PARSONS BRINCKERHOFF

Dec 2014

M80 NI(S)R REPORT

Bilfinger RE Asset Management Ltd

3513048C

Issue 2

M80 NI(S)R Report

3513048C

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CONTENTS

EXECUTIVE SUMMARY

Parsons Brinckerhoff (PB) has been instructed by Bilfinger RE Asset Management Ltd on behalf of Highway Management (Scotland) Limited to undertake a noise assessment for the M80 motorway between Stepps and Haggs. This report is the year 1 assessment and its purpose is to assess the likely properties that are eligible under the Noise Insulation (Scotland) Regulations (NI(S)R) 1975.

A computer noise model using CadnaA was prepared for the pre-construction and post-construction scenarios of the scheme. To validate this model a survey was undertaken in August 2014 at representative locations along the scheme. Results of the validated noise model have been assessed to determine the likely properties eligible for sound insulation under the NI(S)R 1975. None of the properties are currently judged to be eligible for sound insulation as a result of the scheme in year 1. A re-assessment is required to be made in year 5.

1 INTRODUCTION

1.1 Context

1.1.1 Parsons Brinckerhoff (PB) has been instructed by Bilfinger RE Asset Management Ltd to undertake a noise assessment for the M80 motorway between Stepps and Haggs to assist with discharging the obligations under the Noise Insulation (Scotland) Regulations, 1975 (NI(S)R).

1.1.2 The objective of this report is to fulfil the M80 contract requirement of producing a year 1 noise assessment for the purpose of determining eligibility for sound insulation under the NI(S)R. Eligibility is determined by comparing road traffic noise levels in the prevailing year (2008) and the relevant year (2012).

1.1.3 **Appendix A** presents a glossary of acoustic terminology.

1.2 Study Area

1.2.1 The study area for the noise model consists of a calculation area which is 300m either side of the new and existing roads surrounding the M80 scheme.

1.2.2 A total of 3686 buildings are included in the model, and those which are residential have been assessed for their eligibility under the NI(S)R 1975. It should be noted that the majority of these buildings are single dwellings comprising of two floor levels. A limited number of properties correspond to multi-storey buildings; receptors have also been included at higher floors, where applicable, and where single storey buildings were identified, only the ground floor data has been reported.

2 LEGISLATION AND GUIDANCE

2.1 Noise Insulation (Scotland) Regulations 1975

2.1.1 The NI(S)R 1975 defines the legislative duty and additional discretionary powers to carry out sound insulation or to make grants when the use of a new or altered highway and any other highway in the vicinity causes or is expected to cause a noise level ('specified noise level') not less than $L_{A10,18h}$ 68 dB at the façade of an eligible residential building.

2.1.2 In addition, the noise level caused or expected to be caused by the altered or new highway together with other traffic in the vicinity ('relevant noise level') should be at least 1dB higher than the 'prevailing noise level' defined as the noise level immediately before the construction of the works began.

2.1.3 As an example, if the road traffic noise level at the façade of an eligible building was $L_{A10,18h}$ 66 dB before the construction began and $L_{A10,18h}$ 67 dB after, then the property does not qualify under the regulations. Conversely, if the prevailing noise level was $L_{A10,18h}$ 67 dB and the noise level at the facade of the same property is measured to be $L_{A10,18h}$ 68 dB with the new road in operation, then the property may qualify for sound insulation under NI(S)R. It is also possible to find properties which are above $L_{A10,18h}$ 68 dB both before and after the scheme opens, but do not experience a 1 dB increase. These would not be eligible.

2.1.4 An eligible property must be within 300m from the nearest point of the carriageway and have clear line of sight to the new or altered road. The point of assessment corresponds to the most exposed windows or doors on a façade from which a straight line can be drawn to the new or altered road without passing through another building.

2.1.5 The requirement of the NI(S)R 1975 is to assess the noise level in relation to an eligible building within the first 12 months of opening the scheme, which this report is aimed at addressing, and then to reassess at subsequent intervals at 5, 10 and 15 years.

2.2 Memorandum of Advice and Instruction (Noise Insulation (Scotland) Regulations 1975) No. 1/74.

2.2.1 This memorandum describes the methodology to quantify the road traffic noise at a given distance from a highway. It is a technical document that supports the Noise Insulation (Scotland) Regulations 1975.

2.2.2 It has been agreed with HMG that the CRTN method would be used for the purposes of the modelling, using a lower $L_{A10,18h}$ 65 dB as a proxy trigger, following which, eligible facades that are above the proxy trigger and are predicted to have a noise increase of 1 dB or more would be assessed using the NI(S)R 1975 Memorandum method.

2.3 Calculation of Road Traffic Noise (CRTN), 1988

2.3.1 This memorandum describes the methodology to calculate the road traffic noise at a given distance from the highway. This method is more robust than the above Memorandum method in predicting road traffic noise levels.

2.3.2 The methodology takes into account the intervening ground cover, road configuration and road layout. The calculation assumes a typical traffic and noise propagation

conditions. Noise levels are presented in terms of the noise descriptor $L_{A10,18h}$ which is the arithmetic average of the noise level exceeded for 10% of the time each hour between 06:00 and 24:00 hours.

2.3.3 The variables used in the calculation of the traffic noise level are:

- The annual average week day traffic flow (AAWT) for the 18-hour period from 06:00 to 24:00 hours;
- Mean traffic speed;
- Percentage of heavy vehicles;
- Road gradient;
- Type of road surface;
- Distance of the receptor from the road;
- Nature of the ground cover between the road and the receptor;
- Screening and reflections.

3 METHODOLOGY

3.1 Liaison

3.1.1 A meeting was held on 25th February 2014 to agree on the noise survey, modelling and assessment methodologies. The following bullet points summarise the agreement:

- The noise survey will be undertaken in accordance with the shortened measurement procedure in CRTN for the purposes of validating the CRTN noise model;
- Four locations have been selected to undertake CRTN monitoring during a typical working day, as suitable weather conditions allows. Measurements will record the noise parameters L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} and L_{Amin} for 3 x 1hour periods;
- A noise model will be produced for the scheme. The model will be prepared using CadnaA and two scenarios will be created: prevailing year (2008) and relevant year (2012). The model will be based on existing noise models.
- Traffic data will be provided.
- An assessment to determine the number of properties likely to be eligible under the NI(S)R 1975 will be made for those properties identified from the CRTN models. Properties where the proxy trigger of 65 dB $L_{A10,18h}$ is exceeded currently, and have a noise increase of 1 dB or more will be processed using the Memorandum method to NI(S)R, which includes a line-of-sight assessment.

3.1.2 After the meeting, further liaison was made with HMG to discuss the information received and assumptions in the model. These are further detailed later in this report (Methodology – Modelling).

3.2 Noise Survey

3.2.1 A survey was conducted between 19th and 20th August in accordance with the shortened measurement method (Paragraph 43) from CRTN. The results of the CRTN survey have been used to validate the road traffic noise model. The guidance and reporting requirements set out in BS7445-2:1991 *'Description and measurement of environmental noise. Guide to the acquisition of data pertinent to land use'* have also been followed. **Appendix B** presents the noise survey report detailing the methodology and results.

3.2.2 Short-term CRTN noise measurements were undertaken at 4 locations along the scheme, as illustrated in **Figure 1**. One series of 3 x 1-hour measurements were conducted at each of these locations at 1.5m above ground level.

3.2.3 The following parameters were recorded: L_{Aeq}, L_{A90}, L_{A10}, L_{Amax} and L_{Amin} using fast time weighting and A-weighted frequency network. Measurements were made in the absence of precipitation and the wind from source to receiver was recorded as less than 3m/s as identified in **Appendix B**.

3.2.4 Calibration certificates of the equipment used in the survey are presented in **Appendix B**.

Figure 1: Noise Survey Locations

3.3 Noise Modelling

3.3.1 A road traffic noise model for the scheme was prepared using CadnaA. Noise predictions were undertaken following the methodology described in CRTN.

3.3.2 The following bullet points summarise the sources of information and assumptions used in the model. A table with a list of modelling assumptions is presented in **Appendix C** along with details of the traffic data provided by HMG for use in the assessment, and the rationale for the post processing of traffic data undertaken.

- Building height information in the existing models was verified with satellite images and observation during the noise survey. The topographical data for the relevant year (2012) model was extracted from the models produced previously, which is assumed to be based on a detailed topographical survey as part of the project. Vertical alignment data provided was used for the prevailing year (2008) model for all of the M80 scheme except for Auchenkilns junction which was taken from the relevant model.
- For high rise buildings, the assessment assumed that there is one dwelling per floor. This should be further clarified for eligible buildings (if any).
- An address database layer provided by HMG containing a total of 3686 buildings was included in the model. Post-processing of the data was made to filter the building uses and focus only on residential receptors. Receptors locations in the noise model are 1m away from the facades.

- Buildings are included in the model to account for screening effects, but the levels are calculated as free field levels, and thus a correction of 2.5 dB has been added to the modelling results at each of the receptors to convert it to a façade noise level;
- The road surface type was known to be HRA with a texture depth of 1.5mm in 2008. In 2012 the road surface of the M80 was a new low noise surface (-3.5dB). In both years the Auchenkilns Junction had a low noise surface (-2.5 dB). On all minor roads with speeds <75 km/hr a correction of -1 dB is used for both years.
- Noise barriers were included in the model as appropriate. Through liaisons with HMG, PB understands that barriers were in place at the Auchenkilns Junction in 2008, with the remainder in place by 2012;
- Traffic data for the M80 and surrounding road network was provided by HMG from actual traffic counts, and supplemented with data reported in the M80 Environmental Statement. Minor processing was made to convert the sets of data received in hourly format into Annual Average Weekly Traffic (AAWT) 18 hours format as required by CRTN and NI(S)R. Some data has also been extrapolated to ensure a sufficient dataset was available. **Appendix C** lists the complete dataset used for the purposes of the noise modelling, and the rationale for the post processing of data;

3.3.3 The post-construction scenario has been validated against the results of the noise survey. Receptors have been implemented in the noise model at the same locations and height as measured during the survey. Results are presented in the next section.

3.3.4 For properties identified using the proxy trigger of 65 dB under the CRTN method and with the relevant noise level at least 1 dB more than the prevailing noise level, a further calculation of noise levels at the qualifying façade is made using the methodology set out in TS131 Memorandum of Advice and Instruction (Noise Insulation (Scotland) Regulations 1975) No 1/74.

3.4 NI(S)R 1975 Methodology

3.4.1 Memorandum of Advice and Instruction (Noise Insulation (Scotland) Regulations 1975) No. 1/74 provides a uniform basis for traffic noise assessment in highway design through instruction on such aspects as the timing of assessments, the reassessment process, the ineligibility of buildings for insulation work or grant and all the principal stages in assessing noise levels.

3.4.2 The method predicts traffic noise levels at the façade of eligible properties taking into account:

- the traffic flows in the assessment year (2012);
- the class of road (in this case a rural motorway) which takes speed into account;
- A distance correction from the edge of the carriageway to 1m from a façade;
- An adjustment for the percentage of heavy vehicles using the road;
- An adjustment for the gradient of the road;

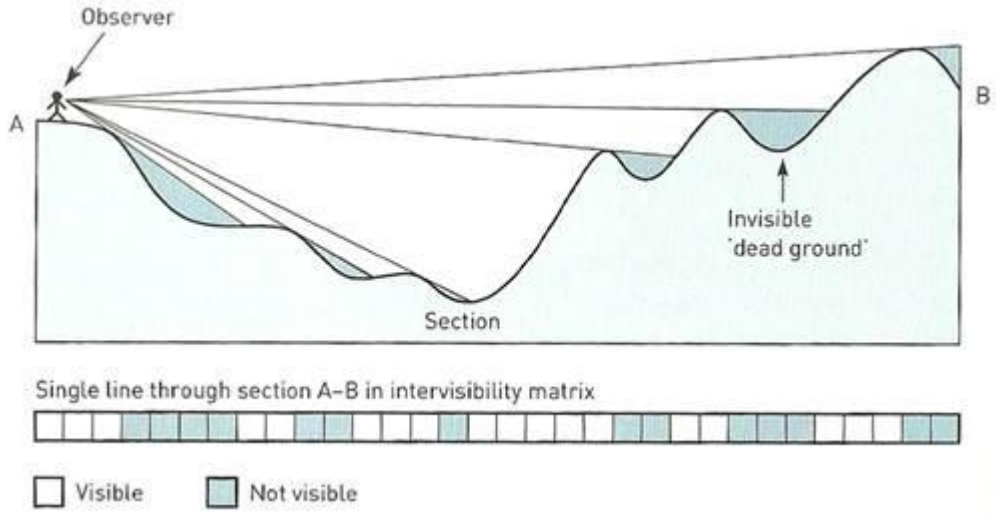
- An adjustment for ground attenuation between the road and the receptor which uses the average height above the ground;
- An adjustment for any noise barriers, or shielding if less than 50% of the road is visible at the receptor;
- Results are rounded up or down to the nearest whole number,

3.4.3 Eligible facades must also:

- Be within 300m from the nearest point on the carriageway to which the Regulations apply;
- Have clear line of sight to the carriageway, and meet a further geometric test.

3.4.4 The second bullet point has been undertaken using the ArcGIS Spatial Analyst Viewshed function, which determines surface locations visible to a set of observer features. For the M80 project, the Digital Surface Model included topography and buildings. The observer feature used was the centreline of the road, which also contained the levels. A study buffer of 300m was produced using the centreline, which was subsequently used to clip the Digital Surface Model (this kept the processing size to a minimum). Once the data was prepared, the computer based analysis was performed. This is an identification process that selects the cells from the surface model that can be seen from one of more of the observation locations. Each visible cell is given a value of 1, whereas, areas which are not visible are given a value of 0.

Figure 2: Illustration of the Viewshed (ZVI) calculation



3.4.5 The resulting model was then overlaid with the spot data of the buildings, to confirm the address / postcode of the affected properties.

3.4.6 As the line of sight model was unable to discern the difference between houses and other objects it was used as a first filter when applying the NI(S)R methodology. Properties that fulfilled the other criteria of having a relevant noise level above 65 dB and a 1 dB or more noise level increase would be further investigated using Google Earth and Cadna A.

3.4.7 A property could have one or more facades that may qualify. It should be noted that once a façade has been identified as potentially qualifying under the NI(S)R, a further assessment will need to be made to identify windows and doors on that façade that belong to eligible rooms within the property. This would normally be undertaken by a site surveyor at the time an offer for eligibility is made, and is not considered in this report.

3.4.8 The calculations under NI(S)R would be undertaken in an Excel spreadsheet.

4 RESULTS

4.1 Noise Survey

4.1.1 Table 1 presents the results of the noise survey in terms of the noise descriptor $L_{A10,3hr}$. In addition, the equivalent $L_{A10,18h}$ value has been calculated by subtracting 1 dB from the 3 x 1 hour readings. The table also shows the distance from the main road to the measurement location.

Table 1: Noise Survey Result Summary

Measurement Location (ML)	Distance from road (Metres)	Measured $L_{A10,3h}$ dB	Equivalent $L_{A10,18h}$ dB (06:00 – 24:00)
ML2 – M73 Off slip	3	73.4	72.4
ML9 - Glenview Avenue	7	73.1	72.1
ML13 – Carrick Road	6	78.8	77.8
ML15 – Castlecary Road	10	80.0	79.0

4.2 Noise Modelling Validation

4.2.1 Validation of the post-construction modelling scenario for 2012 has been undertaken against the survey results from August 2014. Traffic counts and HGV percentages were obtained during the surveys to enable a correction to be applied between 2014 and 2012 to reflect the difference in traffic flows. Traffic flows on the days of the surveys (2014) were compared for each survey location with the traffic flow data in our 2012 noise model. Noise predictions were then made with the traffic data on the day of the survey as input to the model at each survey location.

4.2.2 The changes at each measurement location between 2014 and 2012 were:

- ML2 – M73 Offslip the 2014 flows were 11% greater than the 2012 flows but a 1% decrease in HGVs which would result in a relative change of 0.1 dB at that survey location.
- ML9 – Glenview Avenue the 2014 flows were 2% lower than the 2012 flows but a 6% increase in HGVs which would result in a relative change of 0.2 dB.
- ML13 – Carrick Road the 2014 flows were 4% greater than the 2012 flows and a 10% increase in HGVs which would result in a relative change of 0.9 dB.
- ML15 – Castlecary Road the 2014 flows were 8% greater than the 2012 flows and 4% increase in HGVs which would result in a relative change of 0.6 dB.

4.2.3 Table 2 presents a comparison of the measured data, the 2014/2012 correction and the predicted model data at each location. Positive values mean that the modelling results are higher.

Table 2: Noise Survey vs. Noise Modelling (2012) Results

Measurement Location (ML)	Noise Modelling Results $L_{A10,18h}$ dB	Noise Survey Results $L_{A10,18h}$ dB	Correction due to traffic flow difference between 2014 & 2012	Difference (Model – Survey) dB
ML2 – M73 Off slip	73.2	72.4	0.1	0.9
ML9 - Glenview Avenue	73.2	72.1	0.2	1.3
ML13 – Carrick Road	77.8	77.8	0.9	0.9
ML15 – Castlecary Road	76.7	79.0	0.6	-1.7

4.2.4 It can be seen from Table 2 that the differences between the noise survey and the modelling results are within 1.7 dB for all locations. This is an acceptable tolerance for the purposes of the noise modelling exercise.

NI(S)R eligibility

4.2.5 Façade noise levels have been predicted for the pre-construction (2008) and post-construction (2012) scenarios to establish the 'prevailing' and 'relevant' noise levels, respectively. In order to determine the number of properties eligible under the NI(S)R 1975, processing/filtering steps have been applied to the results in the following order:

1. Determine the properties within 300m of the affected roads with proxy trigger façade noise levels greater or equal than 65 dB $L_{A10,18h}$ on the post-construction scenario (relevant noise level) and where the façade noise level difference between the post-construction (relevant noise level) and pre-construction (prevailing noise level) scenarios is 1 dB or greater;
2. Determine the properties where there is a clear line-of-sight, i.e. there is no point on the façade to the carriageway without passing through a building. All properties without line of sight are then excluded;
3. Determine the properties with façade noise levels greater or equal than 68 dB $L_{A10,18h}$ using the TS131 method for the post-construction scenario. It is noted that the final calculated level is subject to rounding up from 67.5 dB, and this threshold has been used on data calculated to one decimal place in the table.

4.2.6 A total of 638 properties had a traffic noise level of greater than or equal to 65 dB, however none of these properties had a 1 dB increase from the prevailing to the relevant noise level and so no residential properties satisfy criterion (1). For the off-line section this is due to the large separation distances between the new M80 and the nearby receptors ensuring that noise levels do not exceed the proxy threshold. For the on-line section, a combination of noise barriers in critical locations, coupled with the small amounts of traffic growth on the M80 and the use of a low noise surface has ensured that noise levels have not risen significantly in real terms.

4.2.7 As no properties are currently triggering the proxy level, no calculations to NI(S)R have been made. This assessment will need to be revisited in year 5.

5 CONCLUSIONS

5.1 Summary

5.1.1 A noise assessment has been undertaken at the M80 between Stepps and Haggs to assist Highway Management (Scotland) Limited in establishing the number of eligible properties for sound insulation under the Noise Insulation (Scotland) Regulations 1975.

5.1.2 Results of the assessment indicate that no residential properties are currently eligible under the NI(S)R 1975. This will be reassessed in year 5.

APPENDIX A – GLOSSARY OF TERMS

Ambient Noise	The total sound in a given situation at a given time, usually composed of sound form may sources near and far.
A – Weighting	A-weighting has been found to give the best correlation between perceived and actual loudness. Measurement to which this weighting has been applied include an A in their descriptor.
Background Noise Level, $L_{A90,T}$	The level exceeded for 90% of a given time interval, T.
Decibel (dB)	A logarithmic unit for measuring the relative loudness of noise, i.e. the sound level.
Environmental Noise	Noise governed by environmental legislation, and usually enforced by local authorities. Also termed "nuisance".
Facade Effect	The phenomenon of sound energy (noise) being reflected form the hard rigid, external surface of a building or structure. Where a facade is present, this effect adds approximately 2.5 or 3 dB to the free field noise level (at a distance of 1 metre from the facade).
Free Field Noise Level	The noise level measured away from any reflecting surfaces.
Hertz (Hz)	Unit of frequency, equal to one cycle per second. Frequency is related to the pitch of the sound.
$L_{Aeq, T}$	The equivalent continuous sound level. It provides an "average" sound level over a defined period of time (T).
$L_{A10, 3h}$	The L_{A10} is the sound level exceeded 10 per cent of the time and it is used to define road traffic noise. The L_{A10} (3 hour) dB is the arithmetic average of the values of L_{A10} hourly dB for three one-hour periods between 1000 and 1700 hours. It is used as a way of calculating the **$L_{A10, 18h}$** using the equation: $L_{A10, 18h} = L_{A10, 3h} - 1$.
$L_{A10, 18h}$	The L_{A10} is the sound level exceeded 10 per cent of the time and it is used to define road traffic noise. The L_{A10} (18 hour) dB is the arithmetic average of the values of L_{A10} hourly dB for each of the eighteen one-hour periods between 0600 and 2400 hours.
L_{Amax}	The maximum sound level measured.

APPENDIX B – NOISE SURVEY REPORT

PARSONS BRINCKERHOFF

December 2014

NOISE SURVEY REPORT

Bilfinger RE Asset Management Ltd

3513048C

Issue 2

M80 Noise Survey Report

3513048C

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CONTENTS

1 INTRODUCTION

1.1 Background

1.1.1 Parsons Brinckerhoff (PB) has been commissioned by Bilfinger RE Asset Management Ltd to undertake a noise survey at the M80 between Stepps and Haggs, Glasgow.

1.1.2 The purpose of this report is to inform the noise climate at a number of receptors along the M80. In addition, the results of these noise measurements will be used to validate a noise model.

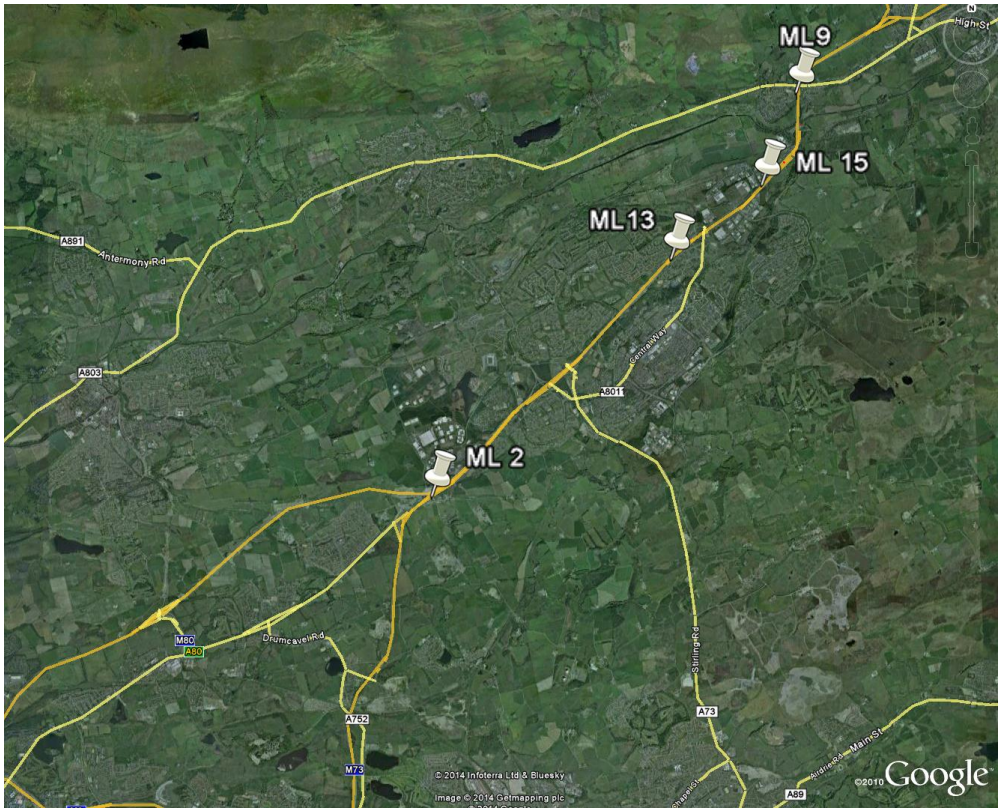
1.1.3 A noise survey was undertaken on the 19th and 20th of August 2014 in accordance with the shortened methodology advised in 'Calculation of Road Traffic Noise' (CRTN)[1] and BS7445 [2],[3].

1.2 Site Description

1.2.1 The noise survey was undertaken at 4 locations along the section of the M80 that runs between the town of Stepps and village of Haggs. The land use in the surrounding areas is predominantly rural, interspersed with small towns, business parks and residential areas.

1.2.2 **Figure A** presents the 4 measurement locations used in the survey. More detailed Figures (**B-F**) showing each location can be found in **Annex A**.

Figure A



2 GUIDANCE

2.1 Calculation of Road Traffic Noise (CRTN)

2.1.1 The shortened measurement procedure given within Calculation of Road Traffic Noise (CRTN) has been adhered to for the measurements.

3 METHODOLOGY

3.1 Noise Surveys

3.1.1 All 4 measurements were attended with 1 engineer from PB mobilised to site and the measurement period was 3 hours at each location, except for measurement location ML13 where a battery failure meant that the measurement was only 2 hours and 50 minutes long. In this instance the L_{A10} was noted down for the last 50 minute period.

3.1.2 From discussions with Bilfinger it was agreed that free field measurements on publically accessible land would be suitable. All measurements were made using Class 1 Integrating-Averaging Sound Level Meters (SLM) as defined in International Electrotechnical Commission (IEC) 61672:2003[4].

3.1.3 For each measurement, the following noise parameters were recorded: L_{eq}, L_{90}, L_{10} L_{max} and L_{min}, in 1/3 octave bands. Fast time weighting and A-weighted frequency network were used.

3.1.4 Calibration certificates for the instrumentation used in the survey are presented in **Annex C**.

3.1.5 It should be noted that for the purpose of this report, emphasis is given to the results for the noise parameter L_{A10} dB, in line with Calculation of Road Traffic Noise (CRTN).

3.1.6 Measurement results for the CRTN shortened procedure have been given as $L_{A10,3h}$, which is the arithmetic average of the 3 measured $L_{A10,1h}$ values in decibels, at each measurement location. CRTN provides an equation which converts $L_{A10,3h}$ into $L_{A10,18h}$.

3.1.7 Measurements were made in the absence of precipitation. The wind direction from source to receiver was less than 3 m/s. A windshield was used to minimise the effects of wind-induced noise at the microphone.

4 RESULTS

4.1.1 **Table A** presents a summary of the noise survey results at the 4 locations. A more detailed version of the results is presented in the noise survey forms (See **Annex B**).

4.1.2 The equivalent $L_{A10,18h}$ was calculated by subtracting 1 dB from the measured $L_{A10,3h}$. The distance of the microphone from the edge of the nearest main road is also presented in **Table A**.

4.1.3 The dominant noise source at all of the locations was that of road traffic noise from the M80 scheme. Further subjective comments on the noise climate can be found in the noise monitoring forms (See **Annex B**).

Table A: Survey Data

Measurement Location (ML)	Distance from road (Metres)	Measured $L_{A10,3h}$ dB(A)	Calculated $L_{10,18h}$ dB(A) (06:00 – 24:00)
ML2(August)- M73 Off slip	3	73.4	72.4
ML9(August)- Glenview Avenue	7	73.1	72.1
ML13(August) – Carrick Road	6	78.8	77.8
ML 15(August) – Castlecary Road	10	80.0	79.0

5 REFERENCES

1. Calculation of Road Traffic Noise' (CRTN) – 1988 Department of Transport, HMSO
2. BS 7445-1: 2003 "Description and Measurement of Environmental Noise: Guide to quantities and procedures", BSI
3. BS 7445-3: 1991 "Description and Measurement of Environmental Noise: Guide to application to noise limits ", BSI
4. IEC 61672:2003 "Electroacoustics - sound level meters", BSI

ANNEX A

SURVEY MEASUREMENT LOCATIONS

Figure B

Figure C

Figure D

Figure E

Figure F

Measurement Location (ML)
ML 2 – M73 Off slip
ML 9 - Glenview Avenue
ML 13 – Carrick Road
ML 15 (August)- Castlecary Road

ANNEX B

NOISE SURVEY FORMS

Noise Monitoring Form

PARSONS BRINCKERHOFF

Project:	M80 (part C)	**Job Number:**	3513048C
Location:	ML2 (August)		
Equipment:	NA-28	**Engineer:**	Adam Price
Pre-Calibration Level:	94.0 dB	**General Weather Description:**	Mix of clear skies and then overcast
Post-Calibration Level:	93.9 dB	**Date:**	19/08/2014

Measurement Period			Weather			Statistical Noise Levels / dB					Description of Audible Noise
Date	Start Time	Elapsed Minutes	Wind Speed (m/s)	Wind Direction (from)	Temperature (°C)	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	
19/08/2014	10:00	60	0-1	SW	12	72.7	86.4	53.8	76.5	62.4	(dominant) Road traffic noise,birdsong
19/08/2014	11:00	60	0-1	SW	12	72.7	86.9	58.5	76.3	63.2	
19/08/2014	12:00	60	0-1	SW	12	73.0	87.2	57.2	76.8	62.7	

Noise Monitoring Form

PARSONS BRINCKERHOFF

Project:	M80 (part C)	**Job Number:**	3513048C
Location:	ML13 (August)		
Equipment:	NA-28	**Engineer:**	Adam Price
Pre-Calibration Level:	94.0 dB	**General Weather Description:**	Mix of clear skies and then overcast
Post-Calibration Level:	94.0 dB	**Date:**	19/08/2014

Measurement Period			Weather			Statistical Noise Levels / dB					Description of Audible Noise
Date	Start Time	Elapsed Minutes	Wind Speed (m/s)	Wind Direction (from)	Temperature (°C)	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	
19/08/2014	14:00	60	0-1	SW	12	77.8	86.4	53.7	80.5	72.4	(dominant) Road traffic noise,birdsong
19/08/2014	15:00	60	0-1	SW	12	78.0	87.9	63.5	80.4	73.7	
19/08/2014	16:00	60	0-1	SW	12	N/A	N/A	N/A	80*	N/A	

Noise Monitoring Form

PARSONS BRINCKERHOFF

Project:	M80 (part C)	**Job Number:**	3513048C
Location:	ML9 (August)		
Equipment:	NA-28	**Engineer:**	Adam Price
Pre-Calibration Level:	94.0 dB	**General Weather Description:**	Mix of clear skies and then overcast
Post-Calibration Level:	93.9 dB	**Date:**	20/08/2014

Measurement Period			Weather			Statistical Noise Levels / dB					Description of Audible Noise
Date	Start Time	Elapsed Minutes	Wind Speed (m/s)	Wind Direction (from)	Temperature (°C)	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	
20/08/2014	11:00	60	0-1	SW	12	70.8	86.8	57.8	73.5	66.1	(dominant) Road traffic noise,birdsong
20/08/2014	12:00	60	0-1	SW	12	70.5	82.3	52.4	73.4	65.5	
20/08/2014	13:00	60	0-1	SW	12	70.8	87.5	56.9	73.4	66.1	

Noise Monitoring Form

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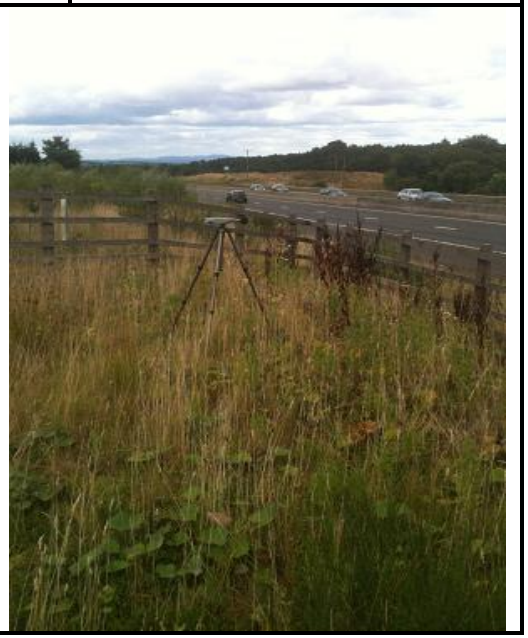
Project:	M80 (part C)	**Job Number:**	3513048C
Location:	ML 15 (August)		
Equipment:	NA-28	**Engineer:**	Adam Price
Pre-Calibration Level:	94.0 dB	**General Weather Description:**	Mix of clear skies and overcast
Post-Calibration Level:	93.9 dB	**Date:**	20/08/2014

Measurement Period			Weather			Statistical Noise Levels / dB					Description of Audible Noise
Date	Start Time	Elapsed Minutes	Wind Speed (m/s)	Wind Direction (from)	Temperature (°C)	L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	
19/08/2014	14:00	60	0-1	SW	12	77.0	86.9	62.1	80.0	69.9	(dominant) Road traffic noise,birdsong
19/08/2014	15:00	60	0-1	SW	12	77.4	87.3	61.6	79.9	71.2	
19/08/2014	16:00	60	0-1	SW	12	77.8	86.3	63.6	80.0	74.2	



ANNEX C

CALIBRATION CERTIFICATES

CERTIFICATE OF CALIBRATION

Date of Issue: 18 June 2014 **Certificate Number: TCRT14/1201**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages
Approved Signatory

M. Breslin [ ] K. Mistry [✓]

Customer	Parsons Brinckerhoff Ltd Amber Court William Armstrong Drive Newcastle Business Park Newcastle upon Tyne NE4 7YQ			
Order No.	83672			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NA-28	00380778
	Rion	Firmware		1.8
	Rion	Pre Amplifier	NH-23	70703
	Rion	Microphone	UC-59	00940
	Rion	Calibrator	NC-74	35173440
		Calibrator adaptor type if applicable		NC-74-002
Performance Class	1			
Test Procedure	TP 2.SLM 61672-3 TPS-49 *Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*			
Type Approved to IEC 61672-1:2002	Yes	Approval Number	21.21/07.01	
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003			
Date Received	13 June 2014	ANV Job No.	TRAC14/06106	
Date Calibrated	18 June 2014			

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	19 June 2012	TCRT12/1069	ANV Measurement Systems

MEASUREMENT SYSTEMS

CERTIFICATE OF CALIBRATION

Date of Issue: 17 June 2014

Certificate Number: TCRT14/1198

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

M. Breslin [ ] K. Mistry [ ]

Customer	Parsons Brinckerhoff Ltd Amber Court William Armstrong Drive Newcastle Business Park Newcastle upon Tyne NE4 7YQ			
Order No.	83672			
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators			
Description	Acoustic Calibrator			
Identification	*Manufacturer* Rion	*Instrument* Calibrator	*Model* NC-74	*Serial No.* 35173440

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the reqirements for pattern evaluation decribed in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	TRAC14/06106	
Date Received	13 June 2014	
Date Calibrated	17 June 2014	
Previous Certificate	*Dated*	12 June 2013
	Certificate No.	TCRT13/1218
	Laboratory	ANV Measurement Systems

APPENDIX C – NOISE MODELLING ASSUMPTIONS & TRAFFIC DATA

M80 DBFO STEPPS to HAGGS Checklist	
Which noise modelling software was used, including version?	Cadna A, Version 4.4.145
What prediction methodology was used?	CRTN
What deviations from the prediction methodology were adopted?	None, however see free field or façade note below.
What search radius was used?	2000m
What number of reflections was used?	Cadna A has been set up to apply 'Reflection via Correction', and therefore compliant with CRTN. Not reflections via mirrored sources.
Has low flow correction been used?	Yes (Low-Traffic-Correction from Chart 12 in CRTN)
How is ground absorption included in the model?	A ground absorption of 0.5 had been set. This describes the variation in soft ground (rural areas) and hard ground (urban areas) in the model.
If a default ground absorption has been used what value was used?	0.5 (globally)
If default heights for buildings were adopted, what heights were used?	Exact heights for buildings beyond (North of) Auchenkilns junction were used. South of Auchenkilns junction the same default value of 8m was used. Google Earth was used to spot check heights of buildings. New buildings not included in the previous models (5 in total) were manually inputted and heights were estimated using Google street view images. 2.5m added to height for each additional storey.
If used, what absorption coefficients were used?	Cadna A has been set up to apply Reflection via Correction. Not reflections via mirrored sources.
What source height and location was adopted?	Following CRTN. 0.5m above the carriageway and 3.5m within the outside edge of the carriageway.
Are noise levels free field or façade?	Free field, (façade correction applied in analysis)
If noise contour grids have been produced, what grid spacing has been used and what height?	10m by 10m grid spacing has been used at a height of 4m
If receptor points have been located at buildings, what distance from the building are they? And how have their locations around buildings been determined.	Set 1m from façade of building, using a Cadna tool.

If acoustic barriers included in the model, what reflectivity/absorption was used?	Cadna A has been set up to apply 'Reflection via Correction', and therefore compliant with CRTN. Not reflections via mirrored sources.
How have modelling attributes/values that lie out with the range of validity of the prediction method been dealt with?	CRTN has been validated to 600m and all calculations were within 600m.
State all model simplifications or assumptions made.	See attached assumptions table from previous report with updates where necessary.
What data sources have been used to create the ground models (include supplier, file name and version)?	Previous models provided the topography/mapping for 2012. For 2008 a detailed digital terrain model provided was used file name: 'Survey_Nat_3D' (06/08/14) for mapping and all of the vertical alignment except for the Auchenkilns Junction section which was taken from the previous model (the same alignment as 2012). For 2003 topo data provided was used in conjunction with 2012 data.
What data sources have been used for the source input data (include supplier, file name and version)?	Road traffic data for 2012 was acquired from HMG. 2008 and 2003 from other sources. See traffic assessment below.
What digital mapping data has been used (e.g OS MasterMap), and where and when was it sourced?	See ground models section.
What data was used to identify addresses?	Address point database from HMG.
If acoustic barrier information supplied, what was the source and what version was included in the model?	Acoustic barrier information for 2012 and 2008 was provided by the project team. The info was also verified using Google Earth.
If proprietary mapping data was used (e.g. OS Mastermap, please provide licensing information)?	OS mapping provided by the project team.
What other datasets were used to create the noise models, provide details of the source of data, and what it was used for?	N/A

Cadna Modelling assumptions

No	Data concerned	Sub category of data	description	date
1	Building Height Data		Building heights from previous model (northern section), used for overlap section Auchenkilns junction. All building height data for previous model (Southern Section) set to 8m.	17-Apr
			Action: used satellite images as well as google street view to verify heights in both North section and South section.	
2	Topography		Topographic data from the previous models was used for the 2012 model, the vertical alignment of the roads for the 2003 model was provided seperately.	Apr
			Action: The 2003 model, used the vertical alignment of the road provided and then used 2012 topographic data for the surroundings. It was deemed no significant changes in topography had occurred in these surrounding areas.	
			update Action 01/09/14: The 2008 model topographic data has been provided by HMG. This was subsequently found to be 2003 vertical alignment and so a 2008 topo datset was constructed by combining the 2003 alignment with the Auchenkilns Junction section from the 2012 model	Aug
3	Road Widths		Road widths are missing in Northern section of the model (2012). and all sections in 2003.	May
			Action: for consistency we used the same widths as used in southern section model (RQ15.5-motorway(3lane), RQ 14 (2lane) and RQ10 for slip & minor roads) and verified with google earth.	
			update Action 01/09/14: The same action but applied to 2008 model.	
4	Noise Barriers 2003 & 2008		We understand from HMG, that it is not possible to confirm the location or existance of any noise barriers implement in the year 2003.	
			Action: No barriers were implemented in our 2003 model including the central reservation barrier.	28-May
			update Action 01/09/14: New information on the 2008 model barrier locations provided by HMG. They detailed barrier locations around the Auchenkilns junction, no barrier locations were detailed for the rest of the scheme and so no other barriers were implemented into 2008 model.	
5	Noise Barriers 2012		Acoustic barrier information for 2012 was provided by HMG.	
			Action noise barriers for our 2012 model were verified using satellite images and as part of the noise survey.	
6	Road Surface		September 2014 Action: advice followed: Where traffic speed is < 75 km/h surface correction is -1.0 dB(A) for all roads and all scenarios. Where traffic speed is >= 75km/h: Pre-Construction scenarios (2003&2008): surface correction is 0 dB(A) unless there are any roads identified as low noise surfaces in which case the surface correction is -2.5 dB(A). Post-construction scenarios: surface correction is 0 dBA except for road surfaces identified as low noise surfaces: For new low noise surfaces at the time of opening (2008 for Auchenkilns section, 2012 for the rest of the M80): surface correct -3.5 dB(A) *(see update); For low noise surfaceing in future scenarios (2012 for Auchenkilns section): surface correction is -2.5 dB(A).	Sep
			location of low noise surfaces provided on as Built drawings.	
			*update Action10/14: From draft report comments PB has been advised that the 2008 Auchenkilns section should be given a surface correction of -2.5dB(A)	
7	Traffic data			
		Road speeds	Speed data not provided for 2012 (unable to extract from data, there are significant gaps).	Aug
			Action: Use CRTN road classification in chart 4 section 14.2 for all years.	
		Traffic flows	Section of Roads absent in 2012 or 2003, for example the A80 section Hornshill roundabout to Crow wood roundabout.	Aug
			Action: unless the section of road appears in both years (2012&2003) it was left out of both.	
			update Action 01/09/14: Roads were extrapolated from (2003/2008/2012) to provide the most complete model possible	
8	Presentation of Results			
		Receptor heights	Bungalows (1 floor dwellings) were not easily identifiable.	12th Sep
			Action: In the assessment the worst case scenario of every property having at least 1 storey (a 1st floor) was taken. For all high rise buildings a calculation was done for each floor. All elligible properties were manually checked using google earth street view and if there were bungalows the first floor receptor was removed.	

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TECHNICAL NOTE

Project Name:	**M80 DBFO Noise Modelling**				
Project Number:	**3513048B**				
Technical Note Number:	**01**				
Technical Note Title:	**Traffic Estimation Methodology**				
Status / Issue Number:	**Issue 1**	Date Issued:	**22 August 2014**		
Prepared By:	**MSR**	Checked by:	**FR**	Issued by:	**RP**

1. INTRODUCTION

1.1. Study Outline

1.1.1. Parsons Brinckerhoff has been commissioned by Bilfinger RE Asset Management Ltd to undertake acoustic analysis along the M80 corridor near Cumbernauld. Part of the study required the assessment of conditions in 2008 prior to construction of the central Stepps to Haggs section of the motorway.

1.1.2. Traffic counts from 2008 were not available for all the sections of highway covered by this assessment and therefore some estimation of likely traffic levels was necessary.

1.2. Document Structure

1.2.1. This note details the data sources and methodology employed in the calculation of these traffic estimates and is structured as follows:

- Section 2 – Traffic Estimation Methodology;
- Section 3 – Summary.

2. TRAFFIC ESTIMATION METHODOLOGY

2.1. Preamble

2.1.1. This section details the supporting data and assumptions used in the estimation of the likely traffic levels in the Cumbernauld area in 2008.

2.2. Available Data Sources

2.2.1. Traffic data for the study area, provided by Transport Scotland, gave the volume of vehicles recorded on various sections of the Cumbernauld area highway network in 2003, 2008 and 2012. The traffic data had been collected and was presented in a variety of ways and levels of detail, ranging from classified hourly counts to daily average flow volumes.

2.2.2. The traffic estimates required for the acoustic analysis were 18hr Annual Average Weekday Traffic (AAWT) flows along with the corresponding proportion of heavy goods vehicles (HGVs) for each section of highway in the study area. Where the 18hr AAWT for 2008 had been surveyed and recorded, this was used.

2.3. Estimation Methodology

2.3.1. As data for 2008 was not available for all sites, a hierarchy of potential alternatives was defined to ensure that the source with the highest confidence level was used in each case.

2.3.2. The available data was employed for the estimation process in the following order:

- 2008 – Original target year;
- 2003 – Same network as the target year;
- 2012 – Different network following completion of construction work.

2.3.3. In the cases where data from an alternative year was used, the recorded volume has been factored to estimate the likely volume in 2008. The scaling factor for each of the links missing from the 2008 data set has been calculated from the recorded flows on adjacent links. In some cases, this factoring method was also used to convert flows presented as 24hr AAWT or Annual Average Daily Traffic (AADT) flows into the required form.

2.3.4. Some M80 slip-roads where adjacent surveys were not available have been estimated using the flow on the slip road carrying the opposing movement to the same location, for example the traffic volume leaving the motorway to access an industrial estate is assumed to be the same volume leaving the estate and re-joining the motorway.

2.3.5. The proportion of HGVs on the missing links was also estimated by combining the observed value from the selected alternative year with the change in HGV proportion between the alternative and target years at an adjacent count site with data covering both years.

2.3.6. For a smaller number of sites there was also no data available for 2012 or 2003, the same estimation process was followed as above for these sites.

2.4. Highway Network Coverage

2.4.1. The highway network extending into the area surrounding the M80 corridor has been assumed to carry traffic volumes observed at count sites adjacent to the motorway.

2.5. Limitations

2.5.1. As the wider highway network extends past junctions away from the survey location, the estimates become subject to progressively higher margins of error.

2.5.2. Estimating traffic flows from volumes recorded in other years is dependent on the assumption that travel patterns are broadly similar across the intervening period, with any changes in traffic volumes occurring uniformly across the study area. As the time difference between the observed and estimated traffic volume increases, the probability of changing travel patterns causing a significant change in traffic flow volume steadily rises.

2.6. Data presentation

2.6.1. All traffic data used in this study has been presented in the traffic data table. Traffic data estimates are highlighted in orange. The main links of the M80 scheme have also been presented in a traffic data figure.

3. SUMMARY

3.1.1. This note summarises the methodology employed in estimating the 2003, 2008 and 2012 traffic levels along the M80 corridor for use in acoustic analysis.

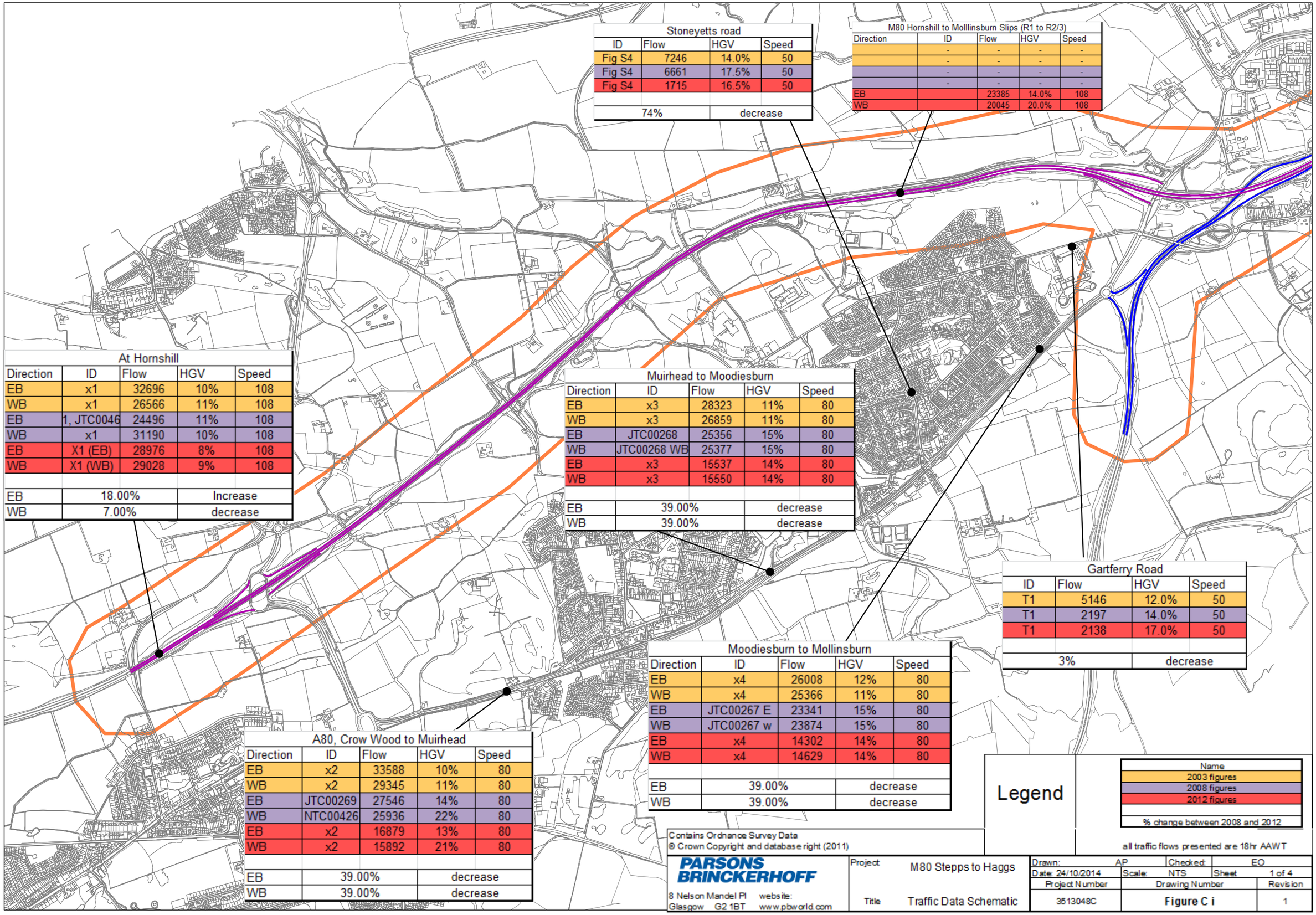
Road Traffic Data Table

2003 road name	ID	AAWT 18hr flow	HGV percentage	Speed KPH	2008 road name	ID	AAWT 18hr flow	HGV percentage	Speed KPH	2012 road name	ID	AAWT 18hr flow	HGV percentage	Speed KPH	Percentage change with 2012& 2008	Comments
At Hornshill E	x1	32696	10%	108	M80 Between A80 and Jct 3 S or E	x1, JTC00468	24496	11%	108	M80 0459N M 11/2 mile N,R1 to R2	X1 (EB)	28976	8%	108	18	
At Hornshill W	x1	26566	11%	108	At Hornshill W	x1	31190	10%	108	M80 0459S M 11/4 mile N,R1 to R3 (west) 1	X1 (WB)	29028	9%	108	-7	
A80, M80 Crow Wood to Hornshill	A80, M8000024	19929	13%	108	M80 Between A80 and Jct 3 N or W	JTC00468	24198	11%	108	M80 Between A80 and Jct,S3 to S4 + S4 to S3	A80, M8000024	10731	6%	108	-56	Link to Crow Wood Roundabout changes to off ramp in 2012
West of Dalshannon EB	x5b	42327	12%	108	(M80) A80 East of M73 Junction	x5b, JTC00266	39984	19%	108	M80 W of J5 Auchenkilns,R1 to R2	X5b (EB)	38913	22%	108	-3	
West of Dalshannon WB	x5b	35556	13%	108	(M80) A80 East of M73 Junction	x5b, JTC00266	38099	20%	108	M80 1425S M W of J5 Au,R1 to R3 (west) 7	X5b WB	39570	22%	108	4	
Low wood Slip to Auchenkilns WB	x6	27098	16%	108	(M80) Low wood slip to Auchenkilns WB	x6	26229	20%	108	M80 1473S M J5 Auchenk,R1 to R3 (west) 7	x6 WB	33294	26%	108	27	
Low wood slip to Auchenkilns EB	x6	27521	15%	108	Low wood Slip to Auchenkilns EB	x6	29240	22%	108	M80 1473N M J5 Auchenk,R4 to R66	x6	29637	32%	108	1	
Auchenkilns to Oldd Inns EB	X7	28557	17%	108	(M80) A80 East of Auchinkilns Rbt EB	X7	33705	24%	108	M80 E of J5 Auchenkilns,M80 Eastbound	X7	34787	22%	108	0	
Auchenkilns to Old Inns WB	X7	32210	17%	108	A80 East of Auchinkilns Rbt WB	X7	27841	17%	108	M80 1833S M W of J6 Ol,M80 Westbound	X7	33812	22%	108	25	
between old inns slips WB	x8 WB	32809	17%	108	(M80) between old inns slips wb	x8 WB (2008)	31462	22%	108	M80 1883S M J6 Old Inn,M80 Westbound	X8	29534	26%	108	-6	
between old inns slips EB	X8	32164	12%	108	between old inns slips EB	X8	35759	20%	108	M80 1892N M J6 Old Inn,M80 Eastbound	X8	28780	26%	108	-20	
Old inns to Castlecary slips wb	x9a	36039	15%	108	(M80) A80 Cumbernauld to Castlecary (WB)	x9a wb	33897	23%	108	M80 2138S M W of J6a C,M80 Westbound	x9a	35509	20%	108	6	
Old Inns to Castle cary slips eb	x9a	32174	12%	108	A80 Cumbernauld to Castlecary (EB)	x9a eb	33564	21%	108	M80 W of J6a Castlecary,M80 Eastbound	x9a (EB)	36231	24%	108	-1	
between Castlecary and Haggs slip roads EB	x9b	36895	14%	108	(M80) A80 South of M80 Junction 4	x9b (JTC00263)	36609	22%	108	M80 2187N M J6a Castle,M80 Eastbound	x9b	35428	26%	108	-3	
Between Castlecary and Haggs slip roads WB	x9b	35626	15%	108	A80 South of M80 Junction 4	x9b JTC00263 (W)	36289	25%	108	M80 2187S M J6a Castle,M80 Westbound	x9b	35467	22%	108	-2	
Between Haggs Slips WB	x10	34750	14%	108	(M80) Between Haggs Slips EB	x10	40549	21%	108	M80 2297N M J7 Haggs,M80 Eastbound	x10	32490	28%	108	-19	
Between Haggs Slips EB	x10	34445	14%	108	Between Haggs Slips WB	x10	36373	26%	108	M80 2297S M J7 Haggs,M80 Westbound	x10	32866	22%	108	-11	
Haggs slip road (E) to tie-in EB	x11	39112	14%	108	(M80) Haggs slip road (E) to tie-in EB	x11	40191	21%	108	M80 E of J7 Haggs,M80 Eastbound	X11	38236	22%	108	-5	
Haggs slip road (E) to tie-in WB	x11	39018	14%	108	Haggs slip road (E) to tie-in WB	x11	38377	26%	108	M80 Haggs Westbound	X11	36076	7%	108	-6	
A73 to roundabout Nth bound	S33	4601	23%	60	A73 to roundabout Nth bound	S33	4671	28%	60	A73 to roundabout Nth bound	S33	5251	32%	60	12	
A73 to roundabout SB	S33	5268	21%	60	A73 to roundabout SB	S33	5348	26%	60	A73 to roundabout SB	S33	6012	30%	60	12	
Low wood off slip	S25	14453	5%	80	Low wood off slip	S25	13989	9%	80	M80 1428NO O Off slip,R18 to 19	S25	7819	2%	80	-44	
Low wood On Slip	S26	7711	5%	80	Low wood On Slip	S26	8192	12%	80	M80 1473SI I On slip a,R20 to R21	S26	7370	14%	80	-10	
Old Inns E/B Diverge slip	S34	3336	29%	80	Old Inns E/B Diverge slip	S34	3708	38%	80	M80 1892NO O Off slip ,Old Inns Eastbound Off S	S34	4135	26%	80	12	
Old Inns E/B merge slip	S35	6980	0%	80	Old Inns E/B merge slip	S35	7760	9%	80	M80 1903NI I On slip a,Old Inns Eastbound On Sl	S35	6005	20%	80	-23	
Haggs E/B diverge slip	S43	876	50%	80	Haggs E/B diverge slip	S43	900	58%	80	M80 2297NO O Off slip ,Haggs Eastbound Off Slip	S43	3617	40%	80	302	attributed to growth in Haggs
M80 2297NI I On slip a,Haggs Eastbound On Slip	S44	4357	18%	80	Haggs E/B merge slip	s44	4477	26%	80	M80 2297NI I On slip a,Haggs Eastbound On Slip	S44	3171	28%	80	-29	
Haggs Westbound On Slip	S45	4574	14%	80	Haggs w/b merge slip	s45	4499	23%	80	Haggs Westbound On Slip	S45	3826	26%	80	-15	
M80 2297SO O Off slip ,Haggs Westbound Off Slip	S46	2450	15%	80	Haggs W/B Diverge slip	s46	2410	25%	80	M80 2297SO O Off slip ,Haggs Westbound Off Slip	S46	3210	34%	80	33	
North road T17, T18	T17/18	4682	10%	50	North road T17, T18	T17/18	3683	3%	50	North Road S19 to S20 + S20 to S19	T17,18	1146	7%	50	-69	
Molliesburn to Dalshannon E and W	T11,12	6480	7%	50	UCL MAIN ROAD CONDORRAT,Main Road West	atcnt004	5097	0%	50	UCL MAIN ROAD CONDORRAT,Main Road West	T11, T12	1869	0%	50	-63	
Dalshannon to Condorrat E and W	T13,14	7242	6%	50	Dalshannon to Condorrat E and W (2008)	T13,14	5697	0%	50	Dalshannon to Condorrat E and W (2008)	T13,14	2033	0%	50	-64	
Main road condorrat	use T17,18 &ratio 2012	2954	10%	50	Main road condorrat	use T17,18 &ratio 2012	2323	3%	50	Main Road East	T17a and 18a	723	7%	50	-69	
Mollinsburn WB Merge	C	13558	6%	80	Mollinsburn WB Merge	C	13644	12%	80	M73 2062SI I On slip a,R62 to R63	C	2259	0%	80	-83	
Mollinsburn WB diverge	c	713	5%	80	Mollinsburn WB diverge	c	718	11%	80	M73 2062SO O Off slip,R64 to R65	c	2798	42%	80	290	Layout and changes in road network
M73 Mainline NB	L	24289	10%	108	M73 Mainline SB	L	24443	16%	108	M73 1962(N) M W of J3,R52 to R53 +R53 to R52	L	21052	24%	108	-14	
M73 Mainline SB	L	22938	12%	108	M73 Mainline NB	L	21127	17%	108	M73 1962(S) M W of J3,R52 to R53 +R53 to R52	L	23262	24%	108	10	
B8048 to roundabout EB and WB	S28	6857	10%	50	B8048 to roundabout EB and WB	S28 (2008)	6962	15%	50	B8048 EB/WB	S28	6482	17%	50	-7	
Westfield road West	T5/6	12382	6%	50	Westfield road West	T5/6	5285	8%	50	Westfield road West	T5/6	5143	11%	50	-3	
Westfield road East	T7/8	14827	7%	50	Westfield road East	T7/8	6329	9%	50	Westfield road East	T7/8	6815	24%	50	8	
Mollins road	Fig S2	19195	7%	50	Mollins road	Fig S2	17646	11%	50	Mollins road	Fig S2	10813	9%	50	-39	
A80, Crow Wood to Muirhead EB	x2	33588	10%	80	A80 West of Muirhead	JTC00269	27546	14%	80	A80 West of Muirhead	x2	16879	13%	80	-39	
A80, Crow Wood to Muirhead WB	x2	29345	11%	80	A80 25W M at J3 Crowwood Rbt	NTC00426	25936	22%	80	A80 25W M at J3 Crowwood Rbt	x2	15892	21%	80	-39	
Muirhead to Muirhead EB	x2a	27864	11%	80	A80 West of Muirhead	JTC00269	27145	15%	80	A80 West of Muirhead	x2a	16633	14%	80	-39	
Muirhead to Muirhead WB	x2a	26763	10%	80	A80 MUIRHEAD WB	JTC00150 WB	27026	15%	80	A80 MUIRHEAD WB	x2a	16560	14%	80	-39	
Muirhead to Moodiesburn EB	x3	28323	11%	80	A80 Muirhead to Moodiesburn	JTC00268	25356	15%	80	A80 Muirhead to Moodiesburn	x3	15537	14%	80	-39	
Muirhead to Moodiesburn	x3	26859	11%	80	A80 Muirhead to Moodiesburn WB	JTC00268 WB	25377	15%	80	A80 Muirhead to Moodiesburn WB	x3	15550	14%	80	-39	
Moodiesburn to Mollinsburn EB	x4	26008	12%	80	A80 West of M73 Junction	JTC00267 E	23341	15%	80	A80 West of M73 Junction	x4	14302	14%	80	-39	
Moodiesburn to Mollinsburn	x4	25366	11%	80	A80 West of M73 Junction	JTC00267 w	23874	15%	80	A80 West of M73 Junction	x4	14629	14%	80	-39	
Gartferry Road	T1	5146	12%	50	Gartferry Road	T1	2197	14%	50	Gartferry Road	T1	2138	17%	50	-3	
Stoneyetts road	Fig S4	7246	14%	50	Stoneyetts road	Fig S4	6661	18%	50	Stoneyetts road	Fig S4	1715	17%	50	-74	data taken from ES figure, as no other data provided
Lindsaybeg Road	S8	4661	10%	50	Lindsaybeg Road	S8	4285	14%	50	Lindsaybeg Road	S8	1103	13%	50	-74	
Mollinsburn	T9,T10	7095	11%	50	Mollinsburn	T9,T10	5581	4%	50	Mollinsburn	T9,T10	2046	0%	50	-63	
Cumbernauld Town Centre E	T19	5223	6%	50	Cumbernauld Town Centre E	T19	10923	0%	50	Cumbernauld Town Centre E	T19	12270	2%	50	12	
Cumbernauld Town Centre W	T20	7625	7%	50	Cumbernauld Town Centre W	T20	9543	10%	50	Cumbernauld Town Centre W	T20	10720	12%	50	12	
Castlecary West	T23/24	19055	13%	50	Castlecary West	T21/22	18901	22%	50	Castlecary West	T21/22	17851	22%	50	-6	
Castlecary east E	T23/24	8150	15%	50	Castlecary east E	T23/24	8194	25%	50	Castlecary east E	T23/4	2237	0%	50	-73	
Castlecary S25/26	Transport Scot	4001	26%	50	Castlecary S25/26	S25/26	8034	33%	50	B816 CASTLECARY ROAD,S25 to S26 New Castlecar	S25/26	3037	4%	50	-62	
Eastfield road	TS2	11773	10%	50	Eastfield road	TS2	12230	10%	50	Eastfield road	TS2	13738	12%	50	12	
Seabegs road	z	7202	19%	50	Seabegs Overbridge	z	9492	42%	50	Seabegs Overbridge	z	7673	39%	50	-19	
A803 Banknock	K5	8948	11%	50	A803 Banknock	K5	9195	19%	50	A803 Banknock	K5	8898	22%	50	-3	
A803 Mainline	K6	9073	12%	50	A803 Mainline	K6	9124	22%	50	A803 Mainline	K6	8872	21%	50	-3	
A803 Haggs	K7	5893	13%	50	A803 Haggs	K7	5796	24%	50	A803 Haggs	K7	5665	21%	50	-2	
Castlecary E/B or N/B merge slip	S40	3427	43%	80	Castlecary junction NB	S40	3488	51%	80	M80 2187NI I On slip a,Castlecary Eastbound On	S40	952	22%	80	-73	
Offslip/diverge Castlecary W/B or S/B	S42	3578	8%	80	Offslip Castlecary SB	S42	3505	18%	80	M80 2187SO O Off slip ,Castlecary Westbound Off	S42	978	24%	80	-72	
Auchengeich road	S21/22	2608	12%	50	Auchengeich road	S21/22	2398	16%	50	Auchengeich road	S21/22	874	23%	50	-64	

note: positive means an increase in flows

roads/sections not comparable in all years					roads/sections not comparable in all years					roads/sections not comparable in all years					Percentage change with 2012& 2008	
	ID	AAWT 18hr flow	HGV percentage	Speed KPH		ID	AAWT 18hr flow	HGV percentage	Speed KPH		ID	AAWT 18hr flow	HGV percentage	Speed KPH		
West of Lowwood EB	x5c	42327	12%	108	(M80) West of Lowwood EB	x5c	38985	17%	108	R52 to R53 +R53 to R52 (M73 between slips)	between slips	38923	32%	108	N/A	
West of Lowwood WB	x5c	34798	14%	108	West of Lowwood WB	x5c	35019	20%	108	R52 to R53 +R53 to R52 (M73 between junc)	between junc	38462	30%	108	N/A	Not comparable sections of road, due to road layout changes
(M80) East of Mollinsburn EB	x5a	42329	12%	108	East of Mollinsburn EB (M80)	x5a	38987	17%	108	M73 2062S M M73 J3 to ,R56 to R57	x5a	17410	28%	108	N/A	
(M80) East of Mollinsburn WB	x5a	35556	13%	108	(M80) East of Mollinsburn WB	x5a	35782	19%	108	M73 2060N M M73 J3 to ,R54 o R55	x5a	21052	30%	108	N/A	Not comparable sections of road, due to road layout changes
A80, M80 on slip at Hornshill	A80, M8000057	26566	11%	80	A80 MOODIESBURN (SB)	JTC00149 (S)	24987	15%	80	A80 MOODIESBURN		3756	14%	80	N/A	
Overbridge @ Hornshill	S4	6637	1%	80	Overbridge @ Hornshill (2008)	S4	6992	5%	80	R12 to R13	Hornsrdbt	6937	4%	50	N/A	with no other available data, the WSP model was used.
Old Inns W/B East merge slip	S36	713	3%	80	Old Inns W/B East merge slip	S36	684	7%	80	M80 629SO O Off slip a,R12 to R13	HornsOffWB	2679	18%	80	N/A	
Old Inns W/B East diverge slip	S37	5416	8%	80	Old Inns W/B East diverge slip	S37	5194	12%	80	M80 629NI I On slip at,R10 to R11	Horns OnEB	2337	19%	80	N/A	
Mollinsburn EB diverge	b	978	5%	80	Mollinsburn EB diverge	b	901	10%	80	M80 1124NO O Off slip ,R14 to R15		3237	18%	80	N/A	
Mollinsburn EB Merge	B	8651	9%	80	Mollinsburn EB Merge	B	7968	14%	80	M80 1124SI I On slip a, R16 to R17		3282	15%	80	N/A	
Old Inns W/B West merge slip	K36	550	3%	80	Old Inns W/B West merge slip	K36	579	11%	80	M73 2001NI I On slip a,R60 to R61		7525	34%	80	N/A	
Old Inns W/B West diverge slip	K37	3100	9%	80	Old Inns W/B West diverge slip	K37	3266	17%	80	M73 1977NO O Off slip ,R58 to R59		4220	22%	80	N/A	
Castlecary W/B or S/B merge slip	S41	3427	43%	80	Castlecary junction W/B or S/B merge	S41	3488	52%	80	M80 1883SI I On slip a,Old Inns Westbound On Sl	S36	4083	24%	80	N/A	
					A80 MOODIESBURN (NB)	JTC00149 (N)	24890	15.0%	80	M80 1938SO O Off slip ,Old Inns Westbound Off S	S37	5795	19%	80	N/A	
					Auchenkilns Offslip EB	Sxx	1614	31%	80	M80 1551NI I On slip a,R26 ti R25	Sxx	1571	34%	80	-3	
					M80 Auchenk, EB between slips		28016	20%	108	M80 1541N M J5 Auchenk,R4 to R66		28066	20%	108	0	
					M80 1551NI I On slip a,R26 ti R27 EB		4308	2%	80	M80 1551NI I On slip a,R26 ti R27		4446	0%	80	3	
					M80 1528SI I On slip a,R24 ro R25		3592	14%	80	M80 1528SI I On slip a,R24 ro R25	Auchen slip	3731	16%	80	4	
					M80 between WB slips Auchenk		26263	19%	108	M80 1541S M J5 Auchenk,R5 to R66 (west)		29406	22%	108	12	
					M80 1551SO O Off slip ,R28 to R29		3428	9%	80	M80 1551SO O Off slip ,R28 to R29		4163	14%	80	21	
					A80 MUIRHEAD junction	JTC00150	27268	15%	80	M80 1124N M J4 Mollins,R1 to R2		19571	20%	108	N/A	
										M80 578S M J3 Hornshil,R1 to R3 (west) 1		20045	20%	108	N/A	
										M80 673S M E of J3 Hor,R1 to R3 (west) 1		22816	16%	108	N/A	
										M80 1124S M J4 Mollins,R1 to R3 (west) 7		19644	16%	108	N/A	
										S4 to S3	Crow to Horns	3721	2%	50	N/A	with no other available data, the WSP model was used.
										S3 to S4	Horns to Crow	5126	3%	50	N/A	with no other available data, the WSP model was used.
										M80 578NO O Off slip a,R6 to R7 (Horns EB)	xi	9566	14%	80	N/A	
										M80 578SI I On Slip at,R8 to R9 Hornshill (WB)	xii	9838	10%	80	N/A	
										Hornshill Roundabout		6207	3%	50	N/A	with no other available data, the WSP model was used.
										A80 MUIRHEAD junction		9944	14%	80	N/A	
										M80 578N M J3 Hornshil,R1 to R2		20150	5%	108	N/A	
										M80 W of J4 Mollinsburn,R1 to R2		23385	14%	108	N/A	
										M80 1223SO O Off slip ,R56 to R57	part of x5a	21342	24%	108	N/A	

KEY	
Extrapolated data:	
data from ES figure	



Stoneyetts road			
ID	Flow	HGV	Speed
Fig S4	7246	14.0%	50
Fig S4	6661	17.5%	50
Fig S4	1715	16.5%	50
74%		decrease	

M80 Hornshill to Molllinsburn Slips (R1 to R2/3)				
Direction	ID	Flow	HGV	Speed
	-	-	-	-
	-	-	-	-
	-	-	-	-
	-	-	-	-
EB		23385	14.0%	108
WB		20045	20.0%	108

At Hornshill				
Direction	ID	Flow	HGV	Speed
EB	x1	32696	10%	108
WB	x1	26566	11%	108
EB	1, JTC0046	24496	11%	108
WB	x1	31190	10%	108
EB	X1 (EB)	28976	8%	108
WB	X1 (WB)	29028	9%	108
EB	18.00%		Increase	
WB	7.00%		decrease	

Muirhead to Moodiesburn				
Direction	ID	Flow	HGV	Speed
EB	x3	28323	11%	80
WB	x3	26859	11%	80
EB	JTC00268	25356	15%	80
WB	JTC00268 WB	25377	15%	80
EB	x3	15537	14%	80
WB	x3	15550	14%	80
EB	39.00%		decrease	
WB	39.00%		decrease	

Gartferry Road			
ID	Flow	HGV	Speed
T1	5146	12.0%	50
T1	2197	14.0%	50
T1	2138	17.0%	50
3%		decrease	

Moodiesburn to Mollinsburn				
Direction	ID	Flow	HGV	Speed
EB	x4	26008	12%	80
WB	x4	25366	11%	80
EB	JTC00267 E	23341	15%	80
WB	JTC00267 w	23874	15%	80
EB	x4	14302	14%	80
WB	x4	14629	14%	80
EB	39.00%		decrease	
WB	39.00%		decrease	

A80, Crow Wood to Muirhead				
Direction	ID	Flow	HGV	Speed
EB	x2	33588	10%	80
WB	x2	29345	11%	80
EB	JTC00269	27546	14%	80
WB	NTC00426	25936	22%	80
EB	x2	16879	13%	80
WB	x2	15892	21%	80
EB	39.00%		decrease	
WB	39.00%		decrease	

Legend

Name
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Project: M80 Stepps to Haggs

Title: Traffic Data Schematic

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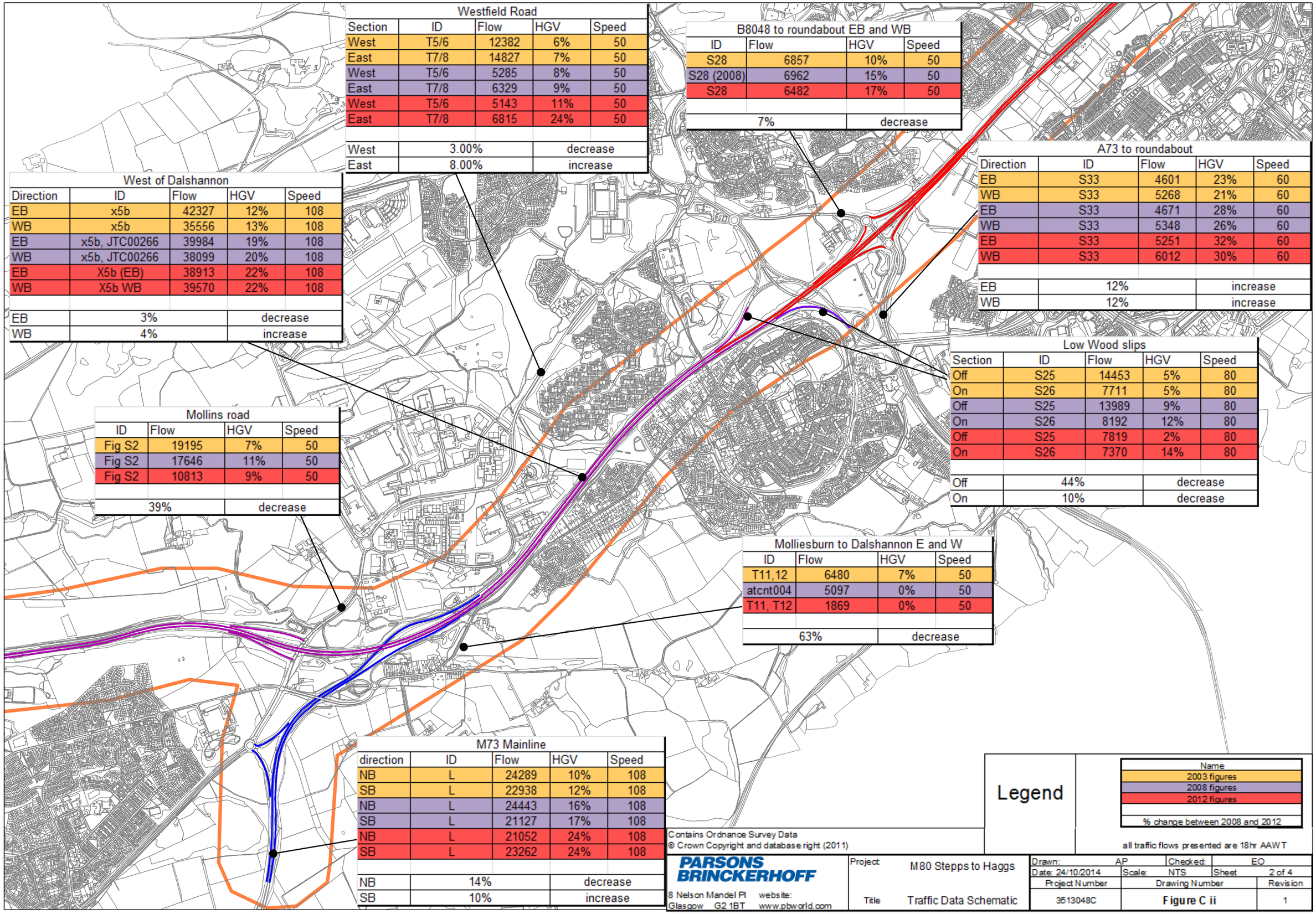
3513048C	Figure C i		1



Westfield Road

Section	ID	Flow	HGV	Speed
West	T5/6	12382	6%	50
East	T7/8	14827	7%	50
West	T5/6	5285	8%	50
East	T7/8	6329	9%	50
West	T5/6	5143	11%	50
East	T7/8	6815	24%	50

West	3.00%	decrease
East	8.00%	increase

B8048 to roundabout EB and WB

ID	Flow	HGV	Speed
S28	6857	10%	50
S28 (2008)	6962	15%	50
S28	6482	17%	50

7%	decrease

A73 to roundabout

Direction	ID	Flow	HGV	Speed
EB	S33	4601	23%	60
WB	S33	5268	21%	60
EB	S33	4671	28%	60
WB	S33	5348	26%	60
EB	S33	5251	32%	60
WB	S33	6012	30%	60

EB	12%	increase
WB	12%	increase

West of Dalshannon

Direction	ID	Flow	HGV	Speed
EB	x5b	42327	12%	108
WB	x5b	35556	13%	108
EB	x5b, JTC00266	39984	19%	108
WB	x5b, JTC00266	38099	20%	108
EB	X5b (EB)	38913	22%	108
WB	X5b WB	39570	22%	108

EB	3%	decrease
WB	4%	increase

Low Wood slips

Section	ID	Flow	HGV	Speed
Off	S25	14453	5%	80
On	S26	7711	5%	80
Off	S25	13989	9%	80
On	S26	8192	12%	80
Off	S25	7819	2%	80
On	S26	7370	14%	80

Off	44%	decrease
On	10%	decrease

Mollins road

ID	Flow	HGV	Speed
Fig S2	19195	7%	50
Fig S2	17646	11%	50
Fig S2	10813	9%	50

39%	decrease

Molliesburn to Dalshannon E and W

ID	Flow	HGV	Speed
T11,12	6480	7%	50
atcnt004	5097	0%	50
T11, T12	1869	0%	50

63%	decrease

M73 Mainline

direction	ID	Flow	HGV	Speed
NB	L	24289	10%	108
SB	L	22938	12%	108
NB	L	24443	16%	108
SB	L	21127	17%	108
NB	L	21052	24%	108
SB	L	23262	24%	108

NB	14%	decrease
SB	10%	increase

Legend

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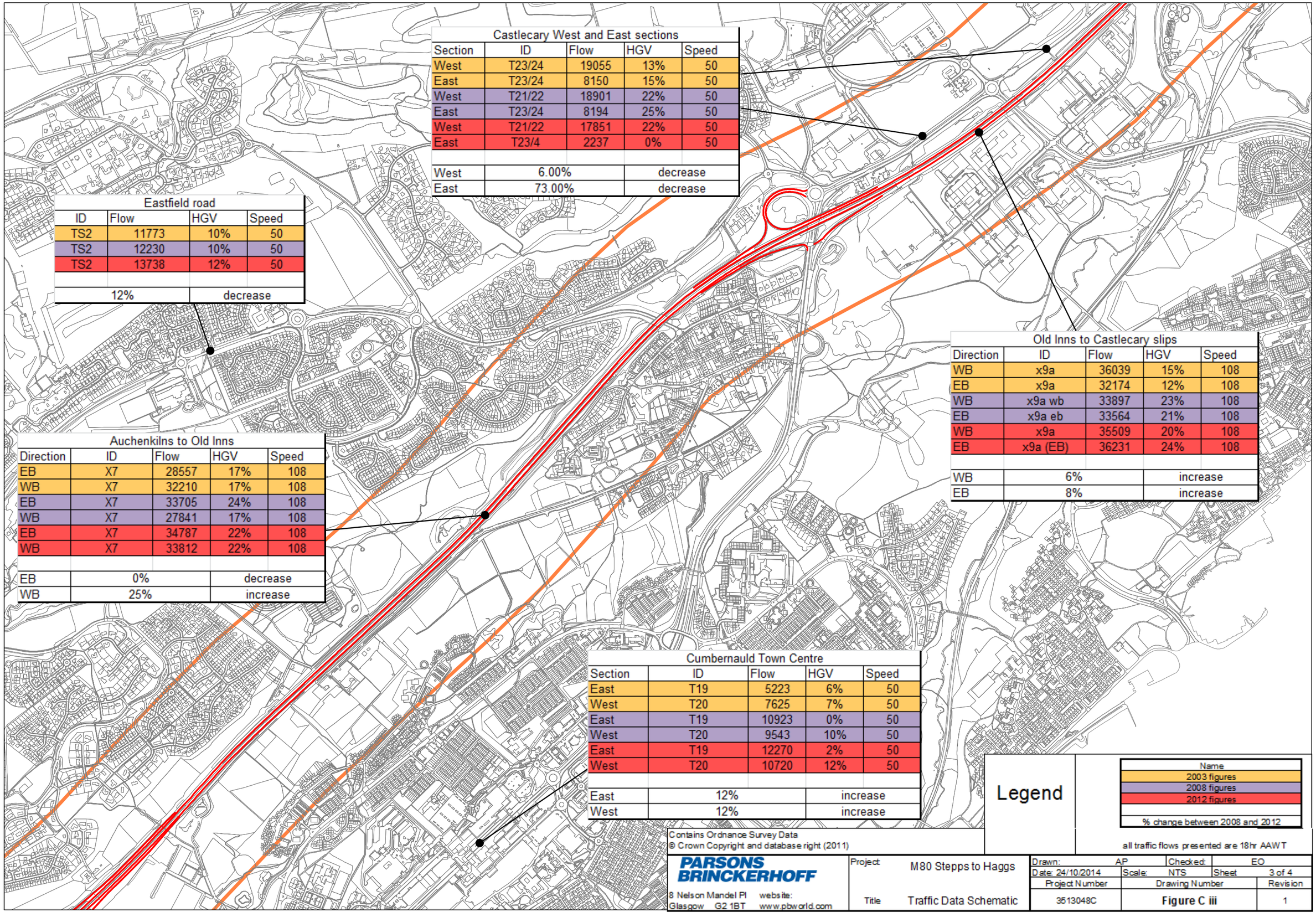
		3513048C	Figure C ii		1



Castlecary West and East sections				
Section	ID	Flow	HGV	Speed
West	T23/24	19055	13%	50
East	T23/24	8150	15%	50
West	T21/22	18901	22%	50
East	T23/24	8194	25%	50
West	T21/22	17851	22%	50
East	T23/4	2237	0%	50
West	6.00%		decrease	
East	73.00%		decrease	

Eastfield road			
ID	Flow	HGV	Speed
TS2	11773	10%	50
TS2	12230	10%	50
TS2	13738	12%	50
12%		decrease	

Auchenkilns to Old Inns				
Direction	ID	Flow	HGV	Speed
EB	X7	28557	17%	108
WB	X7	32210	17%	108
EB	X7	33705	24%	108
WB	X7	27841	17%	108
EB	X7	34787	22%	108
WB	X7	33812	22%	108
EB	0%		decrease	
WB	25%		increase	

Old Inns to Castlecary slips				
Direction	ID	Flow	HGV	Speed
WB	x9a	36039	15%	108
EB	x9a	32174	12%	108
WB	x9a wb	33897	23%	108
EB	x9a eb	33564	21%	108
WB	x9a	35509	20%	108
EB	x9a (EB)	36231	24%	108
WB	6%		increase	
EB	8%		increase	

Cumbernauld Town Centre				
Section	ID	Flow	HGV	Speed
East	T19	5223	6%	50
West	T20	7625	7%	50
East	T19	10923	0%	50
West	T20	9543	10%	50
East	T19	12270	2%	50
West	T20	10720	12%	50
East	12%		increase	
West	12%		increase	

Legend

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A803				
Section	ID	Flow	HGV	Speed
Banknock	K5	8948	11%	50
Mainline	K6	9073	12%	50
Haggs	K7	5893	13%	50
Banknock	K5	9195	19%	50
Mainline	K6	9124	22%	50
Haggs	K7	5796	24%	50
Banknock	K5	8898	22%	50
Mainline	K6	8872	21%	50
Haggs	K7	5665	21%	50
Banknock	3%		decrease	
Mainline	3%		decrease	
Haggs	2%		decrease	

Haggs Eastbound Off/On Slip				
Section	ID	Flow	HGV	Speed
Off	S43	876	50%	80
On	S44	4357	18%	80
Off	S43	900	58%	80
On	s44	4477	26%	80
Off	S43	3617	40%	80
On	S44	3171	28%	80
Off	302%		increase	
On	29%		decrease	

Haggs To Tie-In				
Direction	ID	Flow	HGV	Speed
EB	x11	39112	14%	80
WB	x11	39018	14%	80
EB	x11	40191	21%	80
WB	x11	38377	26%	80
EB	X11	38236	22%	80
WB	X11	36076	7%	80
EB	5%		decrease	
WB	6%		decrease	

Haggs Westbound Off/On Slip				
Section	ID	Flow	HGV	Speed
Off	S46	2450	15%	80
On	S45	4574	14%	80
Off	s46	2410	25%	80
On	s45	4499	23%	80
Off	S46	3210	34%	80
On	S45	3826	26%	80
Off	33%		increase	
On	15%		decrease	

Between Castlecary and Haggs slip roads				
Direction	ID	Flow	HGV	Speed
EB	x9b	36895	14%	108
WB	x9b	35626	15%	108
EB	x9b (JTC00263)	36609	22%	108
WB	x9b JTC00263 (W)	36289	25%	108
EB	x9b	35428	26%	108
WB	x9b	35467	22%	108
EB	3%		decrease	
WB	2%		decrease	

Seabegs road			
ID	Flow	HGV	Speed
z	7202	19%	50
z	9492	42%	50
z	7673	39%	50
19%		decrease	

Legend

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Project:	M80 Stepps to Haggs				
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