ch2m·

A1(M) Junction 47 Study – Stage 1

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Introduction

Junction 47 of the A1(M) [Jn 47] is a four-arm grade separated roundabout which connects the Strategic Road Network [SRN] with the primary road network, in the form of the A59. The A1(M) runs north to south with the A59 passing over the A1(M) at the junction with a west/east orientation. Junction 47 has been identified through planning applications, Harrogate Local Plan assessment work and the Local Enterprise Partnership [LEP] as a significant constraint to development in the area. The junction already exhibits peak hour queues and delays.

North Yorkshire County Council [NYCC] supported by the LEP successfully bid through the Local Growth Fund for money to implement a junction improvement at Jn 47. The scheme includes:

- Traffic signals on all approaches to Junction 47 of the A1(M).

- Widening on all approaches in order to accommodate left turn flares on both diverge slips, and to increase the length of both right turn flares on the A59 approaches.

- Three lane circulatory carriageway at both the north-east and south-west corners of the junction, in order to reduce conflict between exiting and queueing vehicles. Widening is needed to accommodate the introduction of a third lane.

In addition, NYCC are proposing to fund:

- The introduction of traffic signals on the A59 at the junction with the A168 Link Road including islands which are proposed to house the required signal infrastructure. Minimal kerbline changes are required at this junction.

For the remainder of this note both the above schemes will be referred to as the LEP scheme.

Given the various developments which are likely to come forward which will impact on Jn 47, NYCC are undertaking a junction study to determine potential improvements which could deliver additional capacity at the junction going forward. The NYCC study will look at potential solutions and high level associated costs but will not consider in detail what additional capacity they will deliver and whether this matches the current development aspirations in the area.

Purpose of this Study

Highways England is therefore looking to undertake a study which will determine:

- how much capacity will be provided by the LEP scheme and when further improvements are likely to be required; and

- Interim and final solutions for junction improvements to accommodate future likely traffic levels.

This will help with the evidence base for the Local Plan and help determine the viability of the Local Plan, help determine a consistent approach to planning applications and secure appropriate contributions or junction improvements which are consistent with the long term vision for the junction.

It is considered important that the study is carried out with full involvement of Harrogate Borough Council [HBC], NYCC and the LEP to ensure that the outcomes can be supported by all parties.

The study is to be undertaken in three discrete stages. The remainder of this technical note presents the work undertaken and findings of Stage 1 of the study, the primary objective of which is to establish the future year traffic flows that are to be used within the modelling assessments of Stages 2 and 3 of the study.

Stage 1

The main elements of Stage 1 of the study are set out below:

- Review the existing work undertaken on Jn 47

- Identification of scenarios to be tested. Scenarios will be derived and will consider:

  - Harrogate Local Plan (both settlement options separately)

  - York Local Plan

  - Background traffic growth

  - LEP scheme

- Traffic flows for each scenario

- Determination of appropriate modelling package(s).

Previous A1(M) J47 Work – AECOM J47 Upgrade Assessment

This section considers the work presented within the AECOM report 'A1(M) Junction 47 Upgrade: Scheme Development and Modelling Report' (July, 2015) which details the development of the preferred LEP scheme through future year testing.

The AECOM study, in agreement with NYCC and Road Management Services (Darrington) Limited [RMS], utilised a design year of 2022 in assessing the benefits of the signal control scheme at A1(M) J47. Sensitivity tests were also carried out for the 2030 future year. The future year flows were calculated by applying constrained TEMPro (v6.2) growth factors to the 2014 base year flows and adding flows associated with the committed Manse Farm and Flaxby Park developments.

An iterative modelling process was used between the LinSig and VISSIM modelling suites, with the optimum traffic signals staging and timings being determined within LinSig and then entered into the VISSIM model. The reported results of the do something modelling exercise are summarised below, with consideration to the A1(M) J47 and A168 junctions and approaches:

- AM 2022 Do Something – Minimal queueing on all approaches with the exception of a 15.4 vehicle queue on A168 Link Road

- PM 2022 Do Something – Minimal queuing on all approaches to both junctions

- AM 2030 Do Something – Significant queuing on all approaches to the A1(M) J47, including 85+ vehicles on each of the A1(M) off-slip approaches (approximately 500m on each slip road)

- PM 2030 Do Something – Significant queuing (85+ vehicles) on both A1(M) off-slip approaches to J47 (approximately 500m on each slip road)

It can therefore be determined that the LEP scheme will operate within capacity in 2022 with minimal queuing on the approaches to the A1(M) J47 roundabout. The A1(M) junction will begin to operate

above capacity, during both peak periods, at some point between the 2022 and 2030 future years. A more precise estimate of the future year 'breakdown' point will be undertaken in Stage 2 of the study.

Development of 2014 CH2M Base Flows

CH2M has derived base year assessment flows for the A1(M) J47 and A59/A168 junctions using 6-hour manual classified count data from an October 2014 survey, provided by NYCC's consultant, AECOM. The morning survey was undertaken between 07:00 and 10:00 hours and the evening survey 16:00 to 19:00 hours. CH2M determined the AM peak hour to occur between 07:15 and 08:15 and the PM peak hour between 16:30 and 17:30. The hourly vehicle flows for the 2014 AM and PM peak periods are presented in **Figure 1**, attached to this note in **Appendix A.** These flows form the basis of the CH2M future year assessment to which background growth, committed development flows and Harrogate Local Plan growth will be added.

Derivation of Future Traffic Flows

In order to determine when further improvements (in addition to the LEP scheme) are likely to be required at A1(M) J47, CH2M has derived future year traffic flows for 2025 and 2035.

In order to derive these future year flows consideration has been given to the following potential sources of traffic growth:

- Development impact of Harrogate Plan allocations;

- Development impact of York Local Plan allocations;

- Committed Developments, and;

- TEMPro derived (constrained) background growth

The following paragraphs briefly detail the process and assumptions used in determining the future years impact of the Harrogate Local Plan allocations, York Local Plan allocations, committed development flows and TEMPro background growth.

York Local Plan

The York Local Plan preferred sites consultation ended on 12th September 2016. This document contained potential allocations. The overall map showing the allocation sites shows that these are generally located within the York built-up area and those that are not are not located along the A59 corridor. As such the detailed assessment of these sites is not necessary and can be considered to be included within the background TEMPro traffic growth.

TEMPro Growth

The TEMPro v7 software has been interrogated to determine background growth factors for the periods 2014-2025 and 2025-2035. To avoid double counting of the likely trips arising from developments identified within the allocations of the Harrogate Local Plan, alternative planning assumptions have been manually entered into the software, with no growth in jobs and 825 additional dwellings in each period, which takes into account smaller windfall housing sites that are likely to come forward over the period. Growth factors were then determined for the 'Harrogate Rural Principal Roads' AM and PM peak periods. The growth factors extracted were as follows:

- 2014 – 2025 AM Peak – 7.03%, PM Peak – 7.00%

- 2025 – 2035 AM Peak – 1.47%, PM Peak – 1.38%

The 2014 base year flows, growthed to 2025 and 2035 using the TEMPro generated factors, are presented in **Figures 2 and 3** of **Appendix A.**

Committed Developments

Flows associated with 6 committed developments were identified from CH2M's separate work stream to assess the development impact of the emerging Harrogate Local Plan. Through the Local Plan work, HBC identified 95 committed developments and included traffic from 83 of these within their Local Plan modelling. The majority of the developments are located in the Harrogate Central, Harrogate West, Ripon and Boroughbridge areas, for which only a small proportion of traffic would utilise J47, hence, traffic from these sites are not included in the committed development assessment. Other committed developments have not been included in the assessment if the associated traffic impact is negligible or if they are land uses such as a school or local retail (which are unlikely to generate a demand for travel at the SRN). Only 6 of the developments are predicted to generate a significant amount of traffic at the A1(M) J47 and have been included in the J47 study. The traffic impact of the committed developments are shown in **Figure 4**, attached as **Appendix A** to this technical note. All committed development are expected to be complete by 2025, there is therefore no committed development growth beyond 2025.

Harrogate Local Plan

As part of a separate stream of work, on behalf of Highways England, CH2M has performed independent assessment of the development impact arising from the emerging Harrogate Local Plan. The following text represents a brief summary of this work.

CH2M were provided with a spreadsheet list of housing and employment allocations by HBC in June 2016. The housing and employment sites were separated into three tabs, namely Urban Growth Access Points, Green Hammerton [GH] Access Points and Flaxby Access Points. It is currently understood that the Urban Growth Allocations is the least likely to be taken forward within the emerging plan and therefore in order to minimise the necessary assessments this option will not be considered within the Study. From consideration of the spreadsheet it is evident that the majority of the allocation sites appear in both of the aforementioned scenarios. CH2M has taken these sites to be the Core Sites for the Local Plan. CH2M has therefore determined future year traffic flows associated with the following Harrogate Local Plan site allocation assumptions:

- **Green Hammerton Only Sites** – i.e. core sites plus sites that only appear in the GH Access Points scenario

- **Flaxby Only Sites** – i.e. core sites plus sites that only appear in the Flaxby Access Points scenario

Generic trip rates have been derived from TRICS. Table 1 below summarises the TRICS rates derived for residential and employment land uses.

TABLE 1
Trip Rates

Land Use	Trip Rates			
	Peak Hour	Arrivals	Departures	Two Way
Residential	Morning	0.159	0.420	0.579
	Evening	0.391	0.191	0.582
B1 Office	Morning	1.819	0.242	2.061
	Evening	0.195	1.463	1.658
B1 (c) / B2 Industrial	Morning	0.714	0.351	1.065
	Evening	0.153	0.506	0.659
B8 Warehousing	Morning	0.301	0.192	0.493
	Evening	0.125	0.250	0.375

The sites were divided into seven geographical areas and appropriate Middle Layer Super Output Areas [MSOAs] have been identified for each geographic area. Table 2 below shows the MSOAs used for each area.

TABLE 2
MSOA's used for each Distribution Area

Distribution	MSOAs			
Harrogate West	Harrogate 006	Harrogate 008	Harrogate 018	Harrogate 020
Harrogate Central	Harrogate 010	Harrogate 013	Harrogate 014	-
Boroughbridge	Harrogate 005	-	-	-
Ripon	Harrogate 002	Harrogate 004	-	-
Knaresborough	Harrogate 007	Harrogate 009	Harrogate 012	-
Green Hammerton	Harrogate 016	-	-	-
Flaxby	Harrogate 012	Harrogate 016	-	-

The distributions have been based upon the 2011 Journey to Work census data for car drivers that are resident or work in the identified MSOAs who travel to and from surrounding local authorities as listed below.

- Bradford;
- Calderdale;
- Craven;
- Hambleton;
- Harrogate,
- Kirklees;
- Leeds,
- Richmondshire;
- Ryedale,
- Selby;
- Wakefield; and
- York.

Table 3 shows the distributions at Junction 47 for each geographic area.

TABLE 3
Distribution by Routes

Area	Distribution Type	J47 (A1 N)	J47 (A1 S)	J47 (A59 E)	J47 (A59 W)
Harrogate Central	Residential	0.00%	0.00%	3.43%	0.00%
	Employment	0.00%	0.00%	5.21%	0.00%
Harrogate West	Residential	0.00%	0.00%	3.40%	0.00%
	Employment	0.00%	0.00%	3.23%	0.00%
Boroughbridge	Residential	0.00%	0.00%	0.00%	0.00%
Ripon	Residential	0.00%	0.00%	0.00%	0.00%
	Employment	0.00%	0.00%	0.00%	0.00%
Knaresborough	Residential	10.42%	14.70%	6.60%	0.00%
	Employment	15.22%	6.84%	9.92%	0.00%
Green Hammerton	Residential	6.13%	24.07%	0.00%	28.42%
	Employment	6.32%	13.95%	0.00%	22.36%
Flaxby	Residential	10.12%	23.73%	20.86%	0.00%
	Employment	11.39%	14.98%	31.77%	0.00%

The predicted traffic impact of both Local Plan Allocation scenarios are shown in **Figures 5 to 8**, attached as **Appendix A** to this technical note.

Assessment Flows

The final assessment flows for 2025 and 2035 are presented in **Figures 9 to 12** of **Appendix A.**

Consideration of Modelling Approach in Stage 2 and 3

CH2M considers there to be two modelling approach options available in accurately assessing the future year operation of the A1(M) J47, both with and without mitigation measures. One option would be to utilise micro-simulation modelling software e.g. VISSIM or Aimsun, the other option would be to use static, macroscopic modelling e.g. TRANSYT or LinSig.

A micro-simulation model would allow for the representation of traffic flow variation within the defined peak hour by modelling each individual vehicle's progression through the network. A micro-simulation assessment would also allow the modelling of local route choice variation associated with the availability of multiple paths between each network entry and exit.

Macroscopic assessment uses cyclical profiles, and is therefore generally unable to model variations in flow density within the modelled period, route choice variations can be determined within the modelled network extents. TRANSYT and LinSig software also allows for full signal time optimisation, across multiple connected junctions. The main advantages to using a macroscopic model lie in its more simplistic network construction requirements and generated output, resulting in reduced time requirements in both the building and running of the traffic model. The simplified model outputs are also more readily understood than outputs generated from micro-simulation models.

Overall the network is small, route choice is fairly limited, the predicted traffic flows are broad estimates and timescales is producing the results are constrained. As such it is considered that the production of a micro-simulation model which can model random variations of traffic flows within the peak is not necessary and a macroscopic model would represent the most appropriate option for this study.

APPENDIX A
Traffic Flow Figures

FIGURE 1
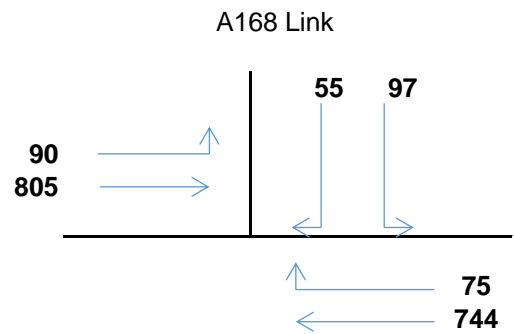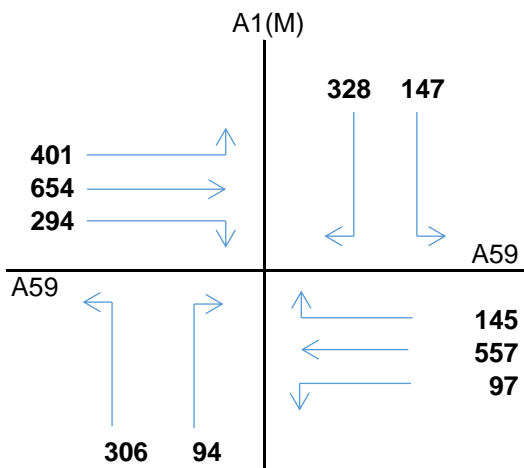## 2014 Existing Vehicle Flows

Morning Peak 07:15-08:15

A1(M)

308 144

277
625
353

A59

A59

132
623
123

287 130

A168 Link

46 107

57
842

67
832

Evening Peak 16:30-17:30

A1(M)

328 147

401
654
294

A59

A59

145
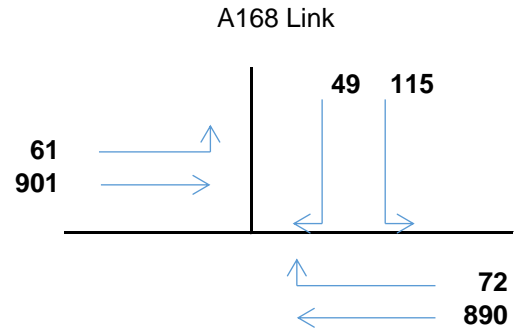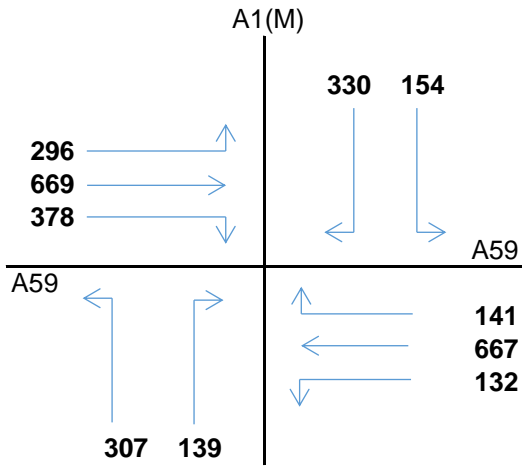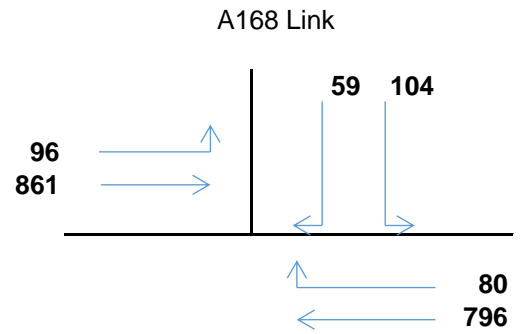557
97

306 94

A168 Link

55 97

90
805

75
744
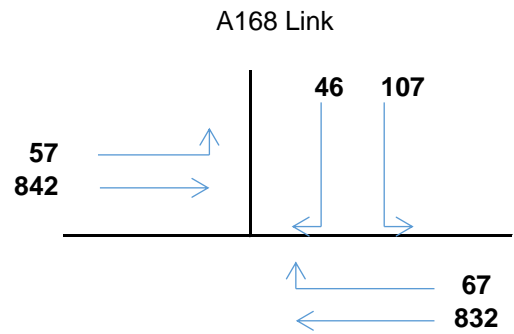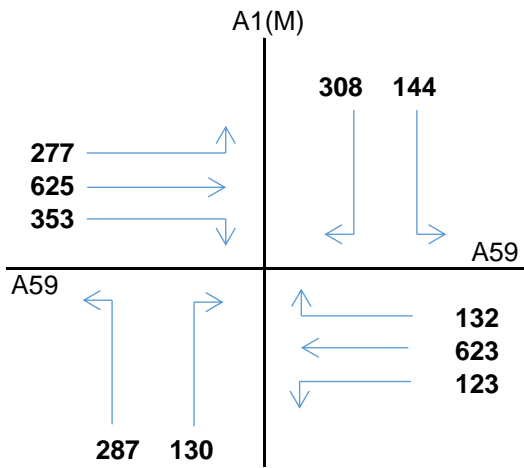
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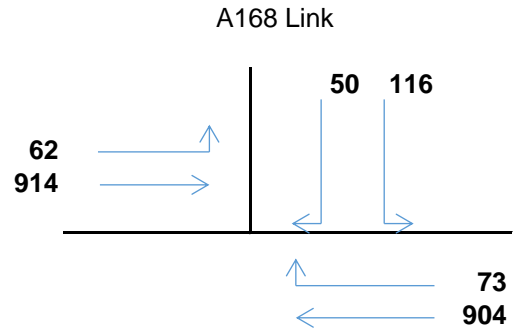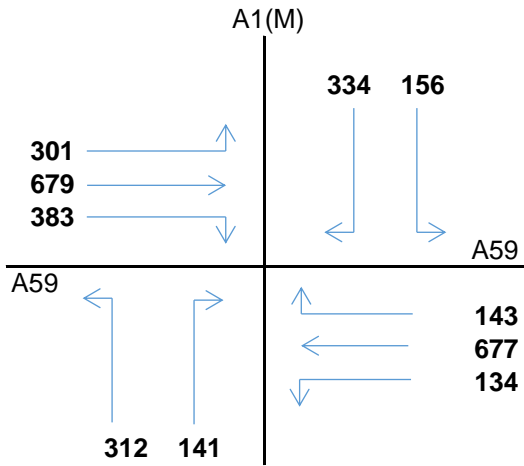## Growthed Vehicle Flows 2025

Morning Peak 07:15-08:15

A1(M)

330   154

296

669

378

A59

A59

141

667

132

307   139

A168 Link

49   115

61

901

72

890

Evening Peak 16:30-17:30

A1(M)

351   157

429

700

315

A59

A59

155

596

104

327   101

A168 Link

59   104

96

861

80

796
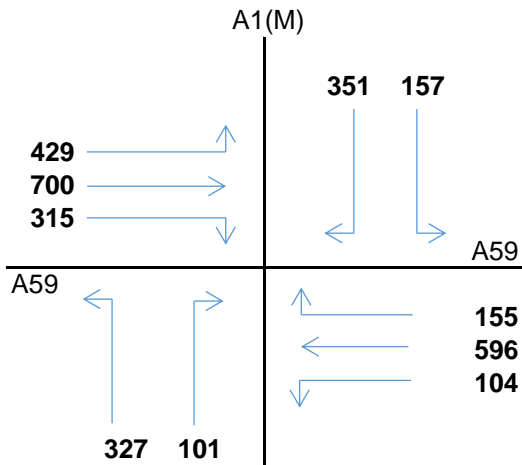
	AM	PM
Growth Factor 2014 - 2025	1.0703	1.0700

FIGURE 3
Growthed Vehicle Flows 2035

Morning Peak 07:15-08:15

A1(M)

334   156

301 →
679 →
383 →

A59

A59

143
677
134

312   141

A168 Link

50   116

62 →
914 →

73
904

Evening Peak 16:30-17:30

A1(M)

356   159

435 →
709 →
319 →

A59

A59

157
604
105

332   102

A168 Link

60   105

98 →
873 →

81
807
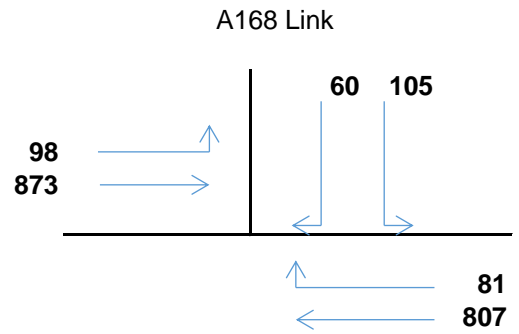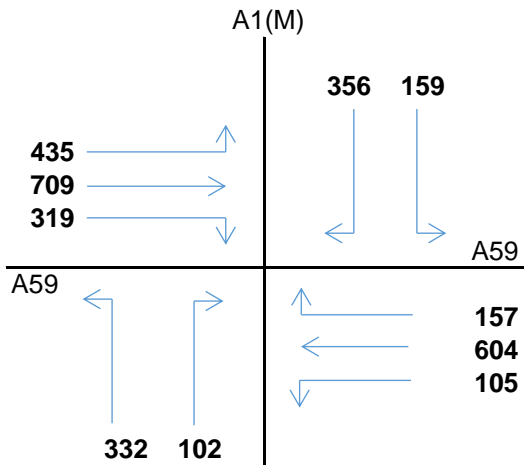
	AM	PM
Growth Factor 2014 - 2035	1.0860	1.0848

FIGURE 4
Committed Development Vehicle Flows

Morning Peak
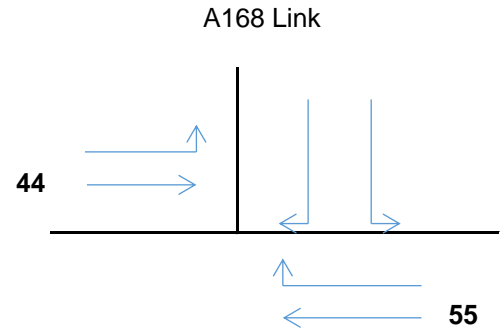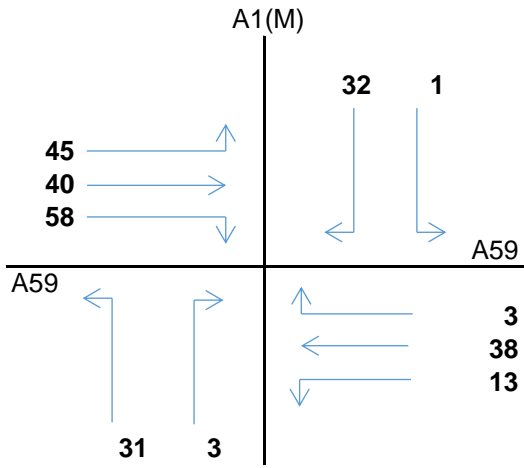
Evening Peak
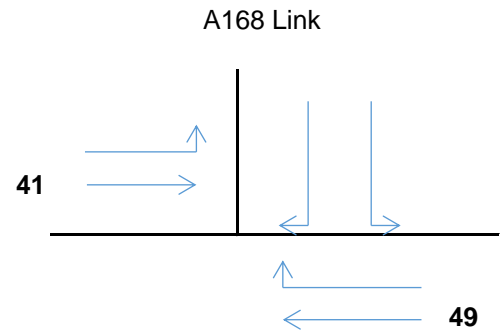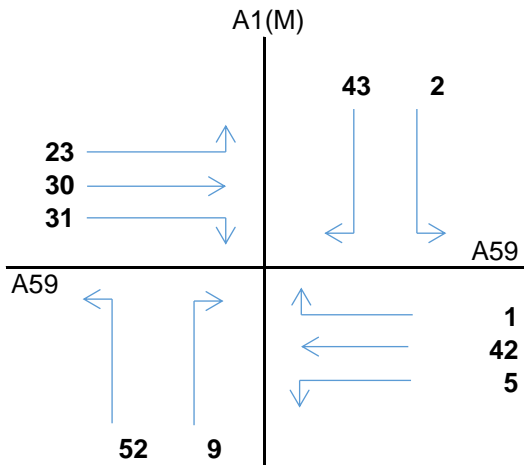
FIGURE 5
Local Plan Vehicle Flows 2025
Flaxby Settlement Option

Morning Peak

A1(M)

51   11

58
170
110

A59

A59

12
198
41

79   30

A168 Link

210

251

Evening Peak

A1(M)

53   9

49
176
79

A59

A59

9
153
27

101   34

A168 Link

219

190
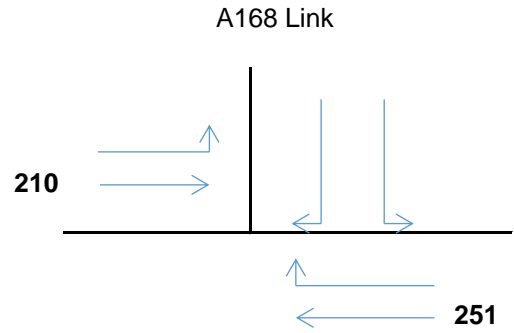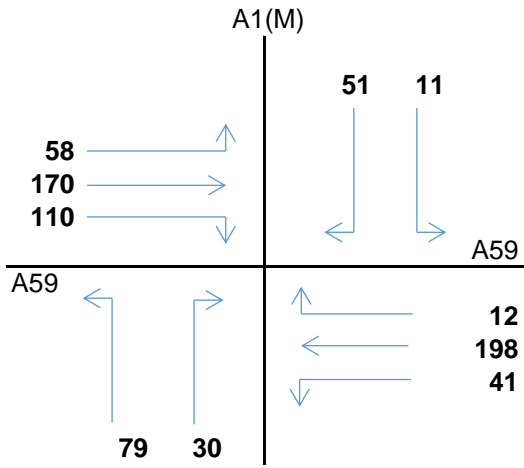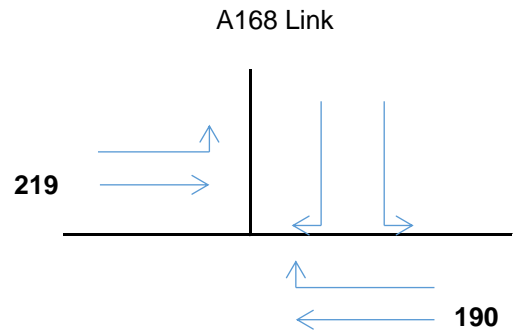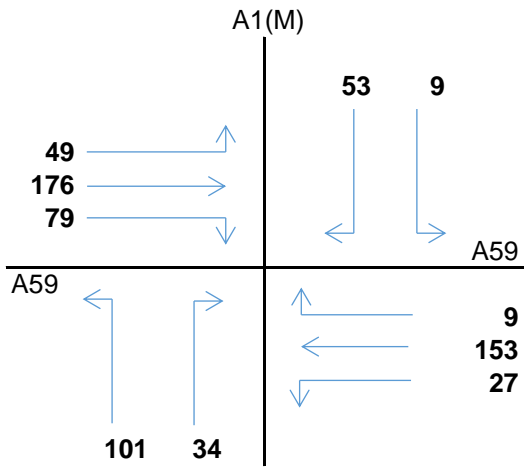
FIGURE 6
Local Plan Vehicle Flows 2025
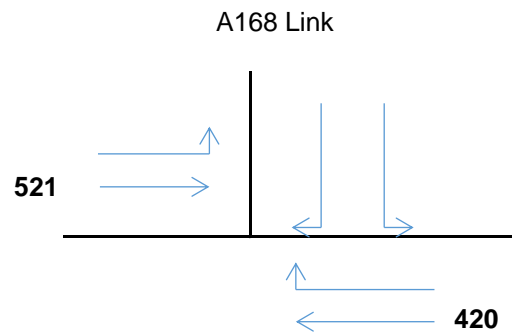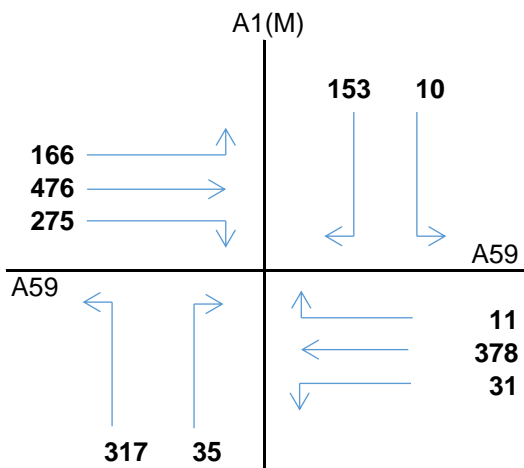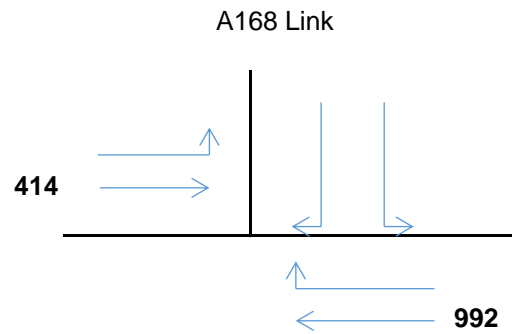**Green Hammerton Settlement Option**

Morning Peak

A1(M)

39   15

27
125
37

A59

A59

23
226
85

52   46

A168 Link

187

334

Evening Peak

A1(M)

24   20

34
195
46

A59

A59

15
117
47

33   75

A168 Link

290

179
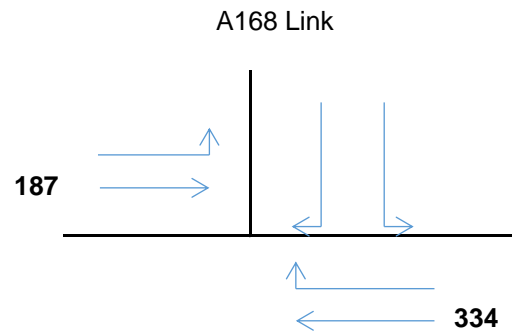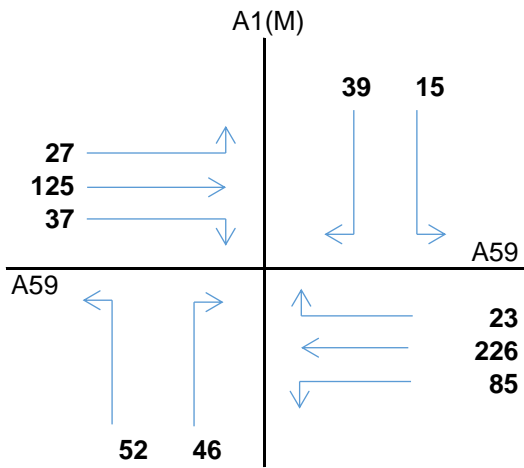
FIGURE 7
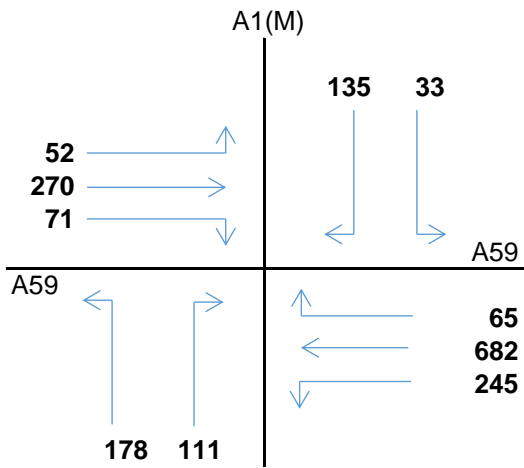## Local Plan Vehicle Flows 2035
Flaxby Settlement Option

Morning Peak

A1(M)

179 13

168

421

345

A59

A59

282 35

13

535

43

A168 Link

469

592

Evening Peak

A1(M)

153 10

166

476

275

A59

A59

317 35

11

378

31

A168 Link

521

420
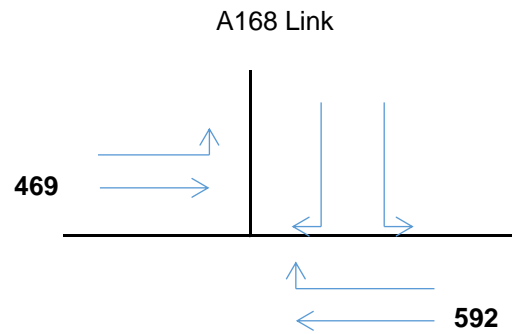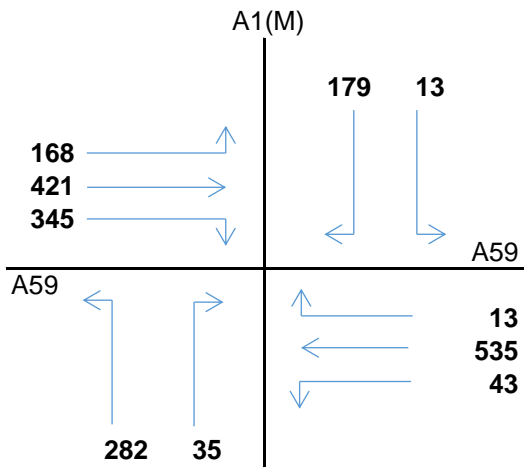
FIGURE 8
Local Plan Vehicle Flows 2035
Green Hammerton Settlement Option

Morning Peak

A1(M)

135   33

52
270
71

A59

A59

65
682
245

178   111

A168 Link

414

992

Evening Peak

A1(M)

45   58

113
588
150

A59

A59

35
262
123

61   223

A168 Link

869

419

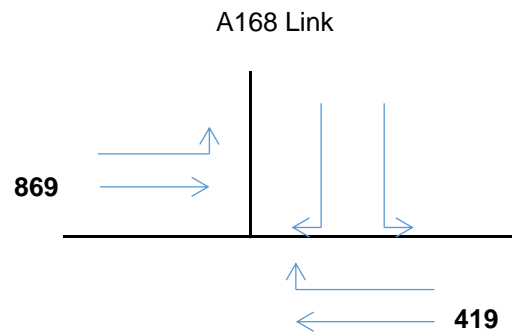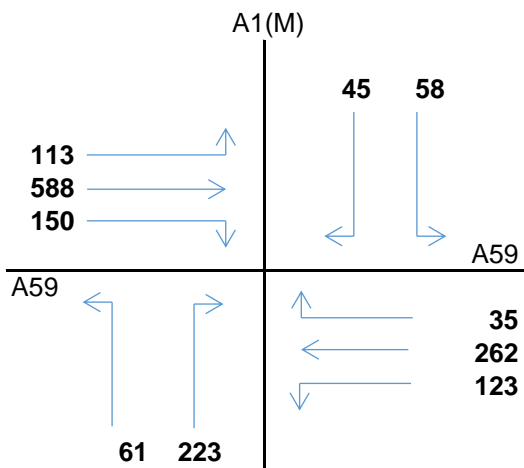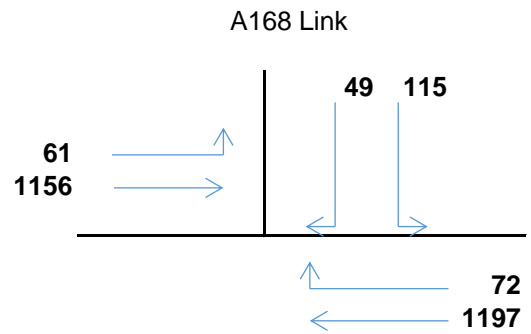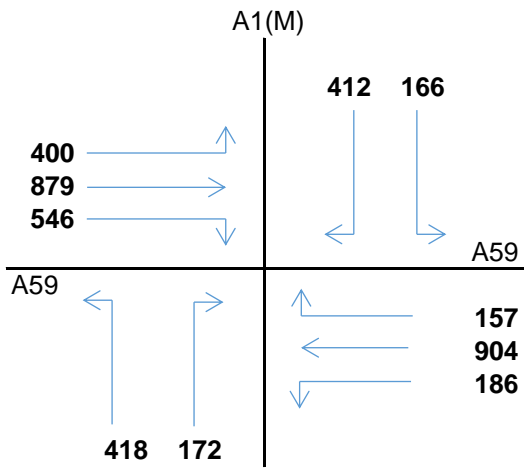# FIGURE 9
Future Vehicle Flows 2025
Flaxby Settlement Option

Morning Peak

A1(M)

412   166

400
879
546

A59

A59

157
904
186

418   172

A168 Link

49   115

61
1156

72
1197

Evening Peak

A1(M)

447   169

501
906
425

A59

A59

166
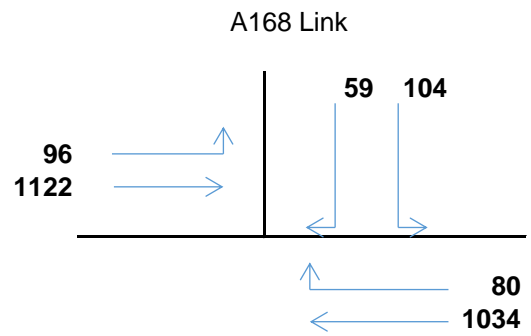791
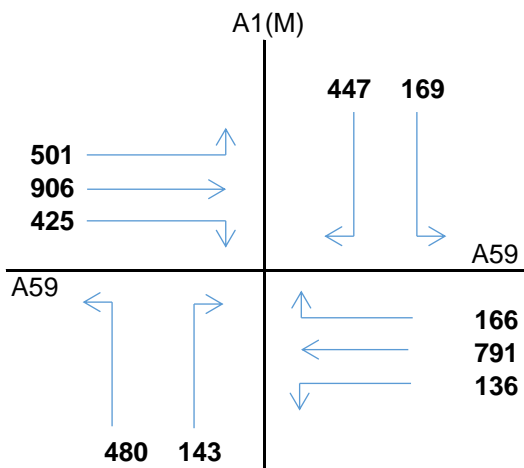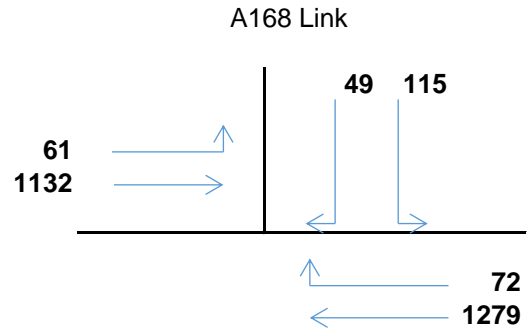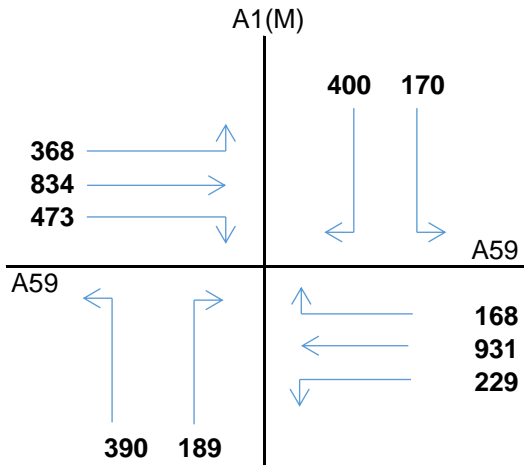136

480   143

A168 Link

59   104

96
1122

80
1034

FIGURE 10
Future Vehicle Flows 2025
Green Hammerton Settlement Option

Morning Peak

A1(M)

400   **170**

368
834
473
                                    A59

A59

                        168
                        931
                        229

390   **189**

A168 Link

49   **115**

61
1132

                        72
                        1279

Evening Peak

A1(M)

418   **179**

487
925
392
                                    A59

A59

                        171
                        755
                        156

412   **184**

A168 Link

59   **104**

96
1192

                        80
                        1023

FIGURE 11
Future Vehicle Flows 2035
Flaxby Settlement Option

Morning Peak

A1(M)

545   **171**

515
1140
786

A59

A59

160
1250
190

625   **179**

A168 Link

50   **116**

62
1428

73
1550

Evening Peak

A1(M)

552   **172**

625
1216
624

A59

A59

170
1025
141

700   **146**

A168 Link
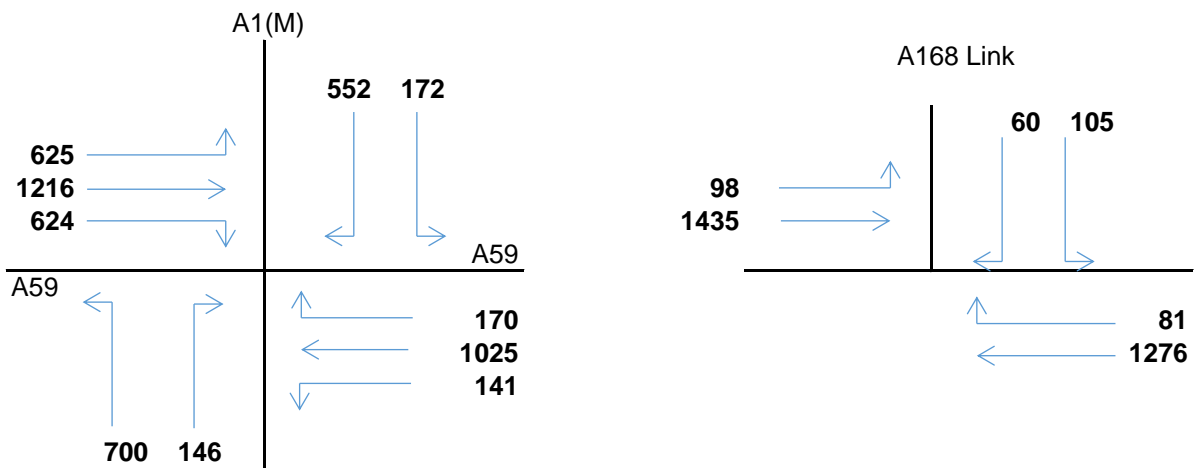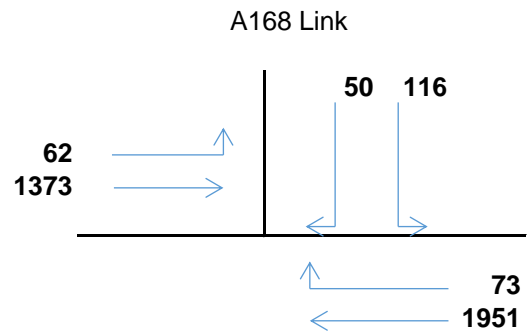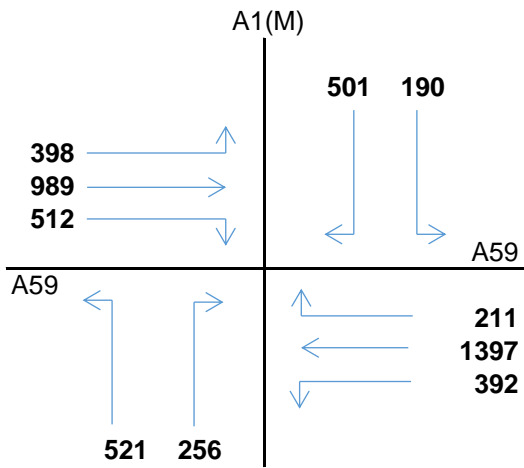
60   **105**

98
1435

81
1276
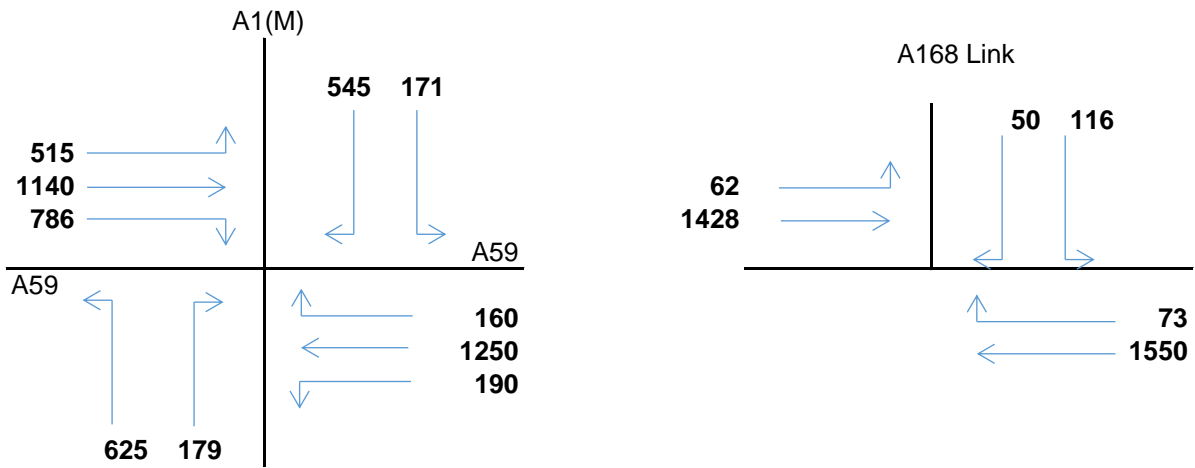
FIGURE 12
Future Vehicle Flows 2035
Green Hammerton Settlement Option

Morning Peak

A1(M)

501   190

398
989
512

A59

A59

211
1397
392

521   256

A168 Link

50   116

62
1373

73
1951

Evening Peak

A1(M)

443   220

571
1328
500

A59

A59

193
909
233

445   334

A168 Link

60   105

98
1783

81
1275