AECOM

Felixstowe Peninsula Area Action Plan (AAP) Cumulative Impact Assessment

Highways England / Suffolk County Council
Final Report

May 2016

60343567 / SS003

Quality information

Document name	Ref	Prepared for	Issue Date
Felixstowe AAP Cumulative Impact Assessment Final Report	60343567 / SS003	Highways England / Suffolk County Council	31/05/16

Originators		Checked by		Verified By		Approved By	
Kelly Davis	29/03/16	Andrew Cuthbert	31/03/16	John Alderman	01/04/16	Andrew Cuthbert	04/04/16
Tania Santiapillai	24/03/16	Kelly Davis	25/03/16				
David Martin	15/03/16	Mark Stapley	29/03/16				
Martyn Gould	29/03/16						
Jon Goni	29/03/16						

Revision history

Revision	Revision date	Details	Name	Position
00	04/04/16	Original Draft Report	Kelly Davis	Senior Consultant
01	15/04/16	Cover Amendment	Kelly Davis	Senior Consultant
02	31/05/16	Final Report: Updated following comments from SCDC and SCC	Andrew Cuthbert	Principal Consultant

Contents

List of Tables

List of Figures

List of Photographs

Executive Summary

Executive Summary

This report has been prepared by AECOM on behalf of Highways England and Suffolk County Council (SCC) to assess the cumulative impact of a number of residential development sites in Felixstowe on the local and Strategic Road Network (SRN).

Suffolk Coastal District Council (SCDC) have produced the Felixstowe Peninsula Area Action Plan (AAP), October 2015, which identifies a number of ‘Preferred Option’ sites for potential development to meet future housing needs. Highways England and SCC have been consulted by SCDC with regards to the potential traffic implications of the ‘Preferred Option’ residential sites. AECOM have been commissioned to assess the cumulative impact of the potential residential developments at key junctions within Felixstowe.

This assessment has been undertaken in accordance with the brief provided by Highways England and SCC (provided in Appendix A). At the request of SCC and SCDC, this report has been updated to include references to the recently published AAP ‘Proposed Submission Document’, April 2016; it does not constitute a full review of the AAP Proposed Submission Document.

The objective of this cumulative traffic impact assessment report is to identify key junctions within the study area that are likely to constrain further traffic growth and those junctions at which traffic capacity mitigation measures may be required. The aim of this report is to allow Highways England and the Local Highway (SCC) and Planning (SCDC) Authorities to understand the potential impact of the AAP with a view to informing the scale of highway infrastructure provision necessary to support it.

The Felixstowe Peninsula AAP covers the communities of Bucklesham, Felixstowe, Kirton, Trimley St Martin and Trimley St Mary. The AAP ‘horizon’ is 2027, which determines the scope of this study. The cumulative assessment considers the impact of up to additional 2,096 residential units some of which are sites listed within the AAP, others relate to currently committed or assumed likely development.

The communities within the Felixstowe AAP boundary are primarily served by the A14 which is also a key strategic route nationally for freight vehicles using the Port of Felixstowe. The A14 / A12 junction (A14 Junction 58) is also included within the boundary of the AAP and is a key junction to consider.

Existing traffic data was used to create a spreadsheet traffic model including eight existing junctions. An additional two ‘potential junctions’ are also included as part of a new link road between Candlet Road and High Road which is a requisite of one of the development sites.

Scenarios with and without development in 2027 were modelled using Junctions 8 software for the non-signalised junctions and LinSig software for the signalised junctions.

In summary, the results of the cumulative impact assessment have led AECOM to form a number of recommendations for further work. as detailed in Chapters 3 and 4 to explore the opportunity for increasing capacity at some junctions which are predicted to experience capacity issues by 2027, with the development sites (and in some cases without) considered. Further work would include identifying potential indicative mitigation measures at the following junctions, where capacity problems have been identified and to model the effectiveness of those mitigation measures:

- Junction A: A14 Junction 58 / A12 / A1156;
- Junction D: A154 Candlet Road / Grove Road / Garrison Lane;
- Junction F: Garrison Lane / High Road West; and
- Junction H: Garrison Lane / Crescent Road / Mill Lane.

Introduction

1

1. Introduction

1.1. Preamble

1.1.1. This report has been prepared by AECOM on behalf of Highways England and Suffolk County Council (SCC) to assess the cumulative impact of a number of residential development sites in Felixstowe on the local and Strategic Road Network (SRN).

1.1.2. Suffolk Coastal District Council (SCDC) have produced the Felixstowe Peninsula Area Action Plan (AAP), October 2015, which identifies a number of 'Preferred Option' sites for potential development to meet future housing needs. Highways England and SCC have been consulted by SCDC with regards to the potential traffic implications of the 'Preferred Option' residential sites. AECOM have been commissioned to assess the cumulative impact of the potential residential developments at key junctions within Felixstowe.

1.1.3. This assessment has been undertaken in accordance with the brief provided by Highways England and SCC (provided in Appendix A). At the request of SCC and SCDC, this report has been updated to include references to the recently published AAP 'Proposed Submission Document', April 2016; it does not constitute a full review of the AAP Proposed Submission Document.

1.1.4. For ease of reference the Felixstowe Peninsula AAP (Preferred Options consultation document, October 2015) is hereinafter referred to as 'the AAP'.

1.2. Objectives

1.2.1. The objective of this cumulative traffic impact assessment report is to identify key junctions within the study area that are likely to constrain further traffic growth and those junctions at which traffic capacity mitigation measures may be required. The aim of this report is to allow Highways England and the Local Highway (SCC) and Planning (SCDC) Authorities to understand the potential impact of the AAP with a view to informing the scale of highway infrastructure provision necessary to support it.

1.3. Background

1.3.1. SCDC'S Preferred Options consultation document was published on 19th October 2015, with a six weeks consultation period until 30th November 2015. Following the original issue of this cumulative impact assessment, the AAP Proposed Submission Document was published on 18th April 2016. A link to the consultation documents can be found in the References section at the end of this report.

1.3.2. The Felixstowe Peninsula AAP covers the communities of Bucklesham, Felixstowe, Kirton, Trimley St Martin and Trimley St Mary. The boundary of the AAP is shown in **Figure 1**.

1.3.3. The AAP 'horizon' is 2027, which determines the scope of this study.

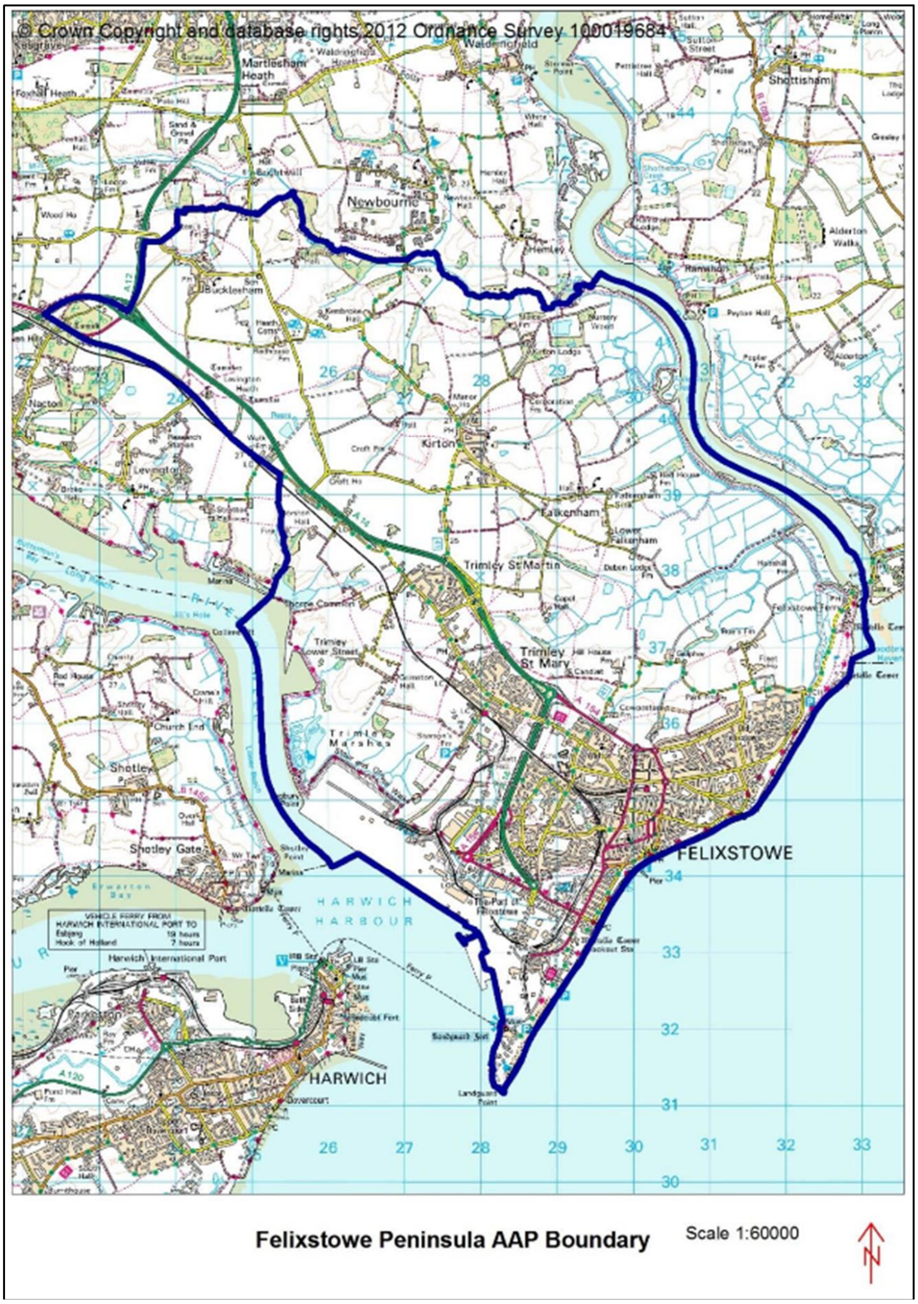

Figure 1: Felixstowe Peninsula AAP Boundary

Source: SCDC

1.3.4. The communities within the Felixstowe AAP boundary are primarily served by the A14 which is also a key strategic route nationally for freight vehicles using the PoF. The A14 / A12 junction (A14 Junction 58) is also included within the boundary of the AAP and is a key junction to consider. The Felixstowe Peninsula AAP Consultation Document states:

"The importance of the A14 is not underestimated in the AAP and it is essential that any future development across the Felixstowe Peninsula take into account the reliance on the A14."

1.3.5. The Preferred Options document identifies seven sites to accommodate approximately 1,135 residential units which are expected to meet the housing needs of the Felixstowe Peninsula up to 2027, summarised in **Table 1**.

Table 1: Summary of Preferred Option Sites

Preferred Policy	Location	Approximate number of units
FPP3	Land at Sea Road, Felixstowe	40
FPP4	Land north of Walton High Street, Felixstowe	400
FPP5	Land north of Conway Close, Felixstowe (Ferry Road)	150
FPP6	Land opposite Hand in Hand Public House, Trimley St Martin	70
FPP7	Land off Howlett Way, Trimley St Martin	360
FPP8	Land off Thurmans Lane, Trimley St Mary	100
FPP9	Land off Bucklesham Road, Kirton	15
	Total:	**1,135**

Source: Felixstowe Peninsula AAP Preferred Options Consultation Document, October 2015

1.3.6. **Appendix A** of this report contains the Inset Map for the AAP which shows the distribution of the site across the settlements of Felixstowe, Trimley St Martin and Trimley St Mary. Details of each site which have been taken from the Preferred Options Consultation documents are also provided in **Appendix A**.

1.3.7. The AAP sets April 2010 as the base date for the plan period. Since that time a number of residential sites have been built, are currently under construction or have planning permission. <u>Applications approved of 5 or more dwellings as at 1st April 2010 to 31st March 2015 were included in the brief for this study and are listed in **Appendix A**. Of those listed, the following three sites have been identified for inclusion in this cumulative impact assessment:</u>

- Walton Green South, High Street, Felixstowe;
- Land west of Ferry Road Residential Centre, Ferry Road, Felixstowe; and
- Land at and adjacent to Mushroom Farm, High Road, Trimley St Martin.

1.3.8. An additional site at Land North of Candlet Road was identified in the brief for inclusion in the assessment, although it does not feature in SCDC's preferred options. In 2015 an outline planning application was made for a mixed use development with up to 560 residential dwellings at the site north of Candlet Road, Felixstowe. The application was refused in June 2015 on the grounds that the site was outside of the defined physical limits of Felixstowe and would lead to an isolated community severed from the existing community of Felixstowe by Candlet Road. Although the application was refused, the applicant has indicated that they are likely to appeal the decision to the Planning Inspectorate, which would have implications for the AAP. It is therefore considered appropriate to assess the potential impact of this site in the cumulative impact assessment. The assessment scenarios listed in paragraph 2.5.2 explain that future scenarios with and without the Candlet Road development have been tested.

1.3.9. Preferred Policy sites FPP3 Land at Sea Road, Felixstowe (40 dwellings) and FPP9 Land off Bucklesham Road, Kirton (15 dwellings) have not been included in the cumulative impact assessment as the traffic implications of these small sites are not thought to be significant enough to merit traffic modelling.

1.3.10. Paragraphs 3.42 – 3.46 of the Proposed Submission Document (April 2016) make reference to the need for a new primary school to serve the needs of the Felixstowe peninsula. A number of potential options are identified. It is acknowledged that provision of a new primary school will generate additional vehicle movements. However, no attempt has been made to include these in the cumulative impact assessment. This is because the location of the new primary school and its relationship with existing schools and their catchments is not known. It would therefore be premature to speculate as to how much vehicular traffic it would generate, over what part of the network. In any case, the nature of primary schools is that they have a predominantly local catchment and the likelihood is that most of the trips generated would be contained within the local area.

1.3.11. A summary of the sites included in the cumulative impact assessment is contained within **Table 5**.

1.4. Scope of the Study

1.4.1. The geographical scope of the study area is presented in **Figure 1.** A number of key junctions were identified in the scoping discussions with Highways England and SCC. The junctions to be included in the cumulative impact assessment have been labelled A – H and are listed in **Table 2**.

Table 2: Key junctions included in the cumulative impact assessment

Junction Identifier	Junction Name	Junction Type
A	A14 J58 / A12 / A1156	Grade separated roundabout
B	Howlett Way / High Road	Roundabout
C	A14 / A154 Candlet Road	Signalised roundabout
D	A154 Candlet Road / Grove Road / Garrison Lane	Roundabout
E	Grove Road / Medical Centre access / Colneis Road / Beatrice Avenue	Roundabout
F	Garrison Lane / High Road West	Signalised cross roads
G	Beatrice Avenue / High Road / Hamilton Road	Roundabout
H	Garrison Lane / Crescent Road / Mill Lane	Signalised cross roads

1.4.2. The locations of the existing junctions are presented in **Figure 2**.

Figure 2: Junction location Map

© Google Maps

1.4.3. The main roundabout at A14 Junction 59 was not identified in the study area brief. This is presumably because it is seen as having a significant amount of spare capacity and it is therefore not necessary to test.

1.4.4. As part of the SCDC's Preferred Policy FPP4 'Land north of Walton High Street, Felixstowe', a new link road is proposed between the A154 Candlet Road and High Street. The potential re-routing of traffic to the link road has been considered in this study, details of which are presented in traffic flow diagrams in **Appendix B** (**Figures 2.3** and **2.4**) and explained further in **Section 2.2**.

1.4.5. The scope of this initial cumulative impact assessment involves:

- Building a spreadsheet traffic model for Felixstowe based on existing data available;
- Using traffic data from strategic traffic counters to validate model data;
- Consideration of the cumulative impact of the sites proposed in the AAP;
- Consideration of the additional impact from the additional site which has been identified by developers north of Candlet Road; and
- Identifying if any of the individual junctions assessed are likely to act as a restriction on any further traffic growth.

1.4.6. Following this initial assessment, there is the potential for further work to be carried out to identify potential indicative mitigation measures at those junctions where capacity problems are identified and to model the effectiveness of those mitigation measures. To clarify, this further assessment would form an additional scope and has not been included as part of this study.

1.4.7. In the case of Junction A (A14 Junction 58 / A12 interchange), AECOM are aware from our previous work (September 2009, Evidence Base for the Core Strategy[1]) of a recommendation to convert the roundabout to full signal control and therefore the potential for signalisation has been considered as part of this study.

[1] *Suffolk Coastal LDF Housing Allocations, Proposed Strategy Transport Appraisal*, AECOM, September 2009

Traffic Forecasting

2

2. Traffic Forecasting

2.1. Methodology

2.1.1. This chapter details the process taken to obtain forecast traffic flows for development sites that have been identified as preferred options in the AAP. This process has involved the following tasks:

- Developing a spreadsheet traffic model for selected Felixstowe junctions;
- Producing traffic flows to a common 2015 base and forecast to 2027 with modelled development;
- Trip generation and distribution of trips across the modelled network;
- Consideration of the cumulative impact of sites proposed in the AAP; and
- Consideration of rerouting via the proposed link road where required.

2.2. Data

2.2.1. Base traffic data was taken from a variety of sources. Due to the short timeframes and the time of the year, collection of new traffic data was not feasible. The data was therefore taken from previous surveys that have been conducted and Transport Assessments (TAs) provided.

2.2.2. The primary data source was traffic flow diagrams supplied by Suffolk County Council. These flows have been derived from the base year flows detailed in the TAs for ‘Land North of Candlet Road, Felixstowe’ in 2014 and ‘Ferry Road, Felixstowe’ in 2012. Checks were undertaken to ensure the accuracy and consistency of this data.

2.2.3. In the spreadsheet model the same peak hours were used throughout the network for simplicity:

- AM Peak: 08:00 - 09:00; and
- PM Peak: 17:00 - 18:00.

2.2.4. Eight existing junctions are considered within the spreadsheet model. An additional two ‘potential junctions’ are also included as part of a new link road between Candlet Road and High Road which is a requisite of one of the development sites (FPP4). The potential junctions are referred to as Junction Y (link road northern access at A154 Candlet Road) and Junction Z (link road southern access at High Street). The eight existing junctions are listed in **Table 3** showing the base year of the data for each junction.

Table 3: Modelled Junctions and Base Data used

Junction Identifier	Junction Name	Base Year Data
A	A14 J58 / A12 / A1156	2015
B	Howlett Way / High Road	2012
C	A14 / A154 Candlet Road	2014
D	A154 Candlet Road / Grove Road / Garrison Lane	2014
E	Grove Road / Medical Centre access / Colneis Road / Beatrice Avenue	2014
F	Garrison Lane / High Road	2014
G	Beatrice Avenue / High Road / Hamilton Road	2014
H	Garrison Lane / Crescent Road / Mill Lane	2014

2.2.5. With the exception of two junctions, the data was sourced from TAs with survey data obtained in 2014. At Junction B, the data came from a TA in 2012 whilst at Junction A the traffic data was obtained from previous work conducted by AECOM, on behalf of Highways England, as part of the East of England Route Strategies work on the A14 in 2015.

2.2.6. For the potential junctions associated with SCDC Preferred Policy FPP4 (Land north of Walton High Street, Felixstowe), data for Junction Z (High Street southern site access) was obtained from a TA conducted in 2009 whilst data for Junction Y (A154 Candlet Road northern site access) was extrapolated from flows at Junction C.

2.2.7. Turning counts were provided in flow diagram format which were checked against the raw data from the TAs to ensure accuracy.

2.2.8. TEMPRO was then utilised to factor the 2009, 2012 and 2014 traffic flows to a common 2015 base for use in the base matrices.

2.2.9. Felixstowe Peninsula AAP is expected guide future development up to 2027 and therefore TEMPRO factors were then extracted to create forecast 2027 flows. Alternative assumptions were used to ensure development flows were not double counted. This involved explicitly not including any of the sites in the Felixstowe area in Suffolk Coastal District Council’s Core Strategy. However, the 560 dwellings planning application off Candlet Road was considered to be in addition to the housing numbers included the TEMPRO growth factors.

2.2.10. The TEMPRO growth factors used are listed in **Table 4**. Trunk Road factors were used for Junctions A and C as they are situated on the Strategic Road Network.

Table 4: TEMPRO Growth Factors

Selection	AM	PM
	2015 Factors	
Felixstowe (Urban All) 2009-2015	1.0356	1.0427
Felixstowe (Urban All) 2012-2015	1.015	1.0175
Felixstowe (Urban All) 2014-2015	1.0049	1.0057
Suffolk Coastal (Urban Trunk) 2014-2015	1.0065	1.0074
	2027 Factors	
	AM	**PM**
Felixstowe (Urban All) 2015-2027	1.1307	1.1401
Suffolk Coastal (Urban Trunk) 2015-2027	1.1756	1.1868

2.3. Development Traffic

2.3.1. Nine development sites have been considered as part of the transport model. As mentioned previously five of these are from the AAP preferred options, the other four are Land north of Candlet Road as explained previously and Walton Green South, Land west of Ferry Road Residential Centre and Land at and adjacent to Mushroom Farm, which are already committed. Sites FPP3: Land at Sea Road, Felixstowe and FPP9 Land off Bucklesham Road, Kirton were not included in the model because the traffic implications of this smaller site is not considered to be significant over the study area. Forecast vehicle trips in the AM and PM have been calculated using a variety of data. Sites with over 50 proposed dwellings were included in the analysis. **Table 5** lists the development sites that have been assessed.

Table 5: Development sites included in the Felixstowe AAP model

Site Reference	Development Site	Indicative size (dwellings)
FPP4	Land north of Walton High Street, Felixstowe	400
FPP5	Land north of Conway Close, Felixstowe	150
FPP6	Land opposite Hand in Hand Public House, Trimley St Martin	70
FPP7	Land off Howlett Way, Trimley St Martin	360
FPP8	Land off Thurmans Lane, Trimley St Mary	100
DC/15/1128/OUT	Land North of Candlet Road, Felixstowe	560
DC/13/3821/OUT	Walton Green South, High Street, Felixstowe	190
DC/13/3069	Land west of Ferry Road Residential Centre, Ferry Road, Felixstowe	200
C13/0219	Land at and adjacent to Mushroom Farm, High Road, Trimley St Martin	66
	Total	**2,096**

2.3.2. Three of the sites have already been granted planning permission and all of these have associated TA’s. Each TA only covered junctions immediate to the development site and therefore flows have not been forecast across the entire modelled network. Assumptions were therefore made to ‘cascade’ the flow throughout all junctions using 2011 Census Journey to Work data where required. Further refinements were made using proportions from the 2015 base flows to understand specific routing.

2.3.3. A rule of 40-45% traffic exiting the network via the A14 towards Ipswich was used for all sites based on analysis of 2011 Census Journey to Work data. For Junction 58 of the A14, turning proportions were calculated by determining the destinations of car trips originating in Felixstowe and vice-versa. Car vehicles instead of PCU values were considered due to the high percentage of HGV traffic continuing along the A14 and because this would be more representative of Journey to Work data and the proposed development sites.

2.3.4. The site ‘Land North of Candlet Road’ has not been granted planning permission but already includes an extensive TA has already been prepared, including a traffic flow diagram, which has been used to calculate development flows.

2.3.5. ‘Land North of Walton High Street, Felixstowe (FPP4)’ also includes a TA and this was reviewed by AECOM in 2014. The initial TA calculated trip rates for 360 dwellings with a retail superstore and employment space. This was then amended to a solely residential development with 400 dwellings in 2015 and work trip distributions were extracted for this site.

2.3.6. For sites without a TA, trip rates were extracted from TRICS based on outline information provided about the type of dwellings expected on the development site at the Preferred Options consultation stage of the AAP. For ‘Land North of Conway Close’ (FPP5), the same TRICS rates were used as in the Ferry Road TA due to their proximity and similarity in housing style. Routing options were grouped together with other nearby sites and adjusted slightly dependent on where the proposed access is likely to be.

2.3.7. All sites were calculated individually and in such a way that specific developments could be included and excluded to calculate the cumulative impact upon any junction should it reach capacity.

2.4. Link Road Rerouting

2.4.1. Suffolk County Council, as the Local Highway Authority, has stated its support for a link road between Candlet Road and the High Street associated with the development on the ‘Land North of Walton High Street (FPP4)’. The link road would facilitate improved access for new and existing residents to the A14 and reduce pressure on the local road network.

2.4.2. Rerouting considerations were included as part of the TA for the above site based on existing traffic flows. The primary rerouting on the modelled network would occur at Howlett Way Roundabout (Junction B) and A14 J60 (Junction C) and for residents living in Trimley St. Martin and Walton. The link road is intended only to serve local journeys and as such only has a localised impact.

2.4.3. It is assumed that only the new development sites in Walton will route via the link road because for the other sites (in the Trimleys and Felixstowe itself) more direct routes are available. The additional complexity of creating separate routes for each site was not feasible within a limited timeframe. This has led to a much larger proportion of traffic continuing straight ahead eastbound-westbound along High Road than turning movements, which may not in reality be realistic routing and should be treated with caution.

2.4.4. Due to the new junctions added for the Link Road, assumptions were made about the traffic that would continue past the junction. At the northern junction, traffic percentages were 100% coming between J60 and Grove Road / Candlet Road (excepting development traffic generated by the Candlet Road site). This is because there are no further accesses or egresses from the highway network here.

2.4.5. At the southern junction, counts were available from 2009 in the Walton Green South TA. These flows were then forecast to a 2027 following the process stated in paragraphs 2.2.8 and 2.2.9. The southern junction also included development flows from the Felixstowe Academy development that was completed in 2015 and was therefore not in operation when the 2014 base traffic flow data was collected.

2.5. Traffic Forecasting Summary

2.5.1. Existing data was utilised to create a spreadsheet model which included building base traffic flow matrices and forecast flows.

2.5.2. The scenarios available from the spreadsheet model are:

- 2015 Base;
- 2027 Base;
- 2027 Base + Development Traffic (excluding Candlet Road); and
- 2027 Base + All Development Traffic.

2.5.3. The '2027 Base + All Development Traffic' scenario includes reassignment of the traffic via the proposed link road whilst the '2027 Base' includes no rerouting.

2.5.4. The '2027 Base' includes background growth but none of the AAP sites. It implicitly includes the growth in Felixstowe Port and also other development sites, for example, those likely to come forward to the east of Ipswich, although the growth associated with those sites is assessed at a district-wide level.

2.5.5. **Appendix B** of this report includes traffic flow diagrams (**Figures 2.1 – 2.4**) for the above scenarios. These flows have been used in the traffic models.

Non-signalised Junction Modelling

3

3. Non-signalised Junction Modelling

3.1. Overview of Non-signalised junction modelling

3.1.1. Junctions 8 is a software package for predicting capacities, queues and delays at priority junctions and roundabouts. The ARCADY module of Junctions 8 has been used to model the non-signalised junctions within the study area. These include:

- Junction A: A14 J58 / A12 / A1156 grade separated large roundabout;
- Junction B: Howlett Way / High Road roundabout;
- Junction D: A154 Candlet Road / Grove Road / Garrison Lane roundabout;
- Junction E: Grove Road / Medical Centre access / Colneis Road / Beatrice Avenue roundabout; and
- Junction G: Beatrice Avenue / High Road / Hamilton Road roundabout.

3.1.2. AECOM representatives carried out a site visit on Tuesday 2nd February 2016 to gain familiarity with the study area. Photographs were taken and junction operation, queue lengths and driver behaviour was observed.

3.1.3. The following scenarios have been modelled using ARCADY, assessed and included in this chapter:

- 2015 Base AM & PM;
- 2027 Forecast AM & PM (no development);
- 2027 + Development (excluding Candlet Road) AM & PM; and
- 2027 + All Development AM & PM.

3.1.4. The ‘RFC’ value refers to the ‘ratio of flow to capacity’ at a junction. If a junction arm has an RFC less than 0.85, it is shown to operate within capacity. RFC’s greater than 0.85 show that a junction arm is over its design capacity. An RFC greater than 1 shows that an arm is over its theoretical capacity.

3.1.5. It should be noted that ARCADY assumes there is never queueing inside the roundabout itself; all queues form behind each give-way line. Furthermore, when the RFC value of any arm is greater than 1, the queue length increases exponentially.

3.1.6. Junction geometry was measured from OS mapping where available; in some cases satellite imagery and on site measurements have been used.

3.1.7. It is important to note that AECOM do not have any observed queue data for all sites that have been modelled and therefore cannot comment on the validity and reliability of the queue lengths calculated and predicted by ARCADY.

3.2. Traffic Flows

3.2.1. The traffic flow data used in the AM and PM scenarios is contained on drawings referenced as:

- Felixstowe AAP Road Network Figure 2.1: ‘2015 Base’ Traffic Flows;
- Felixstowe AAP Road Network Figure 2.2: ‘Forecast 2027’ Traffic Flows (no development);
- Felixstowe AAP Road Network Figure 2.3: ‘2027 Traffic Flows with Development Traffic (excluding Candlet Rd)’; and
- Felixstowe AAP Road Network Figure 2.4 ‘2027 Traffic Flows with All Development Traffic’.

3.3. Junction B: Howlett Way / High Road roundabout ARCADY Results

3.3.1. The Howlett Way / High Road junction is a three arm roundabout which links with the A14 Junction 59 / Kirton Road roundabout via Howlett Way. This junction lies along the High Road just south of Trimley St Martin village.

3.3.2. The proposed Mushroom Farm Development would introduce a fourth arm to Roundabout B. JMS civil & structural consulting engineers (JMS) prepared a Transport Statement (TS) which included a drawing of their proposed site access. This drawing of a four armed roundabout is the most up to date information AECOM have on the geometry of the roundabout for the future year 2027 with development. Therefore, all geometry measurements for the '2027 + Development (excluding Candlet Road)' and '2027 + All Development' scenarios have been measured from this drawing printed to scale. It is worth noting that these measurements are not necessarily the same as the measurements JMS have used to run their ARCADY models in their TS.

3.3.3. The ARCADY results for Junction B are presented in **Table 6**.

Table 6: ARCADY results for Howlett Way / High Road Roundabout (Junction B)

Arms	Max. RFC	Modelled Queue (PCUs)	Max. RFC	Modelled Queue (PCUs)
	AM		PM	
		2015		
A: High Road (west)	0.32	<1	0.24	<1
B: Howlett Way	0.21	<1	0.57	1
C: High Road (east)	0.58	1	0.36	<1
		2027		
A: High Road (west)	0.37	<1	0.27	<1
B: Howlett Way	0.24	<1	0.65	2
C: High Road (east)	0.66	2	0.41	<1
		2027 + Development (excluding Candlet Road)		
A: High Road (west)	0.35	<1	0.26	<1
B: Howlett Way	0.21	<1	0.50	<1
C: High Road (east)	0.58	1	0.38	<1
D: New Site Access	0.05	0	0.02	0
		2027 + All Development		
A: High Road (west)	0.35	<1	0.26	<1
B: Howlett Way	0.21	<1	0.50	1
C: High Road (east)	0.58	1	0.39	<1
D: New Site Access	0.05	0	0.02	0

3.3.4. The ARCADY model results show that all arms of the junction are currently operating well within capacity and are predicted to continue to do so by 2027 in the 'all development' scenario. The ARCADY model also shows that the Candlet Road development only has minimal impact on the High Road East and does not affect Junction B overall.

3.3.5. The addition of Arm D the new site access for the Mushroom Farm development, has resulted in a slight decrease in the RFC values of the existing three arms. This is likely to be because the proposed reconfiguration of the roundabout with the addition of Arm D would remove the existing hatching and therefore increase the width which has a positive effect on the roundabout capacity.

3.4. Junction D: A154 Candlet Road / Grove Road / Garrison Lane roundabout ARCADY Results

3.4.1. Junction D links the A154 Candlet Road from the west to Garrison Lane from the south to Grove Road running east to roundabout E. A 'Toucan' crossing exists on the Garrison Lane arm of the roundabout approximately 10m south of the junction. AECOM do not have signal timing data for the crossing or information on level of crossing demand by pedestrians/cyclists during the morning and evening peak periods. Therefore, the Toucan crossing was modelled using the default settings available in ARCADY.

3.4.2. The ARCADY results for Junction D are presented in **Table 7**.

Table 7: ARCADY results for A154 Candlet Road / Grove / Garrison Lane Roundabout (Junction D)

Arms	Max. RFC	Modelled Queue (PCUs)	Max. RFC	Modelled Queue (PCUs)
	AM		**PM**	
			2015	
A: Grove Road	0.51	1	0.30	<1
B: Garrison Lane	0.39	<1	0.22	<1
C: Candlet Road	0.73	3	**0.86**	5
			2027	
A: Grove Road	0.59	1	0.35	<1
B: Garrison Lane	0.46	<1	0.24	<1
C: Candlet Road	0.83	5	**0.98**	17
		2027 + Development (excluding Candlet Road)		
A: Grove Road	0.69	2	0.42	<1
B: Garrison Lane	0.50	<1	0.30	<1
C: Candlet Road	**0.91**	9	**1.09**	**60**
		2027 + All Development		
A: Grove Road	0.72	3	0.44	<1
B: Garrison Lane	0.53	1	0.36	<1
C: Candlet Road	**1.01**	27	**1.14**	**85**

3.4.3. The ARCADY model results show that Candlet Road is already operating above its design capacity during the PM peak with an RFC of 0.86 on Arm C. The addition of development traffic (excluding Candlet Road) in 2027 results in Candlet Road being well over its theoretical capacity in the PM peak with an RFC of 1.09. Significant queues are predicted on the Candlet Road arm, which, due to the limitations of ARCADY, should be read with caution as existing queue length data was not available for this roundabout. As expected from the 2015 results, the PM peak experiences more congestion than the AM peak and Arm C is pushed over its theoretical capacity with an RFC of 1.14 by 2027 with all development considered. In the AM peak, Arm C of the roundabout would be over its design capacity by 2027 with development (excluding Candlet Road). The ARCADY results show that the Candlet Road development is predicted to add to capacity and queuing issues on Arm C.

3.4.4. AECOM recommend that further work is undertaken in order to assess the impact of development traffic at Junction D. This could include:

- obtaining up to date manual classified turning counts and queue length data or collecting this data if unavailable;
- obtaining signal timing data for the Toucan crossing;

- Carrying out a pedestrian/cyclists count in the morning and evening peak at the Toucan crossing if this data is not already available;
- Calibrating the existing model with the above data to ensure that the modelled queue accurately represents observed levels of queuing.

3.4.5. The Candlet Road approach is currently hatched down from two lanes to one. AECOM understand that this hatching may have been introduced recently as part of a safety scheme associated with the introduction of the Toucan crossing, in order to avoid high vehicle speeds on the roundabout. It would appear that reinstating a second lane on the Candlet Road approach could mitigate the predicted capacity and queueing issues on this arm of the roundabout. However, any proposals to amend these markings would need to be carefully considered. Simply removing the hatching might not be satisfactory. It may be that a scheme to reintroduce a second lane on Candlet Road would require some realignment of the approach to prevent the recurrence of the safety issue that prompted the hatching to be implemented. In advance of such a scheme, AECOM recommend that the roundabout is modelled with new kerb line geometry (potentially with part of the hatched area reinstated as available carriageway whilst maintaining entry deflection) to see what effect this would have on the operation of the roundabout.

3.5. Junction E: Grove Road / Medical Centre access / Colneis Road / Beatrice Avenue roundabout ARCADY results

3.5.1. Junction E is a large non circular roundabout with 5 arms; Grove Road from the west, Beatrice Avenue running south to Roundabout G, the Surgery Access arm provides a link to Grove Medical Centre to the north and Links Avenue and Colneis Road run almost parallel to each other towards the east. Both Links Avenue and Colneis Road run through residential areas and Colneis Road connects to Ferry Road opposite Kingsfleet Primary School.

3.5.2. The ARCADY results for Junction E are presented in **Table 8**.

Table 8: ARCADY results for Grove Road / Medical Centre access / Colneis Road / Beatrice Avenue roundabout (Junction E)

Arms	Max. RFC	Modelled Queue (PCUs)	Max. RFC	Modelled Queue (PCUs)
	AM		**PM**	
			2015	
A: Grove Road	0.49	<1	0.51	1
B: Surgery Access	0.06	0	0.11	<1
C: Links Avenue	0.04	0	0.01	0
D: Colneis Road	0.28	<1	0.10	<1
E: Beatrice Avenue	0.40	<1	0.25	<1
			2027	
A: Grove Road	0.56	1	0.59	1
B: Surgery Access	0.07	0	0.14	<1
C: Links Avenue	0.05	0	0.01	0
D: Colneis Road	0.32	<1	0.12	<1
E: Beatrice Avenue	0.46	<1	0.29	<1
			2027 + Development (excluding Candlet Road)	
A: Grove Road	0.63	2	0.71	2
B: Surgery Access	0.08	0	0.16	<1
C: Links Avenue	0.05	0	0.01	0
D: Colneis Road	0.44	<1	0.19	<1
E: Beatrice Avenue	0.52	1	0.35	<1
			2027 + All Development	
A: Grove Road	0.65	2	0.71	2
B: Surgery Access	0.08	0	0.16	<1
C: Links Avenue	0.05	0	0.01	0
D: Colneis Road	0.44	<1	0.20	<1
E: Beatrice Avenue	0.52	1	0.35	<1

3.5.3. The ARCADY model results show that all arms of the junction are currently operating well within capacity and are predicted to continue to do so by 2027 in the ‘all development’ scenario. The RFC values indicate that Grove Road is the busiest arm on the roundabout and show that the addition of Candlet Road development traffic will have a negligible impact on arms A and D of the roundabout.

3.5.4. It is worth re-iterating that AECOM do not have any observed queue data and therefore cannot comment on the validity and reliability of the queue lengths predicted by ARCADY.

3.6. Junction G: Beatrice Avenue / High Road / Hamilton Road roundabout ARCADY results

3.6.1. Junction G lies along the High Road and is the closest roundabout to Felixstowe railway station. Located in a heavily built-up residential area close to the Town Centre. It is locally known as 'The Orwell' roundabout because of The Orwell hotel and restaurant that is situated on the south eastern corner of the roundabout. An advisory cycle lane runs along High Road on the eastbound and westbound carriageways stopping short of the roundabout on either side.

3.6.2. The ARCADY results for Junction G are presented in **Table 9**.

Table 9: ARCADY results for Beatrice Avenue / High Road / Hamilton Road roundabout (Junction G)

Arms	Max. RFC	Modelled Queue (PCUs)	Max. RFC	Modelled Queue (PCUs)
	AM		**PM**	
		2015		
A: Beatrice Avenue	0.37	<1	0.36	<1
B: High Road East	0.58	1	0.31	<1
C: Hamilton Road	0.39	<1	0.39	<1
D: High Road West	0.42	<1	0.34	<1
		2027		
A: Beatrice Avenue	0.44	<1	0.42	<1
B: High Road East	0.68	2	0.36	<1
C: Hamilton Road	0.46	<1	0.45	<1
D: High Road West	0.50	<1	0.40	<1
		2027 + Development (excluding Candlet Road)		
A: Beatrice Avenue	0.49	<1	0.44	<1
B: High Road East	0.72	2	0.38	<1
C: Hamilton Road	0.48	<1	0.50	<1
D: High Road West	0.51	1	0.42	<1
		2027 + All Development		
A: Beatrice Avenue	0.50	<1	0.45	<1
B: High Road East	0.72	3	0.38	<1
C: Hamilton Road	0.48	<1	0.50	<1
D: High Road West	0.51	1	0.42	<1

3.6.3. The ARCADY model results show that all arms of the junction are currently operating well within capacity and are predicted to continue to do so by 2027 in the 'all development' scenario. The RFC values are currently below 0.60. In the '2027 + All Development' scenario the highest RFC value is 0.72 on Arm B (High Road East) in the AM peak. The ARCADY model shows that the addition of Candlet Road development traffic has a negligible impact on the Beatrice Avenue arm of the roundabout.

3.6.4. It is worth re-iterating that AECOM do not have any observed queue data and therefore cannot comment on the validity and reliability of the queue lengths predicted by ARCADY.

3.7. Summary and Recommendations

3.7.1. The ARCADY results found that Junctions B (Howlett Way / High Road), E (Grove Road / Colneis Road / Beatrice Avenue) and G (Beatrice Avenue / High Road / Hamilton Road) operate well within capacity at present and are predicted to continue to do so in 2027 with all development considered. It should be noted however, that AECOM do not have any observed queue data and therefore cannot comment on the validity and reliability of the queue lengths predicted by ARCADY.

3.7.2. The ARCADY results for Junction D (A154 Candlet Road / Grove Road / Garrison Lane) show that the junction is starting to experience capacity problems on Arm C (Candlet Road) in the PM peak. This is predicted to get worse by 2027 and when development traffic is considered, the capacity problems are also apparent in the AM peak on Arm C (Candlet Road). Capacity issues and queuing is significantly worse with the addition of Candlet Road development traffic. AECOM recommend that further work would be required in order to quantify the potential to mitigate the impact of development traffic at Junction D.

3.7.3. The Candlet Road approach is currently hatched down from two lanes to one. AECOM understand that this hatching may have been introduced recently as part of a safety scheme associated with the introduction of the Toucan crossing, in order to avoid high vehicle speeds on the roundabout. It would appear that reinstating a second lane on the Candlet Road approach could mitigate the predicted capacity and queueing issues on this arm of the roundabout. However, any proposals to amend these markings would need to be carefully considered. Simply removing the hatching might not be satisfactory. It may be that a scheme to reintroduce a second lane on Candlet Road would require some realignment of the approach to prevent the recurrence of the safety issue that prompted the hatching to be implemented. In advance of such a scheme, AECOM recommend that the roundabout is modelled with new kerb line geometry (potentially with part of the hatched area reinstated as available carriageway whilst maintaining entry deflection) to see what effect this would have on the operation of the roundabout.

Signalised Junction Modelling

4

4. Signalised Junction Modelling

4.1. Overview of Signalised junction modelling

4.1.1. LinSig is a computer software package for the assessment and design of traffic signal junctions either individually or as a network comprised of a number of junctions. LinSig has been used to model the following junctions within the study area:

- Junction A: A14 Junction 58 / A12 / A1156 Interchange;
- Junction C: A14 Junction 60 / A154 Candlet Road;
- Junction F: A154 Garrison Lane / High Road; and
- Junction H: A154 Garrison Lane / Mill Lane / Crescent Road.

4.1.2. Junction A is currently un-signalised. The junctions located at sites C, F and H operate under traffic signal control.

4.1.3. AECOM representatives carried out a site visit on Tuesday 2nd February 2016. Check measurements and photographs were taken and road markings recorded. Junction operation, queue lengths and driver behaviour was observed.

4.1.4. It should be noted that, with the exception of Junction A, AECOM do not have observed queue data and therefore cannot comment on the validity and reliability of the queue lengths predicted by LinSig. The queues were observed on site but this was not sufficient to complete a formal validation of the base models.

4.1.5. The following scenarios have been modelled in LinSig:

- 2015 Base AM & PM;
- 2027 Forecast AM & PM (no development);
- 2027 + Development (excluding Candlet Road) AM & PM; and
- 2027 + All Development AM & PM.

4.1.6. The degree of saturation (DoS) is a ratio of demand to capacity on each approach to the junction, with a value of 100% meaning that demand and capacity are equal and no further traffic is able to progress through the junction. Values over 90% are typically regarded as suffering from traffic congestion, with queues of vehicles beginning to form. The term practical reserve capacity (PRC) is often used to refer to the available spare capacity at a junction. A negative PRC indicates that the junction is over capacity.

4.1.7. The technical details relating to the LinSig modelling are provided in **Appendix D**.

4.1.8. The supporting information provided for this assessment includes controller specifications for the three existing signal controlled junctions. The signal timings, intergreens, minimum greens, phase delays and timetable data used in the LinSig modelling have been taken from the traffic signal controller specifications.

4.1.9. Junction A (A14 Junction 58 / A12 / A1156) currently operates as a roundabout with priority junctions on the five entry arms. To model the impact of potential signalisation the junction has been assessed with LINSIG to provide a directly comparative assessment.

4.2. Junction A: A14 Junction 58 / A12 / A1156 Interchange LinSig results

4.2.1. Junction A is a five arm grade separated roundabout that is located approximately half way between Ipswich and Felixstowe. The A14 / A12 interchange is in a rural area and is surrounded by agricultural land with no adjacent development.

4.2.2. There is a ‘free-flow’ left turn lane from the A14 eastbound off-slip that allows northbound traffic to continue left onto the A12 without the need to give way at the roundabout.

Photograph 1: Junction 58 viewed from the start of the A14 westbound on-slip

Photograph 2: Junction 58 viewed from the intersection of the roundabout and the A12 southbound

Photograph 3: Junction 58, A14 eastbound off-slip

Note 'free-flow' left lane onto the A12 northbound.

Photograph 4: Junction 58, south side circulatory carriageway

Note hatched area forming one lane on the roundabout.

4.2.3. The '2015 Base' traffic flow data for Junction A is shown in **Figure 3**, flows in PCUs: AM=BLUE PM= RED.

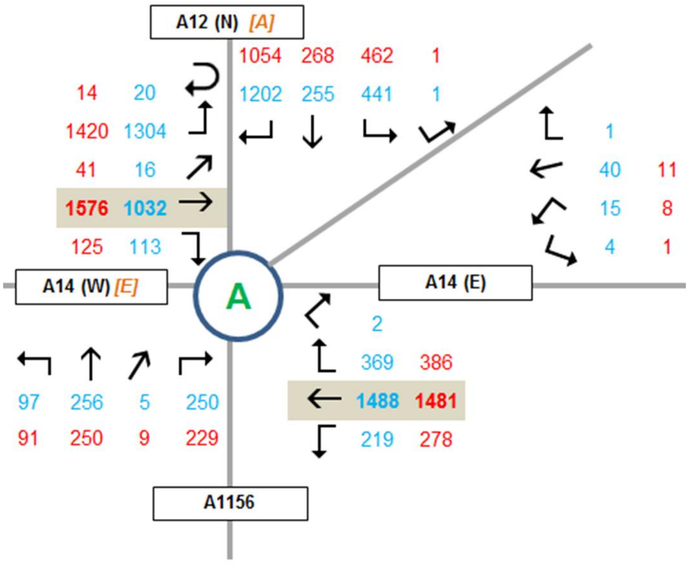

Figure 3: '2015 Base' traffic flows (Junction A)

4.2.4. The significant movements at the junction during the AM and PM peaks are:

- A14 eastbound off-slip to the A12 northbound:

  This movement is via a 'free-flow' left turn lane that bypasses the roundabout so it does not form part of the junction performance assessment.
- A12 southbound right turn movement to the A14 westbound on-slip:

  This movement is by far the largest assessed turning movement at the junction, with a flow that is approximately two and a half times greater than the next largest assessed turning traffic movement and opposes the other two key movements at the roundabout; the A14 westbound off-slip and the A1156 approach.
- A12 southbound left turn movement to the A14 eastbound on-slip:

  This movement has limited impact as it leaves the roundabout after using only one section of the circulatory carriageway.

4.2.5. Of the movements listed above the most significant in terms of its impact on junction performance is the A12 southbound right turn movement to the A14 westbound on-slip. Traffic making this manoeuvre must pass through three sections of circulating carriageway. The current road markings direct drivers to use the offside lane only. The need to restrict drivers to a single lane is due to the layout of circulatory carriageway on the south side of the roundabout as shown in **Photograph 4**.

4.2.6. Junction 58 has been modelled using LinSig to explore the feasibility of placing the roundabout under traffic signal control. The existing carriageway layout has been replicated in LinSig but with the addition of traffic signals. A network layout diagram of the existing un-signalised layout of Junction A is provided in **Figure 4**.

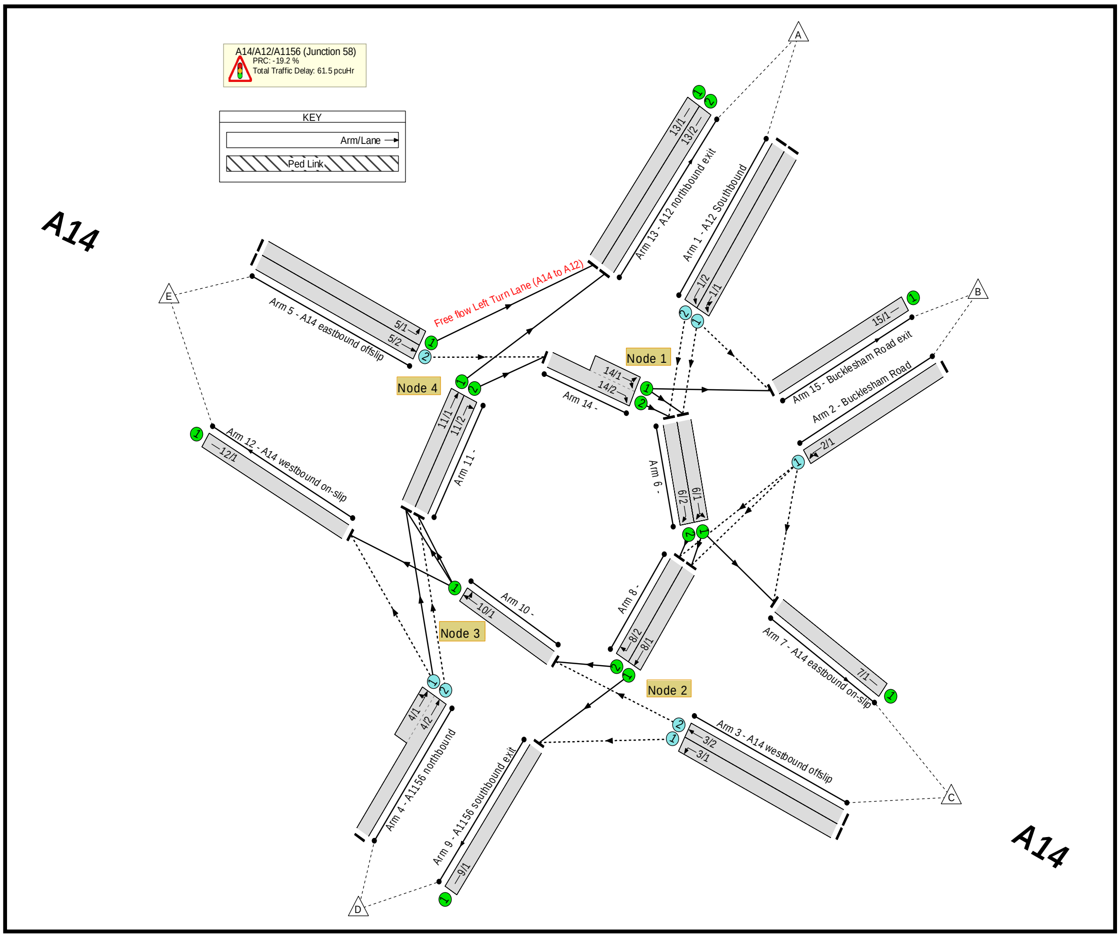

Figure 4: Junction A: Network Layout Diagram Un-signalised

4.2.7. In their 2007 publication ‘Signal Controlled Roundabout Methodology’: Chard, Thomson & Bargh, suggest that when designing for signal control at roundabouts;

“leaving one or more entries under priority control often provides better progression for all traffic through the roundabout. Often a roundabout that will not work with all arms signalled, will work if one or more arms are left as give-way. Full signal control requires more storage space for queuing within the roundabout.”

4.2.8. The methodology for the LinSig modelling is as follows: LinSig has been used to model 5 scenarios with the results for the AM & PM periods generated for each. This enables a comparison between the scenarios to be made.

- Roundabout un-signalised (existing);
- Node 1 Signalised (A12);
- Nodes 1 & 2 Signalised (A12 & A14 West Bound);
- Nodes 1, 2 & 3 Signalised (A12, A14 West Bound & A1156) and
- Nodes 1, 2, 3 & 4 Signalised (A12, A14 West Bound, A1156 & A14 East Bound).

4.2.9. It would be possible to model other node combinations such as 1 & 4, but in order to avoid over complexity at this stage the above methodology has been adopted.

4.2.10. Bucklesham Road has not been modelled as signalised due to the low traffic flows on this approach.

4.2.11. An ARCADY assessment of Junction A was carried out as part of AECOM Technical Note: ‘Package 2 A14 Junction Assessment’, dated October 2015. The performance of the existing roundabout is contained within sections 4.31 to 4.34 of the TN and the results for the AM and PM peak periods are tabulated. The observed maximum queues on site were also recorded. The assessment highlighted the arms of the junction that were nearing capacity during the peaks.

4.2.12. The observed queue lengths have been used to assist in validating a base LinSig model for the existing un-signalled roundabout. Priority junctions can be represented in LinSig although not with the same degree of accuracy as ARCADY. However, for the purposes of this Technical Note a comparison between the un-signalised junction and the LinSig output for the different scenarios provides a measure of the impact of part or full signalisation of the roundabout.

4.2.13. The cycle time optimiser in LinSig has been used to select the most appropriate cycle time for the AM and PM peaks of 60 seconds. This value lies within the range recommended in *LTN 1/09: Signal Controlled Roundabouts.*

4.2.14. LinSig has a range of settings that allow selected lanes to be ‘weighted’ to try and avoid excessive queueing and blocking back. These settings have been used to maintain queue lengths on the circulatory carriageway at an acceptable level.

4.2.15. The excess queue lengths facility in LinSig for individual lanes has, where required, been set to approximately two thirds of the lane capacity. This allows for variations in queuing over the period assessed as per JCT guidance.

4.2.16. The output details for the ‘2015 Base’ Flows AM & PM peaks for all five scenarios are displayed in **Table 10**.

2015 Flows	ROUNDABOUT UNSIGNALISED				NODE 1 SIGNALISED				NODES 1 & 2 SIGNALISED				NODES 1, 2 & 3 SIGNALISED				NODES 1, 2, 3 & 4 SIGNALISED			
	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	n/a		n/a		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec	
Lane	Junction PRC = -19.2%		Junction PRC = -19.7%		Junction PRC = -19.2%		Junction PRC = -19.7%		Junction PRC = -15.9%		Junction PRC = -14.8%		Junction PRC = -56.1%		Junction PRC = -27.1%		Junction PRC = -55.8%		Junction PRC = -27.1%	
	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1: A12 southbound	93.8	6	83.8	2.5	54.3	6.8	58.4	7.6	60.5	8.1	71.6	10.6	81.4	12.2	79.3	12	66.2	9.3	79.3	12
1/2: A12 southbound	99	14.6	97.8	11.4	93.6	24.1	84.3	16.4	104.3	54.7	103.3	44.8	140.4	206	114.4	89.7	114.1	100.7	114.4	89.7
2/1: Bucklesham Road	99.4	3.8	98.5	2.2	35.7	1	12	0.2	30.4	0.9	9.2	0.2	18.2	0.6	7.7	0.2	66.2	1.8	19.5	0.4
3/1: A14 Westbound off-slip	32.5	0.2	99.8	8.2	32.5	0.2	99.8	12.8	51.4	3.7	53.1	4.5	41.8	3.3	49.9	4.4	83.6	5.8	49.9	4.4
3/2: A14 Westbound off-slip	102.1	30.3	99.4	9.3	102.1	28.6	99.3	15.4	86.3	8.7	72.9	7.1	70.1	6.7	68.6	6.8	140.2	62.8	68.6	6.8
4/1 & 4/2: A1156 Northbound	107.3	38.8	107.7	36.8	107.3	37.7	107.7	36.6	101.3	23.5	102.5	27.2	116.2	54.1	112.3	43.3	130.7	82.8	112.3	43.3
5/2 A14 eastbound off-slip	18	0.1	99.3	6.2	18	0.1	97.2	7.7	18.2	0.1	79.5	3.7	17.5	0.4	61.6	2.5	28.7	2	32.3	2.5
6/1: NE circulatory c/way	53	0.6	54.3	0.6	53	0.6	54.3	0.6	53.7	0.6	54.9	0.6	52.1	0.6	53.9	0.6	50.9	0.5	53.9	0.6
6/2: NE circulatory c/way	61.2	0.8	53.6	0.6	61.2	0.8	53.6	0.6	58.6	0.8	51.9	0.6	43.6	0.4	46.9	0.5	53.6	0.6	46.9	0.5
8/1: Eastern circulatory c/way	19.4	0.1	20.3	0.1	19.4	0.1	20.3	0.1	29.8	2.7	33.8	3	32.3	1.4	34.8	2.8	26.4	2	34.8	3.3
8/2: Eastern circulatory c/way	62.9	0.8	53.9	0.6	62.9	0.8	53.9	0.6	92.9	7.1	87	3.5	75.7	3.7	81	2.3	75.6	2.7	81	3.2
10/1: Southern circulatory c/way	77.8	1.7	70.3	1.2	77.8	1.7	70.3	1.2	75.7	1.6	68.6	1.1	85.7	13.8	89.1	11.4	89.7	12.6	89.1	10.9
11/1: Western circulatory c/way	31.6	0.2	32.5	0.2	31.6	0.2	32.5	0.2	32	0.5	32.5	0.5	30.2	0.3	31.1	0.3	37.2	0.3	51.9	3.9
11/2: Western circulatory c/way	12.1	0.1	11.1	0.1	12.1	0.1	11.1	0.1	12.8	0.1	11.7	0.1	11.1	0.6	10.7	0.6	15.6	0.3	17.8	0.7
14/1 & 14/2: Northern circulatory c/way	18.9	0.1	19.8	0.1	87	9.1	84.8	8.8	69.1	7	58.2	6.6	41.3	6.7	48.3	6.2	49.9	5.6	48.3	5.7

Table 10: Junction A: '2015 Base' Flows AM & PM peaks

In this and subsequent tables, red text is used to indicate elements of the junction that are over capacity.

4.2.17. **Roundabout un-signalised (existing layout).**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A14 westbound off-slip and the A1156 northbound
- During the PM peak this includes the A1156 northbound.
- These results coincide with the output from the ARCADY modelling.

4.2.18. **Node 1 (A12) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A14 westbound off-slip and the A1156 northbound.
- During the PM peak this includes the A1156 northbound.
- This scenario does not produce any change in terms of junction PRC when compared to the existing un-signalled layout.

4.2.19. **Nodes 1 & 2 (A12 & A14 westbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM and PM peaks this includes the A12 southbound (offside lane) and the A1156 northbound.
- With two nodes signalised the overall junction PRC improves when compared to the previous models of the roundabout un-signalled and with one node signalised. However, an examination of the queue lengths shows a more complex picture with this option achieving an improved PRC by capacity gains on the A14 westbound off-slip and the A1156 but at the expense of the A12 southbound. By exerting restraint on the major right turn movement from the A12 southbound offside the model has been able to assist the A14 and A1156.

4.2.20. **Nodes 1, 2 & 3 (A12 & A14 westbound & A1156) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM and PM peaks this includes the A12 southbound (offside lane) and the A1156 northbound.
- With three nodes signalised the overall junction PRC reduces significantly when compared to the previous options at the roundabout. Capacity gains on the A14 westbound off-slip have been at the expense of the A12 southbound and the A1156.
- The reduced PRC may be due to the introduction of signals at node 3 (A1156). When node 3 was un-signalised, westbound traffic could exit from the circulatory carriageway on the south side of the roundabout without being stopped. This free-flow movement also allowed vehicles on the A1156 more opportunity to enter the roundabout using gap acceptance.
- The introduction of control by traffic signals at node 3 highlights the capacity limits imposed by the current layout with just a single lane on the southern circulatory carriageway, resulting in capacity issues.

4.2.21. **Nodes 1, 2, 3 & 4 (A12 & A14 westbound & A1156 & A14 eastbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip and the A1156 northbound.
- During the AM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- The signalisation of all four nodes generates similar results to the previous three node option and does not offer any improvements.

4.2.22. **2015 Base Year LinSig results Summary**

- The signalisation of nodes 1 & 2 generates the best results, but still indicates capacity issues on the A12 southbound and the A1156. The cause of this lies in both the demand flows at the roundabout and the current carriageway layout.
- There is a significantly large right turn movement from the A12 southbound to the A14 westbound that needs to be catered for without adversely affecting other movements trying to enter the roundabout.
- The circulating carriageway on the south side of the roundabout is hatched forming a single lane resulting in the right turn movement being restricted to a single lane from the A12 southbound entry round to the A14 westbound on-slip exit arm.
- With this restriction the LinSig output shows that the introduction of traffic signals on the roundabout will not deal effectively with the existing levels of traffic or the address capacity issues highlighted by the ARCADY model.
- If the roundabout layout and carriageway markings were to be revised to permit the A12 right turn to enter the roundabout in two lanes and proceed to a two lane exit at the A14 westbound on-slip, then the results for the two or even three node signalisation could have the potential to be significantly improved. This option could be explored with further LinSig modelling.

4.2.23. The '2027 Forecast' traffic flow data for junction 58 is shown in **Figure 5** (flows in PCUs).

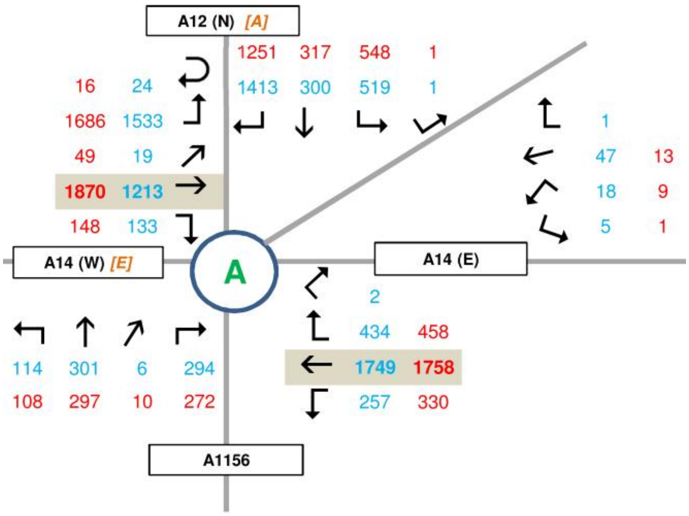

Figure 5: '2027 Forecast' traffic flows (no development) (Junction A)

4.2.24. When compared to the 2015 base flows, all traffic movements at the junction have increased. The A12 southbound right turn movement to the A14 westbound on-slip remains the largest traffic movement at the junction and has increased by approximately 200 PCUs during the AM and PM peaks.

4.2.25. The LinSig output details for the '2027 forecast' flows AM & PM peaks, for all five scenarios are displayed in **Table 11**.

2027 Flows	ROUNDABOUT UNSIGNALISED				NODE 1 SIGNALISED				NODES 1 & 2 SIGNALISED				NODES 1, 2 & 3 SIGNALISED				NODES 1, 2, 3 & 4 SIGNALISED			
'Natural Growth'	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	n/a		n/a		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec	
	Junction PRC = -186.4%		Junction PRC = Infinite		Junction PRC = -36.4%		Junction PRC = -39.4%		Junction PRC = -40.3%		Junction PRC = -59.2%		Junction PRC = -83.4%		Junction PRC = -66.7%		Junction PRC = -70.8%		Junction PRC = -66.7%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1 A12 southbound	112.5	90.6	99.9	20.7	71.2	10.8	84.9	15	73.3	11.4	82.2	14	95.8	21.1	101.2	32.1	85.9	15	94	19.8
1/2 A12 southbound	115	166.5	114.1	143.6	122.6	161	122.6	142.6	126.3	177.7	118.8	126	165.1	312.7	146.2	226.6	148	261	135.7	192.9
2/1 Bucklesham Road	257.8	26.1	Inf	13.1	37.5	1.1	10.6	0.3	34.2	1	11.1	0.3	21.7	0.7	8.3	0.2	67	2	28.2	0.5
3/1 A14 Westbound off-slip	38.6	0.3	125	51.8	39.5	0.3	125.4	52.3	52.3	4.2	59.3	5.4	46.2	3.9	72	6.3	65.4	4.9	91.6	9.6
3/2 A14 Westbound off-slip	121.9	63.6	126	72.5	122.8	62.5	118.7	59.5	87.9	10.2	81.4	9.1	77.5	8.3	98.9	17	109.8	32	125.9	58.6
4/1 & 4/2 A1156 Northbound	116.1	67.6	121.5	77.2	117.8	70.2	123.3	79.6	125.6	88.7	143.3	119.2	153.7	141.9	150	130.5	153.7	141.9	150	129.6
5/2 A14 eastbound off-slip	21.3	0.1	116.1	26.5	21.8	0.1	121.8	29.9	22.4	0.1	100.1	16.6	20.9	0.4	75.9	4	39.5	2.5	38.4	3
6/1 NE circulatory c/way	56.7	0.7	61.9	0.8	61.1	0.8	61.4	0.8	60.4	0.8	61.2	0.8	58.2	0.7	60.3	0.8	58.2	0.7	60.8	0.8
6/2 NE circulatory c/way	62.5	0.8	55.8	0.6	58.6	0.8	51.9	0.6	57	0.7	53.6	0.6	43.6	0.4	43.6	0.4	48.6	0.5	46.9	0.5
8/1 Eastern circulatory c/way	20.6	0.1	22.5	0.1	22.8	0.1	22.7	0.1	37	3.1	41.1	4	39.1	2.1	37.6	2.8	34.3	3.2	35.1	4.1
8/2 Eastern circulatory c/way	62.6	0.8	55.5	0.6	60.8	0.8	52.3	0.5	95.8	11.6	92.6	6.9	78.5	2.5	69.5	1.3	76.1	2.4	69.3	16.1
10/1 Southern circulatory c/way	74.8	1.5	68.6	1.1	75.3	1.6	69.1	1.1	77.6	1.7	73.8	1.4	88.5	14.1	87.6	13	92.4	13.8	85.8	9.3
11/1 Western circulatory c/way	31	0.2	31.6	0.2	33.5	0.3	35.3	0.3	37.6	0.8	38.6	2.8	32.3	0.4	33.6	0.4	45.4	0.5	47.9	0.6
11/2 Western circulatory c/way	13.1	0.1	11.7	0.1	12.9	0.1	11.5	0.1	12.1	0.1	9.9	0.1	9.9	0.1	9.5	0.1	14.9	0.1	15.8	0.1
14/1 & 14/2 Northern circulatory c/way	21.1	0.1	20.6	0.1	73.7	7.8	57.1	6	67	7	60.4	6.2	41.2	6.1	45.4	4.3	46.6	3.7	49.2	3.8

Table 11: Junction A: '2027 Forecast'Flows AM & PM peaks

4.2.26. **Roundabout un-signalised (existing layout).**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (both lanes), Bucklesham Road, A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane), Bucklesham Road, A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- The DoS for Bucklesham Road is predicted as Infinite. This reflects the impact of the increased 2027 traffic flows on the constrained gap acceptance for vehicles from Bucklesham Road resulting from the close proximity to the junction of the A12 southbound and the roundabout.
- Compared to the '2015 Base' flows model the performance of the roundabout is predicted to have deteriorated significantly due to the increased level of traffic on all approaches.

4.2.27. **Node 1 (A12) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- This scenario produces significantly improved overall results when compared to the un-signalled layout. However, the results show a notable reduction in junction performance when compared to the output with the 2015 Base flows.

4.2.28. **Nodes 1 & 2 (A12 & A14 westbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane) A1156 northbound and A14 eastbound off-slip.
- With two nodes signalised the overall junction PRC decreases when compared to the previous model of the roundabout with one node signalised. The results show a notable reduction in junction performance when compared to the output with the 2015 Base flows

4.2.29. **Nodes 1, 2 & 3 (A12 & A14 westbound & A1156) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lanes) and the A1156 northbound.
- With three nodes signalised the overall junction PRC reduces significantly when compared to the previous options of one and two nodes signalised. The results show a notable reduction in junction performance when compared to the output with the 2015 Base flows.

4.2.30. **Nodes 1, 2, 3 & 4 (A12 & A14 westbound & A1156 & A14 eastbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM and PM peaks this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.

- With all four nodes signalised the overall junction PRC in the AM peak reduces significantly when compared to the previous options of one and two nodes signalised. During the PM peak the PRC improves when compared to the options of two and three nodes signalised, but is remains significantly over capacity.

4.2.31. '**2027 Forecast' Flows: LinSig results Summary**

- The signalisation of node 1 alone generates the best results, but still indicates capacity issues on the A12 southbound and the A1156. The cause of this lies in both the demand flows at the roundabout and the current carriageway layout.
- The '2027 forecast' flows suggest that the congestion issues at the junction would be exacerbated by the increased level of traffic. This serves to indicate that if signalisation of the roundabout were pursued then it would require layout changes to be undertaken as part of the work.

4.2.32. The '2027 + Development excluding Candlet Road' traffic flow data for Junction A is shown in **Figure 6** (flows in PCUs).

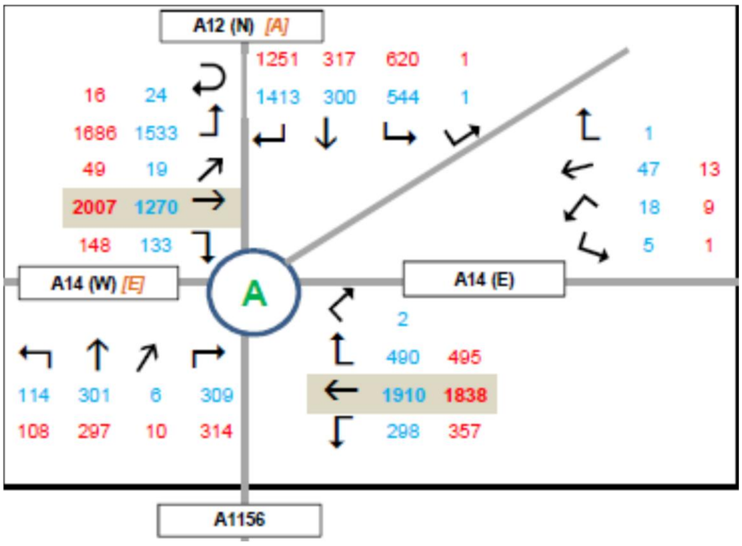

Figure 6: '2027 Forecast + Development (excluding Candlet Road)' traffic flows (Junction A)

4.2.33. When compared to the '2027 + All Development' forecast flows, the additional traffic to and from Felixstowe generated by the developments slightly lower as the Candlet Road development has not been considered.

4.2.34. The LinSig output details for the '2027 + Development excluding Candlet Road' traffic flows AM & PM peaks, for all five scenarios are displayed **Table 12**.

2027 Flows	ROUNDABOUT UNSIGNALISED				NODE 1 SIGNALISED				NODES 1 & 2 SIGNALISED				NODES 1, 2 & 3 SIGNALISED				NODES 1, 2, 3 & 4 SIGNALISED			
'Development without Candlet Road'	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	n/a		n/a		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec	
	Junction PRC = -201.7%		Junction PRC = Infinite		Junction PRC = -45.1%		Junction PRC = -39.4%		Junction PRC = -51.4%		Junction PRC = -84.2%		Junction PRC = -98.7%		Junction PRC = -68.9%		Junction PRC = -83.4%		Junction PRC = -66.7%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1 A12 southbound	115.7	124.3	108.2	88	77.8	12.8	84.9	15	77.8	12.8	91.9	19.4	107	48.8	114	78.9	98.7	25.9	95	22.2
1/2 A12 southbound	114.4	198.9	114.2	144.1	130.1	194.5	122.6	142.6	130.1	194.5	122.6	142.6	178.9	346.6	152	243.5	165.1	312.9	126.7	159.3
2/1 Bucklesham Road	271.5	28.5	Inf	13.1	33.6	1	10.6	0.3	31.8	1	10.5	0.3	20.7	0.7	8.2	0.2	74.9	2.2	37.9	0.6
3/1 A14 Westbound off-slip	44.6	0.4	131.2	62.3	45.8	0.4	125.4	52.3	56.9	4.9	54.5	5.4	45.5	4.3	45.4	4.7	82.7	7	109	25.8
3/2 A14 Westbound off-slip	137.7	106	133.2	88.3	130.5	81.6	118.7	59.5	92.9	13.1	74.8	8.7	74.4	8.7	62.3	7.3	135.2	76.7	149.6	95.9
4/1 & 4/2 A1156 Northbound	123.6	95.4	139.6	121	117	70	123.3	79.6	136.2	114.3	165.8	158.6	153.7	143.1	150	138.1	153.7	144.7	150	137.1
5/2 A14 eastbound off-slip	21.3	0.1	116.4	26.7	22.1	0.1	121.8	29.9	23	0.1	93.8	7.5	21.4	0.4	78.9	4.3	33.8	2.3	40.9	3.1
6/1 NE circulatory c/way	56.6	0.7	62	0.8	63.2	0.9	61.4	0.8	61.3	0.8	64.9	1	57.2	0.7	60	0.8	60	0.8	65.9	1
6/2 NE circulatory c/way	62.8	0.8	55.8	0.6	55.3	0.7	51.9	0.6	55.3	0.7	51.9	0.6	40.2	0.4	41.9	0.4	43.6	0.4	50.3	0.6
8/1 Eastern circulatory c/way	20.2	0.1	21.3	0.1	22.8	0.1	22.7	0.1	38.1	3.4	45	4	41	3.2	47.2	4.1	33.4	1	34.3	3.7
8/2 Eastern circulatory c/way	63.1	0.9	55.5	0.6	57.4	0.7	52.3	0.5	95.7	10.7	98.1	13.8	79.6	3.7	90.7	7.2	67	1.6	72.4	2.5
10/1 Southern circulatory c/way	75.3	1.5	68.6	1.1	73.2	1.4	69.1	1.1	78.8	1.8	74	1.4	87.8	11	87.9	13.3	83.7	13	87.9	12.1
11/1 Western circulatory c/way	31.1	0.2	31.7	0.2	34.6	0.3	35.3	0.3	40.5	3.9	36.6	3.2	35.1	0.3	35.4	0.5	45.2	0.5	43.9	0.5
11/2 Western circulatory c/way	12.9	0.1	11.7	0.1	13.6	0.1	11.5	0.1	11.7	0.1	9.8	0.1	10.4	0.1	10.9	0.6	16.4	0.1	17.6	0.7
14/1 & 14/2 Northern circulatory c/way	20.9	0.1	20.5	0.1	68.3	7.6	57.1	6	62.2	6.6	57.4	5.7	39.3	5.5	46.9	6.2	42.3	2.8	57.6	5.9

Table 12: Junction A: '2027 + Development (excluding Candlet Road)' Flows AM & PM peaks

4.2.35. **Roundabout un-signalised (existing layout).**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (both lanes), Bucklesham Road, A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lanes), Bucklesham Road, A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- As with the 2027 forecast flows model, the DoS for Bucklesham Road is predicted as Infinite. This reflects the impact of the increased 2027 'All development without Candlet Road' traffic flows on the constrained gap acceptance for vehicles from Bucklesham Road resulting from the close proximity to the junction of the A12 southbound and the roundabout.
- Compared to the '2027 All Development' flows model the performance of the roundabout is predicted to improve slightly during the AM peak but remain unchanged in the PM peak.

4.2.36. **Node 1 (A12) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- This scenario produces improved overall results when compared to '2027 All Development' flows model particularly during the PM peak.

4.2.37. **Nodes 1 & 2 (A12 & A14 westbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- This scenario also produces improved overall results when compared to '2027 All Development' flows model particularly during the PM peak.

4.2.38. **Nodes 1, 2 & 3 (A12 & A14 westbound & A1156) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (both lanes) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lane) and the A1156 northbound.
- This scenario produces improved overall results when compared to '2027 All Development' flows model.

4.2.39. **Nodes 1, 2, 3 & 4 (A12 & A14 westbound & A1156 & A14 eastbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (both lanes) and the A1156 northbound.
- This scenario produces improved overall results when compared to the '2027 All Development' flows model.

4.2.40. **'2027 + Development excluding Candlet Road' Flows: LinSig results Summary**

- The signalisation of node 1 alone generates the best results and improves on the 'All Development' scenario. However, LinSig still indicates capacity issues on the A12 southbound, A14 westbound and the A1156. The cause of this lies in both the demand flows at the roundabout and the current carriageway layout.
- The '2027 All Development without Candlet Road' flows suggest that the congestion issues at the junction would still be exacerbated by the increased level of traffic when compared to the results for the '2027 Forecast' flows.
- The value of removing the Candlet Road development can only really be effectively judged once it has been established if a realistic signalisation scheme can be implemented. One that as a starting point manages the '2015 Base' Year traffic flows and the '2027 Forecast' traffic flows.

4.2.41. The '2027 + All Development' traffic flows for junction 58 is shown in **Figure 7** (flows in PCUs).

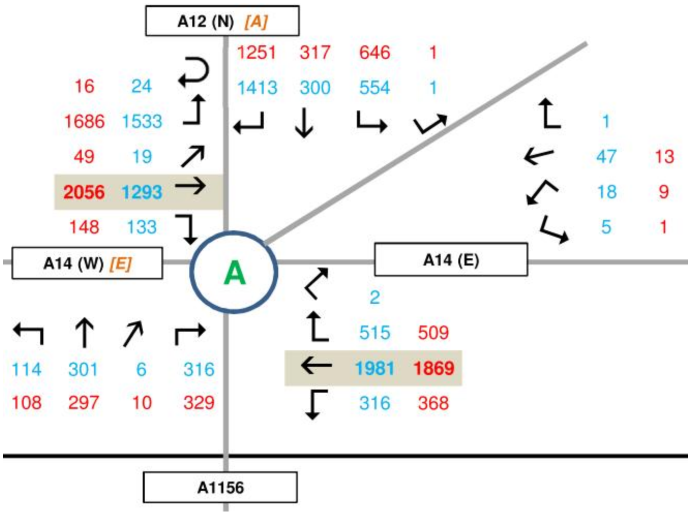

Figure 7: '2027 Forecast + All development' traffic flows (Junction A)

4.2.42. When compared to the '2027 forecast' flows, east and west bound movements to and from Felixstowe have increased due to development generated traffic (including Candlet Road). The A12 southbound right turn movement to the A14 westbound on-slip is unaltered but remains the largest traffic movement at the junction.

4.2.43. The LinSig output details for the '2027 + All Development' traffic flows AM and PM peaks, for all five scenarios are displayed in **Table 13**.

2027 Flows	ROUNDABOUT UNSIGNALISED				NODE 1 SIGNALISED				NODES 1 & 2 SIGNALISED				NODES 1, 2 & 3 SIGNALISED				NODES 1, 2, 3 & 4 SIGNALISED			
'All Development'	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	n/a		n/a		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec		Cycle time = 60 sec	
	Junction PRC = -209.2%		Junction PRC = Infinite		Junction PRC = -49.1%		Junction PRC = -50.9%		Junction PRC = -55.7%		Junction PRC = -97.4%		Junction PRC = -107.4%		Junction PRC = -75.9%		Junction PRC = -90.8%		Junction PRC = -70.9%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1 A12 southbound	117	108.2	111.1	96.8	81.2	13.7	104.6	46.1	78.7	13	94.5	21.9	112.9	70	122	108.7	103.9	39.8	91.5	19.3
1/2 A12 southbound	114.2	162.2	114	138.2	134.1	211.3	135.7	192.9	130.1	194.5	122.6	142.6	186.6	373.7	158.4	263.5	171.7	339.1	118.8	126
2/1 Bucklesham Road	278.2	27	Inf	13	32	0.9	9.5	0.2	31.7	1	10.5	0.3	19.9	0.6	8	0.2	74.1	2.2	36.7	0.6
3/1 A14 Westbound off-slip	47.2	0.4	133.9	65.4	48.5	0.5	135.8	68.7	64.3	5.5	56.2	5.6	56.8	5.1	70.2	6.7	74.2	6.3	112.4	30.9
3/2 A14 Westbound off-slip	144.8	107.4	136.1	92.7	133.3	89.8	120.1	68.2	104.2	26.6	76.9	9.1	91.9	13	96.2	15.6	120.2	56.3	153.9	101.9
4/1 & 4/2 A1156 Northbound	127	96.5	146.9	135.5	116.5	69.5	135.2	113.6	140.1	123	177.6	179.4	153.7	143.4	150	138.3	153.7	143.4	150	138.3
5/2 A14 eastbound off-slip	21.3	0.1	116.7	26	22.3	0.1	132.9	36.1	23	0.1	90.2	6.4	21.7	0.4	81.4	4.7	33.8	2.3	43.9	3.2
6/1 NE circulatory c/way	56.6	0.7	62	0.8	64	0.9	64.9	1	61.7	0.8	66	1	55.7	0.7	58.9	0.7	59.1	0.7	67.7	1.1
6/2 NE circulatory c/way	63	0.8	55.8	0.6	53.6	0.6	46.9	0.5	55.3	0.7	51.9	0.6	38.5	0.3	40.2	0.4	41.9	0.4	53.6	0.6
8/1 Eastern circulatory c/way	20	0.1	20.9	0.1	22.8	0.1	21.4	0.1	37	3.3	45	4	36.2	1.7	35.2	2	34.3	1.1	34.3	3.7
8/2 Eastern circulatory c/way	63.3	0.9	55.5	0.6	55.8	0.6	47.3	0.4	93.1	10.5	98.1	16.4	69.9	3.9	67.8	13.2	67.8	1.7	77.1	2.8
10/1 Southern circulatory c/way	75.5	1.5	68.8	1.1	72.1	1.3	65.9	1	79	1.9	74.7	1.5	87.3	13.1	86.6	8.3	85.9	13.3	92.3	13
11/1 Western circulatory c/way	31.2	0.2	31.8	0.2	35.2	0.3	36.8	0.3	40.7	4.2	34.6	0.7	36.4	0.5	36.2	0.3	50.5	0.7	42.7	0.4
11/2 Western circulatory c/way	12.8	0.1	11.6	0.1	14	0.1	12.6	0.1	11.7	0.1	9.6	0.1	10.7	0.1	11.4	0.6	16.8	0.1	18	0.7
14/1 & 14/2 Northern circulatory c/way	20.8	0.1	20.4	0.1	66	7.6	51	5.5	62	6.2	56.7	5.6	38.5	6.6	46.4	6.2	41.3	6.1	64.9	6.1

Table 13: Junction A: '2027 + All Development' Flows AM & PM peaks

4.2.44. **Roundabout un-signalised (existing layout).**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (both lanes), Bucklesham Road, A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lanes), Bucklesham Road, A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- As with the 2027 forecast flows model, the DoS for Bucklesham Road is predicted as Infinite. This reflects the impact of the increased 2027 'All development' traffic flows on the constrained gap acceptance for vehicles from Bucklesham Road resulting from the close proximity to the junction of the A12 southbound and the roundabout.
- Compared to the '2015 Base' and '2027 Forecast' flows model the performance of the roundabout is predicted to have deteriorated significantly due to the increased level of traffic.

4.2.45. **Node 1 (A12) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lanes), A14 westbound off-slip (both lanes), A1156 northbound and A14 eastbound off-slip.
- This scenario produces significantly improved overall results when compared to the un-signalled layout. However, the results show a notable reduction in junction performance when compared to the output with the '2015 Base' and '2027 Forecast' flows.

4.2.46. **Nodes 1 & 2 (A12 & A14 westbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane) and the A1156 northbound.
- With two nodes signalised the overall junction PRC decreases when compared to the previous model of the roundabout with one node signalised. The results show a notable reduction in junction performance when compared to the output with the '2015 Base' and '2027 Forecast' flows.

4.2.47. **Nodes 1, 2 & 3 (A12 & A14 westbound & A1156) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.
- During the AM peak this includes the A12 southbound (both lanes) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (both lanes), A14 westbound off-slip (offside lane) and the A1156 northbound.
- With three nodes signalised the overall junction PRC reduces significantly in the AM peak when compared to the previous options of one and two nodes signalised. Although the PRC improves slightly when compared to two nodes signalised in the PM peak. However, the results overall show a notable reduction in junction performance when compared to the output with '2015 Base' and '2027 Forecast' flows.

4.2.48. **Nodes 1, 2, 3 & 4 (A12 & A14 westbound & A1156 & A14 eastbound) signalised.**

- During the AM and PM peaks the junction is noted to have a number of arms with a DoS exceeding 100% resulting in significant queuing.

- During the AM peak this includes the A12 southbound (both lanes), A14 westbound off-slip (offside lane) and the A1156 northbound.
- During the PM peak this includes the A12 southbound (offside lane), A14 westbound off-slip (both lanes) and the A1156 northbound.
- With all four nodes signalised the overall junction PRC in the AM peak reduces significantly when compared to the previous options of one and two nodes signalised, but improves over the results for three nodes signalised. During the PM peak the PRC improves when compared to the options of two and three nodes signalised. However, the results overall show a notable reduction in junction performance when compared to the output with '2015 Base' and '2027 Forecast' flows.

4.2.49. **'2027 + All Development' Flows: LinSig results Summary**

- The signalisation of node 1 alone generates the best results, but still indicates capacity issues on the A12 southbound, A14 and the A1156. The cause of this lies in both the demand flows at the roundabout and the current carriageway layout.
- The '2027 All Development' flows suggest that the congestion issues at the junction would be further exacerbated by the increased level of traffic when compared to the results for the '2027 Forecast' flows.

4.3. Junction C: A14 Junction 60 / A154 Candlet Road LinSig Results

4.3.1. Junction C is a three arm roundabout located on the northwest outskirts of Felixstowe. The southern arm of the A14 is a direct link to the Port of Felixstowe which handles large container shipments.

4.3.2. The junction surroundings are mostly rural, with the exception of the southwestern corner which borders the Trimley St. Mary area of Felixstowe. There are plans to introduce a new development on the currently unoccupied land to the southeast of the roundabout (in accordance with Policy FPP4).

4.3.3. All three of the roundabout entries are signal controlled:

- A14 eastbound (includes pedestrian crossing facilities).
- A154 westbound.
- A14 northbound.
- There is also a signal controlled pedestrian crossing on the A14 westbound exit.

4.3.4. The junction operates under traffic signal control using MOVA. This system responds to changes in traffic flows and adjusts the signal timings accordingly.

4.3.5. The pedestrian crossings over the A14 westbound exit and the A14 eastbound entry allow pedestrians from Trimley St Mary to access the Candlet Track footpath which runs parallel to the A14. No pedestrians were observed to use the crossings during the site visit and the lack of development to the north of the junction would suggest that overall use is likely to be infrequent.

4.3.6. No traffic queue or pedestrian flow information is currently available.

Photograph 5: Westside circulatory carriageway

Note the hatched markings, reducing this section of carriageway to a single lane.

Photograph 6: Junction C viewed from the Port of Felixstowe Road entry

Photograph 7: A14 exit slip road with pedestrian crossing leading to the Trimley St. Mary residential area

Photograph 8: Eastside circulatory carriageway

4.3.7. Junction C has been modelled using the LinSig traffic signal design program to evaluate the current and predicted capacities in its operation and assess whether any changes are necessary for current or future use. The existing physical layout has been modelled with the current signal configuration for the base model.

4.3.8. A network layout diagram of Junction C is presented in **Figure 8**.

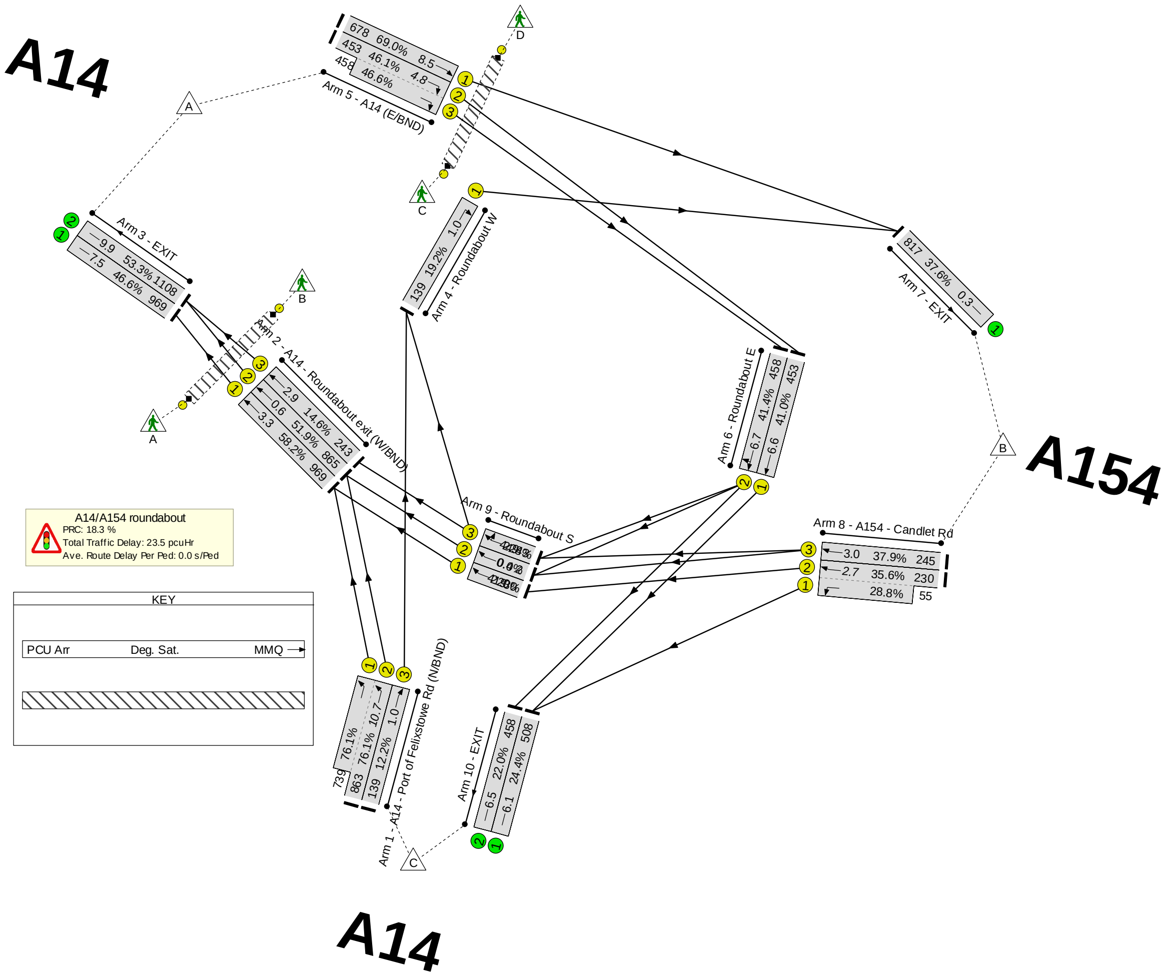

Figure 8: Junction C: Network Layout Diagram

4.3.9. The 60 second cycle time provided in the controller specification has been used in the initial assessment. This value lies within the range recommended in LTN 1/09: Signal Controlled Roundabouts. However, the MOVA system used at the junction will monitor traffic flows and adjust the cycle time, offsets and individual green times to achieved optimum signal performance. In order to model this in LinSig both the cycle time optimisation tool and signal optimisation have been used to generate models that recreate the signal operation on site based on the available data.

4.3.10. The signal timings used in the LinSig are based on the values provided in the controller specification, with the exception of the pedestrian crossing on the A14 westbound exit, which site observations suggest is rarely used. To represent this in the model, bonus green times were added to the opposing phase to reflect the behaviour observed on site, as pedestrian demand was rarely present and vehicles using that exit received uninterrupted green time during most cycles.

4.3.11. The calculation of the bonus green times was carried out considering that the pedestrian demand is present in 5% of the cycles, for both AM and PM flows. This yields an almost complete green time for the vehicle phase in every cycle:

	Stage 1	Stage 2
IP	100	5
OP	100	100
if Y	100%	5%
if N	0%	95%

A	B

	Stage Demand		Stage Probability			Green Time		Additional Green Time		Additional Green Time	
Scenario	Stage 1	Stage 2	Stage 1	Stage 2	Total	A	B	A	B	A	B
i	Y	Y	100%	5%	5%	59	9	0	0	0.0	0.0
ii	Y	N	100%	95%	95%	87	0	28	-9	26.6	-8.6
									Total	27	-9

Figure 9: Junction C AM Period Demand Dependency Calculations

(Used 08:00-09:00)

4.3.12. The '2015 base' traffic flow data for Junction C is shown in **Figure 10** (flows in PCUs).

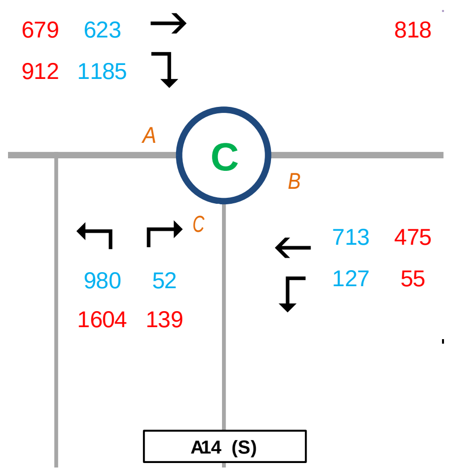

Figure 10: '2015 Base' traffic flows (Junction C)

4.3.13. The significant movements at the junction during the AM (Blue) and PM (Red) peaks are:

- A14 northbound left turn movement to the A14 westbound on-slip.

  This is the largest movement in the junction, especially during the PM Peak period, where it surpasses the other flows by a considerable margin. Drivers take the first exit at the roundabout; the exit to the A14 westbound has a pedestrian crossing that could delay exiting vehicles. Observations however, indicate low usage of the pedestrian crossing, thus it currently has a negligible impact on junction performance.

- A14 eastbound right turn to the A14 southbound.

  This is the second largest movement, using two sections of the circulatory carriageway and generating a significant queue in the southbound circulatory arm on the east. These queues are currently within capacity. Subject to downstream lane availability there may be scope to remove the hatching on the carriageway on this arm improve junction performance (see **Photograph 8**).

4.3.14. Overall, the most important movement impacting junction performance is the A14 eastbound right turn to the A14 southbound. Vehicles making this manoeuvre pass through two signalised sections of the gyratory.

4.3.15. '2015 Base' flows AM & PM: The optimised model output for the AM & PM peaks are displayed in **Table 14**.

Table 14: A14 / A154 Candlet Road: '2015 Base' flows model results summary

2015 Base flows model	AM Peak		PM Peak	
	Cycle time = 57s Junction PRC = 62.2%		Cycle time = 50s Junction PRC = 18.1%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. West Circulatory	8.2	0.3	19.2	1.5
2. A14 Eastbound (1)	55.4	7.2	69.1	8.5
A14 Eastbound (2+3)	55.5	6.7	46.4	4.8
3. East Circulatory (1)	52.8	9.2	41.1	5.4
East Circulatory (2)	53.2	9.5	41.4	5.4
4. A154 Westbound (1+2)	46.1	5.0	26.1	2.4
A154 Westbound (3)	51.9	5.0	40.8	3.2
5. South Circulatory (1)	52.9	0.6	54.4	1.0
South Circulatory (2)	25.3	0.2	33.0	0.5
South Circulatory (3)	27.5	0.2	36.2	0.5
6. A14 Northbound (1+2)	46.7	5.5	76.2	8.3
A14 Northbound (3)	4.9	0.4	10.7	0.8
7. A14 Westbound Exit (1)	39.3	0.4	47.4	0.5
A14 Westbound Exit (2)	31.6	0.2	43.6	0.4
A14 Westbound Exit (3)	8.5	0.0	6.4	0.0

4.3.16. The results for the '2015 Base' flows model show that:

- During the AM peak, the junction is predicted to operate with spare capacity, with a PRC over 60%. No significant queuing is indicated.
- During the PM peak, the junction would also operate with spare capacity, with a PRC over 18%. No significant queuing is indicated.

4.3.17. The '2027 forecast' traffic flow data for Junction C is shown in **Figure 11** (flows in PCUs).

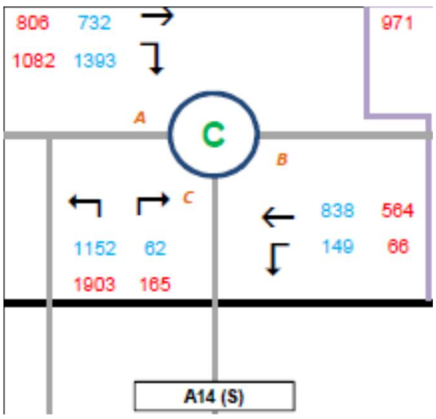

Figure 11: '2027 Forecast' traffic flows (Junction C)

4.3.18. The significant movements at the junction during the AM and PM peaks are:

- A14 northbound left turn movement to the A14 westbound on-slip.

  This is still the largest movement in the junction with 2027 flows, increasing the value from 2015 by 18%.

- A14 eastbound off-slip right turn to the A14 southbound.

  Similar to the 2015 flows, this is the second largest movement in terms of raw numbers and the most important one in terms of junction performance.

4.3.19. '2027 forecast' flows AM & PM: The optimised model output for the AM & PM peaks are displayed in **Table 15.**

Table 15: A14 / A154 Candlet Road: '2027 forecast' flows results summary

2027 Forecast Flows Model	**AM Peak**		**PM Peak**	
	Cycle time = 57s Junction PRC = 37.9%		Cycle time = 50s Junction PRC = -0.4%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. West Circulatory	9.8	0.3	22.8	1.8
2. A14 Eastbound (1)	65.1	9.3	82.1	11.9
A14 Eastbound (2+3)	65.2	8.7	55.1	6.0
3. East Circulatory (1)	62.0	11.8	52.9	5.9
East Circulatory (2)	62.6	11.9	53.1	5.9
4. A154 Westbound (1+2)	52	6.0	29.9	2.8
A154 Westbound (3)	63.0	6.6	43.3	3.7
5. South Circulatory (1)	60.1	0.7	63.7	1.6
South Circulatory (2)	27.5	0.2	35.8	0.7
South Circulatory (3)	36.8	0.3	47.4	0.9
6. A14 Northbound (1+2)	54.7	6.8	90.4	13.5
A14 Northbound (3)	5.8	0.5	12.6	1.0
7. A14 Westbound Exit (1)	45.8	0.5	56.1	0.7
A14 Westbound Exit (2)	36.1	0.3	51.1	0.5
A14 Westbound Exit (3)	11.3	0.1	8.3	0.0

4.3.20. The results for the '2027 forecast' model show that:

- During the AM peak, the junction would operate well within capacity, with a PRC over 37%. No significant queues are indicated, with the longest being approximately 12 PCUs in length.
- During the PM peak however, the 2027 forecast flows move the junction into a negative PRC of -0.4%, with a corresponding increase in queue lengths. Although none of the queues is yet significant, with the longest being on lanes 1 and 2 of A14 northbound at 13.5 PCUs.

4.3.21. The '2027 + Development excluding Candlet Road' traffic flow data for Junction C is shown in **Figure 12** (flows in PCUs).

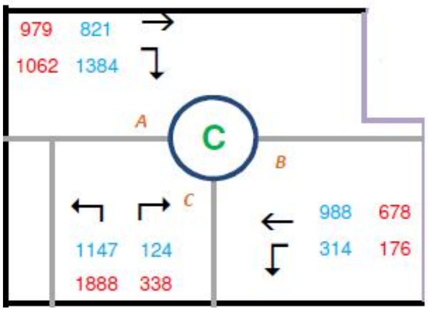

Figure 12: '2027 + Developments (excluding Candlet Road)' traffic flows (Junction C)

4.3.22. The significant movements at the junction during the AM and PM peaks are:

- A14 northbound left turn movement to the A14 westbound on-slip.
  This is the largest movement in the junction during the PM peak period, and the second during the AM peak.
- A14 eastbound off-slip right turn to the A14 southbound.
  Similar to the previous flows, this is the second largest movement in terms of raw numbers and the most important one in terms of junction performance.

4.3.23. '2027 + Development excluding Candlet Road' flows AM & PM: The optimised model output for the AM & PM peaks are displayed in **Table 16**.

Table 16: A14 / A154 Candlet Road: '2027 + Development (excluding Candlet Road)' Optimised model results summary

2027 + Dev (excl. CR) Model	AM Peak		PM Peak	
	Cycle time = 67s Junction PRC = 38.8%		Cycle time = 56s Junction PRC = 0.3%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. West Circulatory	23.0	1.3	52.4	2.5
2. A14 Eastbound (1)	64.4	10.7	88.5	17.0
A14 Eastbound (2+3)	64.8	8.4	49.7	5.7
3. East Circulatory (1)	64.2	13.8	56.0	8.9
East Circulatory (2)	64.2	13.8	56.0	8.9
4. A154 Westbound (1+2)	52.7	8.2	32.8	4.0
A154 Westbound (3)	63.2	8.3	39.7	4.1
5. South Circulatory (1)	64.8	1.1	68.4	2.1
South Circulatory (2)	3.1	0.0	3.4	0.1
South Circulatory (3)	62.1	0.9	65.9	1.9
6. A14 Northbound (1+2)	55.3	8.0	89.7	15.
A14 Northbound (3)	12.0	1.3	27.2	2.7
7. A14 Westbound Exit (1)	50.3	0.6	60.3	0.8
A14 Westbound Exit (2)	28.0	0.2	44.9	0.4
A14 Westbound Exit (3)	21.7	0.1	14.9	0.1

4.3.24. It should be noted that with the removal of the Candlet Road development flows the cycle times in both peak periods have been decreased whilst still maximising the junction PRC.

4.3.25. The results for the optimised model show that:

- The junction operates well within capacity during the AM peak period, with a PRC of 38.8%. This is an improvement over the '2027 + All Development' output.
- The junction operates with the same PRC as with the '2027 + All Development' output but there is a significant reduction in queue lengths on both the A14 eastbound entry lane 1 and the A14 northbound lanes 1 and 2.

4.3.26. The '2027 + All Developments' traffic flow data for Junction C is shown in **Figure 13** (flows in PCUs).

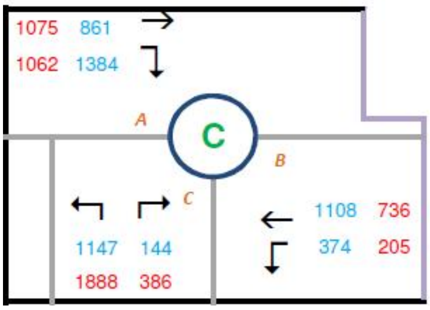

Figure 13: 'Forecast 2027 + All developments' traffic flows (Junction C)

4.3.27. The significant movements at the junction during the AM and PM peaks are similar to the previous flows, with the exception of the following movements:

- A154 – Candlet Road westbound movement.

  This manoeuvre has seen an increase in vehicle flow due to the addition of the development generated traffic. This increase is most noticeable during the AM peak period.
- A14 eastbound to A154 eastbound.

  This movement has also seen an increase in the amount of traffic that use it, especially in the PM peak period, as the number of vehicles entering Felixstowe through the north rises.

4.3.28. '2027 + All Development' flows AM & PM: The optimised model output for the AM & PM peaks are displayed in **Table 17.**

Table 17: A14 / A154 Candlet Road: ‘2027 + All Development’ Optimised model results summary

2027 + All Dev Model	AM Peak		PM Peak	
	Cycle time = 72s Junction PRC = 34.3%		Cycle time = 62s Junction PRC = 0.3%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. West Circulatory	28.7	1.4	66.2	3.8
2. A14 Eastbound (1)	64.5	11.7	89.2	20.0
A14 Eastbound (2+3)	64.5	8.4	49.7	5.7
3. East Circulatory (1)	67.0	14.3	51.6	9.7
East Circulatory (2)	67.0	14.3	51.6	9.7
4. A154 Westbound (1+2)	58.4	9.9	38.2	5.2
A154 Westbound (3)	65.3	9.7	45.7	5.1
5. South Circulatory (1)	66.9	1.3	71.2	2.2
South Circulatory (2)	3.0	0.0	3.5	0.1
South Circulatory (3)	64.4	1.2	68.8	2.1
6. A14 Northbound (1+2)	57.7	9.0	89.7	16.0
A14 Northbound (3)	14.5	1.7	30.7	3.4
7. A14 Westbound Exit (1)	53.2	0.7	61.7	0.8
A14 Westbound Exit (2)	28.0	0.2	45.0	0.4
A14 Westbound Exit (3)	24.4	0.2	16.3	0.1

4.3.29. It should be noted that as part of the optimisation process in LinSig the cycle times in both peak periods have been increased in order to maximise the junction PRC. This mimics the actions of the MOVA system in dealing with changes to the traffic patterns.

4.3.30. The results for the optimised model show that:

4.3.31. In the AM peak with the ‘All development’ flows the junction PRC decreases, but only slightly. This is due to the higher cycle time resulting in the junction is still operating with a PRC of 34.3% and all queue lengths below 15 PCUs.

4.3.32. For the PM peak period the increase in the cycle time means the junction operates with a small positive PRC at 0.3%. However, it should be noted that queue lengths have increased on the A14 eastbound entry lane 1 and the A14 northbound lanes 1 & 2.

4.4. Junction F: A154 Garrison Lane / High Road West LinSig results

4.4.1. The Garrison Lane / High Road West is a four-arm signal controlled junction that lies in the centre of Felixstowe, connecting two of Felixstowe's busiest roads. A network layout diagram of Junction F is presented in **Figure 14.**

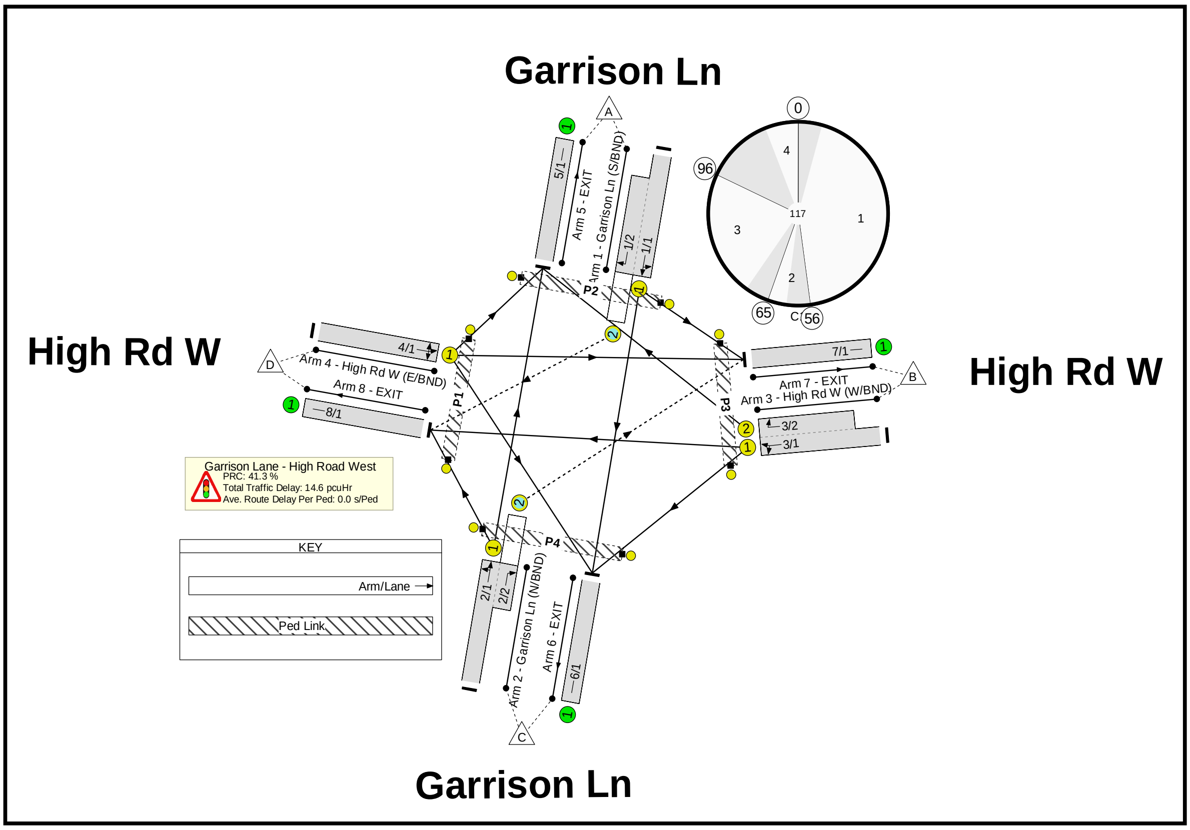

Figure 14: Junction F: Network Layout Diagram

4.4.2. The current method of control is consists of the following stages:

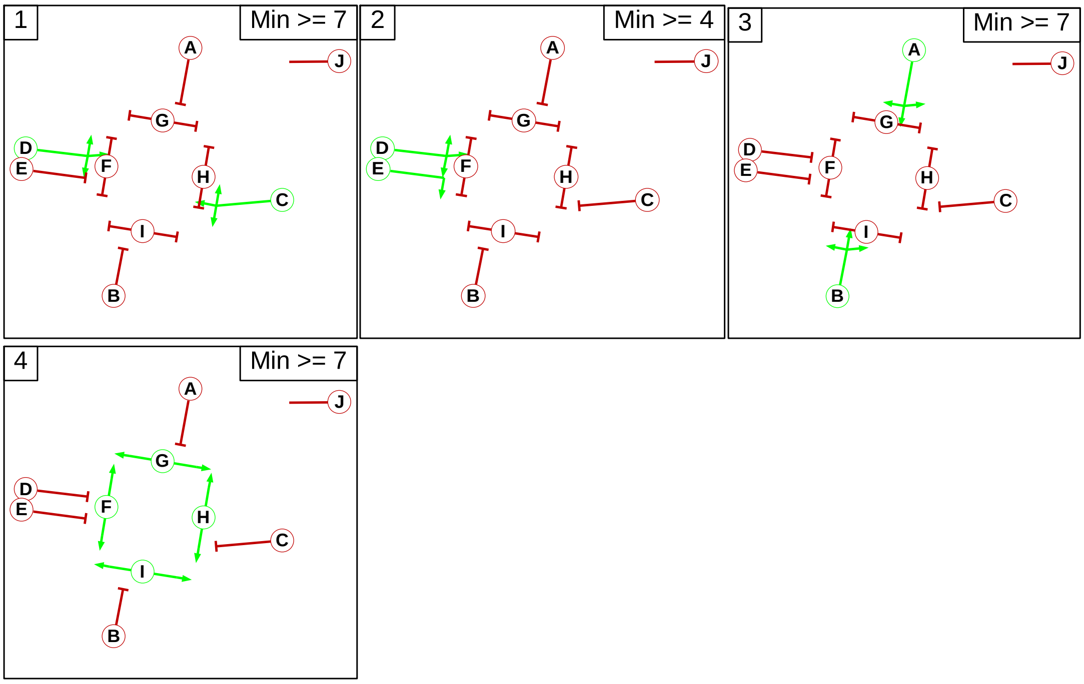

Figure 15: Junction F: Staging Diagram

4.4.3. The Method of Control incorporates a right turn indicative green arrow (RTIGA) to assist drivers turning from the High Road West eastbound into Garrison Lane south. Shown as phase E on the stage diagram.

4.4.4. To assist traffic on Garrison Lane turning right into both arms of High Road West, a lane is provided in the centre of the junction. This helps align drivers who are seeking to turn using gaps in the opposing traffic flow and maximises the holding capacity for the north and south right turn movements.

4.4.5. No traffic queue or pedestrian flow information is currently available.

4.4.6. The Garrison Lane/High Road West junction has been modelled using the existing layout. Phases and stages are based on the controller specification provided, but fixed time plans were not available. A worst-case-scenario comprising of green times extended to maximums in all stages was modelled, trying to imitate MOVA behaviour under heavily congested situations. Additionally, following site observations, a double cycle time was used to allow the all-around-pedestrian stage to run once every two cycles for the most critical flows (2027 + Developments), as the results for both 2015 and 2027 base flows are acceptable even when considering a 100% appearance rate for the pedestrian stage.

4.4.7. The MOVA system used at the junction will monitor traffic flows and adjust the cycle time, offsets and individual green times to achieve optimum signal performance. In order to model this in LinSig both the cycle time optimisation tool and signal optimisation have been used to generate models that re-create signal operation on site as close as possible in the absence of queue length surveys, on site measured saturation values or peak period site observations.

Photograph 9: Junction viewed from the Garrison Lane northern approach

Photograph 10: Junction viewed from the Garrison Lane/High Road West southwestern corner

Photograph 11: Right turn lane viewed from Garrison Lane northern exit

4.4.8. Existing cycle times were not available, as MOVA changes them every cycle, so the necessary time to run all stages on the worst-case-scenario plus all stages except pedestrians was used for the model. For the optimised model, LinSig's cycle time tool yields an optimal cycle time within a specified range which improves junction reserve capacity at the expense of increasing queue lengths. However, the generated queues are not always significant dependant on the storage space available.

4.4.9. For the purposes of this model the cycle time was kept as low as possible in order to reduce pedestrian waiting time whilst trying to achieve an acceptable junction PRC along with acceptable queue lengths.

4.4.10. The '2015 base' traffic flow data for the Garrison Lane/High Road West junction is shown in **Figure 16** (flows in PCUs).

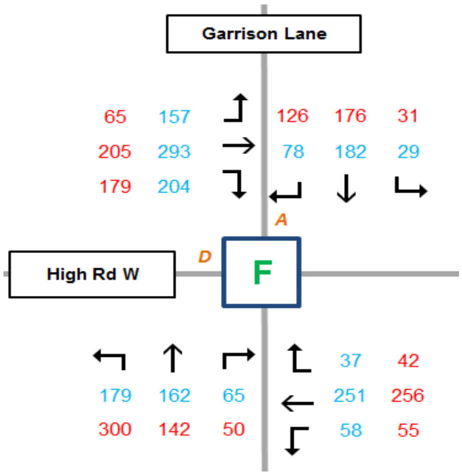

Figure 16: '2015 Base' traffic flows (Junction F)

4.4.12. The most significant movements according to the current flow data are:

- High Road West eastbound and westbound.
  With a significant ahead movement on both approaches and a notable right turn movement from High Road West eastbound.
- Garrison Lane northbound to High Road West westbound, and vice versa.
  Also significant, the southbound route is more predominant in the AM Peak scenario, while the westbound left turn comprises the largest vehicle flow in the PM Peak period.

4.4.13. '2015 Base' flows AM & PM: The Optimised model output for the AM & PM peaks are displayed in **Table 18** and **Table 19**, with the pedestrian stage running every cycle and every other cycle, respectively.

Table 18: A154 Garrison Lane / High Road West: '2015 Base' flows model results summary, pedestrians in every cycle

2015 Pedestrians every cycle Model	**AM Peak**		**PM Peak**	
	Cycle time = 73s Junction PRC = 26.6%		Cycle time = 78s Junction PRC = 13.1%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. Garrison Lane Southbound	40.1	3.8	52.6	4.0
2. Garrison Lane Northbound	71.1	7.8	79.6	11.2
3. High Rd W Westbound	48.9	5.4	79.5	8.2
4. High Rd W Eastbound	71.1	11.8	70.9	9.7

Table 19: A154 Garrison Lane / High Road West: '2015 Base' flows model results summary, pedestrians every other cycle

2015 Pedestrians every other cycle Model	AM Peak		PM Peak	
	Cycle time = 152s Junction PRC = 27.0%		Cycle time = 150s Junction PRC = 34.1%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. Garrison Lane Southbound	42.0	4.0	49.4	3.9
2. Garrison Lane Northbound	70.7	8.2	67.1	10.0
3. High Rd W Westbound	49.1	5.6	67.1	7.1
4. High Rd W Eastbound	70.9	12.5	60.9	8.8

4.4.14. The results for the '2015 base' optimised model show a substantial PRC and short queues for both scenarios and during both AM and PM peaks.

4.4.15. The '2027 forecast' traffic flow data for the Garrison Lane/High Road West junction is shown in **Figure 17** (flows in PCUs).

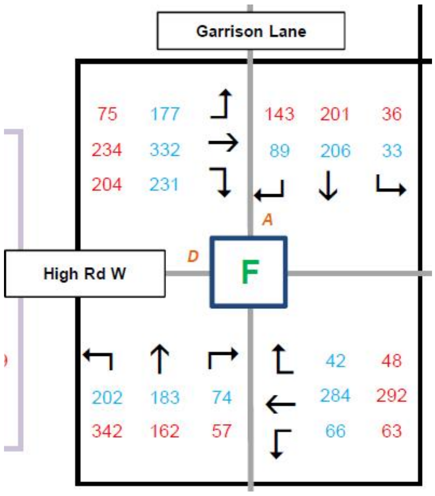

Figure 17: '2027 Forecast' traffic flows (Junction F)

4.4.16. All flows have increased uniformly from the 2015 values. The Garrison Lane northbound left turn to High Road West remains the largest movement in the junction, with an increase of 42 PCUs.

4.4.17. '2027 Forecast' flows AM & PM: The optimised model output for the AM & PM peaks are displayed in **Table 21** and **Table 20** with the pedestrian stage running every cycle and every other cycle, respectively.

Table 20: A154 Garrison Lane / High Road West: '2027 forecast' flow model results summary, pedestrians every cycle

2027 Pedestrians every cycle Model	AM Peak		PM Peak	
	Cycle time = 88s Junction PRC = 1.0%		Cycle time = 88s Junction PRC = 7.6%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. Garrison Lane Southbound	55.6	5.6	75.6	5.9
2. Garrison Lane Northbound	88.6	13.5	82.6	14.3
3. High Rd W Westbound	60.0	7.8	83.6	10.6
4. High Rd W Eastbound	89.1	20.4	78.8	13.1

Table 21: A154 Garrison Lane / High Road West: '2027 forecast' flow model results summary, pedestrians every other cycle

2027 Pedestrians every other cycle Model	AM Peak		PM Peak	
	Cycle time = 160s Junction PRC = 14.1%		Cycle time = 150s Junction PRC = 17.6%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. Garrison Lane Southbound	48.2	5.2	69.0	5.3
2. Garrison Lane Northbound	78.9	11.4	76.5	13.3
3. High Rd W Westbound	53.7	6.7	76.5	8.8
4. High Rd W Eastbound	78.9	15.8	69.6	10.7

4.4.18. When compared to the '2015 Base' flows model, the results show that the '2027 forecast' flows have led to a reduction in junction PRC, but it still remains acceptable in all scenarios. It should be noted that some queue lengths have increased slightly, but still remain acceptable.

4.4.19. The '2027 + Development excluding Candlet Road' traffic flow data for the Garrison Lane/High Road West junction is shown in **Figure 18** (flows in PCUs).

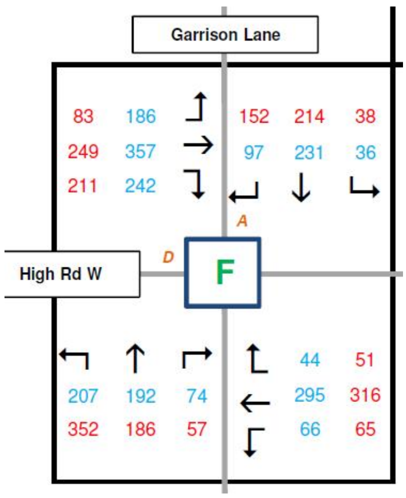

Figure 18: '2027 Forecast + Development (excluding Candlet Road)' traffic flows (Junction F)

4.4.20. With the addition of development flows to the model, the overall flows have increased slightly when compared to the '2027 Base' flows.

4.4.21. '2027 + Development excluding Candlet Road' flows AM & PM: The optimised model output details for the AM & PM peaks are displayed in **Table 22** and **Table 23**, with the pedestrian stage running every cycle and every other cycle, respectively.

Table 22: A154 Garrison Lane / High Road West: '2027 + Development (excluding Candlet Road)' flows model results summary, pedestrians every cycle

2027 + Dev (Excl. CR) Pedestrians every cycle Model	AM Peak		PM Peak	
	Cycle time = 89s Junction PRC = -3.4%		Cycle time = 88s Junction PRC = -4.5%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
1. Garrison Lane Southbound	64.1	6.6	92.1	9.2
2. Garrison Lane Northbound	92.6	15.6	85.0	15.7
3. High Rd W Westbound	60.6	8.1	94.1	14.9
4. High Rd W Eastbound	93.1	24.0	86.4	15.3

Table 23: A154 Garrison Lane/High Road West: '2027 + Development (excluding Candlet Road)' flows model results summary, pedestrians every other cycle.

2027 + Dev (Excl. CR) Pedestrians every other cycle Model	AM Peak		PM Peak	
	Cycle time = 146s Junction PRC = 5.5%		Cycle time = 148s Junction PRC = 7.8%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
5. Garrison Lane Southbound	55.9	5.6	83.5	6.8
6. Garrison Lane Northbound	85.0	11.7	81.7	14.7
7. High Rd W Westbound	58.3	7.1	83.1	9.6
8. High Rd W Eastbound	85.3	18.3	74.0	11.1

4.4.22. The results of the '2027 + Development excluding Candlet Road' model show a significant deterioration in PRC compared with the '2027 Base' model (results follow this section) even when considering the worst scenario, running pedestrians every cycle.

4.4.23. The '2027 + All Developments' traffic flow data for the Garrison Lane/High Road West junction is shown in **Figure 19** (flows in PCUs).

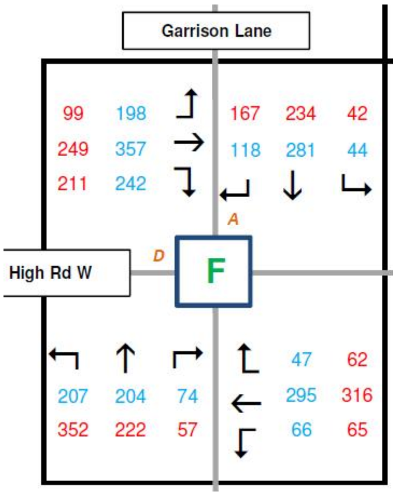

Figure 19: '2027 Forecast + All Developments' traffic flows (Junction F)

4.4.24. The '2027 + All Developments' flows have seen increases coming south through Garrison Lane, where the number of vehicles making the southbound movement in the AM peak flows is increased by 50 PCUs. This is repeated to a smaller extent during the PM period, where the increase is reduced to 20 PCUs, but the northbound movement is increased by 36 PCUs.

4.4.25. 'Forecast 2027 + All Developments flows' AM & PM: The optimised model output details for the AM & PM peaks are displayed in **Table 24** and **Table 25,** with the pedestrian stage running every cycle and every other cycle, respectively.

Table 24: A154 Garrison Lane / High Road West: '2027 + All Developments' optimised model results summary, pedestrians every cycle

2027 + All Dev Pedestrians every cycle Model	**AM Peak**		**PM Peak**	
	Cycle time = 89s Junction PRC = -5.7%		Cycle time = 76s Junction PRC = -15.8%	
Lane	Degree of Saturation (%)	Mean Max Queue (MMQ)	Degree of Saturation (%)	Mean Max Queue (MMQ)
9. Garrison Lane Southbound	79.1	9.1	104.3	20.7
10. Garrison Lane Northbound	95.1	17.5	104.1	34.0
11. High Rd W Westbound	60.8	8.1	100.5	19.3
12. High Rd W Eastbound	94.5	25.5	89.6	15.0

Table 25: A154 Garrison Lane / High Road West: '2027 + All Developments' optimised model results summary, pedestrians every other cycle

2027 + All Dev Pedestrians every other cycle Model	**AM Peak**		**PM Peak**	
	Cycle time = 140s Junction PRC = 2.0%		Cycle time = 156s Junction PRC = 2.1%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1. Garrison Lane Southbound	69.1	7.3	87.6	7.8
2. Garrison Lane Northbound	87.9	12.8	80.0	14.7
3. High Rd W Westbound	60.6	7.0	88.1	11.7
4. High Rd W Eastbound	88.3	19.0	80.3	13.3

4.4.26. When tested under the worst-case hypothesis with the pedestrian stage called every cycle, the model produces results indicating the junction has negative PRC and the queues predicted under this hypothesis have increased notably. When tested with pedestrians running every two cycles, the results for both AM and PM peak periods show a positive PRC and queues below 25 PCUs.

4.5. Junction H: Garrison Lane / Mill Lane LinSig Results

4.5.1. Garrison Lane/Mill Lane is a staggered four arm junction located in a residential area within central Felixstowe. The junction currently operates under vehicle actuated traffic signal control. The LinSig model is shown in **Figure 20**.

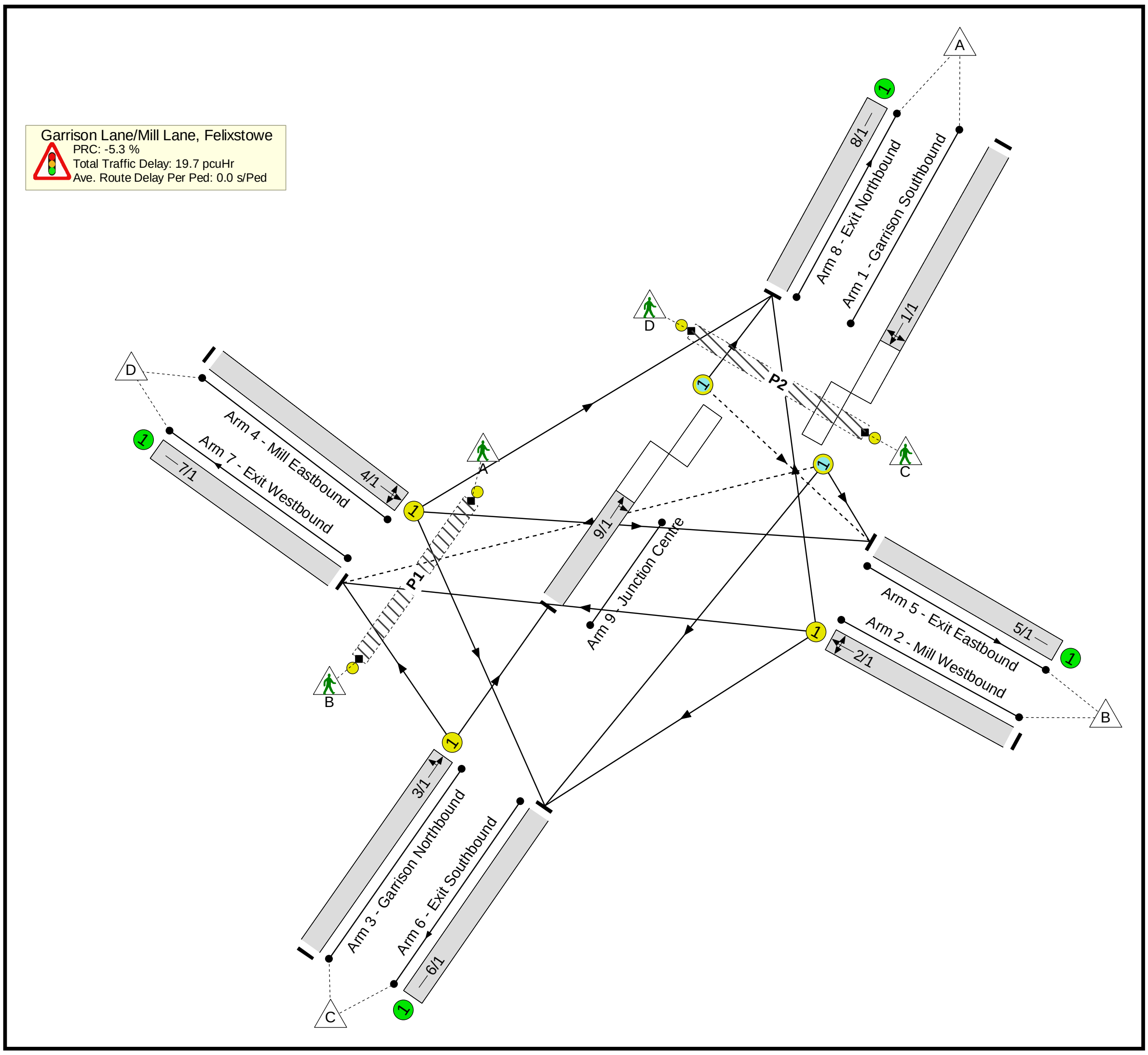

Figure 20: Junction H: Lane Network Layout Diagram

4.5.2. There is a pronounced offset between the Mill Lane arms of the junction. In order to address this, the signals operate in a slightly unusual way (see **Figure 21**):

- The control of northbound traffic on Garrison Lane is split into two phases; the first phase controls traffic up to the stop line whilst the second phase controls traffic within the junction centre. This allows northbound vehicles in the junction to receive a green signal whilst northbound vehicles approaching the junction are held at the stop line (stages 1 & 2). This 'clearance/right turn' movement in stage 2 then permits Mill Road west to run whilst the northbound movements within the junction centre are still on green as there is no conflict (stage 3).
- The Mill Lane traffic movements are run in separate stages to avoid difficult manoeuvres with potential conflicts in the junction centre (stages 3 & 4).

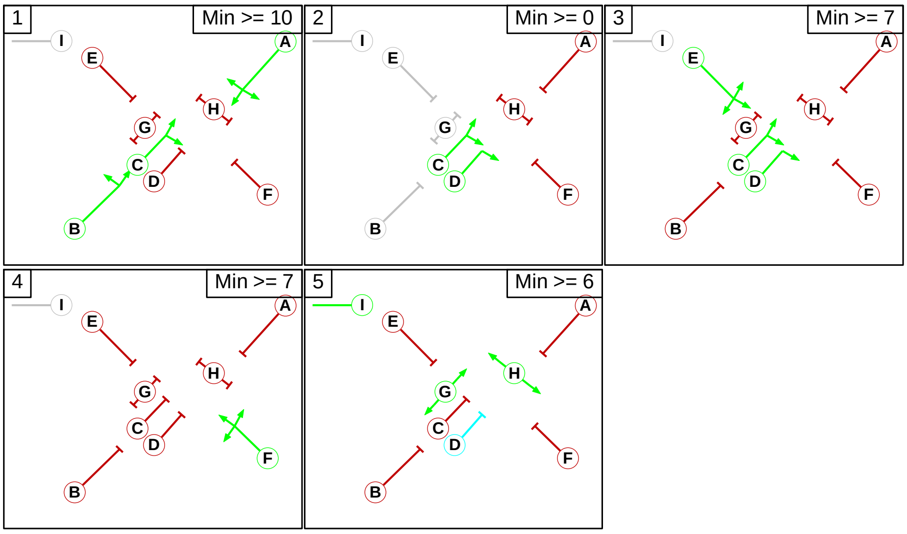

Figure 21: Junction H: Staging Diagram

4.5.3. In addition to the above features, there is a Right Turn Indicative Green Arrow (RTIGA) to assist vehicles turning right from Garrison Lane south into Mill Lane east (stage 2). The junction also has controlled pedestrian crossing facilities over Garrison Lane north and Mill Lane west (stage 5)

4.5.4. The signal sequence described in 4.5.2 above requires the green aspects on the northbound secondary signals on Garrison Lane to be louvered to avoid ‘see-through’ by northbound drivers held at the stop line (see **Photograph 13**).

4.5.5. No traffic queue or pedestrian flow information is currently available.

4.5.6. Felixstowe International College is located on Garrison Lane approximately 200m to the north of the junction.

4.5.7. It is common practice to model the worst case scenario to assess the performance of a signal controlled junction, i.e. with all stages demanded every cycle. However, this may not reflect the reality with some traffic and pedestrian movements only being demanded every other cycle or less.

4.5.8. As the operation of the junction during peak periods is not currently known it has been decided that for the purposes of this Technical Note that the LinSig model should generate results for an ‘all stages run every cycle’ scenario and a ‘RTIGA & pedestrian crossings every other cycle’ scenario.

4.5.9. The aim of the modelling is to that re-create signal operation on site as close as possible in the absence of queue length surveys, on site measured saturation values or peak period site observations.

Photograph 12: Mill Lane west, looking towards the junction

Photograph 13: Garrison Lane looking northeast

The offset between the Mill Lane approaches is clearly visible.

Photograph 14: Mill Lane east approach viewed from the western footway

Note the louvered hoods on the green aspects on the northbound secondary signals.

Photograph 15: Garrison Lane looking south from the northeast corner of the junction

4.5.10. The '2015 Base' traffic flow data for Garrison Lane/Mill Lane is shown in **Figure 22** (flows in PCUs).

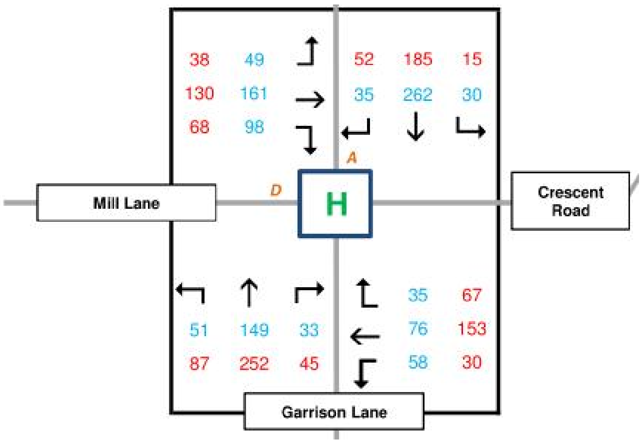

Figure 22: '2015 Base' traffic flows (Junction H)

4.5.11. The significant movements at the junction during the AM and PM peaks are:

- Garrison Lane southbound.
  This is the busiest arm during the AM peak, with the southbound ahead being the largest single movement at the junction.
- Garrison Lane northbound.
  This is the busiest arm during the PM peak, with the northbound ahead being the largest single movement at the junction.

4.5.12. A degree of tidal movement can be recognised at the junction with a north to south and west to east movement during the AM peak and a south to north and east to west movement during the PM peak.

4.5.13. Although the signals feature a RTIGA to assist the right turn from Garrison Lane into Mill Lane, the survey data indicates a relatively low number of drivers wishing to make this manoeuvre.

4.5.15. ‘2015 Base’ flows AM & PM: The output details for the AM & PM peaks are displayed in **Table 26** and Error! Reference source not found..

Table 26: A154 Garrison Lane / Mill Lane: ‘2015 Base’ model results summary, all stages run every cycle

2015 All stages, every cycle Model	AM Peak		PM Peak	
	Cycle time = 128s Junction PRC = -5.0%		Cycle time = 128s Junction PRC = -11.9%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	51.0	9.7	40.3	7.1
2/1 Mill Lane - westbound	69.8	6.8	100.7	17.3
3/1 Garrison Lane - northbound	36.6	6.5	60.4	12.1
4/1 Mill Lane - eastbound	94.5	16.1	72.2	9.1
9/1 Garrison Lane - internal lane	15.9	0.1	25.4	0.2

Table 27: A154 Garrison Lane / Mill Lane: ‘2015 Base’ model results summary, RTIGA & pedestrian crossings every other cycle

2015 RTIGA & pedestrian every other cycle Model	AM Peak		PM Peak	
	Cycle time = 227s Junction PRC = 7.4%		Cycle time = 227s Junction PRC = -0.8%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	44.2	9.0	34.9	6.6
2/1 Mill Lane - westbound	61.9	6.2	89.3	11.9
3/1 Garrison Lane - northbound	32.5	6.1	53.5	11.1
4/1 Mill Lane - eastbound	83.8	12.7	64.0	8.4
9/1 Garrison Lane - internal lane	14.9	0.1	24.0	0.2

4.5.16. The results for the 2015 base model show that during the AM peak ‘all stages run every cycle’ the junction will operate with a negative practical reserve capacity of -5.0%. This is due to excess demand on Mill Lane eastbound which has a DoS of 94.5% and a queue of 16.1 PCUs which equates to approximately 93m. The remaining lanes all operate with positive PRC and acceptable queues.

4.5.17. The results for the 2015 base model show that during the PM peak ‘all stages run every cycle’ the junction will operate with a negative practical reserve capacity of -11.9%. This is due to excess demand on Mill Lane westbound which has a DoS of 100.7% and a queue of 17.3 PCUs which equates to approximately 100m. The remaining lanes all operate with positive PRC and acceptable queues.

4.5.18. The results for the 2015 base model show that during the AM peak ‘RTIGA & pedestrian crossings every other cycle’ the junction will operate with positive practical reserve capacity of 7.4%. The highest degree of saturation remains on Mill Lane eastbound at 83.8%, although it has been reduced with a queue of 12.7 PCUs which equates to approximately 73m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.19. The results for the 2015 base model show that during the PM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative practical reserve capacity of -0.8%. This is due to excess demand on Mill Lane westbound which has a DoS of 89.3% and a queue of 11.9 PCUs which equates to approximately 68m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.20. Although the junction has negative PRC for the 'all stages run' scenario during the AM and PM peaks and during the PM peak in the 'RTIGA & pedestrian crossings every other cycle' scenario, the cause of this is only one lane in each case. The resultant queues are notable but not exceptionally large, and the rest of the lanes at junction have an acceptable DoS and short queues.

4.5.21. This suggests that there could be scope to reallocate time within the signal operation and address the congestion issues. A system such as MOVA would be suitable and offers many advantages over the simple V/A (vehicle actuated) operation currently used at the junction.

4.5.22. It should however be noted that once the DoS on individual lanes exceeds 100% any increase in traffic flows could lead to substantial increases in queuing.

4.5.23. The '2027 Forecast' Flows for Garrison Lane / Mill Lane is shown in **Figure 23** (flows in PCUs).

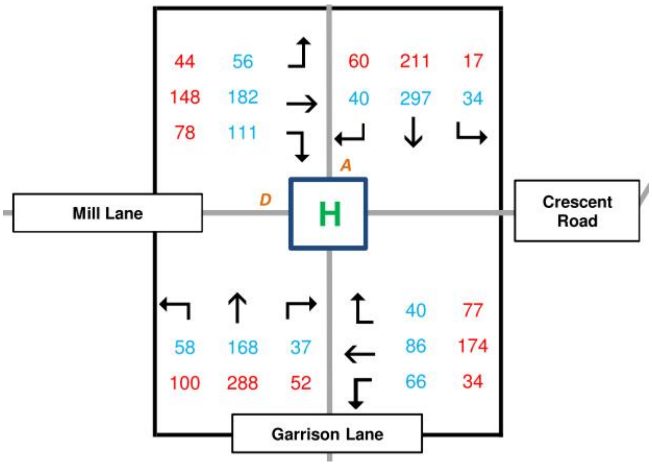

Figure 23: '2027 Forecast' traffic flows (Junction H)

4.5.24. The significant movements at the junction during the AM and PM peaks are:

- Garrison Lane southbound.

  Total traffic demand on this arm has increased over the 2015 Base Flows by 44 PCUs during the AM peak and 36 PCUs during the PM peak.
- Garrison Lane northbound.

  Total traffic demand on this arm has increased over the 2015 Base Flows by 30 PCUs during the AM peak and 56 PCUs during the PM peak.
- Mill Lane east & West.

  Total traffic demand on the side roads has also increased over the 2015 Base Flows but not to the same extent as on Garrison Lane.

4.5.25. The number of drivers wishing to turn right from Garrison Lane into Mill Lane has increased marginally, but the survey data still suggest that there would only be intermittent use of the RTIGA.

4.5.26. '2027 Forecast' flows AM & PM: The output details for the AM & PM peaks are displayed in **Table 28** and **Table 29**.

Table 28: A154 Garrison Lane / Mill Lane: '2027 Forecast' model results summary, all stages run every cycle

2027 All stages every cycle Model	AM Peak		PM Peak	
	Cycle time = 128s Junction PRC = -19.0%		Cycle time = 128s Junction PRC = -27.6%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	58.1	11.4	47.1	8.4
2/1 Mill Lane - westbound	79.3	8.4	114.9	33.4
3/1 Garrison Lane - northbound	41.3	7.4	69.2	14.6
4/1 Mill Lane - eastbound	107.1	30	82.7	11.4
9/1 Garrison Lane - internal lane	18.0	0.1	29.1	0.2

Table 29: A154 Garrison Lane / Mill Lane: '2027 Forecast' model results summary, RTIGA & pedestrian crossings every other cycle

2027 RTIGA & pedestrians every other cycle Model	AM Peak		PM Peak	
	Cycle time = 227s Junction PRC = -5.5%		Cycle time = 227s Junction PRC = -13.2%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	50.4	10.6	40.2	7.8
2/1 Mill Lane - westbound	70.3	7.4	101.9	20.0
3/1 Garrison Lane - northbound	36.7	7.0	61.4	13.4
4/1 Mill Lane - eastbound	94.9	17.7	73.3	10.1
9/1 Garrison Lane - internal lane	16.9	0.1	27.5	0.2

4.5.27. The results for the '2027 forecast' flows model show that during the AM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -19.0%. This is due to excess demand on Mill Lane eastbound which has a DoS of 107.1% and a queue of 30.0 PCUs which equates to approximately 172m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.28. The results for the '2027 forecast' flows model show that during the PM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -27.6%. This is due to excess demand on Mill Lane westbound which has a DoS of 114.9% and a queue of 33.4 PCUs which equates to approximately 192m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.29. The results for the '2027 forecast' flows model show that during the AM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -5.5%. The highest DoS remains on Mill Lane eastbound at 94.9%, although it has been reduced when compared to the 'All Stages Run' scenario with a queue of 17.7 PCUs, which equates to approximately 102m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.30. The results for the '2027 forecast' flows model show that during the PM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -13.2%. This is due to excess demand on Mill Lane westbound which has a Dos of 101.9% and a queue of 20.0 PCUs which equates to approximately 115m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.31. The junction has negative PRC for the 'all stages run' and the 'RTIGA & pedestrian crossings every other cycle' scenarios, during both the AM and PM peaks. The cause of this is predominately one lane in each case, either Mill Lane east or Mill Lane westbound.

4.5.32. The '2027 forecast' flows have a significant impact on junction performance even when applied to the 'RTIGA & pedestrian crossings every other cycle' scenario. Should the 'All stages Run every cycle' scenario prove a more accurate reflection of driver and pedestrian behaviour then the junction could experience severe congestion.

4.5.33. Whilst the introduction of the MOVA system of signal control would be beneficial there are limits to the capacity gain that can be achieved dependent on junction layout. In this case the staggered side roads and close proximity of the building line prohibit physical improvements by junction realignment and therefore alteration to the signal sequence.

4.5.34. The '2027 + All Development excluding Candlet Road' flows for Garrison Lane / Mill Lane is shown in **Figure 24** (flows in PCUs).

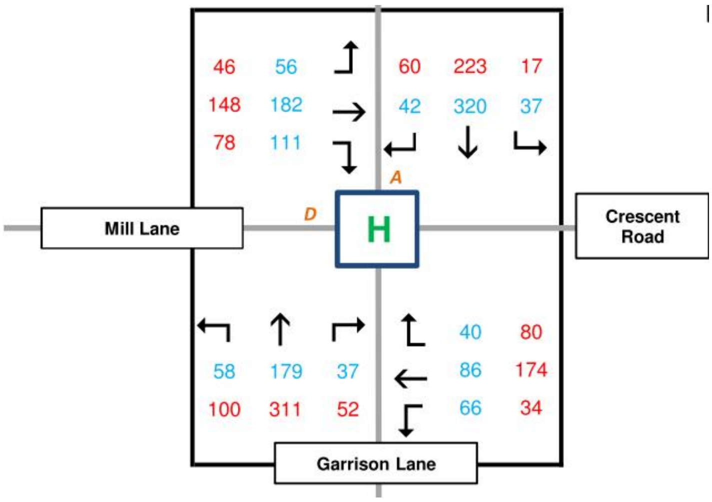

Figure 24: 2027 Forecast + All Development (excluding Candlet Road)' traffic flows (Junction H)

4.5.35. The significant movements at the junction during the AM and PM peaks are:

- Garrison Lane southbound

  Total traffic demand on this arm has decreased compared to the '2027 + All Development Traffic' scenario by 50 PCUs during the AM peak and 20 PCUs during the PM peak.
- Garrison Lane northbound

  Total traffic demand on this arm has decreased compared to the '2027 + All Development Traffic' scenario by 8 PCUs during the AM peak and 26 PCUs during the PM peak.
- Mill Lane east & west

  Total traffic demand on the side roads has also decreased compared to the '2027 + All Development' traffic scenario but by a negligible amount.

4.5.36. The number of drivers wishing to turn right from Garrison Lane into Mill Lane has remained the same when compared to the '2027 Flows + All Development' scenario.

4.5.37. '2027 Forecast + Development (excluding Candlet Road) flows' AM & PM: The output details for the AM & PM peaks are displayed in **Table 30** and **Table 31**.

Table 30: A154 Garrison Lane / Mill Lane: '2027 + Development (excluding Candlet Road)', all stages run every cycle

2027 + Dev (excl. CR) All stages, every cycle Model	AM Peak		PM Peak	
	Cycle time = 128s Junction PRC = -19.0%		Cycle time = 128s Junction PRC = -29.1%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	62.4	12.6	49.2	8.8
2/1 Mill Lane - westbound	79.3	8.4	116.1	35.1
3/1 Garrison Lane - northbound	43.0	7.8	72.7	15.6
4/1 Mill Lane - eastbound	107.1	30.0	83.3	11.6
9/1 Garrison Lane - internal lane	19.0	0.1	31.0	0.2

Table 31: A154 Garrison Lane / Mill Lane: '2027 All Development (excluding Candlet Road)', RTIGA & pedestrian crossings every other cycle

2027 + Dev (excl. CR) RTIGA & pedestrians every other cycle Model	AM Peak		PM Peak	
	Cycle time = 227s Junction PRC = -5.5%		Cycle time = 227s Junction PRC = -14.4%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	54.1	11.7	41.9	8.2
2/1 Mill Lane - westbound	70.3	7.4	103.0	21.5
3/1 Garrison Lane - northbound	38.1	7.3	64.5	14.4
4/1 Mill Lane - eastbound	94.9	17.7	73.9	10.2
9/1 Garrison Lane - internal lane	17.8	0.1	29.3	0.2

4.5.38. The results for the 2027 + All Development excluding Candlet Road model show that during the AM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -19.0%. This is due to excess demand on Mill Lane eastbound which has a DoS of 107.1% and a queue of 30.0 PCU which equates to approximately 173m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.39. The results for the 2027 + All Development excluding Candlet Road model show that during the PM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -29.1%. This is due to excess demand on Mill Lane westbound which has a DoS of 116.1% and a queue of 35.1 PCU which equates to approximately 202m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.40. The results for the 2027 + All Development excluding Candlet Road model show that during the AM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -5.5%. The highest DoS remains on Mill Lane eastbound at 94.9%, although it has been reduced when compared to the 'All Stages Run' scenario with a queue of 17.7 PCU which equates to approximately 102m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.41. The results for the 2027 + All Development excluding Candlet Road model show that during the PM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -14.4%. This is due to excess demand on Mill Lane westbound which has a Dos of 103.0% and a queue of 21.5 PCU which equates to approximately 124m. The remaining lanes all operate with an acceptable DoS and acceptable queue lengths.

4.5.42. The junction still has negative PRC for the 'all stages run' scenario and the 'RTIGA & pedestrian crossings every other cycle' scenario, both during the AM and PM peaks. The removal of the Candlet Road generated traffic has improved the PRC for all scenarios by up to 3%. However, the LinSig output still indicates that the junction faces significant congestion issues.

4.5.43. The '2027 + All Development' flows for Garrison Lane / Mill Lane is shown **Figure 25** (flows in PCUs).

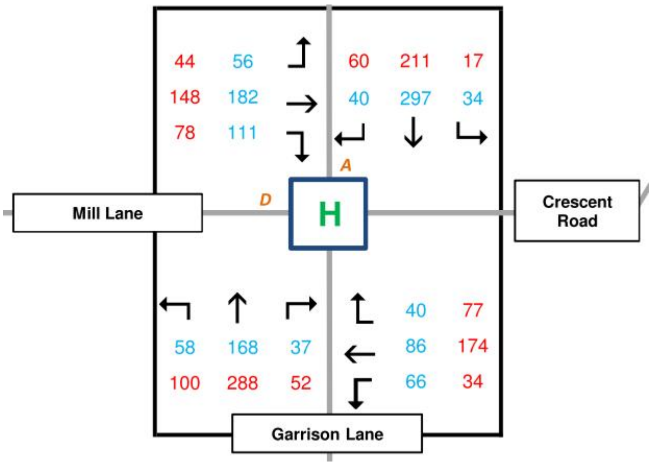

Figure 25: '2027 Forecast + All Development' traffic flows (Junction H)

4.5.44. The significant movements at the junction during the AM and PM peaks are:

- Garrison Lane southbound
  Total traffic demand on this arm has increased over the 2015 Base Flows by 122 PCUs during the AM peak and 68 PCUs during the PM peak.
- Garrison Lane northbound
  Total traffic demand on this arm has increased over the 2015 Base Flows by 49 PCUs during the AM peak and 105 PCUs during the PM peak.
- Mill Lane east & West
  Total traffic demand on the side roads has also increased over the 2015 Base Flows but not to the same extent as on Garrison Lane.

4.5.45. The number of drivers wishing to turn right from Garrison Lane into Mill Lane has increased marginally, but the survey data still suggests there would only be intermittent use of the RTIGA.

4.5.46. '2027 Forecast + All Development flows' AM & PM: The output details for the AM & PM peaks are displayed in **Table 32** and **Table 33**.

Table 32: A154 Garrison Lane / Mill Lane: '2027 + All Development', all stages run every cycle

2027 + All Dev All stages, every cycle Model	**AM Peak**		**PM Peak**	
	Cycle time = 128s Junction PRC = -20.1%		Cycle time = 128s Junction PRC = -32.4%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	70.3	14.9	53.0	9.5
2/1 Mill Lane - westbound	80.1	8.6	119.2	39.2
3/1 Garrison Lane - northbound	44.2	8.2	76.7	17.1
4/1 Mill Lane - eastbound	108.1	31.5	84.6	11.9
9/1 Garrison Lane - internal lane	19.8	0.1	33.2	0.2

Table 33: A154 Garrison Lane/Mill Lane: '2027 + All Development', RTIGA & pedestrian crossings every other cycle

2027 + All Dev RTIGA & pedestrians every other cycle Model	**AM Peak**		**PM Peak**	
	Cycle time = 227s Junction PRC = -6.5%		Cycle time = 227s Junction PRC = -17.4%	
Lane	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)	Degree of Saturation (DoS) %	Mean Max Queue (MMQ)
1/1 Garrison Lane - southbound	60.9	13.7	44.9	8.9
2/1 Mill Lane - westbound	71.0	7.6	105.7	25.2
3/1 Garrison Lane - northbound	39.2	7.6	68.0	15.6
4/1 Mill Lane - eastbound	95.9	18.3	75.0	10.4
9/1 Garrison Lane - internal lane	18.5	0.1	31.4	0.2

4.5.47. The results for the 2027 + All Development model show that during the AM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -20.1%. This is due to excess demand on Mill Lane eastbound which has a DoS of 108.1% and a queue of 31.5 PCUs which equates to approximately 181m. The remaining lanes all operate with an acceptable DoS. However, when compared to the 2015 LinSig output, queue lengths are noted to have increased on Garrison Lane southbound and would now extend for approximately 79m.

4.5.48. The results for the 2027 + All Development model show that during the PM peak 'all stages run every cycle' the junction will operate with a negative practical reserve capacity of -32.4%. This is due to excess demand on Mill Lane westbound which has a DoS of 119.2% and a queue of 39.2 PCUs which equates to approximately 225m. The remaining lanes all operate with an acceptable DoS. However, when compared to the 2015 LinSig output, queue lengths are noted to have increased on Garrison Lane northbound and would now extend for approximately 90m.

4.5.49. The results for the '2027 All Development' model show that during the AM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -6.5%. The highest DoS remains on Mill Lane eastbound at 95.9%, although it has been reduced when compared to the 'All Stages Run' scenario with a queue of 18.3 PCUs which equates to approximately 105m. The remaining lanes all operate with an acceptable DoS and acceptable queues.

4.5.50. The results for the '2027 All Development' model show that during the PM peak 'RTIGA & pedestrian crossings every other cycle' the junction will operate with negative PRC of -17.4%. This is due to excess demand on Mill Lane westbound which has a Dos of 105.7% and a queue of 25.2 PCUs which equates to approximately 145m. The remaining lanes all operate with an acceptable DoS and acceptable queues.

4.5.51. The junction has negative PRC for the 'all stages run' scenario and the 'RTIGA & pedestrian crossings every other cycle' scenario, during both the AM and PM peaks. The PRC has decreased when compared to the '2027 Forecast' flows due to the increase in development related traffic.

4.5.52. The '2027 All Development' flows have a significant impact on junction performance even when applied to the 'RTIGA & pedestrian crossings every other cycle' scenario and may lead to congestion. Should the 'All stages run every cycle' scenario prove a more accurate reflection of driver and pedestrian behaviour then the junction could experience severe congestion.

4.5.53. In order to make the impact of the differing scenarios clear all the results for the differing flow groups are tabulated in **Table 30**.

'All Stages Run'	2015				2027				2027 All Development				2027 All Development excluding Candlet Road			
	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec		Cycle time = 128 sec	
	Junction PRC = -5.0%		Junction PRC = -11.9%		Junction PRC = -19.1%		Junction PRC = -27.6%		Junction PRC = -20.1%		Junction PRC = -32.4%		Junction PRC = -19.0%		Junction PRC = -29.1%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1 Garrison Lane - southbound	51	9.7	40.3	7.1	58.1	11.4	47.1	8.4	70.3	14.9	53	9.5	62.4	12.6	49.2	8.8
2/1 Mill Lane - westbound	69.8	6.8	100.7	17.3	79.3	8.4	114.9	33.4	80.1	8.6	119.2	39.2	79.3	8.4	116.1	35.1
3/1 Garrison Lane - northbound	36.6	6.5	60.4	12.1	41.3	7.4	69.2	14.6	44.2	8.2	76.7	17.1	43	7.8	72.7	15.6
4/1 Mill Lane - eastbound	94.5	16.1	72.2	9.1	107.1	30	82.7	11.4	108.1	31.5	84.6	11.9	107.1	30	83.3	11.6
5/1 Garrison Lane - internal Lane	15.9	0.1	25.4	0.2	18	0.1	29.1	0.2	19.8	0.1	33.2	0.2	19	0.1	31	0.2

'RTIGA & Pedestrian Crossings every other cycle'	2015				2027				2027 All Development				2027 All Development excluding Candlet Road			
	AM peak		PM peak		AM peak		PM peak		AM peak		PM peak		AM peak		PM peak	
	Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec		Cycle time = 227 sec	
	Junction PRC = 7.4%		Junction PRC = -0.8%		Junction PRC = -5.5%		Junction PRC = -13.2%		Junction PRC = -6.5%		Junction PRC = -17.4%		Junction PRC = -5.5%		Junction PRC = -14.4%	
Lane	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)	Degree of Saturation (%)	Queue (MMQ)
1/1 Garrison Lane - southbound	44.2	9	34.9	6.6	50.4	10.6	40.2	7.8	60.9	13.7	44.9	8.9	54.1	11.7	41.9	8.2
2/1 Mill Lane - westbound	61.9	6.2	89.3	11.9	70.3	7.4	101.9	20	71	7.6	105.7	25.2	70.3	7.4	103	21.5
3/1 Garrison Lane - northbound	32.5	6.1	53.5	11.1	36.7	7	61.4	13.4	39.2	7.6	68	15.6	38.1	7.3	64.5	14.4
4/1 Mill Lane - eastbound	83.8	12.7	64	8.4	94.9	17.7	73.3	10.1	95.9	18.3	75	10.4	94.9	17.7	73.9	10.2
5/1 Garrison Lane - internal Lane	14.9	0.1	24	0.2	16.9	0.1	27.5	0.2	18.5	0.1	31.4	0.2	17.8	0.1	29.3	0.2

Table 30: Garrison Lane / Mill Lane: Results for both Signal Sequences for all flow groups

4.6. Summary & Recommendations

4.6.1. **Junction A: A14 Junction 58 / A12 / A1156**

a) The LinSig modelling has indicated that it would not be feasible to introduce traffic signal control at the roundabout within the existing layout with the '2015 base' traffic flows without exacerbating congestion. This also applies to the 2027 forecast year where the increased traffic flows lead to a further decline in signal performance.

b) The physical layout of the roundabout, carriageway markings and signage could potentially be revised to improve capacity and make signalisation a more realistic option.

c) It should be noted that these measures could also potentially enhance the performance of the roundabout with the conventional priority junction on each entry arm.

d) It is further recommended that LinSig modelling is undertaken to confirm if amending the layout would also enhance signal performance and establish the optimum number of entries that need to be signalised. Once this option is validated as being beneficial then signalisation could be brought forward.

4.6.2. **Junction C: A14 Junction 60 / A154 Candlet Road**

a) The LinSig modelling indicates that the junction operates with spare capacity in the 2015 base year but sees this capacity diminish in the 2027 forecast year, particularly during the PM peak, although none of the predicted queues can be regarded as excessive.

b) By using the optimiser facility in LinSig alongside a higher cycle time, the impact of the 'All development' flows is mitigated and the junction PRC remains approximately the same for both the AM and PM peak periods as the '2027 forecast' year. The removal of the Candlet Road development brings a further small improvement in junction performance and a reduction in queue lengths.

c) The current operation with the MOVA system should accomplish the results seen in the LinSig models without any further immediate action required and the junction should operate at an acceptable level with the forecast and development flows.

d) One proviso to the LinSig predictions lies with the current low usage of the pedestrian crossings over the A14, it is based on this movement remaining unchanged. Capacity issues are not a problem in the modelled scenarios, but this could alter if pedestrian demand increases in the future.

e) Further to point c) above; the modelling could be further enhanced by a site visit during the peak periods to undertake observations and record timings.

4.6.3. **Junction F: A154 Garrison Lane / High Road**

a) The LinSig modelling indicates that the junction operates with a significant margin of spare capacity for all scenarios in the 2015 base year. This capacity diminishes in the '2027 forecast' year, but still remains acceptable even for the 'pedestrians every cycle' scenario. Although increased queuing on High Street West eastbound should be noted.

b) The LinSig output for the 'All Development' flows and 'pedestrians every cycle' scenario shows that the junction PRC is reduced significantly and results in significant queueing. The removal of the Candlet Road Development brings a small improvement in junction performance and a slight reduction in queue lengths,

c) The LinSig results indicate that if the worst case scenario of 'pedestrian stage every cycle is reflected on site, then the junction will encounter significant congestion with the 2027 'All development' flows applied. If the 'pedestrian stage every other cycle' scenario is a more accurate reflection of the signal sequence then the junction would operate with a small PRC with the '2027 All Development' flows' applied.

d) There is no information as to the current use of the pedestrian stage or guarantee of future levels of use. In order to review the signal operation sensibly then the worst case scenario should be taken and that by 2027 with 'All Development' the junction would face capacity issues. It is recommended that a review of the junction layout is carried out to see if any capacity gains could be achieved by amendments to the kerb lines, carriageway markings and signal location. Further LinSig modelling could also be undertaken.

e) If point 4.6.3 d) is pursued, then a site visit during the peak periods is recommended to undertake observations and record timings.

4.6.4. **Junction H: A154 Garrison Lane / Mill Lane**

a) If the ‘RTIGA & pedestrian crossings every other cycle’ scenario is taken to be most representative, the LinSig modelling indicates that overall the junction currently operates with acceptable performance during the peak periods. However, even with this ‘best case’ scenario capacity issues are already developing on some arms, most notably Mill Lane westbound. The potential exists for improvements in junction performance with the introduction of a signal control system such as MOVA. However, safety issues imposed by the staggered layout may restrict the degree of capacity gain possible even with a system such as MOVA.

b) With the ‘2027 forecast’ and ‘2027 forecast including development’ flows the performance of the junction rapidly deteriorates, resulting in a negative PRC and increased queue lengths. The removal of the Candlet Road development flows result in only a marginal improvement.

c) As the junction lies within a residential area it is worth noting that changes to the traffic patterns that lead to increased queueing and delays at the junction may well attract adverse comment.

d) It is recommended that further LinSig modelling is undertaken to replicate the impact of installing a system such as MOVA along with a review of the junction layout to see if any capacity gains could be achieved by amendments to the kerb lines, carriageway markings and signal locations.

e) If point 4.6.4 d) above is pursued, then a site visit during the peak periods is recommended to undertake observations and record timings.

Conclusion and Recommendations

5

5. Conclusion and Recommendations

5.1. Overview

5.1.1. This report has been prepared by AECOM on behalf of Highways England and Suffolk County Council (SCC) to assess the cumulative impact of a number of residential development sites in Felixstowe on the local and Strategic Road Network (SRN).

5.1.2. Suffolk Coastal District Council (SCDC) have produced the Felixstowe Peninsula Area Action Plan (AAP), October 2015, which identifies a number of 'Preferred Options' sites for potential development to meet future housing needs. Highways England and SCC have been consulted by SCDC with regards to the potential traffic implications of the 'Preferred Option' residential sites. AECOM have been commissioned to assess the cumulative impact of the potential residential developments at key junctions within Felixstowe.

5.1.3. This assessment has been undertaken in accordance with the brief provided by Highways England and SCC (provided in Appendix A). At the request of SCC and SCDC, this report has been updated to include references to the recently published AAP 'Proposed Submission Document', April 2016; it does not constitute a full review of the AAP Proposed Submission Document.

5.1.4. The objective of this cumulative traffic impact assessment report is to identify key junctions within the study area that are likely to constrain further traffic growth and those junctions at which traffic capacity mitigation measures may be required. The aim of this report is to allow Highways England and the Local Highway (SCC) and Planning (SCDC) Authorities to understand the potential impact of the AAP with a view to informing the scale of highway infrastructure provision necessary to support it.

5.1.5. The Felixstowe Peninsula AAP covers the communities of Bucklesham, Felixstowe, Kirton, Trimley St Martin and Trimley St Mary. The AAP 'horizon' is 2027, which determines the scope of this study. The cumulative assessment considers the impact of up to 2,096 residential units, some of which are sites listed within the AAP, others relate to currently committed or assumed likely development.

5.1.6. The communities within the Felixstowe AAP boundary are primarily served by the A14 which is also a key strategic route nationally for freight vehicles using the Port of Felixstowe. The A14 / A12 junction (A14 Junction 58) is also included within the boundary of the AAP and is a key junction to consider.

5.1.7. Existing traffic data was used to create a spreadsheet model including eight existing junctions. An additional two 'potential junctions' are also included as part of a new link road between Candlet Road and High Road which is a requisite of one of the development sites.

5.1.8. 2015 was identified as a base year, growth was applied to the 2015 base flows to forecast traffic to 2027 which is the horizon year of the AAP. It should be noted that the spreadsheet model does not consider the effects of congestion on the network, for example, the reassignment of traffic that could arise in the future due to delay or attraction of traffic to/from other routes. Nine development sites have been considered in the spreadsheet model, five of which are from the AAP preferred options, three are committed developments and the other is a site at Candlet Road that has previously been refused planning permission but is anticipated to go through the appeal process and has therefore been included in the cumulative impact assessment.

5.1.9. Scenarios with and without development in 2027 were modelled using Junctions 8 software for the non-signalised junctions and LinSig software for the signalised junctions.

5.2. Modelling Results Summary and Recommendations

Junctions B (Howlett Way / High Road), E (Grove Road / Colneis Road / Beatrice Avenue) and G (Beatrice Avenue / High Road / Hamilton Road)

5.2.1. The ARCADY results found that Junctions B (Howlett Way / High Road), E (Grove Road / Colneis Road / Beatrice Avenue) and G (Beatrice Avenue / High Road / Hamilton Road) operate well within capacity at present and are predicted to continue to do so in 2027 with all development considered. It should be noted however, that AECOM do not have any observed queue data and therefore cannot comment on the validity and reliability of the queue lengths predicted by ARCADY.

Junction D (A154 Candlet Road / Grove Road / Garrison Lane)

5.2.2. The ARCADY results for Junction D (A154 Candlet Road / Grove Road / Garrison Lane) show that the junction is starting to experience capacity problems on Arm C (Candlet Road) in the PM peak. This is predicted to get worse by 2027 and when development traffic is considered, the capacity problems are also apparent in the AM peak on Arm C (Candlet Road). Capacity issues and queuing is significantly worse with the addition of Candlet Road development traffic. AECOM recommend that further work would be required in order to quantify the potential to mitigate the impact of development traffic at Junction D.

5.2.3. The Candlet Road approach is currently hatched down from two lanes to one. AECOM understand that this hatching may have been introduced recently as part of a safety scheme associated with the introduction of the Toucan crossing, in order to avoid high vehicle speeds on the roundabout. It would appear that reinstating a second lane on the Candlet Road approach could mitigate the predicted capacity and queueing issues on this arm of the roundabout. However, any proposals to amend these markings would need to be carefully considered. Simply removing the hatching might not be satisfactory. It may be that a scheme to reintroduce a second lane on Candlet Road would require some realignment of the approach to prevent the recurrence of the safety issue that prompted the hatching to be implemented. In advance of such a scheme, AECOM recommend that the roundabout is modelled with new kerb line geometry (potentially with part of the hatched area reinstated as available carriageway whilst maintaining entry deflection) to see what effect this would have on the operation of the roundabout.

Junction A: A14 Junction 58 / A12 / A1156

5.2.4. Through AECOM's previous ARCADY model assessment on Junction A (A14 Junction 58 / A12 / A1156) we are aware that the existing layout of the roundabout will not be able to accommodate future growth in traffic by 2027. AECOM have previously recommended that the junction is modelled to test the potential for signalisation. The observed queue lengths from our previous work have been used to assist in validating a 2015 base LinSig model for the existing un-signalised roundabout. A comparison between the un-signalised junction and the LinSig output for the different scenarios provides a measure of the impact of part or full signalisation of the roundabout.

5.2.5. The LinSig modelling has indicated that it would not be feasible to introduce traffic signal control at the roundabout within the existing layout with the '2015 base' traffic flows without exacerbating congestion. This also applies to the 2027 forecast year where the increased traffic flows lead to a further decline in signal performance.

5.2.6. The physical layout of the roundabout, carriageway markings and signage could potentially be revised to improve capacity and make signalisation a more realistic option.

5.2.7. It should be noted that these measures could also potentially enhance the performance of the roundabout with the conventional priority junction on each entry arm.

5.2.8. It is further recommended that LinSig modelling is undertaken to confirm if amending the layout would also enhance signal performance and establish the optimum number of entries that need to be signalised. Once this option is validated as being beneficial then signalisation could be brought forward.

Junction C: A14 Junction 60 /A154 Candlet Road

5.2.9. The LinSig modelling indicates that the junction operates with spare capacity in the 2015 base year but sees this capacity diminish in the 2027 forecast year, particularly during the PM peak, although none of the predicted queues can be regarded as excessive.

5.2.10. By using the optimiser facility in LinSig alongside a higher cycle time, the impact of the 'All development' flows is mitigated and the junction Practical Reserve Capacity (PRC) remains approximately the same for both the AM and PM peak periods as the '2027 forecast' year. The removal of the Candlet Road Development brings a further small improvement in junction performance and a reduction in queue lengths.

5.2.11. The current operation with the MOVA system should accomplish the results seen in the LinSig models without any further immediate action required and the junction should operate at an acceptable level with the forecast and development flows.

5.2.12. One proviso to the LinSig predictions lies with the current low usage of the pedestrian crossings over the A14, it is based on this movement remaining unchanged. Capacity issues are not a problem in the modelled scenarios, but this could alter if pedestrian demand increases in the future.

5.2.13. Further to the point above; the modelling could be further enhanced by a site visit during the peak periods to undertake observations and record timings.

Junction F: A154 Garrison Lane/High Road

5.2.14. The LinSig modelling indicates that the junction operates with a significant margin of spare capacity for all scenarios in the 2015 base year. This capacity diminishes in the '2027 forecast' year, but still remains acceptable even for the 'pedestrians every cycle' scenario. Although increased queuing on High Street West eastbound should be noted.

5.2.15. The LinSig output for the 'All Development' flows and 'pedestrians every cycle' scenario shows that the junction PRC is reduced significantly and results in significant queueing. The removal of the Candlet Road Development brings a small improvement in junction performance and a slight reduction in queue lengths.

5.2.16. The LinSig results indicate that if the worst case scenario of 'pedestrian stage every cycle is reflected on site, then the junction will encounter significant congestion with the 2027 'All development' flows applied. If the 'pedestrian stage every other cycle' scenario is a more accurate reflection of the signal sequence then the junction would operate with a small PRC with the '2027 All Development' flows' applied.

5.2.17. There is no information as to the current use of the pedestrian stage or guarantee of future levels of use. In order to review the signal operation sensibly then the worst case scenario should be taken and that by 2027 with 'All Development' the junction would face capacity issues. It is recommended that a review of the junction layout is carried out to see if any capacity gains could be achieved by amendments to the kerb lines, carriageway markings and signal location. Further LinSig modelling could also be undertaken.

5.2.18. If the above point is pursued, then a site visit during the peak periods is recommended to undertake observations and record timings.

Junction H: A154 Garrison Lane/Mill Lane

5.2.19. If the 'right turn indicative green arrow (RTIGA) & pedestrian crossings every other cycle' scenario is taken to be most representative, the LinSig modelling indicates that overall the junction currently operates with acceptable performance during the peak periods. However, even with this 'best case' scenario capacity issues are already developing on some arms, most notably Mill Lane westbound. The potential exists for improvements in junction performance with the introduction of a signal control system such as MOVA. However, safety issues imposed by the staggered layout may restrict the degree of capacity gain possible even with a system such as MOVA.

5.2.20. With the ‘2027 forecast’ and ‘2027 forecast including development’ flows the performance of the junction rapidly deteriorates, resulting in a negative PRC and increased queue lengths. The removal of the Candlet Road development flows result in only a marginal improvement.

5.2.21. As the junction lies within a residential area, changes to the traffic patterns that lead to increased queueing and delays at the junction may well attract adverse comment.

5.2.22. It is recommended that further LinSig modelling is undertaken to replicate the impact of installing a system such as MOVA along with a review of the junction layout to see if any capacity gains could be achieved by amendments to the kerb lines, carriageway markings and signal locations.

5.2.23. If the point above is pursued, then a site visit during the peak periods is recommended to undertake observations and record timings.

5.3. Conclusion

3.7.4. The scope of this initial cumulative impact assessment has included:

- Building a transport model for Felixstowe based on existing data available;
- Using traffic data from strategic traffic counters to validate model data;
- Consideration of the cumulative impact of the sites proposed in the AAP;
- Consideration of the additional impact from the additional site which has been identified by developers north of Candlet Road; and
- Identifying any junctions that are likely to act as a restriction on any further development.

5.3.1. In summary, the results of the cumulative impact assessment have led AECOM to form a number of recommendations for further work. Namely at junctions A (A14 Junction 58 / A12 / A1156), D (A154 Candlet Road / Grove Road / Garrison Lane), F (A154 Garrison Lane / High Road West) and H (A154 Garrison Lane / Crescent Road / Mill Lane), to explore the opportunity for increasing capacity at these junctions which are predicted to experience capacity issues by 2027, with the development sites (and in some cases without) considered. Further work would include identifying potential indicative mitigation measures these junctions where capacity problems have been identified and to model the effectiveness of those mitigation measures.

References

References

Suffolk Coastal District Councils' Preferred Options consultation document (October 2015): http://www.suffolkcoastal.gov.uk/yourdistrict/planning/policy

Suffolk Coastal District Councils' Proposed Submission document (April 2016): http://www.suffolkcoastal.gov.uk/assets/Documents/District/Planning-policy/Local-Plan/FINAL-Publication-Draft-April-2016.pdf

Ipswich Eastern Fringe & Felixstowe/Trimleys, Transport Studies, Faber Mansell / AECOM, August 2008

Suffolk Coastal LDF Housing Allocations, Proposed Strategy Transport Appraisal, AECOM, September 2009

Suffolk Coastal LDF Housing Allocations, Proposed Strategy Transport Appraisal Addendum, AECOM, November 2009

Package 2 A14 Junction Assessment, AECOM, October 2015

About AECOM

AECOM (NYSE: ACM) is built to deliver a better world. We design, build, finance and operate infrastructure assets for governments, businesses and organizations in more than 150 countries.

As a fully integrated firm, we connect knowledge and experience across our global network of experts to help clients solve their most complex challenges.

From high-performance buildings and infrastructure, to resilient communities and environments, to stable and secure nations, our work is transformative, differentiated and vital. A Fortune 500 firm, AECOM companies had revenue of approximately US$19 billion during the 12 months ended June 30, 2015.

See how we deliver what others can only imagine at aecom.com and @AECOM.