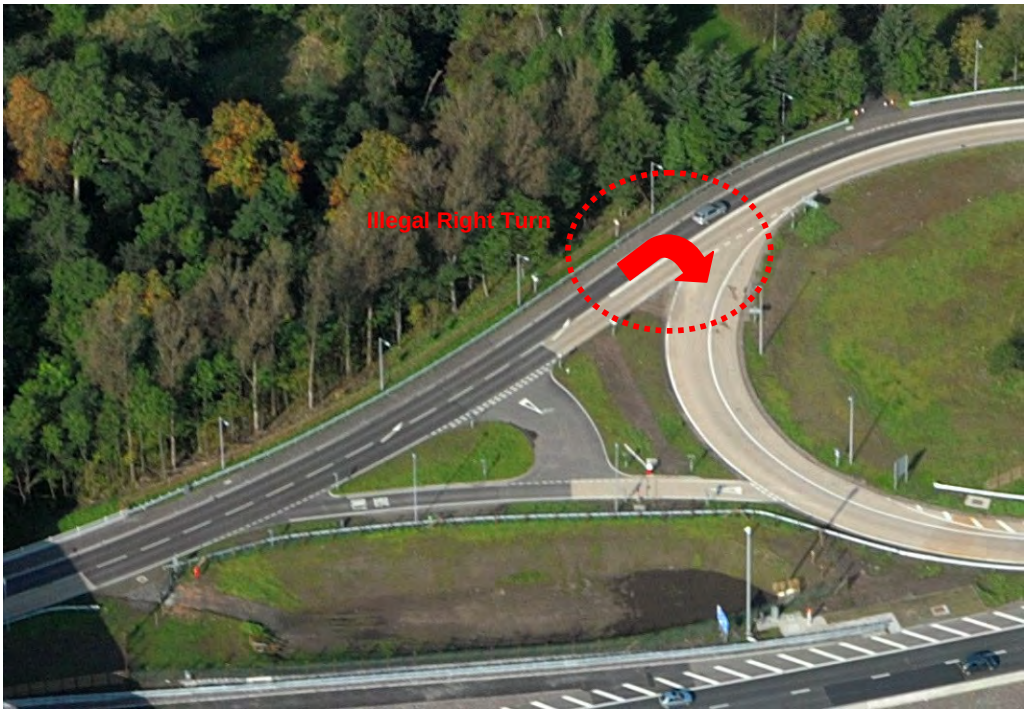

Figure 6: Location of Northbound Bus Gate and Illegal turning location

Appendix B U-turn Manoeuvre Data for Dundas Cottages

AM Peak U-turn traffic flow data for the access to Dundas Cottages between the period 01 April 2009 and 25 August 2011

Date	Cars	HGVs
02/04/2009	34	1
16/04/2009	18	0
23/04/2009	35	0
30/04/2009	23	0
07/05/2009	29	1
14/05/2009	32	0
21/05/2009	42	0
28/05/2009	38	0
04/06/2009	54	0
18/06/2009	39	0
26/06/2009	20	1
23/07/2009	26	0
20/08/2009	47	0
27/08/2009	42	0
03/09/2009	42	0
10/09/2009	31	0
17/09/2009	47	0
24/10/2009	29	0
01/10/2009	27	0
08/10/2009	33	0
15/10/2009	28	0
22/10/2009	39	0
29/10/2009	35	0
05/11/2009	30	0
12/11/2009	43	0
19/11/2009	26	0
26/11/2009	26	0
03/12/2009	26	0
25/03/2010	38	0
01/04/2010	23	0
08/04/2010	24	0
15/04/2010	10	0
22/04/2010	31	0
29/04/2010	34	0
06/05/2010	25	1
13/05/2010	26	0
20/05/2010	32	0
27/05/2010	21	0
03/06/2010	21	0
10/06/2010	27	1
17/06/2010	39	0
24/06/2010	33	2
22/07/2010	14	0
29/07/2010	29	0

Date	Cars	HGVs
05/08/2010	18	0
12/08/2010	22	0
19/08/2010	27	0
26/08/2010	40	1
09/09/2010	26	0
23/09/2010	38	0
07/10/2010	20	0
14/10/2010	18	6
21/10/2010	35	0
28/10/2010	49	0
04/11/2010	38	0
18/11/2010	36	2
25/11/2010	28	0
20/01/2011	13	0
27/01/2011	25	1
03/02/2011	17	0
10/02/2011	14	0
17/02/2011	12	0
21/04/2011	20	0
05/05/2011	10	0
12/05/2011	5	0
19/05/2011	8	0
26/05/2011	6	0
02/06/2011	8	0
09/06/2011	14	0
16/06/2011	8	0
23/06/2011	16	0
25/08/2011	18	0

AM Peak U-turn Counts at Dundas Cottages

PM Peak U-turn traffic flow data for the access to Dundas Cottages between the period 01 April 2009 and 25 August 2011

Date	Cars	HGVs
01/04/2009	36	0
15/04/2009	17	0
22/04/2009	48	1
29/04/2009	33	1
13/05/2009	45	1
20/05/2009	26	0
27/05/2009	39	0
03/06/2009	105	0
10/06/2009	39	0
17/06/2009	32	1
25/06/2009	19	0
22/07/2009	34	0
05/08/2009	32	0
12/08/2009	26	0
19/08/2009	40	0
26/08/2009	26	0
02/09/2009	31	0
09/09/2009	45	0
16/09/2009	44	0
23/09/2009	29	0
30/09/2009	25	0
07/10/2009	39	0
14/10/2009	29	0
21/10/2009	27	0
28/10/2009	30	0
04/11/2009	32	0
18/11/2009	42	0
25/11/2009	23	0
02/12/2009	38	1
24/03/2010	17	0
31/03/2010	15	0
07/04/2010	13	0
14/04/2010	12	0
21/04/2010	42	0
28/04/2010	42	0
05/05/2010	16	0
12/05/2010	38	0
19/05/2010	51	0
02/06/2010	20	0
09/06/2010	23	0
23/06/2010	18	1
21/07/2010	18	0
28/07/2010	26	0
04/08/2010	21	0
18/08/2010	18	0
25/08/2010	31	1
22/09/2010	19	0
06/10/2010	24	2

Date	Cars	HGVs
13/10/2010	18	4
20/10/2010	24	0
27/10/2010	41	0
03/11/2010	20	0
17/11/2010	25	1
24/11/2010	31	0
19/01/2011	8	0
26/01/2011	11	0
02/02/2011	24	0
09/02/2011	8	0
16/02/2011	13	0
20/04/2011	48	0
04/05/2011	5	3
11/05/2011	15	0
18/05/2011	4	0
25/05/2011	3	0
01/06/2011	6	0
08/06/2011	11	0
15/06/2011	9	0
22/06/2011	15	0
24/08/2011	8	1

PM Peak U-turn Counts at Dundas Cottages

Annex B – Castlecary Junction – Options Report

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M80 Stepps to Haggs DBFO

Castlecary Junction - Options Report

September 2013

JACOBS

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Contents

1 Introduction

1.1 Introduction

During construction and following the opening of the M80 Stepps to Haggs scheme, a number of vehicles have been observed performing U-turns or making illegal right turn manoeuvres at Castlecary Junction following the implementation of restrictions to turning movements of all vehicles, except buses.

An interim report on the monitoring and assessment of traffic movements at Castlecary Junction was prepared in January 2012, entitled 'Interim Assessment of Traffic Movements at Castlecary Junction Slip Roads'. A further report, 'Assessment of Traffic Movements at Castlecary Junction Slip Roads' was prepared in July 2012. This provided the findings of the assessment of traffic monitoring and also reported the outcome of consultations with key stakeholders and recommended options to be taken forward to reduce the number of U-turns and illegal right turn manoeuvres.

Two options were identified for further consideration in the July 2012 report:

- Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads
- Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816 through Castlecary.

The purpose of this report is to:

- summarise the outcome of the further consultations undertaken since the July 2012 report;
- summarise the assessment of those options identified; taking due account of the findings of the Stage 4 Road Safety Audit;
- identify the preferred option; and
- outline a strategy and timescale for implementing the preferred option.

1.2 Report Structure

This report is structured as follows:

- ***Section 2 – Background – provides details of the scheme background, traffic movements, and summarises the findings of the Stage 4 Road Safety Audit;***
- ***Section 3 – Description of Options/Engineering Assessment - summarises the implications of the options considered and provides a cost estimate of these options;***
- ***Section 4 – Traffic Impact Assessment – details the traffic information collected, the modelling and the traffic impact of the options;***
- ***Section 5 – Environmental Assessment – provides a qualitative assessment of the environmental impact;***
- ***Section 6 – Consultations – summarises the further consultations undertaken with key stakeholders; and***

- ***Section 7 – Conclusion and Recommendation – summarises the assessment process and recommends the next steps to be undertaken, outlining a strategy and timescale for implementing the recommended option.***

2 Background

2.1 Introduction

Castlecary Junction is situated adjacent to the Castlecary Viaduct on the M80 motorway. The layout of Castlecary Junction was reconfigured as part of the M80 Stepps to Haggs scheme to upgrade the A80 between Stepps and Haggs to motorway standard, refer to Figures 1 and 2 in Appendix A.

To reduce traffic volumes in Castlecary Village, the right turn movement from the B816 to the M80 Eastbound Merge Slip Road and the right turn movement from the M80 Westbound Diverge Slip Road onto the B816 were prohibited to all vehicles, except buses, as part of the scheme. Bus gates were introduced at these junctions to permit scheduled bus services only. Vehicles prohibited from making right turn manoeuvres at the Castlecary Slip Roads are intended to access or egress the M80 via the improved Old Inns Junction, to the west of Castlecary Village, thereby reducing through traffic in Castlecary Village. These restrictions were also in place during much of the construction phase of the scheme; with the implementation of a temporary traffic management scheme, to similarly manage the traffic flow through Castlecary during the works.

During the construction phase and following the completion of the final junction layout vehicles have circumvented the right turn prohibitions by either:

- making a U-turn manoeuvre to gain access to the westbound B816 and the eastbound M80; or
- undertaking illegal right turn manoeuvres onto the eastbound M80 (refer to Figure 6 in Appendix A).

Concerns have been raised by a number of parties regarding these manoeuvres both during the construction and after completion of the scheme. Similar concerns regarding these manoeuvres were also included in the Stage 4 Road Safety Audit. (The manoeuvres are discussed in further detail below)

2.2 Junction Layout

2.2.1 Temporary Traffic Management Scheme

During the construction phase, in March 2009, a Temporary Traffic Management Scheme (TTMS) was implemented at Castlecary Junction. The TTMS effectively managed the traffic in the same way as the new junction layout, with the exception that the physical bus gates were not installed. Right turn manoeuvres to and from the slip roads were prohibited under a Temporary Traffic Regulation Order and relevant signage erected.

2.2.2 Scheme Completion Junction Layout

In August 2011, the final layouts were established when the bus gates were introduced on the Castlecary Westbound Diverge Slip Road and the Castlecary Eastbound Merge Slip Road. On the south side, the bus gate was installed on the right hand lane of the Westbound Diverge Slip Road; allowing buses only to turn right onto the B816. On the north side, the bus gate was installed on the Eastbound

Merge Slip Road; allowing only buses from the northbound traffic flow on the B816 to access the merge slip road. The bus gates (physical barriers) installed as part of the new junction layout are operated manually by bus drivers, travelling to and from Castlecary area, entering a code into a keypad located by each gate.

The illegal right turn movement onto the B816 from the Westbound Diverge Slip Road (left hand lane) is physically prevented by a raised central median, consisting of a kerbed island, on the B816 at this location.

As part of the motorway upgrade, an access track (Access Track 11) for maintenance of a road drainage pond, was constructed (refer to Figure 4 in Appendix A). As the location of Access Track 11 is between the Castlecary Westbound Diverge Slip Road and Dundas Cottages this has become a locus of u-turn manoeuvres.

2.3 Traffic Flow Information

2.3.1 Traffic Data Collection

Following the implementation of the bus gates as part of the TTMS, monitoring of traffic movements has been undertaken, using a variety of techniques, at the following locations:

Castlecary Westbound Diverge Slip Road:

- Slip Road;
- B816 Castlecary Road;
- Access Track 11;and
- Dundas Cottages.

Castlecary Eastbound Merge Slip Road:

- Castlecary Eastbound Merge Slip Road (Bus Gates Access); and
- Walton Road.

Manual counting of traffic U-turn movements at Dundas Cottages (refer to Figure 3 in Appendix A) was undertaken once a week during the AM peak and PM peak from April 2009 to June 2012. For purpose of this data collection, the AM peak is defined as the time period between the hours of 7am and 9am and the PM peak is defined as the time period between the hours of 4pm and 6pm.

Similarly, manual counting of traffic U-turn movements at Access Track 11 was undertaken once a week during the AM peak and PM peak from August 2011 to June 2012.

In addition to the manual traffic counting noted above, and data received from Automated Traffic Counters, 12 hour video surveys were undertaken for the full working weeks from 12 to 16 September 2011, 5 to 9 March 2012 and 24 to 30 April 2012. The video surveys were undertaken in September, March and April as these periods are less affected by holidays and weather.

2.3.2 Traffic Data Analysis

(a) Castlecary Westbound Diverge Slip Road

From the traffic information collected to date it is evident that the number of vehicles performing a U-turn manoeuvre at Dundas Cottages has reduced over the course of the monitoring period; particularly following the opening of Access Track 11. Surveys undertaken in March and April 2012 show the average number of vehicles performing a U-turn manoeuvre on the B816 between the Castlecary Westbound Diverge Slip Road and the environs of Allandale as 430 vehicles (5% HGV) on average per 12 hour period, with 390 vehicles (5% HGV) undertaking a U-turn at Access Track 11 and 40 vehicles (8% HGV) undertaking a U-turn manoeuvre at Dundas Cottages.

The traffic data collected in March and April 2012 confirms the total number of vehicles currently using the Castlecary Westbound Diverge Slip Road as 850 vehicles on average per 12 hour period (20% HGV). The number of vehicles performing a U-turn manoeuvre therefore represents 45% of the total volume of traffic using this slip road.

(b) Castlecary Eastbound Merge Slip Road

From the surveys reported in the July 2012 report, analysis showed that on average nearly 400 vehicles coming from the Castlecary/Wardpark direction, between the hours of 7am and 7pm, access the Eastbound Merge Slip Road either by performing an illegal right turn manoeuvre (150 vehicles with 4% HGV) or by performing a U-turn at Walton Road (220 vehicles with 3% HGV) – refer to Figure 5 in Appendix A. This traffic movement is largely unchanged from the results established in the January 2012 report.

(c) Castlecary Road (B816)

The M80 Environmental Statement was based upon predicted Annual Average Daily Traffic flows of 10,600 and 12,500 in years 2010 and 2025 respectively, without the scheme in place, and 9,400 and 11,400 in years 2010 and 2025 respectively with the scheme in place.

Prior to the M80 scheme opening, the AADT through Castlecary was observed as approximately 8,500 vehicles. Following opening of the scheme, the AADT is approximately 5,500 vehicles, a reduction of approximately 3,000 vehicles (35%).

2.4 Stage 4 Road Safety Audit

A Stage 4 Road Safety Audit was undertaken during October 2012, covering the first 12 months after the opening of the new M80 to traffic. The purpose of the Audit is to provide details of any specific safety problems identified through traffic accident record analysis and to provide recommendations to address any problems highlighted. The Audit also highlighted issues that had been incorporated into the works by recommendation from the Stage 3 Audit, but which had outstanding issues.

Those items identified within the Audit relating to Castlecary Junction are summarised in Appendix B. It should be noted that the directions utilised within the Audit, northbound and southbound, are equivalent to the eastbound and westbound directions utilised within this Report.

As noted within Appendix B, the Audit Team have identified that concerns remain regarding u-turns and illegal right-turns being undertaken within the Castlecary Junction area. The Auditor recommended that further discussions be held with respect to potential enforcement measures to reduce prohibited turns and also the introduction of further physical measures.

The Stage 4 Audit also summarised the available Personal Injury Accident/ Collision Data. This data came from a number of sources: Transport Scotland; Falkirk Council; North Lanarkshire Council; and Central Scotland Police. No data was supplied recording any incidents within the Castlecary area, although it should be noted that there is no requirement to report damage only accidents to the Police.

However, there is anecdotal evidence of a pedestrian being struck by a u-turning vehicle at Allandale and also of a collision between two vehicles at Access Track 11, where a vehicle performing a U-turn struck a vehicle going straight ahead on the B816.

A recommendation of the July 2012 report was that the existing junction configuration and traffic movements were to be assessed taking account of the outcome of the Stage 4 Road Safety Audit. Whilst there appears to be no accident trends occurring at this location, the Auditor has highlighted that there are on-going operational concerns which have not been resolved.

3 Description of Options/Engineering Assessment

3.1 Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

3.1.1 Closure of Eastbound Merge Slip Road (refer to Figure 1)

The following describes the key works to be undertaken as part of this option:

(a) Side Road & Slip Road Works

The junction of the B816 and the Eastbound Merge Slip Road incorporates three discrete junctions: the junction of the B816 with the bus lane onto the slip road, the junction of the B816 with the escape lane from the bus lane; and the junction of the B816 with the merge onto the M80 for eastbound B816 traffic. The closure of the slip road will require these three junctions to be stopped-up.

The existing slip road pavement should be removed, topsoiled and seeded with grass. The edge line of the B816 should be kerbed and an edge-line placed. All traffic signs within the junction area, together with the barrier should be removed and the electrical connection to the bus gate barrier made safe. Furthermore as this junction is lit, street lighting columns adjacent to the slip road and the bus-lane would therefore be removed and electrical connections made safe.

A drainage pond is located to the west of this junction. Access to the adjacent pond will be retained via the existing access from the B816.

(b) M80 Works

This slip road forms the commencement of the eastbound climbing lane on the M80, providing 3 lanes. On closure of the slip road, the third lane of the M80 would be formed via a nearside taper. It should be noted that the existing layout of the M80 incorporates discontinuous hardshoulders between Seabegs Overbridge and the Forth & Clyde Canal. The removal of this slip road would permit the introduction of standard hardshoulders, however this would require the commencement of the climbing lane to be moved to the east of the Forth & Clyde Canal.

It should be further noted that between Seabegs and the Canal, access to a drainage pond is currently provided via a 2m wide section of hardshoulder. The commencement of the climbing lane to the east of the Canal would permit access to the pond from a standard hardshoulder, improving the access arrangements. Alternatively, part of the slip road could be retained for the purposes of providing access to this pond.

The existing white lining within the merge nose would require to be removed and the edge line continued on to the commencement of the taper. The existing direction sign showing the lane gain arrangement would also require to be amended to show the revised road layout and countdown markers erected in advance of the taper.

3.1.2 Closure of Westbound Diverge Slip Road (refer to Figure 1)

The following describes the key works to be undertaken as part of this option:

(a) Side Road & Slip Road Works

The closure of this slip road will require the access point from the M80 and the access point to the B816 to be stopped-up. The existing slip road pavement should be removed, topsoiled and seeded with grass.

A footway is located on the eastern side of the B816, this footway should be continued through the junction area. The edge of the B816 should be kerbed in the former junction area and an edge-line placed. The kerbed island on the B816 in the junction area should also be removed and reinstated. This would result in an overwidened area of carriageway which could be narrowed through the introduction of hardstrips.

A road restraint barrier is located to the north and south of the junction and connects to barriers on the slip road. The barrier should be continued through the junction and the remaining sections of barrier removed from the slip road.

All traffic signs within the junction area, together with the bus-gate barrier should be removed and the electrical connection to the barrier made safe.

As noted in Section 4, the closure of the eastbound diverge slip road will result in some Allandale-bound traffic diverting to Old Inns. Further signing at the Old Inns environs will be required to direct traffic along the B816 towards Allandale.

(b) M80 Works

This slip road forms the end of the westbound weaving lane between Haggs and Castlecary. On closure of the slip road, the weaving lane should be replaced with an auxiliary lane merge from Haggs. It should be noted that the existing layout of the M80 incorporates discontinuous hardshoulders between over the Forth & Clyde Canal. The removal of this weaving lane road would permit the introduction of standard hardshoulders.

The existing white lining within the diverge nose would require to be removed and the edge line continued westwards to the end of the merge taper from Haggs. The existing direction signs showing the diverge arrangement, including countdown markers, would be removed. The destination shown on traffic signs for diverging signs is currently shown as “Bonnybridge”, however this destination is also shown at Haggs, therefore no change to the Haggs signage is required.

3.1.3 Junction Improvement Works

As noted in Section 3, the closure of these slip roads will result in additional traffic at both Haggs and Old Inns junctions, however it is not expected that improvement works at these junctions will be required with the exception of adjustments to the signal timings at Old Inns.

3.1.4 Constructability

Prior to undertaking works on the slip roads and the B816, it would be necessary to close the junctions. It is anticipated that this would be undertaken during night-time lane closures of both the M80 and the B816, with a temporary traffic management scheme closing off the junctions.

All works immediately adjacent to the M80 would then be undertaken during night-time lane closures of the M80 eg removal of traffic signs, white lining etc. The remainder of the works on the slip road eg pavement removal, topsoiling etc would be undertaken during the day, with no lane-closures in place on the M80.

It is envisaged that works adjacent to the B816 would be undertaken during the daytime off-peak with the B816 reduced to one lane to minimise disruption.

To minimise disruption to road users, signs would be erected advising drivers of the closure of the slip roads 2 weeks, as a minimum, in advance of the works.

It is anticipated that the works described in this report would take approximately four weeks to complete.

3.2 Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

3.2.1 Open Eastbound Merge Slip Road

The following describes the key works to be undertaken as part of this option:

(a) Side Road & Slip Road Works

The opening of this slip road will require all traffic signs and road markings prohibiting its use to right-turning vehicles and bus-only traffic to be removed. The bus-lane barrier would also require to be removed and the electrical connection made safe. Furthermore the section of carriageway connecting the bus lane to the B816 should also be removed as this was constructed to allow vehicles prohibited from accessing through the bus gate to regain the B816, should they have attempted to gain access to the slip road in error.

3.2.2 Open Westbound Diverge Slip Road

The following describes the key works to be undertaken as part of this option:

(a) Side Road & Slip Road Works

The opening of this slip road will require all traffic signs and road markings prohibiting its use to right-turning vehicles and bus-only traffic to be removed. The bus-lane barrier would require to be removed and the electrical connection made safe.

(b) M80 Works

This opening of the slip to all traffic would permit a more direct route to Castlecary to be provided. However to minimise the volume of traffic utilising this junction to access Castlecary, it is recommended that the existing signage at this location for diverging traffic is retained, with Castlecary traffic continuing to be signed from Old Inns.

3.2.3 Traffic Calming

As noted in Section 4, traffic calming measures through Castlecary Village (refer to Figure 10) will discourage traffic from utilising Castlecary Junction to access the

Village and Wardpark Industrial Estate, thus minimising traffic flows through the Village. North Lanarkshire Council (NLC) has previously prepared a traffic management scheme for Castlecary utilising a combination of speed cushions and build-outs of the kerb-line. Following discussions with NLC these proposals have been amended and the proposed scheme incorporates:

- Traffic calming along Castlecary Road from east of Wyndford Road in the west to the eastern periphery of Castlecary;
- A gateway feature incorporating “sharks teeth” at each of the start/end points of the traffic calming;
- Speed cushions approximately every 40m;
- Horizontal build-outs of the kerb-line such that Castlecary Road is reduced to a single lane at 3 locations;
- A zebra crossing, with Castlecary Road reduced to a single lane, adjacent to the swing park.

3.2.4 Constructability

It is anticipated that all works adjacent to the slip roads would be undertaken during closures of the slip roads. It is envisaged works adjacent to the B816 would be undertaken during the daytime off-peak with the B816 reduced to one lane to minimise disruption.

Works to install traffic calming measures would likely be undertaken during day-time lane closures of the B816, it is anticipated that these works would result in a degree of disruption to road users and in particular may deter vehicles, which undertake prohibited right-turns and u-turns, from using Castlecary Junction.

To minimise disruption to road users, signs would be erected advising drivers of the temporary closure of the slip roads 2 weeks, as a minimum, in advance of the works. This gives drivers advance notification to seek an alternative route.

3.3 Cost Estimate

3.3.1 Introduction

A cost estimate exercise has been carried out to provide an indication of construction costs involved in providing each option.

Cost rates are based on SPONS Civil Engineering and Highway Works price book for the year 2006, the construction rates have been indexed up to current 2013 rates using the Retail Price Index (RPIx) provided by the Office of National Statistics. An exception to this being the costs provided for the speed cushions and the traffic bollards, which have been provided by a typical supplier at current 2013 prices.

All cost estimates provided exclude VAT (20%), risk and Optimism Bias – a demonstrated systematic, tendency for project appraisers to be overly optimistic in preparing cost estimates.

3.3.2 Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

Closing of the slip roads is the more costly option. The existing road construction, slip road signs and markings and bus gates require removal. Electrical supply to the bus gates requires to be disconnected, new boundary fence erected and the redundant slip roads topsoiled, grass seeded and planted. Overall cost for closing both slip roads is in the region of £120,000.

3.3.3 Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

The overall cost for providing the traffic calming measures is estimated as being in the region of £80,000.

Removing the bus only restrictions from the slip roads consists of removing the bus gates and disconnecting the electrical supply; and removing the signs and markings which make reference to the bus lane and bus gates. Overall cost of removing the bus only restrictions is in the region of £10,000, giving a total cost of this Option in the region of £90,000.

4 Traffic Impact Assessment

4.1 Introduction

In order to assess the impacts of the two options a traffic impact assessment has been undertaken. This impact assessment examines the change in traffic levels through Castlecary/Wardpark on the B816 and forecast variation in journey times to/from Allandale.

With Castlecary Junction closed (Option 1), the routing options reduce, and journeys could be made via Old Inns Junction instead. The worst case impact for Castlecary is that all trips divert from Castlecary Junction to Old Inns Junction and in doing so travel through the Village. This can be assumed without traffic modelling, therefore the assessment of the impact of Option 1 has been undertaken without modelling.

In order to assess the impacts of the opening of slip roads (Option 2) a micro-simulation model has been developed using PTV AG's software suite, VISSIM. The latest version VISSIM 5.40, has been used in the development of the models. An approach using a local traffic model is suitable as this best assesses the impact of the traffic calming proposed on the B816 and its impact on route choice.

4.2 Study Area

The area under consideration covers the M80 between Auchenkilns Junction and Haggs Junction, which includes the junctions at Old Inns and Castlecary. The model also covers the A8011 and B816 side roads.

4.3 Traffic Surveys

To establish the existing traffic patterns within the area under consideration, traffic data was obtained from a number of sources:

- Registration surveys were undertaken at Castlecary Junction to capture the Castlecary traffic exiting the M80 Westbound Diverge slip and determine the destination of the u-turning traffic. These traffic surveys were undertaken in the first week of December 2012. In addition, the junction turning counts undertaken during both the construction period for the M80 and following completion of the M80 were also included.

- Traffic surveys in the form of junction turning counts have been undertaken at Old Inns Junction and at the A8011/M80 Junction. The surveys at these locations were undertaken in the first week of December 2012. The traffic data at these locations only relates to the post-construction period.

- Automatic Traffic Counter (ATC) data was also obtained for the B816, mainline M80 and for the Old Inns and Castlecary slip roads.

4.4 Vehicle Types Modelled

The following vehicle types were modelled within the micro-simulation model:

- Cars;
- Light Goods Vehicles (LGVs); and
- Heavy Goods Vehicles (HGVs).

4.5 Base model

To aid in the assessment of the impact of the options, a base model representing the existing situation was prepared. The model was based upon those traffic surveys described in section 4.3. This base model reflects the existing speeds of vehicles on the B816 at Castlecary. Figure 7 in Appendix A shows the extent of the modelled network and presents the traffic flows.

4.6 Impact Assessment

As noted above a manual assessment has been undertaken on Option 1 and a modelled assessment on Option 2. The outcome of these assessments is described below.

4.6.1 Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

Option 1 involves assessing the study area with Castlecary Slip Roads closed.

(a) Closure of Castlecary Westbound Diverge Slip Road

With the westbound diverge slip at Castlecary closed, M80 traffic travelling towards the Allandale area could route via either of the M80 junctions at Haggs or Old Inns to reach their destination. In addition, traffic travelling westbound on the M876 could leave at J1 and utilise the side road network to reach the Allandale area.

Journey Times

As a comparison, an analysis of the journey times and distances from the M876 J1 to Allandale was undertaken:

Route	Distance (km)	Time (mins)
Existing Situation		
M876 J1 to Allandale via M80 Castlecary	7.2	5
Option 1 – closure of slip road		
M876 J1 to Allandale via M80 Haggs, A803	12.7	14
M876 J1 to Allandale via M80 Old Inns, B816	13	12
M876 J1 to Allandale via Bonnybridge and side road network	6.6	11

Table 4.1 – Journey Times and Distances to Allandale (Option 1)

The closure of Castlecary Westbound Diverge Slip Road significantly increases the journey time to Allandale by: 6 minutes for M876 traffic leaving at J1; and between 7 minutes (Old Inns) and 9 minutes (Haggs) for traffic using the M80.

The distance travelled by M876 traffic to Allandale decreases by 0.6km for traffic travelling via Bonnybridge. M80 westbound traffic distance travelled increases by 5.5km for traffic using Haggs and by 5.8km for traffic using Old Inns.

Whilst the distance to Allandale is marginally shorter via Haggs than Old Inns, the estimated journey time via Old Inns is shorter by 2 minutes; traffic would likely remain on the M80 for a longer part of the journey, avoiding delays travelling through Bonnybridge if they exit the M80 at Haggs.

Castlecary/Wardpark Traffic

The level of average annual daily traffic (AADT) currently using the Castlecary Westbound Diverge Slip road is approximately 1000 vehicles. An analysis of the surveys undertaken show that 45% (450 AADT) of this traffic travels towards Castlecary/Wardpark. For the purposes of this report it has been assumed that all traffic would re-route via Old Inns Junction, resulting in an additional 450 vehicles through this junction.

This would result in a reduction in westbound traffic through Castlecary Village as traffic with destinations in Wardpark would no longer require to travel through the Village. It has been assumed that 50% of this traffic is going to Wardpark with the remaining traffic continuing to the Village. This would result in a decrease of 450 AADT in the westbound direction and an increase of 225 AADT in the eastbound direction.

Allandale Traffic

Currently 55% (550 AADT) of diverging traffic travel towards the Allandale area. In terms of impact to Castlecary Village, the worst case scenario would be that all of this traffic routed via Old Inns junction, resulting in an additional 550 vehicles eastbound passing through Castlecary Village.

However it should be noted that the traffic currently diverging from the M80 to the Allandale area will include traffic heading towards Bonnybridge south. It is expected that some of this traffic would utilise either M876 J1 or the M80 Haggs junction on closure of the slip road.

(b) Castlecary Eastbound Merge Slip Road

Closure of the merge could see traffic using a variety of alternative routes. As a comparison, an analysis of the journey times and distances from Allandale to the M876 J1 was undertaken:

Route	Distance (km)	Time (mins)
Existing Situation Allandale to M876 J1 via M80 Castlecary	7.3	5
Option 1 – closure of slip road Allandale to M876 J1 via A803, M80 Haggs Allandale to M876 J1 via B816, M80 Old Inns Allandale to M876 J1 via Bonnybridge and side road network	 12.8 12.9 6.6	 14 11 12

Table 4.2 – Journey Times and Distances from Allandale (Option 1)

The closure of this slip road significantly increases the journey time from Allandale by: 7 minutes for M876 traffic travelling via Bonnybridge; and between 6 minutes (Old Inns) and 9 minutes (Haggs) for M80 traffic.

In reality, during the AM peak, the journey time via Old Inns is likely to be higher as traffic slows on the M80 eastbound between Old Inns and Castlecary during this period.

Castlecary/Wardpark Traffic

The level of average annual daily traffic (AADT) currently using the Castlecary Eastbound Merge Slip road is approximately 1000 vehicles. An analysis of the surveys undertaken show 50% (500 AADT) of this traffic is estimated to originate in Castlecary/Wardpark. It is estimated that as a result of closing the eastbound merge slip road, the traffic originating in Castlecary/Wardpark would re-route via Old Inns Junction to reach their destinations. For the purposes of this report, it has been assumed that the traffic is split 50/50 in terms of originating in Wardpark/Castlecary Village.

This would result in a reduction in eastbound traffic (500 AADT) through Castlecary, with this traffic routing through Old Inns junction and would increase the westbound traffic through Castlecary by 250 AADT.

Allandale Traffic

Currently 50% (500 AADT) of merging traffic at the Castlecary Junction originates in the Allandale area. In terms of impact to Castlecary Village, the worst case scenario would be that all of this traffic routed via Old Inns junction, resulting in an additional 500 vehicles passing through Castlecary Village westbound.

However it should be noted that the traffic currently merging from the Allandale area to the M80 will include traffic from Bonnybridge south. It is expected that some of this traffic would utilise either M876 J1 or the M80 Haggs junction on closure of the slip road.

(c) Combined Impact

The combined closure of both slip roads could result in an estimated increase in traffic levels on the B816 through Castlecary Village. Assuming all trips re-routed through Old Inns junction gives an additional 300 vehicles westbound and an additional 275 vehicles eastbound. This is equivalent to an increase of approximately 600 AADT (11%), increasing the flow from 5500 AADT to 6100 AADT. However it should be noted that prior to the M80 scheme opening, the traffic flow on the B816 was observed as 8,500 AADT. Therefore the traffic flow predicted as a result of the implementation of this option represents a decrease in the flows on the B816 as a result of the M80 scheme of 28%.

Furthermore it is unlikely that all of the trips to/from Allandale would utilise the junction at Old Inns to access the M80, therefore the additional trip impact within Castlecary Village would be expected to be lower.

With respect to the impact at Old Inns Junction, there would be an additional flow of 1000 AADT on both the westbound diverge and the eastbound merge. This would likely require the timings of the signalised junction at Old Inns to be changed to minimise queuing on the slip road. Furthermore, as noted previously, all traffic is unlikely to divert to Old Inns Junction, particularly during the AM peak.

In summary, if the junction was closed, the traffic levels through the Village would be expected to be broadly similar with a slight increase in flow most likely. For the worst case scenario, if traffic re-routes via Old Inns, there would be an increase of up to approximately 600 vehicles AADT. The traffic flows as a result of the implementation of this Option are shown in Figure 8.

The impact on journeys to and from Allandale would include an increase in journey times and distance. The potential for further trips at Old Inns Junction would further exacerbate operational conditions during the AM peak period.

4.6.2 Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

Option 2 involves assessing the study area with the Castlecary Slip Roads open to all traffic.

In order to assess the impact of Option 2, a traffic model was prepared to test the network with the Castlecary slip roads open and traffic calming measures in place on the B816 in Castlecary. The traffic calming measures proposed for the B816 in Castlecary are in the form of speed cushions and build outs. These measures are expected to delay traffic through Castlecary Village, hence reducing the attractiveness of this route. In addition, as the measures assist in managing vehicle speeds, this option could provide further benefits in terms of safety benefits for residents within the Village.

The model has been used to assess both - journey times and speeds through Castlecary as well as any changes in traffic volumes. The journey time has been measured along the B816 between Wardpark Roundabout and the Castlecary Eastbound Merge Slip Road.

The base situation models the traffic manoeuvres made at present, including U-turn manoeuvres in the vicinity of Castlecary Junction. With the junction open to all traffic, direct access is provided to the motorway without the need to perform a u-turn and this is reflected in the model.

Table 4.3 below details the journey times, speeds and 2-way traffic flows along the B816 during the AM & PM peaks, with and without Castlecary Junction open to all traffic, and also the forecast change to these parameters.

Model / Scenario	Peak	Eastbound		Westbound		2-way Traffic Flow (vehicles/ hour)
		Journey Time (mins)	Ave Speed (km/h)	Journey Time (mins)	Ave Speed (km/h)	
Base (Existing)	AM	3.3	23.5	2.2	35.1	560
	PM	3.2	24.7	2.3	32.7	700
Castlecary Junction Open	AM	3.5	22.1	2.9	26.7	630
	PM	3.9	20.3	3.8	20.4	800
Difference	AM	+0.2	-1.4	+0.7	-8.4	+70
	PM	+0.7	-4.4	+1.5	-12.3	+100

Table 4.3 – B816 Journey Times and Traffic Flows (Option 2)

The model forecasts an increase in the number of trips passing through Castlecary as a result of fully opening the junction. However the increase in traffic levels is minimised by the traffic calming measures that result in increased journey times and reduced speed of traffic through Castlecary, particularly in the PM peak period, which has the effect of reducing the attractiveness of this route as an alternative to continuing on the M80 to Old Inns junction.

Journey Times

As noted above, the opening of the junction to all traffic and in particular the introduction of traffic calming measures results in an increase in the journey time through the Village, particularly in the PM peak. This will impact on Allandale traffic to/from Old Inns and to a lesser extent, Castlecary Village traffic to/from Old Inns. Outwith the peak hours there is expected to be minimal delay due to the implementation of the traffic calming.

Traffic Flows

The model indicates that during the peak hours that the traffic flows could increase by a total of 170 vehicles through the Village. This is equivalent to an increase of approximately 700 AADT, increasing the flow from 5500 AADT to 6200 AADT, an increase of 13%. However it should be noted that prior to the M80 scheme opening, the traffic flow on the B816 was observed as 8,500 AADT. Therefore the traffic flow predicted as a result of the implementation of this option represents a decrease in the flows on the B816 as a result of the M80 scheme of 27%.

This increase in flow through the Village and the resultant increased flow through Castlecary Junction will result in a slight reduction in traffic utilising Old Inns Junction. The traffic flows as a result of the implementation of this option are shown in Figure 9.

5 Environmental Assessment

5.1 Introduction

In assessing the impact of the options on the environment, a qualitative assessment has been undertaken of the options using the M80 Stepps to Haggs Environmental Statement (ES) for comparative purposes and also against the "as now" situation. The assessment has been undertaken on only those environmental criteria which are considered to be subject to change, generally as a result of alterations to traffic flows. The qualitative assessment of the options is considered further below.

5.2 Traffic Noise and Vibration

5.2.1 Traffic Noise

As noted in the M80 Stepps to Haggs Environmental Statement the properties representative of those in Castlecary Village were predicted to be subject to a reduction in noise following completion of the motorway, which dominates the ambient noise climate. This was primarily as a result of: the introduction of the climbing lane on the west bound carriageway; the change in the horizontal alignment with the M80 moving further away from the Village; and changes in traffic speeds in the area. The impact at 2a Castlecary Road was predicted to be moderately to substantially beneficial in 2010 and 2025. The effect of these changes represented a moderately to substantially beneficial impact for the remainder of the representative properties in Castlecary Village in 2010 and 2025.

This reduction in noise predicted in the ES was based upon predicted Annual Average Daily Traffic (AADT) flows on the B816 of 9400 and 11400 for 2010 and 2025 respectively. Noise calculations within the ES were undertaken using the Average Annual Weekday Traffic (18hr, 5 day average) with AADT flows presented for comparative purposes.

When considering noise levels the following points are worthy of consideration:

- a change in noise level of 1 dB $L_{A10,18h}$ is equivalent to a 25% increase or a 20% decrease in traffic flow, assuming other factors remain unchanged;
- doubling or halving of the otherwise similar traffic flow is equivalent to a change of approximately 3 dB(A) and a subjective impression of a doubling of loudness generally corresponds to a 10 dB(A) sound level increase; and
- When considering two sounds of similar acoustic properties, i.e. similar spectral and temporal characteristics, a change of more than 3 dB(A) is regarded as being just perceptible to the human ear, people are more sensitive to abrupt changes in traffic noise associated with new road schemes than would be predicted from the steady state evidence. In the period following a change in traffic flow, people may find benefits or disbenefits when the noise changes are as small as 1dB(A).

(a) Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

As noted in Section 4, Option 1 is expected to result in traffic flows below the flows predicted in the ES for both the B816 and the M80 so there should be no change to the predicted impacts in the ES of moderate to substantial benefit.

With regards to the "as now" situation, Option 1 is predicted to increase the traffic flows through Castlecary Village by approximately 600 AADT, from 5500 AADT to 6100 AADT. This increase is below 25% so is expected to cause an approximate increase in noise of less than 1db(A), which, as outlined above, is considered imperceptible. It should also be borne in mind that the M80 is the dominant noise source. Consequently any impact is considered negligible.

(b) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

As noted in Section 4, Option 2 is expected to result in traffic flows below the flows predicted in the ES. Therefore no increase to the predicted impacts in the ES is expected with regards to the changes in traffic flows due to the implementation of this option.

With regards to the "as now" situation, Option 2 is predicted to increase the traffic flows through Castlecary Village by approximately 700 AADT, from 5500 AADT to 6200 AADT, similar to Option 1 and therefore any change in noise is considered imperceptible and the impact negligible.

However it is recognised that the introduction of traffic calming, in particular speed cushions, can alter noise levels. Research advises that the presence of a speed cushion can result in a substantial drop in traffic noise levels. Studies have shown that, where the vehicle flow predominantly consists of light vehicles, with very few large commercial vehicles, day-time traffic noise levels can be reduced by the introduction of traffic calming measures. Studies have shown day-time traffic noise levels to be reduced by about 4 dB(A) alongside speed cushions due to the reduction in vehicle speeds.

The results for night-time traffic noise levels were less clear cut. Night-time traffic noise levels alongside road humps were about 2 dB(A) higher than in the same period during the before survey, but were about 2 dB(A) lower alongside the speed cushions. Night-time changes in traffic noise levels are more susceptible to the influence of noise from non-traffic sources or noise from distant heavier trafficked roads, such as the M80.

It should be noted that given the proximity of the M80 to Castlecary Village, the M80 is considered to be a dominant noise source within the area, for both daytime and night-time. Notwithstanding the benefits/dis-benefits that traffic calming can bring with respect to noise, it is expected that there would be little change in noise levels experienced by residents in the area given the dominance of the M80 with respect to noise.

5.2.2 Vibration

The ES also considered the effects of traffic induced vibration. There is a link between noise nuisance and the nuisance caused by vibration and the assessment

has limitations. However, the reduction in traffic noise predicted in the ES suggests properties in the Village would benefit from reduced noise nuisance.

(a) Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

As noted in Section 5.2.1 the impact on residents with regards to traffic noise is negligible. Given the correlation between those bothered by vibration and those bothered by noise nuisance, it is therefore considered that there would be no change to the number of people affected by vibration due to the increased traffic.

(b) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

The increase in traffic flows through Castlecary Village is considered similar to those as a result of Option 1. It is therefore considered that there would no change to the number of people affected by vibration due to the increased traffic volume alone, as the increase in traffic noise would be negligible.

However, it is recognised that the introduction of speed cushions can increase vibration effects from ground borne vibration. Traffic Advisory Leaflet 8/96 summarises investigations carried out and the results of track trials to assess the effect which road humps (including speed cushions) might have in generating ground-borne vibrations when commercial vehicles are driven over them.

Vehicle generated ground-borne vibration is produced by reaction-forces imparted as a vehicle's wheels pass over discontinuities, such as road humps, on the road surface. The highest levels of vibration are generated by heavy vehicles. Traffic vibration is a common source of nuisance; most of the nuisance results from low frequency noise emitted principally by large commercial vehicles. However, in some cases the problem has been thought to be due to ground-borne vibration, which was the subject of this study.

This study demonstrated that, depending upon the type of traffic calming measure and the soil in the vicinity that:

- Minor damage to a building would not be expected unless a road hump was placed within 1m of a building;
- Superficial cracking to buildings could occur when the road hump is within 3m of a building;
- Complaints regarding vibration could be received where the building is 12m or less from the road hump; and
- Vibration is perceived to increase within 56m of a road hump.

It should be noted that the effects above are dependent on both the traffic calming measure and the soil. The layout of the traffic calming measure (eg height, length, slope etc) contributes to the vibration. Also, the firmer the soil in the vicinity, the more localised will be the vibration effects.

The speed cushions proposed are of a type where heavy goods vehicles are not expected to cause undue vibration. No buildings in the Castlecary area are within 3m of the road edge and therefore it is not expected that the traffic calming would result in either superficial cracking or damage to buildings. However, with a number

of properties within 12m of the road edge, vibration impacts may potentially cause disturbance. However, by locating any speed cushions away from properties, where possible, the overall impact of the speed cushions could be minimised.

5.3 Air Quality

As noted in the M80 ES, emissions from vehicles can have a significant impact on air quality. The local air quality assessment focused on properties and sensitive ecosystems in the vicinity of the scheme corridor that may be subject to a change in air quality. Pollutant concentrations are known to decline rapidly on moving away from the edge of a road; the study area was defined as 200m from the centre of the proposed M80.

A regional air quality assessment was also carried out considering all traffic on the entire network modelled for the M80 between Stepps and Haggs. In this context the change in traffic flow and assignment outlined in Section 3 is negligible and therefore regional air quality has not been considered further.

As reported in the Environmental Statement, the scheme in the Castlecary area was expected to:

- reduce the annual mean concentrations of nitrogen dioxide by between 9% and 13% in 2010 and by between 4% and 7% in 2025;
- reduce the annual mean concentrations of PM_{10} by between 3% and 7% in 2010 and by between 2% and 5% in 2025
- result in no exceedences of the annual mean nitrogen dioxide objective (40 $\mu g/m_3$) in either 2010 or 2025
- result in no exceedences of the 24-hour PM_{10} objective (Days > 50 $\mu g/m_3$) in either 2010 or 2025

In terms of the overall impact significance criteria, the overall significance of impacts for nitrogen dioxide ranged from moderate beneficial to slight adverse. The overall significance of impacts for PM_{10} ranged from moderate beneficial to insignificant adverse.

(a) Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

As noted in Section 4, the traffic volumes on the B816 in Castlecary and also on the M80 are assessed to be considerably less than those predicted within the ES. The changes to the flows as a result of the implementation of this Option are therefore not expected to alter negatively the finding on the air quality assessment reported within the ES.

When considering the impact of this Option against the “as now” situation and in particular local air quality, the small increase in traffic flows through Castlecary Village are considered to have an insignificant impact on air quality.

(b) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

As noted in Section 4, Option 2 is likewise expected to result in traffic flows considerably less than those predicted in the ES. Therefore no negative change to

the predicted impacts in the ES is expected with regards to the changes in traffic flows due to the implementation of this option.

With regards to the “as now” situation, Option 2 is predicted to cause a small increase in the traffic flows through Castlecary Village, similar to Option 1, and this Option is therefore considered to have an insignificant impact on air quality.

However, the implementation of traffic calming measures may have a negative impact on air quality, though not significant. Previous studies have indicated that if the type and number of cars using roads following installation of traffic calming measures remains the same then roads with traffic calming measures may show an increase in pollutants due to the slowing and accelerating of vehicles.

5.4 Landscape and Visual Impact

(a) Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

The closure of the slip roads (Option 1) would result in changes to the character of the landscape with areas of road pavement grassed over.

Whilst the closure of the eastbound merge slip road, is not anticipated to impact on the visual amenity of the area, it is recognised that screening the M80 from the B816 would reinforce the closure of the slip road. It is therefore recommended that scrub planting is undertaken along the fringes of the B816.

The closure of the westbound diverge slip road is again not expected to impact on the visual amenity of the area, however the opportunity should be taken to integrate the existing road within the landscape by planting of sections of the slip road with woodland. This planting would improve the visual amenity of the area from receptors at the Forth & Clyde Canal and also from Banknock.

(b) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

The implementation of this option is not considered to impact on the landscape or change the visual impact of the scheme on the area.

5.5 Pedestrians, Cyclists, Equestrians and Community Effects

5.5.1 Assessment Aspects

The M80 ES states that the assessment of impacts on pedestrians and others focuses on three key aspects of peoples’ journeys:

- key journey parameters - changes in journey lengths and times resulting from any diversions or closures of footpaths, tracks, public rights of way or roads;
- amenity value - the effect on the amenity value of journeys, where amenity is defined as the relative pleasantness of a journey; and
- community severance - changes in community severance, where community severance is defined as the separation of residents from facilities and services they use within their community caused by new or improved roads or by changes in traffic flows.

Of the three aspects above, amenity value and community severance are considered relevant to Option 2, with no change to Option 1.

(a) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

As noted previously, traffic flows will not change significantly as a result of implementing either option. The amenity value of any journeys is therefore not expected to change as a result of any changes in traffic flow themselves. However the introduction of traffic calming measures on the B816 is expected to impact on the amenity value.

Lower traffic speeds, as a consequence of traffic calming, are expected to positively contribute to both pedestrians and cyclists journeys. Most cyclists avoid speed cushions and ride between the cushions and the nearside kerb or between two cushions. It is therefore considered that the installation of traffic calming would be of a positive, if marginal, benefit.

Community severance is likely to be reduced through lower traffic speeds and specifically the introduction of a zebra crossing and also build-outs. The introduction of these features should increase the opportunity for pedestrians to cross Castlecary Road.

5.6 Accessibility & Social Inclusion

Accessibility was one of the scheme specific objectives of the M80 scheme, where accessibility was defined as:

To provide adequate access to facilities, in particular to jobs, and adequate accessibility to freight deliveries, consistent with the strategic role of the scheme corridor (linking North and North East Scotland with the M6 main route to the European markets).

Since the publication of the ES, the Government's objectives have extended this concept to include Social Inclusion.

Accessibility is a broad concept that defines the ability of people and businesses to access goods, services, people and opportunities. Two key criteria are:

- Community Accessibility – consideration of public transport network coverage and access to local services:

- Comparative Accessibility – distribution of accessibility impacts by people group and by location.

5.6.1 Summary of Assessment

Two bus services currently serve the Castlecary and Allandale areas:

- X37 (operated by First Scotland East) – Falkirk – Glasgow via Camelon, Bonnybridge, High Bonnybridge, Allandale and Cumbernauld

- X39 (operated by First Scotland East) – Stirling - Glasgow via Denny, Cumbernauld, Muirhead and M80 Motorway.

The X37 operates at an hourly frequency and connects Allandale with Castlecary via the B816 and provides both these communities with direct connections to the Falkirk, Cumbernauld and Glasgow environs.

The X39 is an express bus service between Stirling and Glasgow, which operates on a frequency of between 60minutes and 120 minutes throughout the day via Denny, Haggs, Castlecary and Cumbernauld. The X39 is the only scheduled bus service which utilises the bus gates.

The X37 and X39 services both provide public transport links to Cumbernauld and Glasgow from Castlecary. The X39 provides the only direct public transport link between Castlecary and Stirling.

(a) Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

First Scotland East have indicated that the removal of the direct access to the M80 at Castlecary would result in the X39 service utilising the slip roads at Old Inns to serve the Cumbernauld area. The re-routing of this service would firstly remove a direct public transport link between the Castlecary/Wardpark area and Stirling and secondly reduce the frequency of services to Cumbernauld and Glasgow from the area by around 50%.

These changes would affect the level of accessibility by public transport to both Castlecary and Wardpark, particularly for those without access to a car. Travel to/from the Stirling area by public transport would require a change of bus in Cumbernauld village with a subsequent increased journey time and potential cost to the user. This in turn is likely to reduce the attractiveness of the bus service to/from the area and may therefore affect mode choice.

No change to the opportunity to walk or cycle to services or facilities is expected as a result of the implementation of this option.

(b) Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

The implementation of this Option is not considered to impact on accessibility or social inclusion.

6 Consultation

6.1 Introduction

During the development of the scheme and in particular the design of the bus-gates, key stakeholders were consulted with respect to the layout of Castlecary Junction. Following the introduction of the bus-gates the performance of the junction layout continued to be discussed with the consultees. These discussions culminated in a Consultation Meeting of 28 January 2013 attended by:

Falkirk Council (Russell Steedman & Gavin Davie)
North Lanarkshire Council (John Ashcroft)
Strathclyde Police (Stuart Hunter)
Jacobs (John Quail & Ravi Grandhi)

At this meeting the draft assessment of the options was presented by Jacobs and the impacts of the options were discussed and the views of each of the consultees in attendance were sought. The key points raised during the course of the meeting and the final views of the consultees are summarised below.

It should be noted that Central Scotland Police (Bob Murphy) also planned to attend this meeting, however due to unforeseen issues elsewhere, they were unable to attend. However, the key points were discussed separately with them and their views sought on the proposals.

6.2 Key Points

The following summarises the key points discussed at the Consultation Meeting of 28 January 2013:

- Complaints continued to be received regarding the number of vehicles performing u-turns and illegal right turn manoeuvres in the Allandale/Castlecary areas;

- Option 1 - Closure of Eastbound and Westbound Castlecary Slip Roads

  - The closure of the slip roads, without traffic calming, would result in an increase in traffic through Castlecary.

  - An existing bus service, Stirling-Glasgow, would be lost to the Castlecary area on closure of the slip roads.

  - The closure of the Castlecary Slips Roads would result in additional traffic diverting to Haggs Junction. This would be exacerbated by the housing developments planned in the Haggs area which will result in an increase in traffic using Haggs Junction. Concerns were raised over the ability of Haggs Junction to accommodate increased traffic flows without substantial queuing occurring.

- Option 2 - Open the Eastbound and Westbound Slip Roads to all traffic with Traffic Calming Measures on B816

- The introduction of traffic calming would lead to complaints with respect to noise, vibration and damage to buildings and vehicles.

- During incidents which result in the diversion of traffic from the M80, traffic calming would reduce the volume of traffic that could divert along the B816.

- Jacobs presented the preliminary traffic modelling assessment to all the Consultees in January 2013.

6.3 Outcome of Consultation

Following the discussion of the Options, the consultees were asked for their preference, these were:

- ***Falkirk Council – Option 2***
- ***North Lanarkshire Council - Option 1***
- ***Central Scotland Police – Option 2***
- ***Strathclyde Police - Option 1***

6.4 First Scotland East

Discussions have also been held with First Scotland East on the possible implementation of the options. Whilst their preference has not been sought, they have confirmed that the implementation of Option 1 (closure) would see the X39 bus service leave/join the M80 at Old Inns via Cumbernauld, with no stops along the B816.

7 Option Summary and Recommendation

7.1 Option Summary

The following summarises the outcome of the assessment of the options:

Assessment Criteria	Sub-Criteria	Option	Option Summary
Description of Options/Engineering Assessment		1	The closure of the slip roads is not expected to result in significant changes to the layout of the M80 in the Castlecary area. Works to the side road network, other than the closure of the junctions, would not result in significant changes to the road layout. No significant disruption to road users is anticipated during works to close the slip roads. Cost for closing both slip roads is estimated in the region of £120,000.
		2	Disruption to the traffic in the Castlecary area is expected as a result of implementing traffic calming measures. Cost for opening both slip roads to all traffic and providing traffic calming through Castlecary, is estimated in the region of £90,000.
Traffic Impact Assessment	Traffic Flows	1	The traffic flow through Castlecary Village on the B816 would increase by approximately 600 vehicles per day as a result of implementing this option. This flow is below that predicted in the ES.
		2	The traffic flow through Castlecary would increase by approximately 700 vehicles per day as a result of implementing this option. This flow is below that predicted in the ES.
	Journey Times	1	Journey times for Allandale traffic would increase by between 6 and 9 minutes.
		2	The journey time through Castlecary would increase as a result of the traffic calming measures, by up to 1.5 minutes (PM peak).

Environmental Assessment	Traffic Noise	1	No negative change to the predicted impacts in the ES of moderately to substantial benefit Any change in noise is considered imperceptible and the impact negligible.
		2	No negative change to the predicted impacts in the ES of moderately to substantial benefit Any change in noise is considered imperceptible and the impact negligible.
	Vibration	1	No negative change to the number of people affected by vibration due to the increased traffic.
		2	No negative change to the number of people affected by vibration due to the increased traffic. Traffic calming may increase the number of people disturbed by vibration.
	Air Quality	1	No negative change to the finding on the air quality assessment reported within the ES anticipated. The increase in traffic flows through the Village is considered to have an insignificant impact on air quality.
		2	No negative change to the finding on the air quality assessment reported within the ES anticipated. The increase in traffic flows through the Village is considered to have an insignificant impact on air quality. However, the implementation of traffic calming measures may have an insignificant negative impact on air quality.
	Landscape and Visual Impact	1	Results in changes to the character of the landscape with areas of road pavement grassed over and planting of sections of the diverge with woodland. However no impact on the visual amenity of the area is anticipated.
		2	No change
	Pedestrians, Cyclists, Equestrians and Community Effects	1	No change

		2	Lower traffic speeds, as a consequence of traffic calming, are expected to positively contribute to both pedestrians and cyclists journeys, giving a marginal benefit. The traffic calming is anticipated to reduce community severance with an increased opportunity to cross the B816 through the Village.
	Accessibility and Social Inclusion	1	Removal of the direct access to the M80 at Castlecary would see the X39 service utilise the slip roads at Old Inns to serve the Cumbernauld area. The re-routing of this service would firstly remove a direct public transport link between the Castlecary/Wardpark area and Stirling and secondly reduce the frequency of services to Cumbernauld and Glasgow from the area by around 50%. Reduced level of accessibility by public transport to both Castlecary and Wardpark. Travel to/from the Stirling area by public transport would require a change of bus in Cumbernauld Village with a subsequent increased journey time and potential cost to the user. Reduces attractiveness of the bus service to/from the area and may therefore affect mode choice.
		2	No change
Consultations		1	Of the five bodies consulted, two (North Lanarkshire Council & Strathclyde Police) have expressed a desire for this option to be implemented (First Bus have not expressed a preference).
		2	Of the five bodies consulted, two (Falkirk Council & Central Scotland Police) have expressed a desire for this option to be implemented (First Bus have not expressed a preference).

7.2 Recommendation

As noted from the assessment there are two criteria which are expected to have a significantly detrimental impact: journey times for Allandale traffic (Option 1); and Accessibility & Social Inclusion – the loss of a bus service to Castlecary (Option 1).

On the basis of the assessment criteria above it is therefore recommended that Option 2 is taken forward as the preferred option.

7.3 Strategy and Timescale

The successful promotion of any scheme requires key stakeholder involvement early within the scheme development. In the first instance it is proposed that both Castlecary and Allandale Community groups are consulted with respect to taking forward Option 2 – this option results in increased traffic flows through Castlecary Village and also slightly increased journey times, particularly for Allandale traffic going through traffic calming measures.

Prior to undertaking the above consultation exercise it is proposed that details of the traffic calming measures are discussed with NLC and finalised.

Following the consultation exercise it is proposed that any comments received as part of the exercise are considered for incorporation into the scheme, where appropriate, in an effort to address any potential objections.

In tandem, legal advice should be sought with respect to the need for any new Road Orders required to implement Option 2 and the implications of commitments given at the M80 Stepps to Haggs Public Local Inquiry (PLI) in 2005. Furthermore, NLC should be consulted with respect to the approvals process required for the installation of traffic calming on the B816. Further consultation with the key stakeholders should be undertaken prior to the implementation of this option.

It is anticipated that if a PLI can be avoided, it is likely the statutory process could be complete by the winter 2013/spring 2014, with construction works following thereafter. However, if a PLI is required this would potentially add significantly to the timescale.

Appendix A Figures

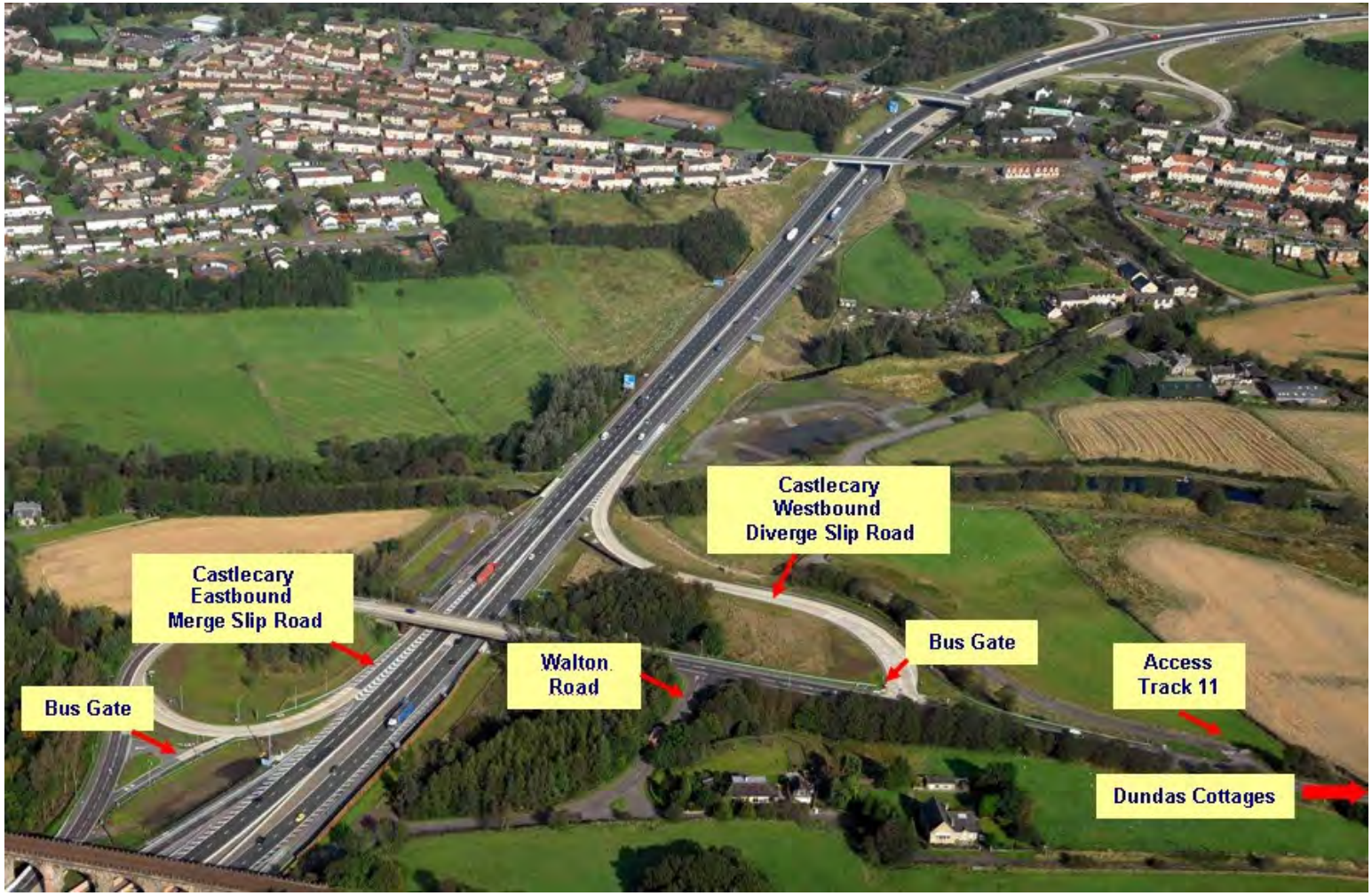

Figure 1: Castlecary Junction – post-construction

Figure 2: Castlecary Junction prior to Construction

Figure 3: Location of Dundas Cottages

Figure 4: Location of Access Track 11(Post Construction)

Figure 5: Junction of Walton Road with B816

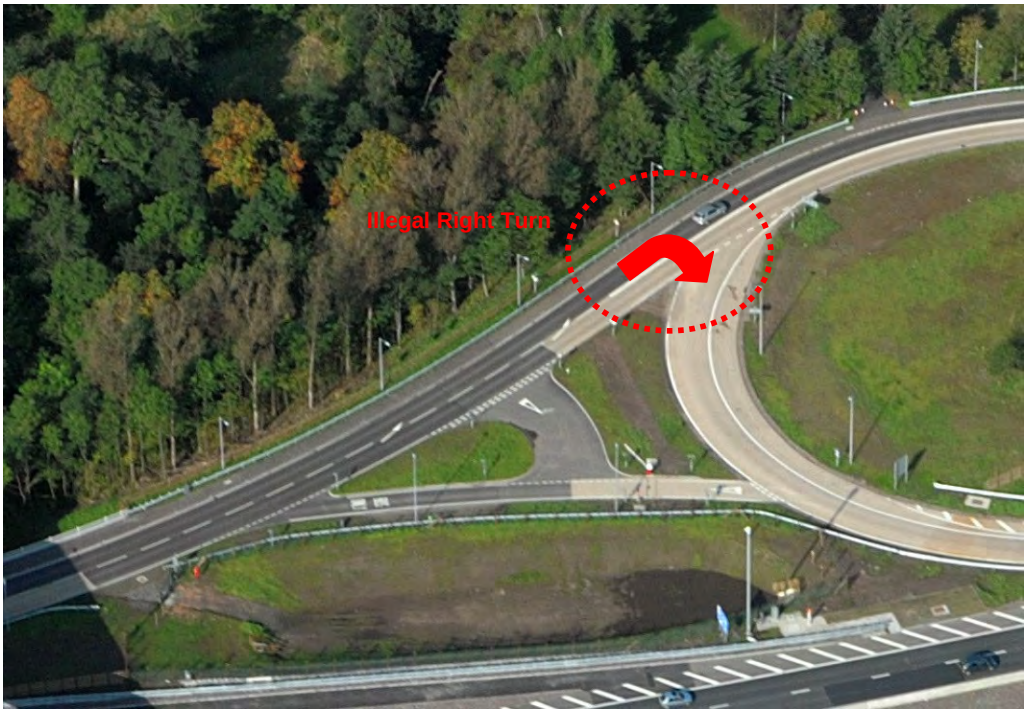

Figure 6: Castlecary Eastbound Merge - Bus Gate and illegal turning location

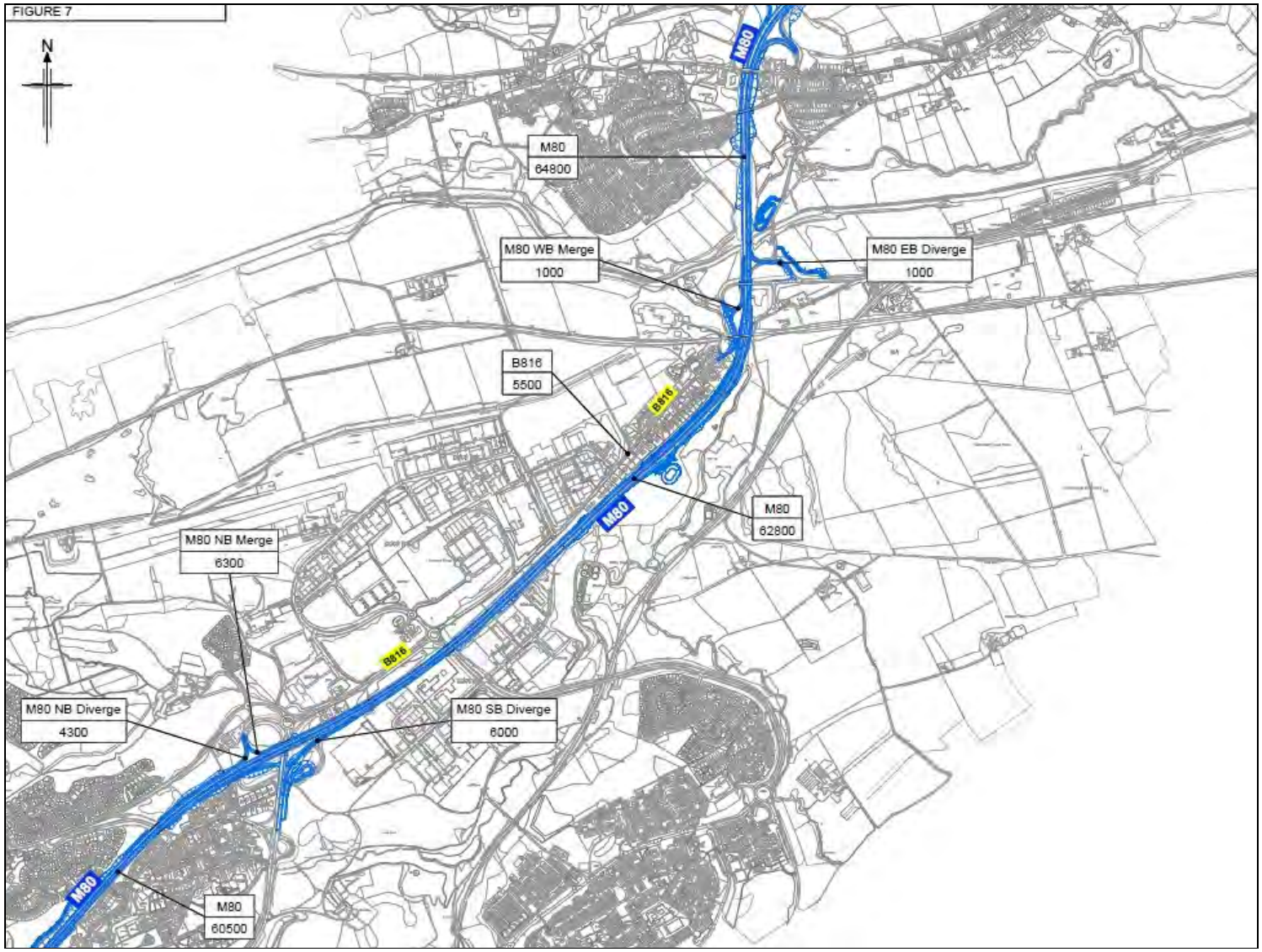

Figure 7: Existing AADT Flow levels

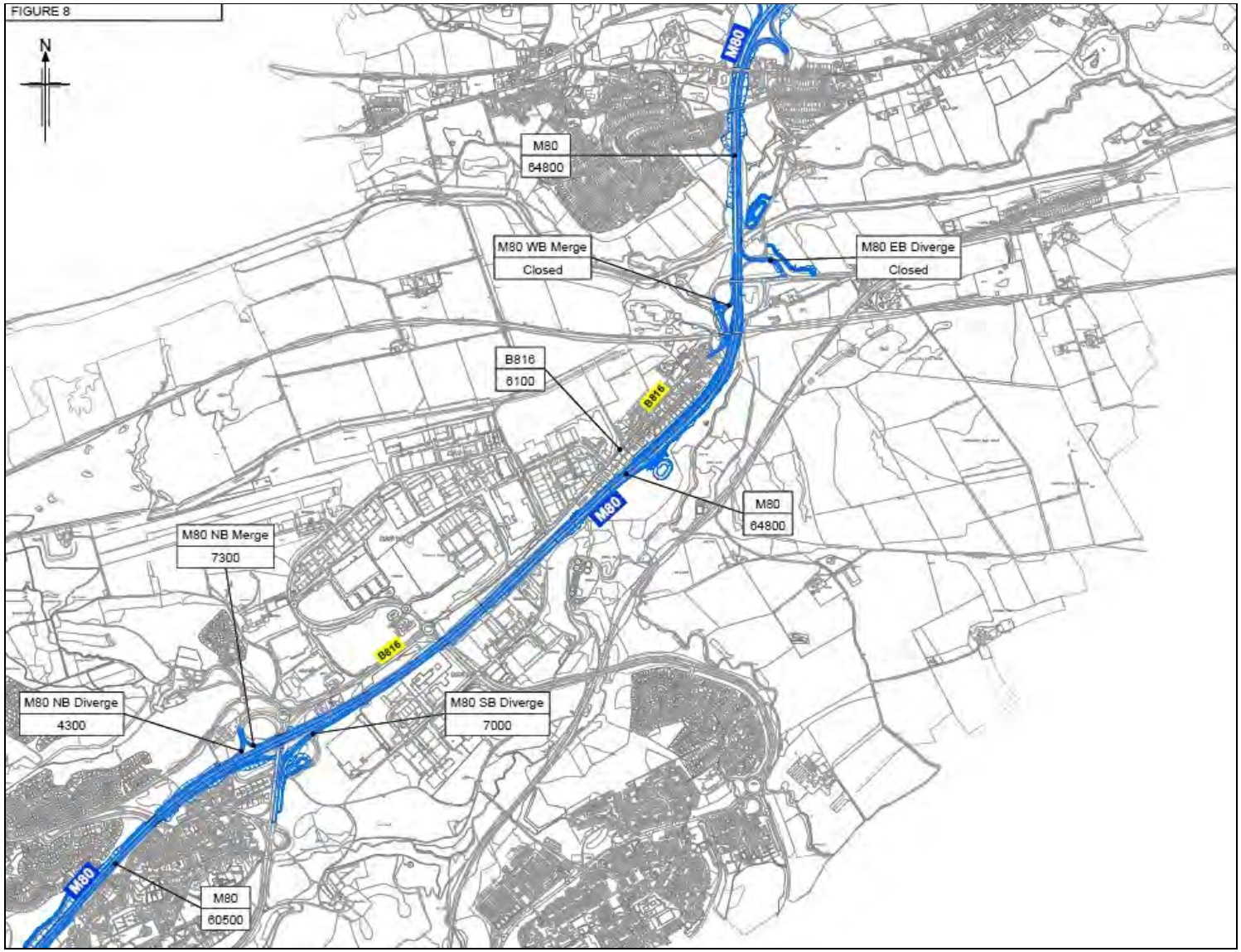

Figure 8: Predicted AADT Flows with Eastbound Merge and Westbound Diverge Slips Closed

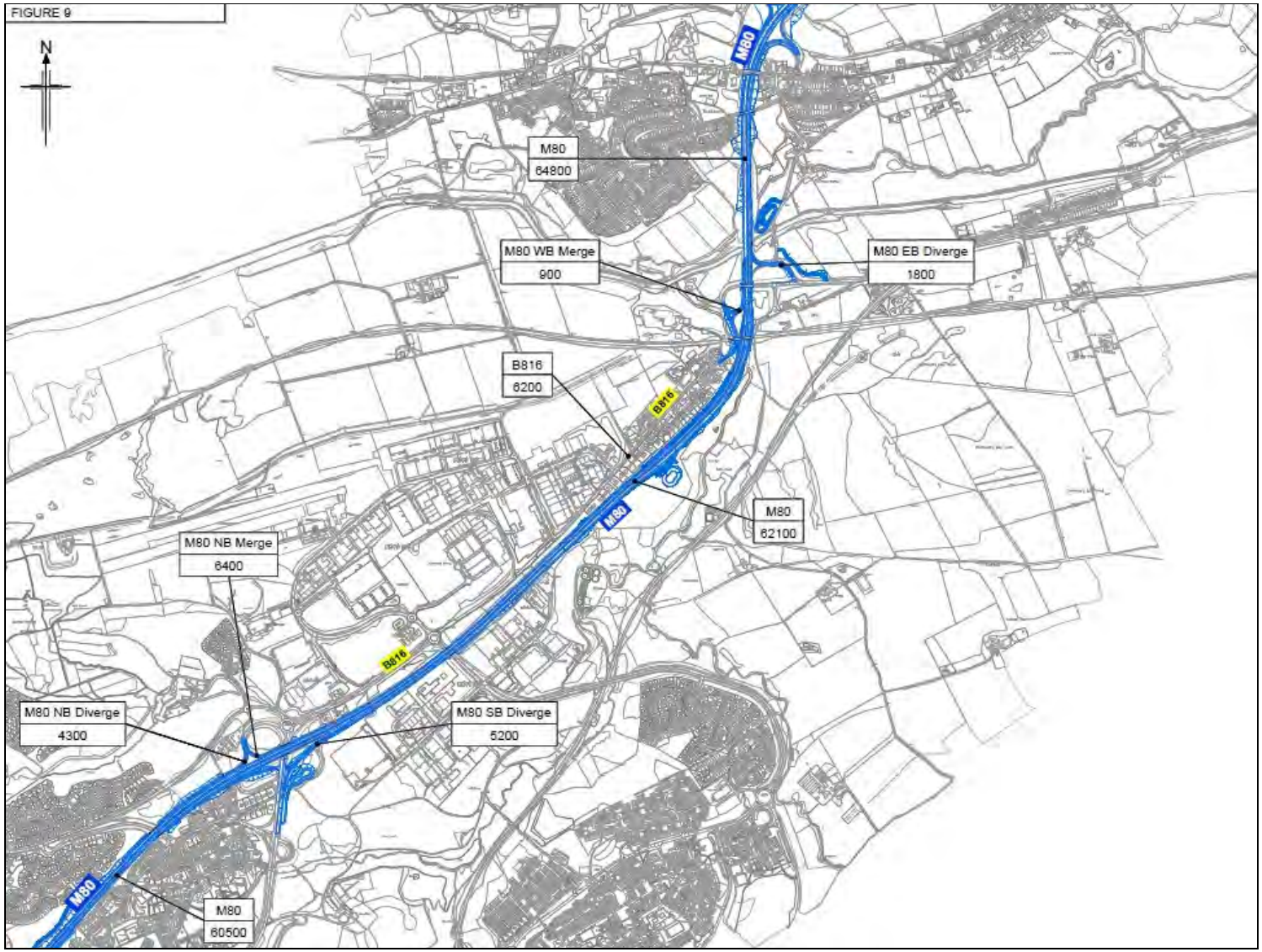

Figure 9: Predicted AADT Flows with Eastbound Merge and Westbound Diverge Slips Opened

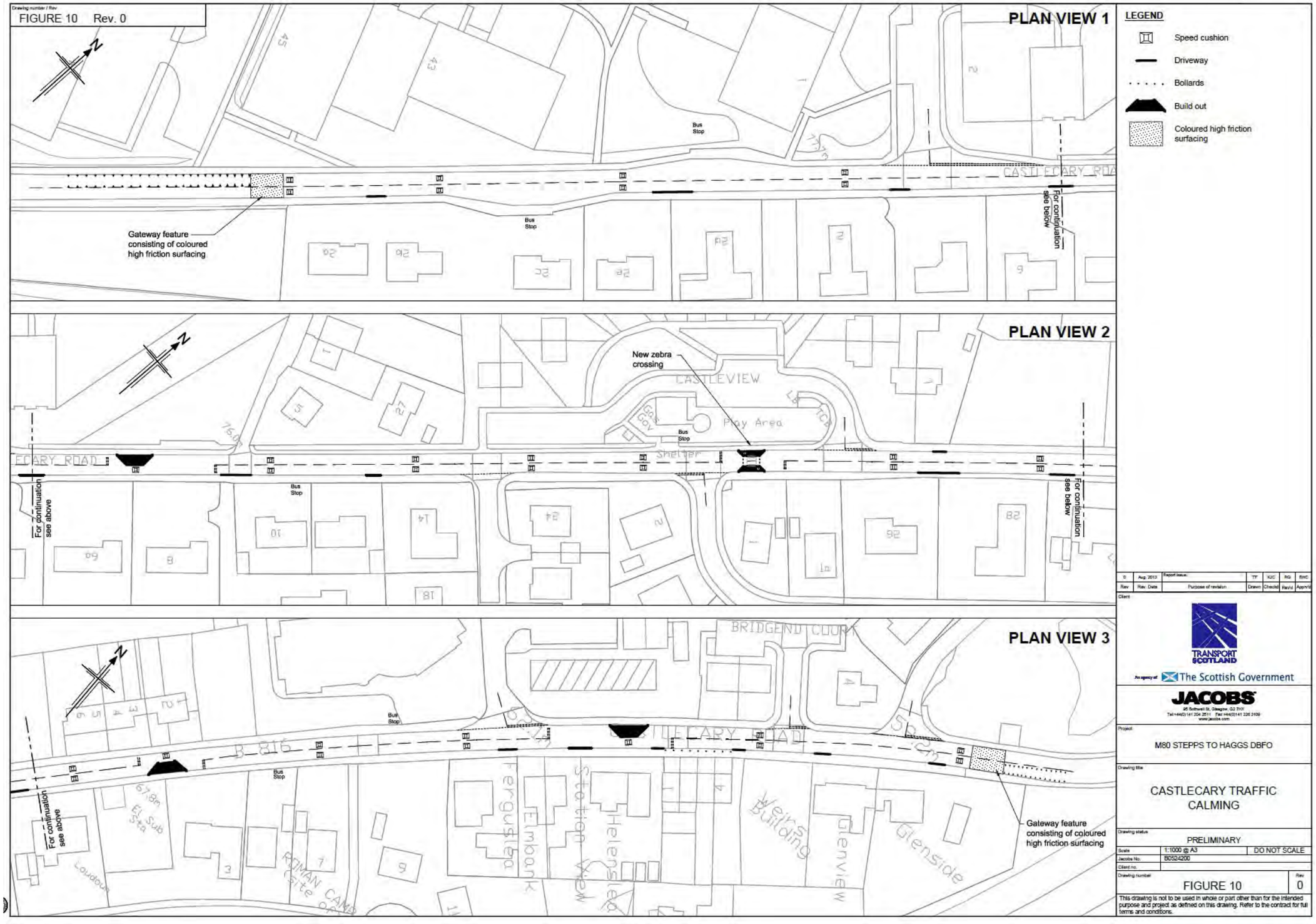

Figure 10: Proposed traffic calming measures through Castlecary Village

Appendix B Stage 4 Road Safety Audit

Review of issues raised in previous audit stages with outstanding issues:

Audit Stage/Item No	C4.3.2/St3/Online
Audit Team Observation	Abuse of prohibited right turn (Castlecary Road NB On slip)
Audit Team Recommendation	It is recommended that the double white lining system is extended south of the nosing to reaffirm the banned turn. An additional banned right turn sign could also be provided on the eastern verge. Further monitoring of the situation will be required, however, without constant enforcement the problem is unlikely to be completely removed.
Designer's Response	Recommendation accepted. Extend double white lines. Provide additional "no right turn" sign on east verge.
Stage 4 Audit Team Comment	Whilst no collisions are noted to have occurred at this location, further comment has been made in section D3 of this report.

Audit Stage/Item No	C4.3.3/St3/Online
Audit Team Observation	Abuse of prohibited right turn (Castlecary Road SB Off slip)
Audit Team Recommendation	It is recommended that sections of guardrail are provided on the splitter island to either side of the tactile paving and pedestrian desire line. The guardrail will prevent any vehicles from being able to cross the splitter island.
Designer's Response	Accepted.
Stage 4 Audit Team Comment	Whilst no collisions are noted to have occurred at this location, further comment has been made in section D3 of this report.

Items Raised at the Stage 4 Audit:

Audit Item No	D.3.3.1
Problem	Illegal U-Turns
Audit Team Observation	Castlecary northbound on slip
Audit Team Observation	While no collisions have occurred at this location, there is clear evidence that a high frequency of illegal turns are being performed with vehicle wheel tracks over the corner of the verge.
Recommendation	The section of double white lining is still fairly short and should be extended further and the police should be consulted over possible enforcement. There may be a requirement to extend kerbing as previously discussed at earlier stages and providing a reflective bollard.
Designers response	This will be discussed with the relevant authority and action taken if considered necessary.
Audit Team Review	No further comments.

Audit Item No	D.3.3.2
Problem	Potentially unsafe U-turns
Audit Team Observation	East of Castlecary southbound off slip
Audit Team Observation	With the right turn banned at the end of the southbound off-slip at Castlecary vehicles are u-turning using the field access to the east. This

	has worn away the edge of the verge on the southern side as well as the verge on the northern side. It would appear that this manoeuvre is being undertaken by fairly large vehicles. With this being undertaken, there are risks of conflict between pedestrians and cyclists as well as side impact collisions with passing traffic.
Recommendation	The Audit team would recommend that this is discussed with the local authority with regards to potential enforcement or physical restrictions to prevent this manoeuvre.
Designers response	This will be discussed with the relevant authority and action taken if considered necessary.
Audit Team Review	No further comments.

Audit Item No	D.3.3.3
Problem	Inadequate turning area for large vehicles resulting in vehicles over-running waiting area for crossing point.
Audit Team Observation	Castlecary southbound off slip
Audit Team Observation	With the central island in place opposite the off-slip, there is insufficient space available for large vehicles to undertake the left turn manoeuvre without over-running the verge and footway. This has damaged the tactile paving and verge and also creates a risk of collisions involving large vehicles and pedestrians.
Recommendation	The kerb alignment will need to be reviewed and assessed with a swept path analysis to provide a solution to allow this manoeuvre to be undertaken safely.
Designers response	We have reviewed the design of the junction and have conducted a swept path analysis on the left turn from Castlecary Southbound off slip to Castlecary Road eastbound. I can confirm that a 16.4m long articulated vehicle can make the manoeuvre without crossing the verge (see attached). I would therefore suggest that the defects are caused by driver error.
Audit Team Review	The Audit Team have no further comment on this issue.

Annex C – M80 Operational Assessment Stage 1 – Hornshill Junction 3 to M80/M876 Junction

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M80 Stepps to Haggs DBFO

M80 Operational Assessment Stage 1– Hornshill Junction 3 to M80 / M876 Junction 8

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ORIGINAL	NAME	NAME	NAME
Approved by	NAME	As Project Manager I confirm that the above document(s) have been subjected to Jacobs' Check and Review procedure and that I **approve them for issue**	INITIALS:
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Contents

1 Introduction

1.1 Background

The purpose of this report is to identify and quantify the locations, extent, duration and consequences of operational issues on the M80 between Junction 3 and Junction 8 and on the M876 on approach to the M80. An analysis of the available data has been undertaken and based on the outcome of this analysis; the causes of the delay and congestion are identified in this report. Following on from this report, it is envisaged that a Stage 2 report will be prepared which will provide recommendations on minor improvements to signing or the layout of the junctions that could be considered to mitigate the identified issues.

When considering the findings of this analysis, some details relating to the background to the scheme should be considered. The M80 Stepps to Haggs DBFO project, completed in August 2011, provided a new 18 kilometre section of motorway, comprising of off-line new construction and an on-line upgrade. The completed works provide improved transport links and operational performance of the route between Glasgow, Stirling and the North East. However, during peak hours, delays and congestion on sections of the M80 motorway between Junction 3 and Junction 8 and on the southbound M876, between the M9 and the M80, are experienced by road users.

Following the outcome of the Central Scotland Transport Corridor Studies, the policy at the time was that it was no longer sustainable to provide for future growth, particularly long distance commuter traffic. It was intended to secure a level of service benefits through the construction of a motorway and the removal of conflict between strategic and local trips on the urban, built-up sections of the A80 through Moodiesburn and Muirhead. A sub-optimal design solution, providing two lanes instead of three, was provided with the view that traffic demand management measures may be required to assist in managing operational performance within the corridor.

This report should be read in conjunction with the “1YA Evaluation Report for the M80(T) Stepps to Haggs” that was prepared by Transport Scotland’s term consultant CH2M Hill in line with Scottish Trunk Road and Infrastructure Project Evaluation guidance.

Further to the above, during construction and following the opening of the M80 Stepps to Haggs scheme, a number of vehicles have been observed performing U-turns or making illegal right turn manoeuvres, on the secondary network at Castlecary Junction, following the implementation of restrictions to turning movements of all vehicles, except buses.

Following a period of monitoring, the “Castlecary Junction - Options Report” was prepared. This presented the findings of the assessment of traffic monitoring and also reported the outcome of consultations with key stakeholders and recommended options to be taken forward to reduce the number of U-turns and illegal right turn manoeuvres. The issues and options to be taken forward are not included within this report.

1.2 Consultation

While formal consultations were not carried out specifically for the M80 operational issues, regular dialogue between Jacobs on-site staff and BEAR Scotland, who are the Operations and Maintenance Contractor for the route, was established to obtain relevant information. Furthermore during consultation with Falkirk Council and North Lanarkshire Council, both councils have not raised any concerns except for the operational issues at Castlecary Junction. The separate report referred to above was prepared to address these issues. In the recent consultations with Police Scotland relating to the Castlecary Junction - Options Report, Police Scotland did not identify any operational issues other than those that are discussed within the body of this report.

1.3 Report structure

The structure adopted within this report is as follows:

- *Section 2 provides details of the features of the M80 Stepps to Haggs motorway, such as, location, connectivity and layout;*
- *Section 3 summarises the volume of traffic movements in each direction on each section of the route;*
- *Section 4 discusses the operational issues ; and*
- *Section 5 provides a summary of the analysis.*

2 Study Area

2.1 Introduction

The study area extends from Hornshill junction to the south to the M80/ M876 junction to the north, which has not been subject to any change as part of the M80 DBFO scheme. The entire M80 Stepps to Haggs scheme is approximately 18 kilometres in length and runs in a south-west to north-east direction providing accessibility between Glasgow and Stirling and the surrounding area. It is dual carriageway along its entire length with hard shoulders in both the directions.

The junctions along the scheme from south to north are:

- Hornshill (M80 Junction 3);
- M80/M73 Mollinsburn (M80 Junction 4);
- Low Wood (M80 Junction 4A);
- Auchenkilns (M80 Junction 5);
- Old Inns (M80 Junction 6);
- Castlecary (M80 Junction 6A); and
- Haggs (M80 Junction 7).

In addition to these junctions within the scheme, a review of the operation of the route also includes examination of the M80 / M876 junction (M80 Junction 8). Commentary is also provided on the section of the M80 south of Hornshill junction, as the operation of this section could impact the performance of the M80 within the scheme extents.

2.1.1 Description of the scheme

The new scheme can be considered as three discrete sections as follows:

- **Stepps to Mollinsburn** (J3 to J4) – approximately 8.0 kilometres of off-line route from the M80 at Hornshill Junction, passing through agricultural land to the north of Muirhead, Chryston and Moodiesburn and re-joining the route of the previous A80 at Mollinsburn Interchange;

- **Mollinsburn to Auchenkilns** (J4 to J5) – approximately 2.7 kilometres of on-line upgrade, extending from Mollinsburn Interchange, along the route of the previous A80 and tying in to the western side of the previously constructed Auchenkilns Junction; and

- **Auchenkilns to Haggs** (J5 to J7) – approximately 7.3 kilometres of on-line upgrade extending from Auchenkilns Junction to the existing M80 at Haggs.

The new carriageway provision for each of the three sections is as follows:

(a) Stepps to Mollinsburn

- Offline Dual two-lane (D2M) carriageways, each 7.3m wide; and
- 3.3m hard shoulders;
- Hornshill Junction is a grade separated junction allowing movements in all directions; and

- M80/M73 Mollinsburn junction is a grade separated interchange, again allowing all movements, where the M73 connects with the M80.

(b) Mollinsburn to Auchenkilns

- dual three-lane (D3M) carriageways, each 11.0m wide, between Mollinsburn Interchange and Low Wood Junction;
- Dual two-lane (D2M) carriageways, each 7.3m wide, between Low Wood Junction and Auchenkilns Junction;
- 3.3m hard shoulders except at localised constraints; and
- At Low Wood junction there are west facing slip roads. These are lane gain and lane drop, which permit free flow access to and from the west side of Cumbernauld.

(c) Auchenkilns to Haggs

- Dual two-lane (D2M) carriageways, each 7.3m wide;
- Auxiliary lane on the southbound carriageway between Castlecary Junction and Old Inns Junction, resulting in an 11.0m carriageway in this direction only (7.3m wide northbound);
- Climbing lane/lane gain on the northbound carriageway between Castlecary Junction and the tie-in at Haggs, resulting in an 11.0m carriageway;
- Climbing lane/lane gain on the southbound carriageway between Haggs and Castlecary junction, resulting in an 11.0m carriageway;
- 3.3m hard shoulders except at localised constraints;
- emergency vehicle bypass lanes 3m wide in both directions through Castlecary Viaduct
- Auchenkilns junction all movements are possible via a grade separated junction;
- Old Inns Junction, again all movements are available. The junction is grade separated, with the northbound merge quadrant, being a loop slip;
- At Castlecary Junction there are north facing slip roads, which are formed as lane gain and lane drop; and
- At Haggs junctions all movements are possible via loop merge slip roads; the southbound diverge is a lane drop.

(d) Haggs to M80/M876

- M80 northbound comprises of a three lane motorway for approximately 700m with a lane drop provided for the diverge to the M876;
- M80 southbound comprises of a two lane motorway with a weaving lane provided between the merge from the M876 and the diverge to Haggs; and
- M80 to the north and the M876 to the east of the M80/M876 junction area thereafter becomes dual two-lane motorway (D2M).

3 Traffic Volumes

3.1 Traffic Volumes

Traffic data referred to in this report were obtained from the CH2MHill report "1YA Evaluation Report for the M80 (T) Stepps to Haggs" and further augmented by traffic data from existing Automatic Traffic Counters (ATC) at locations along the route.

Data from various ATCs has been obtained along the full length of the route and analysis made for the post opening traffic volumes (i.e. 2012 to March 2014 flow levels). The AADT analysis has been presented based on junctions from Hornshill (J3) to the M80/M876 merge (J8).

3.2 Traffic volumes

From the ATC data analysis, there is a general increase in annual average daily traffic flows from 2012-2013 (Table 3.1) to 2013-2014 (Table 3.2) over the majority of sections analysed. As detailed in Table 3.3 below the increases are generally in the region of 5% with the largest increase recorded on the M80 to the north of the M876 junction.

The traffic flows are discussed further within the Operational Issues section of the report.

Table 3.1: M80 Stepps to Haggs Observed AADT 2012 – 2013

Location	AADT (July 2012 – June 2013)		
	N	S	Two Way
M80 J2 (Robroyston) - M80 J3 (Hornshill)	28,845	28,904	57,749
M80 J3 (Hornshill) – M80 J4 (Mollinsburn) Moodiesburn Bypass Section	21,957	22,239	44,196
M73 Merge – M80 J4a (Low Wood)	38,522	37,937	76,459
M80 J5 (Auchenkilns) – M80 J6 (Old Inns)	32,511	32,111	64,622
M80 J6 (Old Inns) – M80 J6a (Castlecary)	34,007	33,327	67,334
M80 J6a (Castlecary) – M80 J7 (Haggs)	34,747	35,079	69,826
M80 North of M80 / M876 Junction	-	-	33,414
M876 East of M80 / M876 Junction 8	-	-	35,107

Table 3.2: M80 Stepps to Haggs Observed AADT 2013 – 2014

Location	AADT (July 2013 – June 2014)		
	N	S	Two Way
M80 J2 (Robroyston) - M80 J3 (Hornshill)	30,546	30,255	60,801
M80 J3 (Hornshill) – M80 J4 (Mollinsburn) Moodiesburn Bypass Section	22,720	23,387	46,107
M73 Merge – M80 J4a (Low Wood)	41,232	38,761	79,994
M80 J5 (Auchenkilns) – M80 J6 (Old Inns)	33,346	33,968	67,314
M80 J6 (Old Inns) – M80 J6a (Castlecary)	34,813	35,932	70,745
M80 J6a (Castlecary) – M80 J7 (Haggs)	36,571	36,786	73,357
M80 North of M80 / M876 Junction 8	17,977	18,154	36,131
M876 East of M80 / M876 Junction 8	18,440	18,156	36,596

Table 3.3: M80 Stepps to Haggs Observed AADT Comparison

Location	AADT (Two Way)		Difference %
	(July 2012 – June 2013)	(July 2013 – June 2014)	
M80 J2 (Robroyston) - M80 J3 (Hornshill)	57,749	60,801	5.28%
M80 J3 (Hornshill) – M80 J4 (Mollinsburn) Moodiesburn Bypass Section	44,196	46,107	4.32%
M73 Merge – M80 J4a (Low Wood)	76,459	79,994	4.62%
M80 J5 (Auchenkilns) – M80 J6 (Old Inns)	64,622	67,314	4.17%
M80 J6 (Old Inns) – M80 J6a (Castlecary)	67,334	70,745	5.07%
M80 J6a (Castlecary) – M80 J7 (Haggs)	69,826	73,357	5.06%
M80 North of M80 / M876 Junction	33,414	36,131	8.13%
M876 East of M80 / M876 Junction 8	35,107	36,596	4.24%

HGV levels in the 2013 to 2014 period are between 7% and 8% on the M80 with the exception of the sections to the south of Hornshill (J3) where the HGV's account for 3% of traffic.

In addition to the daily levels presented in this section, peak period flows have been calculated for the relevant mainline, merges and diverges and are detailed within the Operational Issues section of the report.

4 Operational Issues

4.1 Introduction

This section provides commentary on the operational issues identified in the corridor. A review of the layout and any associated departures from standard are summarised. In addition, analysis of key operational indicators has been undertaken and is included within this section. When discussing each operational issue, the section generally includes commentary on:-

- Engineering Design Constraints;
- Key Operational Issues;
- Peak Period Flows;
- Vehicle Speed;
- Safety Review; and
- Summary of Findings.

Engineering Design Constraints

The operation can be largely influenced by the road layout and in this instance the design is a key factor, particularly as the scheme was not developed to cater for growing traffic levels. There were a number of departures associated with the design, in part, due to the number of motorway lanes provided being less than necessary to cope with projected traffic volumes. Where 2 lanes have been maintained from the A80 dual carriageway layout, 3 lanes should generally have been provided for the upgrade to motorway standard. This reduced capacity provision is detailed later in this report, particularly in relation to peak performance at Old Inns junction. In addition, the general topographical constraints can also influence the level of departures. For each location where operational issues have been identified the constructed engineering parameters have been presented and considered to determine the level of influence that departures, geometries, gradients and general layout may have on the relevant operational issue.

Key Operational Issues

Within this section observed vehicle queuing has been reported and in areas, supported by reviews of video footage. Google travel information has also been referred to for an indication of queue lengths and operational issues during peak periods. This evidence provides the most obvious indication that operational issues exist in the corridor.

For this study, specific queue length surveys were not commissioned. Queue length information was generally gathered from on-site monitoring and through consultation with BEAR Scotland. The on-site monitoring comprised of site visits, monitoring by Jacobs site staff and observations at the Traffic Scotland monitoring centre in Queensferry.

In addition, video surveys were undertaken in November 2014 for the section southbound between Old Inns and Haggs, adjacent to the M80 / M876 Junction and at J2 Hornshill.

Queue length information has been presented in both northbound and southbound directions during the AM and PM peaks. The Key used in the queue length graphics is detailed below:

- RED – Stationary or slow moving traffic;
- AMBER – Below the free flow speed limit; and
- GREEN – Free flow speed limit.

Peak Period Flows

As noted in Section 3, flows have been derived from traffic data included within the "1YA Evaluation Report for the M80(T) Stepps to Haggs" report and ATC data supplied by Transport Scotland. These have been calculated for the Hornshill, Old Inns and M80 / M876 junctions for weekday hourly flows between 0600 and 2000. These flow profiles have been derived for a neutral month (May 2013) and identify the AM and PM peak periods. Where relevant, comparisons with 2006 and 2008 data have been undertaken to illustrate changes in flow patterns since the opening of the scheme.

In addition at Old Inns junction traffic flows have been obtained for a day in November 2014 from the ANPR surveys which were commissioned as described later within this section.

Vehicle Speed

The average speed of the vehicles has been determined from two sources:

- Journey Times – these have been calculated between the start of the merge at M80 Junction 2, Robroyston, in the south and M80 Junction 4 Haggs exit in the north, based on moving observer surveys undertaken in 2013. The journey times were recorded, in both directions, between timing points on the M80 at different times of the day; and
- Spot speeds from Automatic Traffic Counters (ATCs) – based on speeds at specific locations, used as a proxy for speeds along the sections of the route that the ATC is located.

Safety Review

The accident data further to the opening of the M80 scheme in August 2011 has been reviewed and assessed. There were 62 accidents (to April 30 2014) for the sections between M80 Junction 2 Robroyston and M80 Junction 8 at the M876. The accidents comprised of two fatalities, six serious and the remainder slight. Details of accidents are provided in the following operational review sections.

4.2 AM Peak Operational Review

The following sections of the M80 are considered to have operational issues during the AM peak period:

- M80 Low Wood junction to M80 Old Inns (northbound);
- M80 Old Inns to M80 Haggs Junction, including Castlecary Junction (northbound); and
- M80 Hornshill to M8 Provan (southbound).

M80 Low Wood Junction northbound to Old Inns Junction

Engineering Design Constraints

The geometric alignment of the mainline carriageway is similar to the previous A80. As the northbound carriageway departs from Auchenkilns Junction the road is relatively flat rising at a 0.5% gradient, gradually increasing to a maximum of 3.7% and reducing to a rising 0.5% gradient as the M80 crosses over Dullatur Road and on towards the Old Inns Junction. The mainline crests approximately 20 metres east of the Old Inns overbridge then falls at 0.4% towards the Forrest Road overbridge and from here the mainline gradient increases as it falls towards Castlecary Viaduct. The gradients through this section are generally 2% to 3% with a maximum of 3.6% over a short 200 metre section. The DMRB states that the desirable maximum gradient on a typical motorway is 3%. However, where there are significant savings in construction or environmental costs the design standard allows for an absolute maximum gradient of 4%. Road gradients approaching 4% are typical of on-line upgrades especially in urban areas where the road corridor is constrained. Outside the morning peak, this uphill climb has little significance with large vehicles maintaining momentum; however, during periods of congestion, any loss of momentum of larger vehicles could influence vehicle speed and operation.

The northbound slip roads at Old Inns generally maintain the same horizontal alignment as the original A80 layout due to site constraints and to maintain a similar configuration as before. The diverge and merge slip roads are subject to a number of approved departures, which are listed in Appendix A. It is considered that of the approved departures none are contributing to the congestion issues at the junction.

In the southbound direction the junction configuration at Old Inns is more typical of a standard grade separated junction. The layout of the junction is shown in Figure 4-1, and the list of approved departures associated with the slip roads are included in Appendix A.

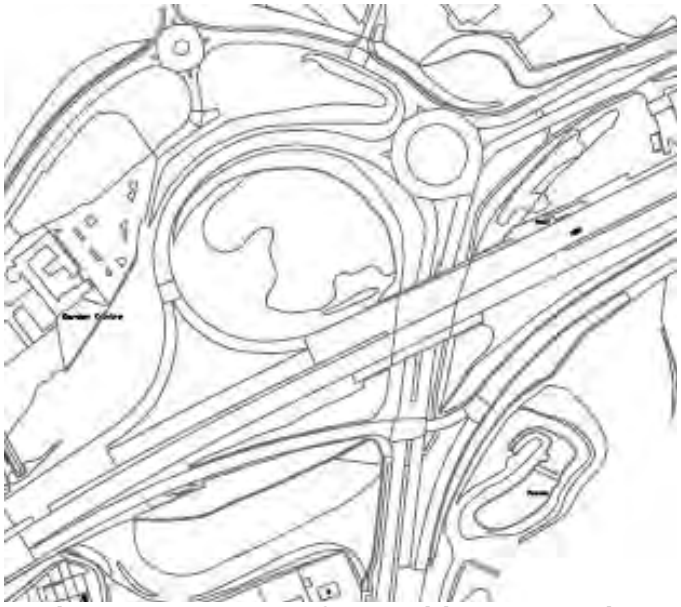

Figure 4-1: Layout of M80 Old Inns Junction

Key Operational Issues

In the northbound direction the operational issues appear to originate at Old Inns junction, which causes congestion and queues extending for 3 to 4 miles south to

Low Wood junction, as shown in Figure 4-2. The queuing continues through Auchenkilns junction which can result in delay and merging issues for northbound traffic joining at this junction. In congested periods the queuing can continue south to the M73 merge at Mollinsburn.

The typical operational issues are present from around 07:15 to approximately 08:30. Queueing can occur beyond this time and it does take some time to dissipate until more normal operational conditions are experienced. When examining CCTV footage at the Traffic Control Centre, congestion continued through to 09.00, however, operational conditions were noted to improve from approximately 08:30.

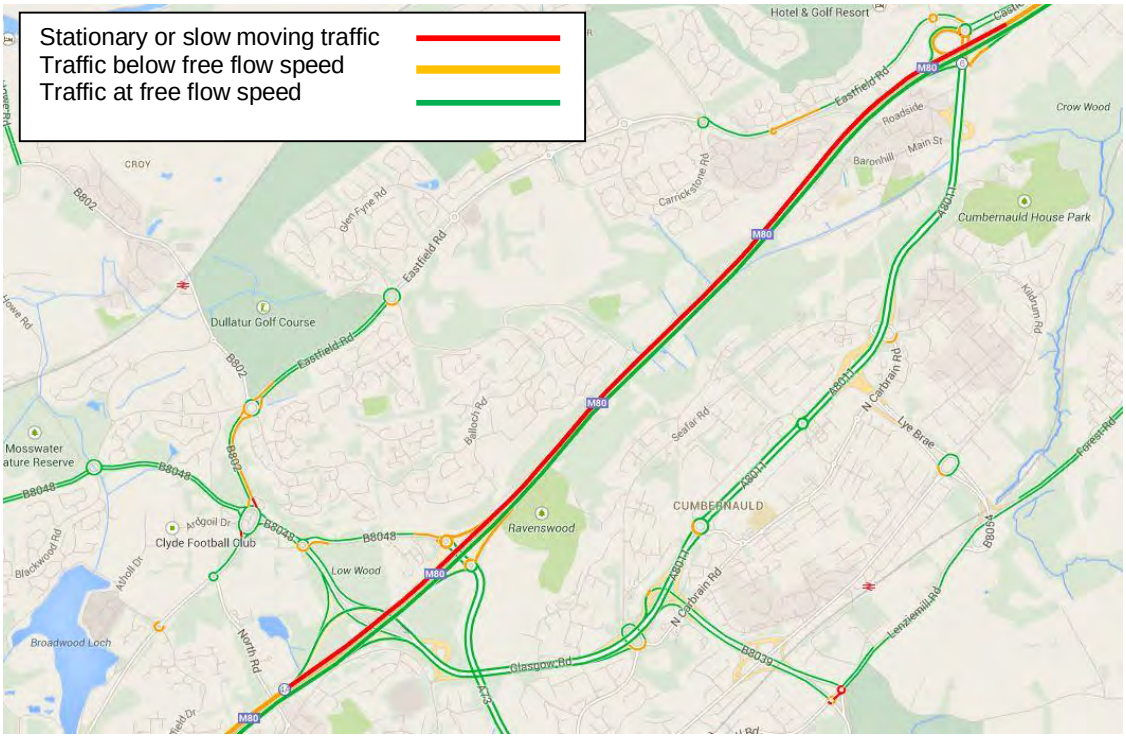

Figure 4-2: M80 Low Wood to M80 Old Inns

The M80 scheme has removed a number of congestion bottlenecks upstream of this location. Prior to the scheme there was considerable congestion south of Old Inns at the Mollinsburn junction and further south west along the A80 where at-grade signalised junctions caused delay. These bottlenecks controlled traffic flow by creating platoons, however, within the completed M80 scheme traffic flows freely along the route, which may exacerbate conditions at Old Inns Junction. This cannot be substantiated by reviewing traffic levels, as the data would need to be available at 5 minute intervals or lower, however it is considered that this could be a factor.

The main cause of the queuing and delays appears to be due to driver behaviour at the Old Inns northbound merge. From onsite observations, vehicles joining the northbound merge do not appear to utilise the full length of the merge and attempt to merge at the first opportunity, which is generally at the end of the chevron markings. This behaviour was also observed when reviewing CCTV footage at the junction, indeed many vehicles were observed to cut over the chevron markings. Some vehicles stopped on the merge and one vehicle was observed undertaking a stopped vehicle, using the hard shoulder to get further along the slip road.

The reason for drivers merging early, at the nose, or across the chevrons, may be due to driver perception of the merge length given the combined horizontal and

vertical alignment of the merge and mainline which comprises a long left hand bend with a rising gradient.

In addition, it appears that drivers on the mainline anticipate the potential for slower merging traffic and move towards the offside lane of the M80, and therefore the mainline capacity is reduced which exacerbates the situation.

A further impact of the queuing and mainline congestion is that the increased journey time on the mainline, can mean that routing through Cumbernauld can be faster. Indeed Google travel information, during the AM peak period, suggests that drivers can re-route from the M80 at Low Wood and travel via the A8011 (which is partially dualled) to Old Inns junction quicker than via the M80. Satellite navigation or smart phones that use similar information will guide traffic to undertake this diversion.

Automatic Number Plate Recognition (ANPR) Surveys

ANPR surveys were undertaken on Tuesday 25th November to confirm the number of trips that were diverting off the M80 and using the local road network to avoid congestion on the M80 and to also record the volume of traffic using Old Inns merge. The survey locations were selected to identify the vehicles exiting the M80 northbound at Low Wood junction and re-joining at either Old Inns junction or Castlecary junction. The survey method also established if the diverting traffic used either the A8011 via Cumbernauld Town Centre or Eastfield Road via the northern side of Cumbernauld.

Analysis of survey results identified the journey time of vehicles diverting and re-joining the M80 at the above locations during both the AM and PM peaks

A review of available data indicated that the diversion via the A8011 typically has a journey time of 7 mins and 9 mins in off peak conditions to Old Inns and Castlecary respectively. The typical journey times via Eastfield Road are 9 mins and 12 mins respectively.

It was assumed that where journey times were greater than 15 minutes, that these vehicles were undertaking pass-by trips (e.g. to a petrol station) or legitimate diverted trips such as dropping off a child/partner at school/work.

A summary of the diverted trips with a journey time less than 15 minutes are illustrated in Tables 4.1 and 4.2 are shown below.

Table 4.1 AM Diversion Volumes for Matched Trips < 15mins 0700 to 1000

Destination	Old Inns	Castlecary	Total
Diversion via Eastfield Road	34	10	44
Diversion via A8011 Cumbernauld town centre	292	58	350
Total	326	68	394

Table 4.2 PM Diversion Volumes for Matched Trips < 15mins 1500 to 1900

Destination	Old Inns	Castlecary	Total
Diversion via Eastfield Road	3	0	3
Diversion via A8011 Cumbernauld town centre	47	2	49
Total	50	2	52

The ANPR data indicates that there is traffic diverting from the M80 to avoid queuing, with the occurrence being more prevalent in the AM peak, which is to be expected given the observed queuing issues in this peak. Based on the figures in Table 4.1, within the AM peak, 90% of diverting traffic routes through Cumbernauld Town Centre on the A8011 and 10% diverts via Eastfield Road. 83% of this diverting traffic re-joins the M80 northbound at Old Inns with the remaining 17% re-joining at Castlecary.

The recorded volumes of traffic re-joining at Old Inns is 326 which accounts for 14.4% of the total northbound surveyed merge flows (2268) between 0700 and 1000.

The AM peak hour on the day of the survey occurred between 0730 and 0830. The recorded volumes merging at Old Inns in the AM peak was 1089 with 142 diverted trips occurring within this period which accounts for 13% of the peak hour merge traffic flow.

As noted in Table 4.2 above the number of diversions within the PM peak is considerably less than during the AM peak. The PM peak hour within the surveyed period was 1630 to 1730 with a corresponding flow of 551, approximately 50% of the merge flow within the AM peak.

The M80 operates better during the PM peak at this location and it is expected that the number of diverting trips are lower. However, it does appear that some drivers still perceive a lower travel time via Cumbernauld.

In comparison to the average merge flows from May 2013, detailed in the section below, the flows observed in the November survey are considerably higher than the average AM peak, 1089 compared to an average 632. In the PM peak the peak flow from the ANPR survey is 551 compared to the average PM peak flow of 539.

The above may be evidence of an increase in diverting traffic in the AM peak but may also suggest there is considerable day to day variance in the diverting traffic volumes which will be dependent on the queues and delay on the M80 and subsequently driver's inclination to divert, whether as a choice or influenced by satellite navigation traffic information.

The critical issue is that there is approximately 326 vehicle (14.4%) using Old Inns that are exacerbating congestion issues.

Peak Period Flows

The average northbound traffic flow during the AM peak hour on a weekday has 632 vehicles merging with a mainline flow of 2,486 vehicles on approach to the northbound merge. This indicates a total flow of 3,118 vehicles north of Old Inns junction towards Castlecary. The traffic flows are presented in Figure 4-3.

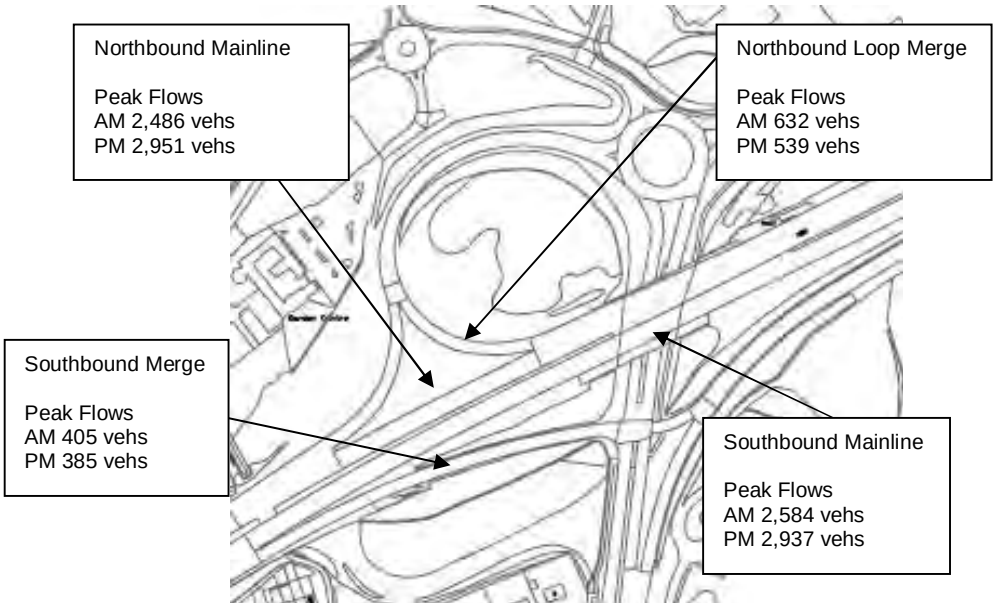

Figure 4-3: Old Inns Junction Traffic Flows

The theoretical capacity of a lane can vary quite considerably, influenced by, for example, location, road standard, layout, the proportion of goods vehicles, junction spacing and merging lanes. The theoretical capacity of a standard two lane motorway is approximately 4,500 vehicles per hour (2,250 vehicles per lane). However, the aforementioned factors and driver behaviour could bring this level down to approximately 3,600 vehicles per hour (1,800 vehicles per lane).

The review of traffic levels in comparison with capacity (see Figure 4-4 below), suggests the mainline traffic flow north of Old Inns operates within capacity; 69% of the upper bound theoretical flow (4,500 vehicles) and around 86% of the lower bound flow (3,600 vehicles). Therefore the effective capacity at the northbound merge is at a level such that the traffic volumes result in the operational issues at the junction.

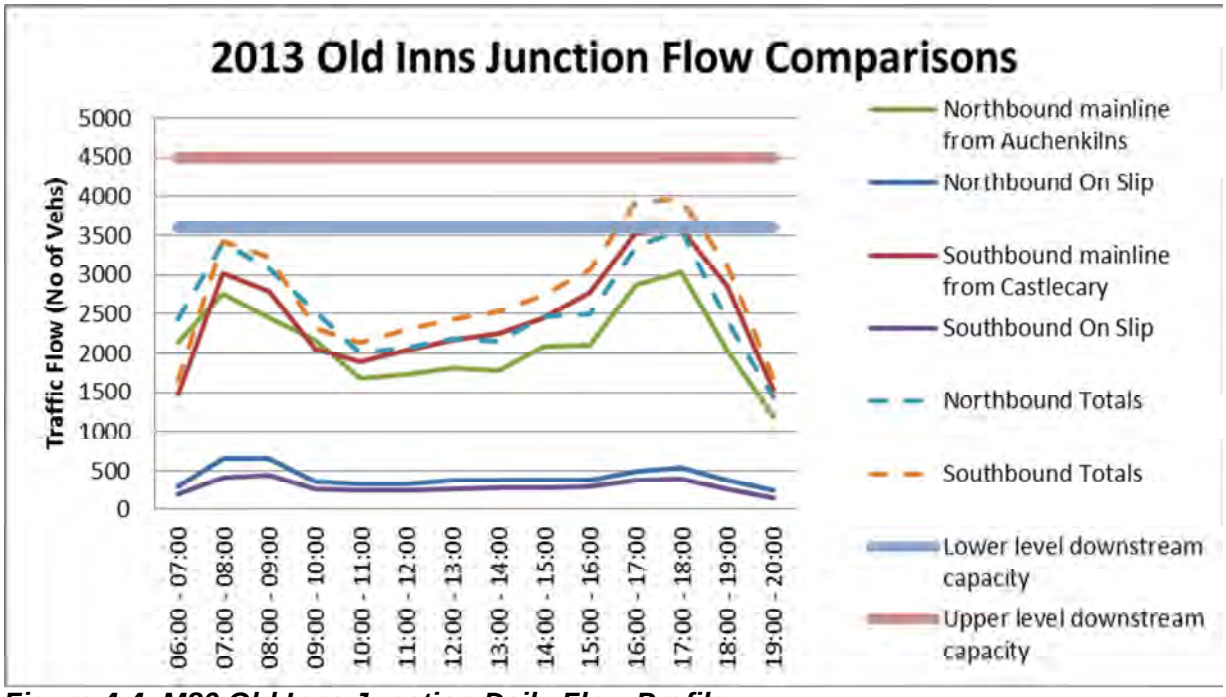

Figure 4-4: M80 Old Inns Junction Daily Flow Profile

Although the PM peak traffic flows are slightly greater than the AM, the actual queuing and delay observed at the junction, is greater during the AM peak.

In comparison with the northbound traffic level, the average southbound flows during the AM peak on a weekday are 405 and 2,584 vehicles on the merge and mainline respectively. The combined level south of Old Inns is therefore 3,430, which is comparable with the northbound level of 2,989 vehicles. The traffic levels are greater on the northbound merge compared with the southbound merge, however the mainline average traffic level, during both the AM and PM peak, is greater southbound compared with northbound.

Despite this there is no significant congestion observed southbound during the AM or PM peak hours, and the difference in traffic levels from the northbound direction is fairly marginal, which indicates that the layout of the junction, and possibly driver behaviour, is having a considerable impact on operational conditions.

Vehicle Speed

The merging issues described above compound to create a stop start traffic flow situation, with speeds being observed lower than 5mph and sometimes to a complete halt even on the offside lane of the mainline. This stop start traffic flow situation on the northbound carriageway creates a condition where vehicles approaching the rear of the slow moving traffic are still travelling at the motorway speed limit with some approaching drivers unaware of the slower moving traffic in front. This can result in drivers braking sharply and in some cases coming to an abrupt halt.

It is worth noting that northbound traffic speeds begin to increase again once vehicles have cleared the extents of the Old Inns northbound merge.

Based on site observations, the tightening of the loop radius coupled with a slight uphill grade on the slip road appears to influence vehicle speed as they approach the merge/auxiliary lane.

Safety Review

Since scheme opening there has been one slight accident at the junction on the northbound diverge. There have been 10 slight accidents on the northbound mainline between Auchenkilns junction and Old Inns, with a cluster in the vicinity of the northbound on slip of Auchenkilns. Of these, 6 have occurred within the AM peak. The majority of these have involved vehicles going ahead and causation includes 'Failure to judge other persons path/speed' which indicate shunt type accidents have occurred.

Summary

It is considered that the M80 scheme provides improvements to Old Inns junction, with the key changes including a considerable extension to the merges, diverges and the removal of the short diverge to a petrol station, which is located northwest of the junction. It is considered that the improvements at the junction provide an overall benefit, however, drivers merging and on the mainline, may not have fully adjusted to the revised layout, as there appears to be a tendency to not use the full merge lane.

On site observations and a review of CCTV footage demonstrates the operational issues. Traffic operation levels provided by Google traffic information, are consistent with observations. In addition, analysis of traffic flows and capacity, indicates that the effective capacity may be reduced by driver behaviour and the layout, which impacts on the effective operation, resulting in reduced speed and stop start conditions, extending south for 3 to 4 miles. Average traffic flows are greater southbound on the mainline, but marginally lower on the southbound merge. However, in the southbound direction the merge is relatively straight and joins the M80 on a downward gradient, while in the northbound direction there is a loop merge to the M80 at the top of a gradient as the mainline begins to level out.

Traffic re-routing to Old Inns, however, could also be exacerbating the issue. Drivers that are aware of this route, or following satellite navigation information are likely to use this diversion to a degree.

Within this section of the M80 there have been 10 accidents northbound, of which 6 occurred during the AM peak and the majority of these appear to typical 'shunt' type accidents that can occur in congested conditions. The lower level of operation northbound on the M80 could impact the number of incidents on the route, however it is considered that the incidents are a result of driver behaviour.

There has been no step change in mainline capacity and therefore congestion during peak periods was anticipated. Integrated demand management measures were identified as a potential future solution to cope with operational conditions further to scheme construction. These measures may include mainline speed management and ramp metering with peak traffic signals on the merge. However, alterations to lane markings may provide a short term improvement.

Old Inns to Haggs Junction including Castlecary Junction

Engineering Design Constraints

The Castlecary Viaduct structure was a significant alignment constraint in the design with each carriageway of the M80 travelling through one of the viaduct arches. To the north of the viaduct the carriageway rises at approximately 3% towards Haggs Junction and slackens off to 2.3% as it proceeds towards the M80/M876 junction. Due to the constraints in alignment, on the approach to the Castlecary Viaduct, two departures were granted; however it is considered that these are not contributory factors in terms of reduced operation. The details of the two departures are provided in Appendix A.

Between the Castlecary Viaduct and Haggs junction the alignment of the new M80 motorway generally follows that of the original A80 trunk road with five mainline departures approved, as listed in Appendix A. Again it is considered that these do not impact operational levels.

Key Operational Issues

It has been observed that poor lane discipline and weaving on the northbound three lane section of the M80 between Castlecary Junction and Haggs has increased journey times through this section. This is not limited to the peak hours. A contributory factor to the weaving within this section is the near side lane gain at Castlecary junction merge. With the commencement of the additional lane, heavy goods vehicles, overtaking in the offside lane of the two lane section on the approach to the Castlecary Viaduct, are then faced with being in the offside lane of the three lane section as they pass the nose of the northbound merge. This HGV positioning is in contravention of the Highway Code and therefore vehicles have to move in to lane 2, and preferably lane 1. However, on-site observations have indicated that in many cases HGVs continue northbound in lane 2 although lane 1 is clear. North of Haggs junction, lane 1 becomes a lane drop to the M876 (M9), while the two outer lanes remain for the M80 north. Drivers are aware of this and therefore this may also influence lane selection between the Castlecary and Haggs junctions. This behaviour can result in other vehicles undertaking the HGVs on the nearside lane.

Since the end of 2013 legislation makes it illegal to use lane 2 when lane 1 is vacant, as it is now classed as careless driving. It is considered that there is likely to be some allowance for lane misuse at the start of a 3 lane section of motorway, however it is possible that this change in the law, may begin to influence driver behaviour at this location.

Vehicle Speeds

From the Old Inns northbound merge to Castlecary Junction, traffic moves slowly with speed ranging from 38mph to 44mph, with average speeds increasing to 49mph between Castlecary and Haggs. This is due to the gradual return to full capacity downstream from the reduced capacity situation borne from the merging behaviour at Old Inns, however, merging and weaving north from Castlecary means that speeds below the speed limit can be experienced up to Haggs.

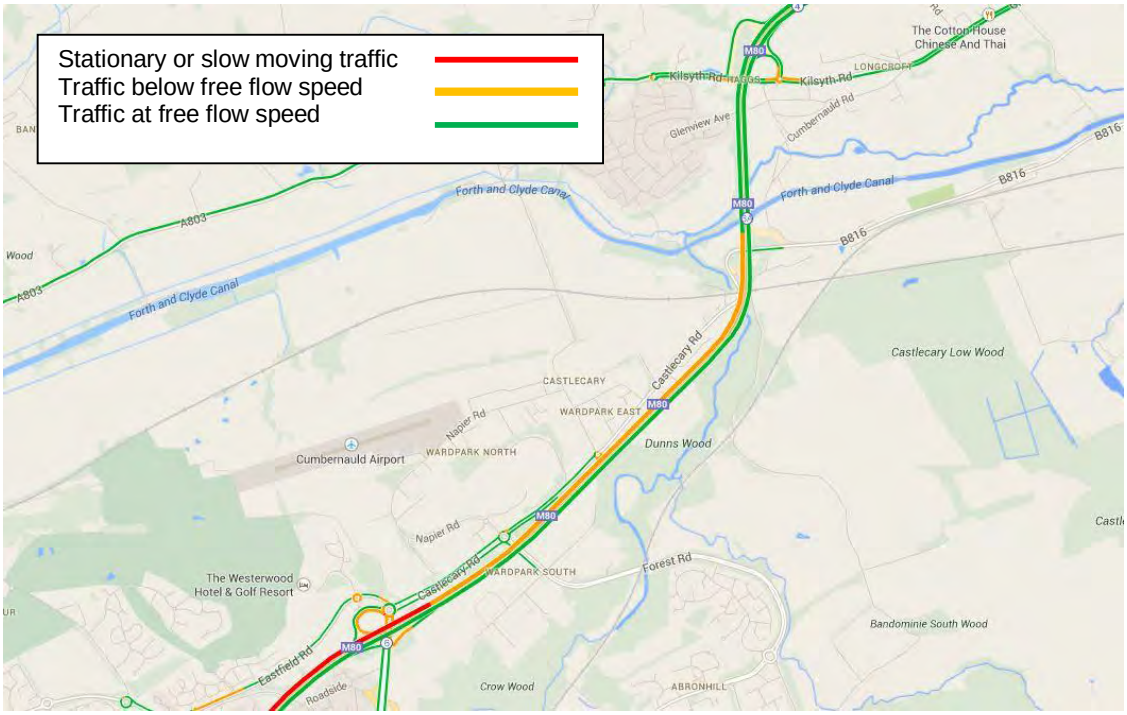

Figure 4-5: M80 Old Inns to M80 Castlecary

Safety Review

Northbound between Old Inns and Castlecary there have been two serious and three slight accidents with three in the AM peak and two in the PM peak. One slight and one serious have occurred in the vicinity of the Forrest Road overbridge and the remainder have occurred in the vicinity of the left hand bend in advance of the viaduct.

There has been one northbound slight accident in the vicinity of the Castlecary junction. This was on the on slip during the inter-peak. The causation was reported as careless driving and a poor manoeuvre.

There has been one northbound slight accident in the vicinity of the Haggs junction, which occurred during the PM peak, which was due to slippery conditions.

Summary

During the AM peak the northbound M80 between Old Inns and Haggs experiences operational issues as a result of the Old Inns junction and the lane gain at Castlecary junction.

A return to effective capacity downstream from Old Inns results in slow moving traffic during the AM peak, however, traffic speeds pick up on the downhill section toward Castlecary Viaduct. The lane gain at Castlecary results in weaving into the nearside lane and lane discipline issues where HGVs remain within the middle or offside lane. This can result in undertaking of the HGVs by other traffic and speeds remaining below the optimum speeds.

Lane selection by drivers could also be influenced by the M80 and M876 junction markings north of Haggs.

The analysis of accidents on this section does not suggest that the operational issues are a significant contributory factor to the cause of accidents.

Hornshill Junction southbound to M80 Robroyston and M8 Provan

This section is out with the M80 Scheme extents, however the operation could, in the future, impact operation in the scheme and therefore an overview is provided.

Key Operational Issues

In the southbound direction typical queuing starts at M8 Provan and can extend north towards Hornshill Junction as shown in Figure 4.3. The queuing generally begins at 07:45 and lasts until approximately 09:00 in the AM peak. The queue length is generally 2.5 to 3 miles, depending on road and weather conditions. On site observations indicate that slow moving vehicles and queuing on this section can impact on upstream traffic at Hornshill junction.

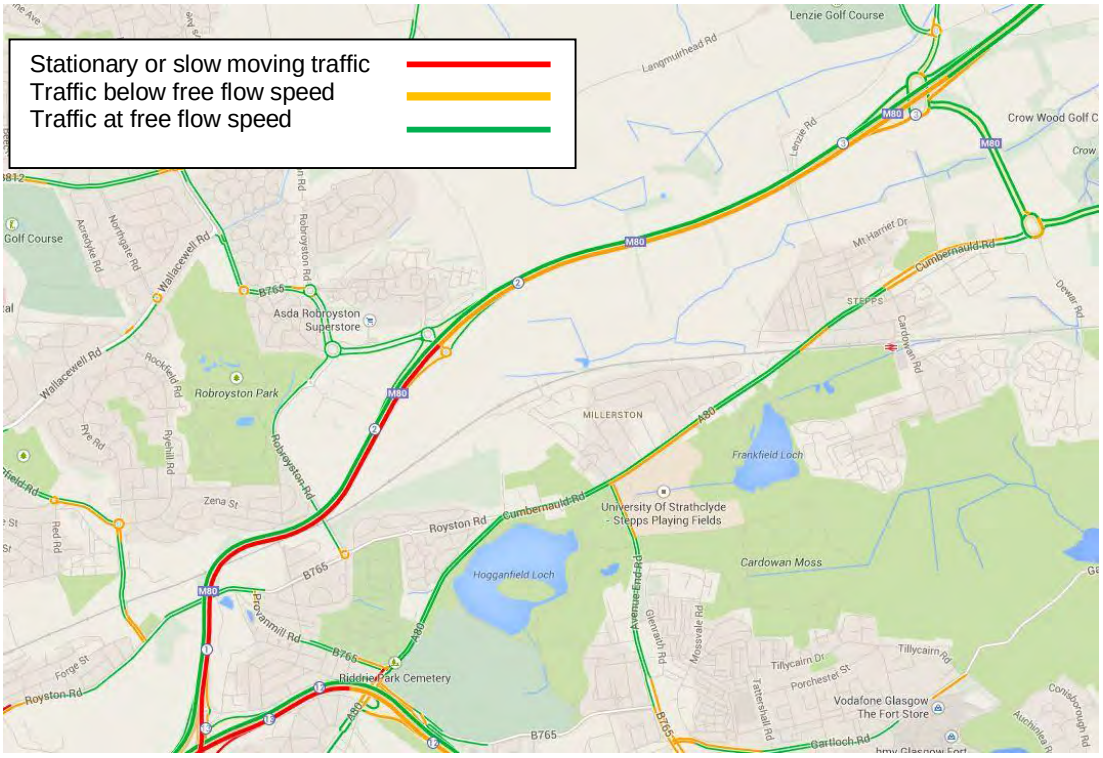

Figure 4-6: M80 Hornshill to M8 Provan

Operational issues are mainly as a result of blocking back from the mainline queuing traffic from the M8, which also impacts on Junction 2 of the M80 at Robroyston. On occasion, where the flow of southbound traffic from the Hornshill roundabout is high, additional delays can be incurred as drivers merge with the southbound carriageway of the M80. This results in a degree of slow moving vehicles on the merge and onto the circulatory carriageway of the Hornshill roundabout. However, if the southbound M80 traffic is free flowing, and there is no queuing downstream, the merging traffic does not impact upon the operation of the Hornshill Junction.

At the Robroyston Junction traffic queues affect the southbound mainline during the AM peak due to the extensive queuing from the M8/M80 Provan merge. Due to the congestion on the M80 beyond Robroyston, on-site observations indicate that a proportion of the southbound mainline traffic diverts via the Robroyston junction to bypass the queues on the mainline. This causes an additional delay on the mainline as the additional traffic attempts to re-join the southbound M80. This behaviour may

also contribute towards the queues which can extend back towards the Hornshill junction.

As noted, these issues are generated at junctions to the south west of the M80 scheme extents; however in a similar manner to the northbound situation, the improvements on the M80 may be allowing traffic to flow quicker towards the M8, where congestion builds during each morning peak. This is not currently a significant issue within the section of M80 scheme under consideration within this review, however, growth in traffic could impact future conditions on the mainline and also further impact the issues noted at the Hornshill junction.

Vehicle Speeds

Speeds were not surveyed on this section as it falls out with the M80 DBFO extents. However it is considered that the queuing information provided above highlights a sufficient overview of the current operational conditions.

Safety Review

There has been one slight accident on the southbound mainline during the AM peak. This involved three vehicles and the data indicates that this has been a shunt with causation attributed to an inexperienced driver and inattention.

Summary

The operational issues at this junction in the AM peak are mainly attributable to blocking back from the M8 Provan and M80 Robroyston downstream junctions. There is evidence of drivers attempting to minimise the impact of the queues on their journeys by leaving and re-joining the motorway at the Robroyston junction. There are no significant accident issues on this section.

4.3 PM Peak Operational Review

During the PM peak, between the M80/M876 merge to M80 Hornshill junction, queuing was observed at the following locations:

- M80/M876 Merge;
- M80/M876 Merge to M80 Castlecary; and
- M80 Hornshill Northbound Diverge.

The initial two issues are located out with the extents of the M80 scheme, where minimal alterations were included within the scheme; however it is considered that it is appropriate to highlight the issues within this report.

M80 / M876 Merge to M80 Castlecary

Engineering Design Constraints

The upgrade of the M80 from Stepps to Haggs did not alter the layout of the M80 / M876 merge. A general review of the junction make-up was carried out from OS mapping and the radius of the approach bends has been approximated.

From the North, the M80 approaches the M876 junction on a bend with an approximate horizontal radius of 500m. Advisory 50mph maximum speed signing for the bend is provided on both northbound and southbound carriageways. The

M876 (M9) provides two lane motorway connections, on approach to the M80 the southbound M876 is on a left hand bend of an approximate radius of 380m. The two lanes of the M876 are merged onto a single lane which forms the dedicated southbound diverge to Haggs. At this merge point, drivers can also choose to merge with the M80. The northbound diverge from the M80 has an advisory maximum 40mph speed limit signs.

Key Operational Issues

The layout of this junction has not changed as part of the M80 DBFO scheme and delays were experienced at this location prior to and during construction of the scheme.

On site observations indicate that during the PM peak (16:00-18:00), on the M80 southbound, queuing typically starts at M80 Haggs and extends back to the M80 for 2 miles and on the M876 for around 2 to 2.5 miles as shown in Figure 4.3. However, the queuing on the M80 varies between 1.5 miles to 3 miles depending on the weekday. The typical queuing on the M80 and M876 starts around 16:45 and lasts until approximately 18:15.

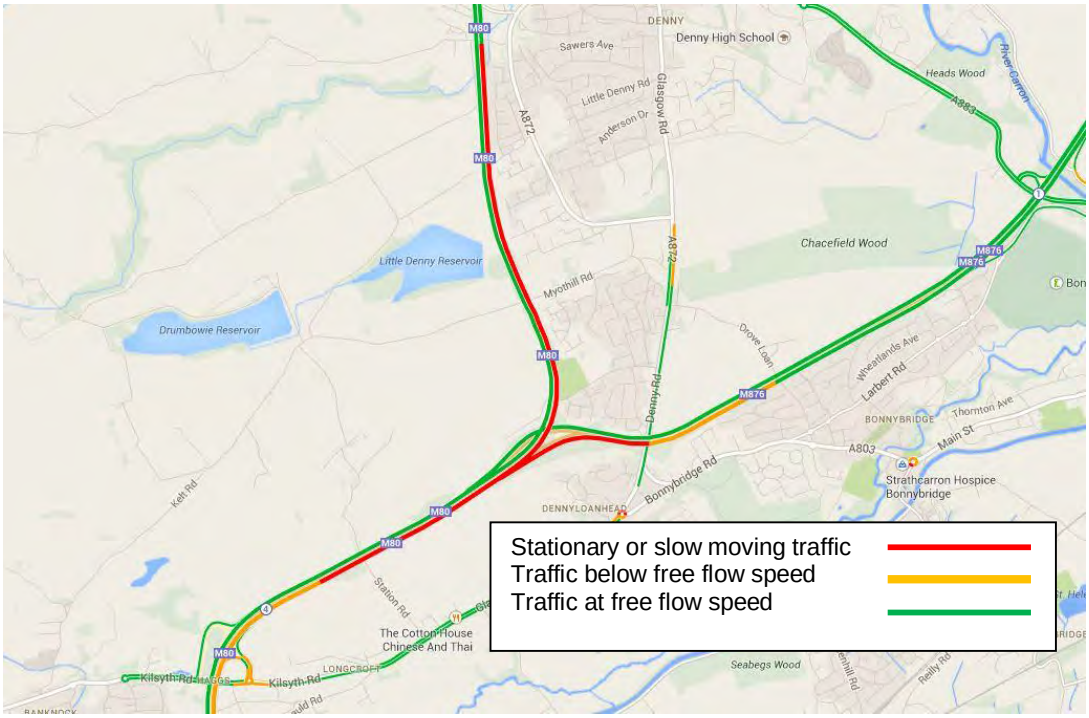

Figure 4-7: M80/M876 Merge

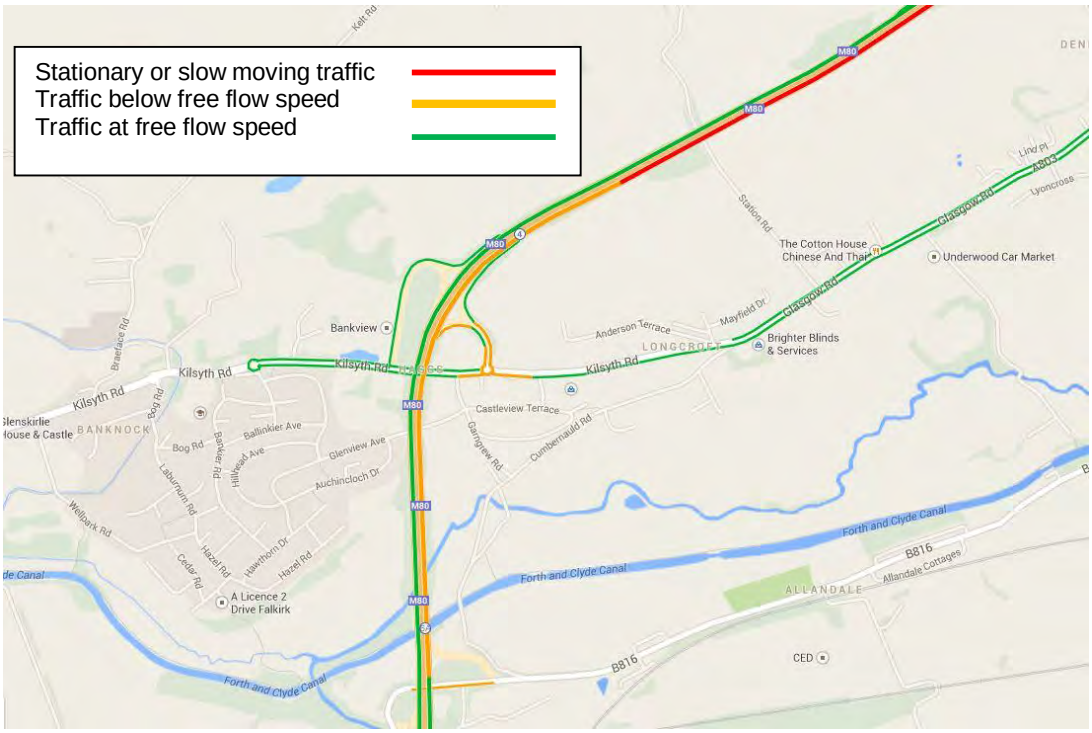

Figure 4-8: M80/M876 Merge to M80 Castlecary

On site observations indicate that queuing and delays are experienced by drivers travelling on the M876 from the Falkirk and Kincardine areas. Delays on the M876 approach to the southbound M80 can be attributed to the layout of this junction where two lanes of traffic on the M876 merge into one over a short distance prior to the main M80 merge.

The single lane merge continues for some distance running parallel to the main carriageway of the M80 and acting as a lane gain. The lane is then signposted and road marked to show the dedicated diverge lane to the A803 to Kilsyth and Bonnybridge. A significant contributing factor to the delays is believed to be driver behaviour on both motorways, where the full length of the merge and diverge is not utilised, as drivers on both the southbound M80 and M876 appear to weave and merge as early as possible.

From the video surveys carried out the majority of traffic is observed trying to merge immediately from the offside M876 lane rather than making use of the lane gain to Haggs and merging further south onto the M80.

Peak Period Flows

The average southbound flows during the PM peak hour on a weekday are 2,377 and 1,719 vehicles on the M876 merge and M80 mainline respectively. At this merge four lanes reduce to three lanes. The three lane capacity at this section ranges from an upper level of 6,750 vehicles per hour to 5,700 vehicles per hour which indicates that current traffic level is within theoretical capacity at this junction. However, the observed merging behaviour is predicted to reduce the effective capacity level given that there is a minimal use of the lane gain/ Haggs diverge.

Within Section 3, traffic levels in Table 3.1 indicate that the M80 (33,414 vehicles) and the M876 (35,107 vehicles) carry similar traffic flows. However as demonstrated

in Figure 4-8 it is clear that, within the peak periods, the M876 has a greater traffic flow than the M80.

In the PM peak the 2013 traffic flows on the M876 and M80 are considerably different to the flows in 2008 and 2006 at the junction. On the M876 the peak hour flows have increased by approximately 240 vehicles since 2008. Since 2006 the southbound peak hour flow on the M80 has fallen by approximately 500 vehicles. Therefore in the PM peak there has been a switch in the predominant traffic flows between the motorways. While the M876 is also dominant in the AM peak this profile has been consistent since 2006, however, the southbound M80 flow has decreased by approximately 350 vehicles since 2006 while the M876 has experienced a marginal increase.

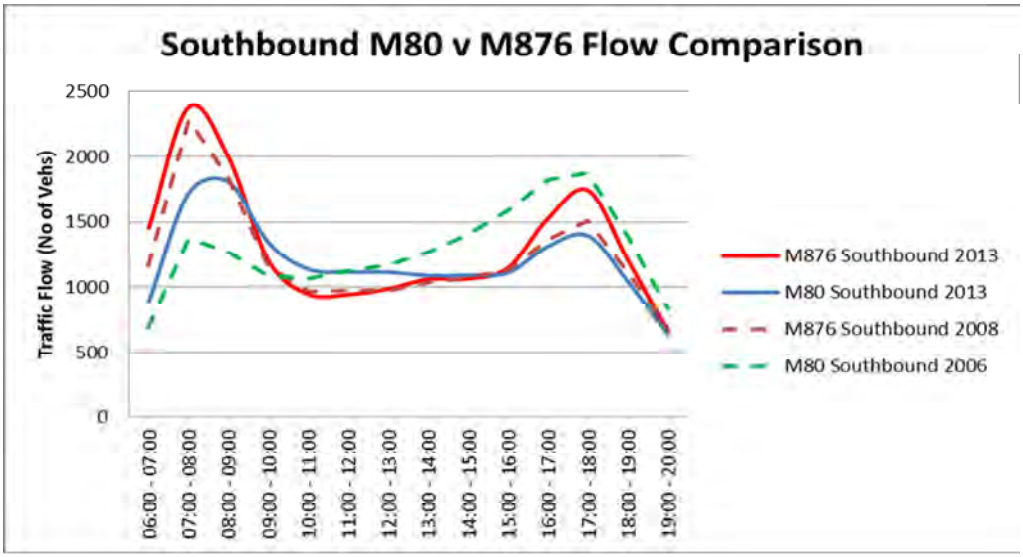

Figure 4-8 – Southbound traffic flow at M80/M876

In comparison, the northbound traffic flows on the M80 and M876, as detailed in Figure 4-9, shows a fall in M80 northbound traffic in the AM peak between 2006 and 2013 which correlates with the southbound PM peak traffic flows.

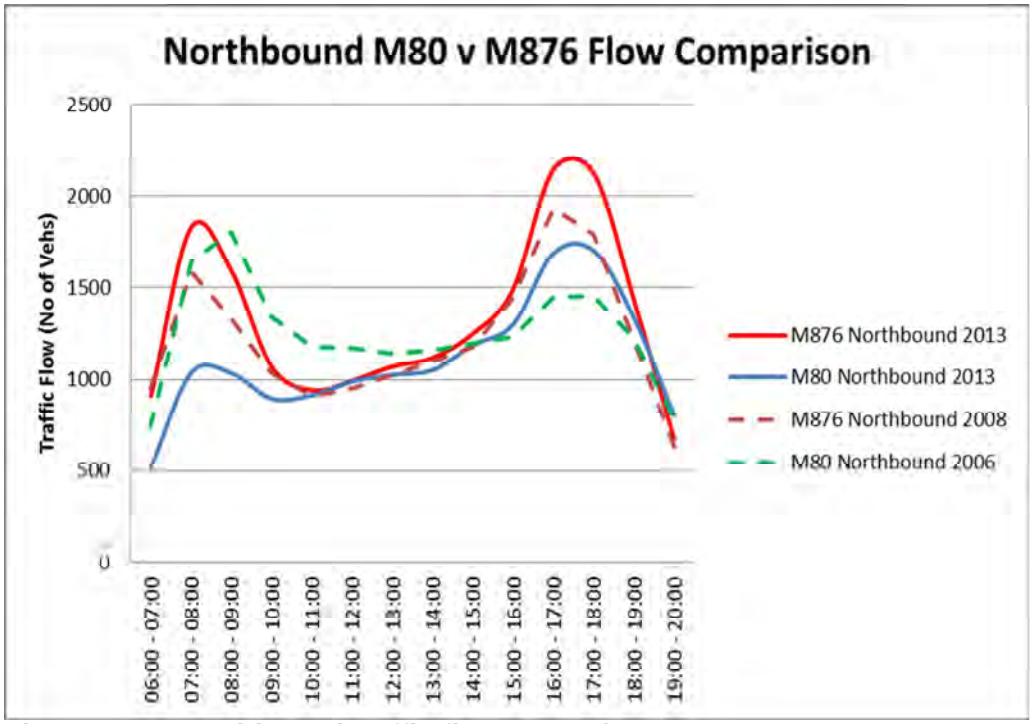

Figure 4-9 – Northbound traffic flow at M80/M876

Vehicle Speeds

Speed analysis support the above observations, with average speeds of 38mph experienced between Haggs and Castlecary and 49mph between Castlecary and Old Inns during the PM peak period. The speeds calculated, based on the journey time surveys, are not matched by those recorded at the ATCs; however this is to be expected as the ATCs provide a speed only for a spot location on the mainline, and therefore do not reflect operation elsewhere on the section.

Safety

There have been no recorded injury accidents on the southbound M80 or M876 in the vicinity of the junction. The northbound accidents have included a fatality on the M80 to the south of the M876. The remainder have been slight accidents with the majority occurring on a wet or flooded road surface. On the M876 there have been four accidents, all occurring on the northbound diverge in the vicinity of the M80 overbridge. One of these was serious and all would suggest loss of control on the right hand bend.

Summary

The M80 / M876 traffic levels are fairly balanced across the day, however the M876 carries a far greater level of traffic during the peak periods. The M80 has priority at the junction as there is a lane drop and gain from the M876. There are no significant operational issues northbound, as there is a capacity increase of 3 to 4 lanes at the junction, whereas southbound there is a reduction from 4 to 3 lanes.

Traffic volume at the junction is greater during the morning period and therefore it would be expected that delays would be higher during this period. However the significant delays, in terms of stop start queuing is generally limited to the PM peak.

The effective capacity of the southbound merge is reduced due to merging actions and driver behaviour where the full length of the weaving section between the M80 / M876 junction and Haggs does not appear to be fully used.

In terms of incidents, there have been no recorded accidents adjacent to the southbound merge, whereas the northbound M80 and M876 has experienced accidents. The causation appears to be related to weaving towards and at the diverge and loss of control during wet weather and at the right hand bend on the M876.

Hornshill Junction Northbound Diverge

Engineering Design Constraints

Hornshill junction is a two bridge roundabout junction. The scheme tied in at this location and made use of the existing slip roads and existing structure. The adjacent secondary roads access the motorway via a grade separated roundabout, and the west circulating carriageway of this junction utilises an existing structure.

The northbound diverge slip road is subject to three approved departures, which are listed within Appendix A. The departures associated with the reduced vertical stopping sight distance and the visibility to the right at the junction, towards the circulatory carriageway of the roundabout, may be a contributing factor to reduced operation. These are both a consequence of the previous configuration of the junction, where the existing mainline levels were maintained and the existing overbridge, which is on a skew, was retained to support the western circulatory carriageway of the roundabout.

Ducting on the roundabout was included during construction to accommodate future signalisation, as it was expected that signals would be required to manage demand at this location.

Key Operational Issues

During the PM peak, queuing occurs on Hornshill northbound diverge slip road as shown in Figure 4-10. The queuing typically occurs at 17:15 and lasts until 17:45. The delay occurs over a short time period and does not currently impact the operation of the M80 motorway. The M80 scheme does provide a suitable diverge, and it has two lanes compared to the previous single lane, however the original layout allowed diverging traffic a longer queuing area towards the existing roundabout on the secondary network. The new interchange at Hornshill now permits traffic to travel from the A80 (Stepps and Muirhead) over the M80 (towards Lenzie and Kirkintilloch). The interchange does appear to be coping with the traffic demand, however future conditions and increased demand, particularly during the PM peak, are likely to further impact the operation on the M80 northbound diverge.

From on-site observations, the visibility to the circulatory carriageway, coupled with relatively high vehicle speeds on the circulatory carriageway, may be contributory factors impacting operation. These elements may mean that drivers require a larger gap in traffic before merging on to the roundabout, however as noted, traffic signals were anticipated to be required at this location. The video surveys have also indicated that the position of traffic on the circulatory carriageway is inconsistent and traffic on the diverge is unable to gauge the destination of circulatory traffic and therefore increasing the hesitation of traffic at the give way line.

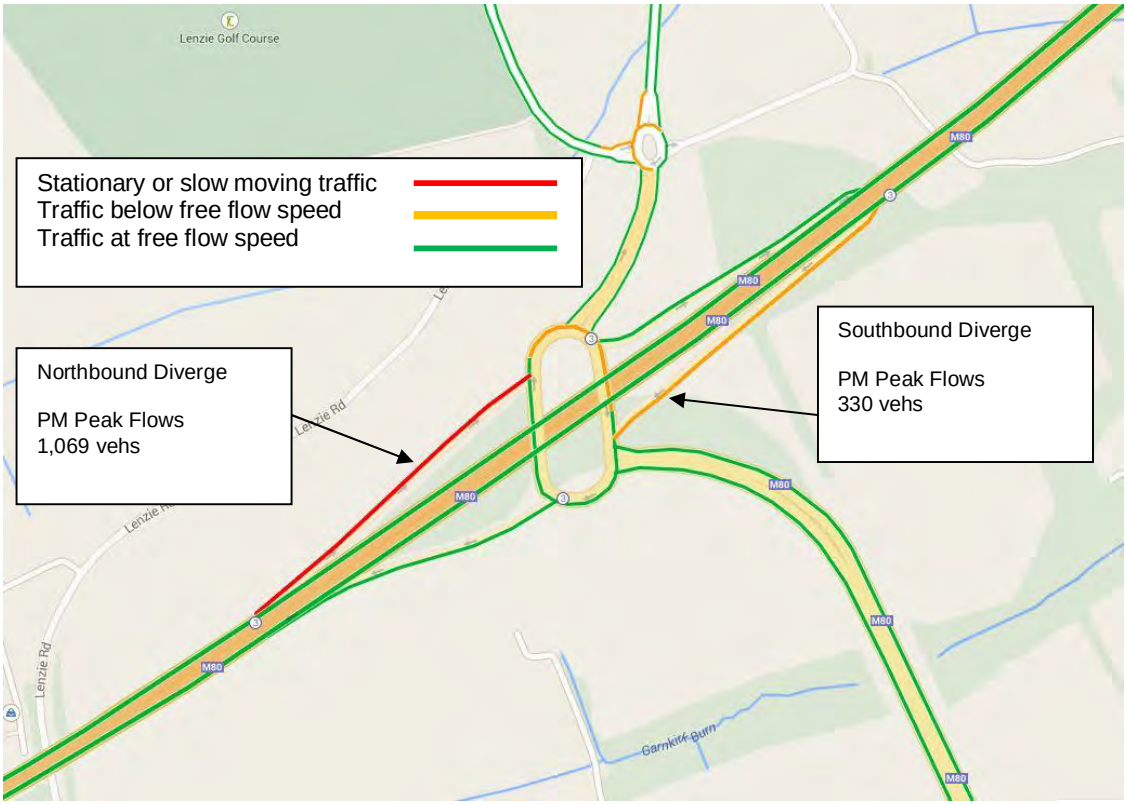

Figure 4-10: M80 Hornshill Northbound Diverge

Peak Period Flows

As illustrated in Figure 4-6 the PM peak hour flow on the northbound diverge is over 1,000 vehicles. While there is no current turning count data, observations confirm that the majority of traffic turns left towards Kirkintilloch and therefore the majority of traffic use the nearside lane. The commissioned video surveys have confirmed the lane allocation with the majority occupying the left lane for Kirkintilloch.

In comparison, the southbound diverge flow in the same peak is 330 vehicles which is approximately the same level as AM peak flows on this diverge. The southbound diverge is also at a skew to the circulatory carriageway, however, the same operational issues are not evident. While the flows are one third of the northbound diverge the visibility is clearer with a reduced level of street furniture compared with the northbound diverge layout. Therefore the operational issues at the northbound diverge can be attributed to a combination of layout and traffic flows.

Safety Review

There have been three northbound slight accidents since the opening of the scheme in the vicinity of Hornshill junction. All of these are located to the south of the scheme and the junction. Despite the design constraints noted there have been no accidents recorded on the northbound diverge, which provides evidence that the issues are operational in nature.

Summary

The existing layout appears to operate within capacity levels, however observations confirm that queuing occurs on the northbound diverge during the PM peak. It is considered that the queuing is a function of the level of demand and the layout, however operational issues were predicted from previous modelling studies and traffic signals were expected to be required.

A review of incidents indicates that there are no related issues and therefore that the impacts are operational in nature. Increased traffic could exacerbate the issues and lead to tailbacks south onto the motorway, which could in turn further impact delays, but more significantly would raise the risk of an incident at this junction.

4.4 Other Operational Considerations

While not being attributed to any peak time issues, Police Scotland raised concerns over the auxiliary lane on the southbound carriageway between Castlecary Viaduct and the southbound diverge at Old Inns junction. It has also been suggested that the provision of the auxiliary lane, and associated lane markings, which show the nearside lane as a lane drop, has prompted some motorists to pass vehicles on the main M80 carriageway on the nearside. During on-site visits this issue was not observed.

It has been suggested that the lane could be marked as a climbing lane, which could mitigate the issue, however this was considered prior to construction and the introduction of a short climbing lane section could have led to greater conflict at Old Inns junction, as traffic would weave out at the end of the climbing lane, just as traffic would be weaving to exit the motorway. This could raise safety and operational issues. The current layout is considered to provide the optimum operational layout and reduced risk, however further monitoring is required.

Analysis of the available accident records, show that two slight accidents have occurred within this section in the last three years. One accident appeared to be a ‘shunt’ type and the second appeared to be a loss of control, due to surface conditions, and resulted in a vehicle colliding with a vehicle on the hard shoulder. Both incidents therefore do not appear to be related to the undertaking issue identified.

5 Conclusion and Recommendations

5.1 Overview

The M80 Stepps to Haggs DBFO project, completed in August 2011, provided a new 18 kilometre section of motorway, both off-line and on-line from the previous A80. It is considered that the completed works provide improved transport links and operational performance of the route between Glasgow, Stirling and the North East. However, the design was selected to provide a similar level of mainline capacity, providing two lanes instead of three, and therefore that integrated demand management measures may be required to cope with future demand and operational issues.

Fundamentally there are 4 lanes of traffic demand approaching either end of the M80 scheme. To the south, there are two lanes from the M73 and M80 (M8), and to the north, two lanes on both the M80 and M876. It is considered that although these routes are not operating at maximum theoretical capacity, the total demand entering the M80 scheme, which is predominantly 2 lanes per carriageway, can cause operational issues during the peak periods at particular locations.

This review has established that the key delays observed during the AM peak are primarily located in the northbound towards Old Inns Junction. At this location the results of the ANPR video surveys have confirmed the volume of traffic diverting off the M80 at Low Wood and re-joining further north which is exacerbating the situation.

There are also delays at Hornshill Junction in the southbound direction during the AM peak. These are out with the M80 Stepps to Haggs DBFO project boundaries, and result from congestion tailing north from the M8.

During the PM peak, the delays are mainly experienced in the southbound direction at M80 Haggs and on the M80 /M876 merge and there is a degree of delay on the Hornshill Junction northbound diverge.

Concern has also been raised regarding undertaking on the M80 between Castlecary Viaduct and Old Inns junction

5.2 Summary of Traffic and Operational Issues

Section 4 included a summary for each location, however the following intends to capture these issues and contributory factors.

5.2.1 AM Peak – Hornshill Junction

In the southbound direction operational issues have been identified at the M80 Hornshill Junction.

Primary reasons for the delay

- Blocking back from the mainline M80/M8 weaving section; and
- Slip road traffic attempting to re-join the M80 at Robroyston.

5.2.2 AM Peak – Old Inns Junction

In the northbound direction the operational issues at Old Inns result in queuing which also impacts upon the Low Wood and Auchenkilns Junctions. It also results in slow moving traffic downstream towards Castlecary Junction.

Primary reasons for the delay

- Driver behaviour at Old Inns merge, possibly as a result of junction layout;
- Traffic volume;
- Removal of upstream operational issues through Moodiesburn and Chryston could have exacerbated the issue; and
- Mainline traffic re-routing through Cumbernauld as confirmed through ANPR surveys.

5.2.3 AM Peak – Castlecary to Haggs Junction

In the northbound direction the operational issues between Castlecary and Haggs are related to reduced speeds and journey times.

Primary reasons for the delay

- Poor lane discipline and weaving between Castlecary and Haggs

5.2.4 PM Peak – M80 / M876 merge

In the southbound direction the merging traffic flows at the M80/M876 merge results in queuing on both motorways and slow moving traffic downstream to the Haggs junction.

Primary reasons for the delay

- Merge layout;
- Peak traffic flow imbalance of M876 over M80; and
- Driver behaviour.

5.2.5 PM Peak – Hornshill Junction

In the northbound direction the M80 Hornshill junction experiences short term queuing on the northbound diverge.

Primary reasons for the delay

- Volume of traffic on approach to the interchange;
- Visibility at the give way line, due to layout; and
- Traffic speeds on the circulatory carriageway.

5.2.6 Castlecary Viaduct Southbound to Old Inns Junction

No significant operational issues identified through on-site observations, however consultation has suggested that drivers may be undertaking at this location.

Primary reasons for the issue

- Nearside lane marked as lane drop, consultation suggested that motorists may use this lane to undertake slower vehicles using the mainline, before re-joining the main carriageway lanes.

5.3 Recommendations

In line with the strategy for the corridor, long term management measures may be necessary to assist in coping with increased demand; however it is considered that a second stage review would provide a more in depth assessment and also confirm any potential short to medium term solutions. The following provides an overview of locations and possible mitigation measures:

- At Old Inns junction, revisions to road markings and signing may encourage drivers to use the full length of the slip road. Ramp metering may also be considered as a mitigation measure.

- At the M80/M876 merge a revised layout of the merge in advance of the junction could allow a smoother change in capacity, thereby reducing operational issues.

- Also a review of the operation of Hornshill junction is undertaken to advise on potential improvements, such as traffic signals or alterations to the diverge lane markings, roundabout entry and lane discipline on the circulatory carriageway.

Based on this review, it is considered that the issues are localised in nature and occur during periods of peak demand. However as the mainline capacity has not significantly increased, localised issues can cause poor operational performance on a wider extent, however a review of these issues and appropriate solutions may improve the performance in advance of more extensive management measures.

Appendix A

DEPARTURE	INFLUENCING OPERATION
OLD INNS JUNCTION – Northbound diverge slip road	
Auxiliary lane provided from two lane motorway in lieu of taper diverge from three lane motorway	No
Reduction in stopping sight distance from 295m to 160m	No
Length of near straight not provided at the diverge nosing	No
OLD INNS JUNCTION - Northbound merge slip road	
No physical barrier separating the 2-way road	No
Horizontal loop curve radius has been reduced from 70m to 61m	No
Length of near straight section on approach to the nosing reduced from 115m to 5m	No
Auxiliary lane provided onto two lane motorway in lieu of taper merge to three lane motorway	Possible
OLD INNS JUNCTION – Southbound diverge slip road	
Providing an auxiliary lane of 1675m between Castlecary Viaduct and Haggs Junction diverge	No
Reduction in stopping sight distance from 295m to 192m	No
OLD INNS JUNCTION – Southbound merge slip road	
Reduction in stopping sight distance from 295m to 249m	No
Length of near straight reduced from 115m to 70m	No
Merge taper from a three lane motorway reduced to a merge onto a two lane motorway.	No
OLD INNS TO CASTLECARY VIADUCT – Northbound carriageway	
Stopping Sight Distance reducing forward visibility from 295m to 162m combined with the horizontal curvature reduced from 1020m to 510m	No
CASTLECARY VIADUCT TO HAGGS JUNCTION – Northbound carriageway	
Weaving length reduced desirable minimum of 1000m to 720m	Possible
Castlecary northbound junction merge design being provided as an auxiliary/climbing lane rather than taper onto three lanes	No
Reduced stopping sight distance from 295m to 167m on the mainline for the uphill section towards Haggs Junction combined with the horizontal curvature reduced from 1020m to 550m as the mainline rounds the right hand bend passing Haggs junction.	No
HORNSHILL JUNCTION – Northbound diverge slip road	
Auxiliary lane provided from two lane motorway in lieu of taper diverge from three lane motorway	No
Reduced vertical stopping sight distance	No
Visibility to the right at the junction with the circulatory carriageway of the roundabout.	Possible

Table A-1: Approved Departures from Standard