Cheltenham Borough Council

Cheltenham Plan Transport Assessment

Phase 1 Report

Final 2 | 22 February 2018

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 256784

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Appendix A

Highway Assignment Flow and Difference Plots

1 Executive Summary

To inform the emerging Cheltenham Plan a local highways site assessment is required to understand the impacts of proposed site allocations.

The future year 2031 Central Severn Vale (CSV) SATURN strategic highway model was used to identify junctions impacted by the proposed development.

Two development options assessed;

- Option A, where all 14 sites mainly residential, and
- Option B, where Leckhampton site incorporates a secondary school as well

The overall development impact in terms of link flow is modest.

The following criteria set was used to identify model nodes for further assessment:

- Node inbound traffic volume increase more than 20%, or
- Node delay is above 60s, or
- Node delay increase is above 30s, or
- Node V/C ratio is above 85%, or
- Node V/C ratio increase is above 20%.

The junctions identified to be taken forward for detailed modelling in Phase 2 are shown in Table 1.

Table 1 Unique list of junctions for detailed analysis in Phase 2

No	Junction
1	Junction with A417
2	A4019 - Hayden Road
3	A4019 - Hayden Road - Manor Road
4	Priors Road - Harp Hill - Hewlett Road
5	Old Bath Road - London Road (A40)
6	A40 - A435
7	A435 - Moorend Road - Lyefield Road
8	Arle Court Roundabout
9	Drews Court - Paynes Pitch
10	Shurdington Road - Leckhampton Lane
11	Zoons Road - Churchdown Lane
12	Fiddlers Green Lane- Telstar Way
13	A435 - Bramble Chase
14	North Road West - Grovefield Way
15	A46 - Church Lane
16	Old Gloucester Road - Cheltenham Road B4063
17	Stoke Orchard Road - A435
18	A46 - B4079
19	A417 - Zoons Court (Zoons Court Roundabout)

2 Introduction

2.1 Background to study

In May 2017 Cheltenham Borough Council (CBC) invited proposals for a consultant team to undertake a local highways site assessment to provide the transport evidence base that would support the emerging Cheltenham Local Plan (CLP). Following the submission of proposals, CBC appointed Arup to undertake this work.

2.2 Context

To inform the emerging Cheltenham Plan a local highways site assessment is required to understand the impacts of proposed site allocations. A robust evidence base will enable an assessment of the transport impacts of both existing development as well as that proposed, and can inform sustainable approaches to transport at a plan-making level. This will include consideration of viability and deliverability.

Using the future year 2031 Central Severn Vale (CSV) SATURN strategic highway model as provided by Gloucestershire County Council (GCC), the objective of Phase 1 of the commission is to identify junctions impacted by the proposed development in the 2031 forecast year as, well as to monitor the impact on key junctions and corridors within Cheltenham. Having identified these junctions, the objective of Phase 2 will then be to undertake detailed junction modelling to inform junction design and consider the mitigation strategies that may be required as a result of development.

2.3 Forecast Scenarios

The following four forecast scenarios have been assessed as per the study scope:

- 2031 Do Minimum AM peak hour;
- 2031 Do Minimum PM peak hour;
- 2031 Do Minimum plus Option A AM peak hour; and
- 2031 Do Minimum plus Option A PM peak hour.

In addition, the following eight forecast scenarios have also been assessed:

- 2031 Do Minimum plus Option B AM peak hour;
- 2031 Do Minimum plus Option B PM peak hour;
- 2031 DS7 Sensitivity Test AM peak hour;
- 2031 DS7 Sensitivity Test PM peak hour;
- 2031 DS7 Option A AM peak hour;
- 2031 DS7 Option A PM peak hour.
- 2031 DS7 Option B AM peak hour; and
- 2031 DS7 Option B PM peak hour.

2.4 Report structure

This Phase 1 report outlines the modelling approach and implementations, and presents the modelled impacts which allow the identification of key links and junctions. These will need to be modelled in more detail with mitigation may be required as a result of development.
The report is structured as follows:

- Section 2 – Phase 1 Scope
- Section 3 – Cheltenham Plan Sites
- Section 4 – Modelling Methodology
- Section 5 – Modelling Results
- Section 6 – Conclusions and Recommendations

3 Phase 1 Scope

The Central Severn Vale (CSV) SATURN strategic highway model was originally developed in 2003 on behalf of Gloucestershire County Council (GCC) and Highways England (HE). Since then, it has been periodically updated to better reflect current conditions. The latest version of the CSV base year model was finalised in March 2017 by Amey and was used to support the Joint Core Strategy (JCS) submission.

Geographically, the model covers the whole of the Gloucester, Cheltenham and Tewkesbury urban areas and their surrounding environs and has been developed in order to:

- Inform the assessment of individual planning applications;
- Assist in the development of Local Plans and site allocations; and
- Inform the development of GCC's Local Transport Plan (LTP).

According to the GCC CSV Highways Model Third Party Access Protocol the CSV SATURN model has been developed in accordance with Department for Transport (DfT) guidelines and advice set out in the Design Manual for Roads and Bridges (DMRB) and WebTAG acceptability criteria. This aims to achieve relevant validation standards, ensuring high levels of confidence in the model and fitness for purpose in terms of calibration and validation requirements. The LMVR for the base model states that the model is an accurate representation of base year conditions.

As such, the forecast year CSV models, developed from the base models and provided by GCC, have been taken as the Do Minimum models for this commission without further development.

The Phase 1 deliverables are:

- Highways flow diagrams;
- Identification of key junctions to be taken forward for detailed modelling in Phase 2;
- Sustainable Transport Assessment;
- Phase 1 report; and
- Phase 1 presentation.

4 Cheltenham Plan Sites

There are a number of different sites currently being considered as potential site allocations in the Cheltenham Plan. Site location, size and composition has been supplied by Cheltenham Borough Council and site locations are shown in Figure 1.

The existing characteristics of each site have been audited individually and are presented in Table 1. More details can be found in the Sustainable Transport Assessment (STA) report.

Table 2. Proposed land use options

	Option A		Option B	
Site Name	**Proposed Use**	**Quantity [units]**	**Proposed Use**	**Quantity [units / pupils]**
Arle Nurseries / Old Gloucester Road	Housing	300	Housing	300
Land at former Monkscroft Primary School	Housing	60	Housing	60
Christ College Site B	Housing	100	Housing	100
Lansdown Road	Housing	68	Housing	68
Land at Leckhampton	Housing	370	Housing, Education	250 units, 900 pupils
Land at Reeves Field	Housing	80	Housing	80
North Place and Portland Place	Mixed Use	143	Mixed Use	143
Land at 100 - 102 Prestbury Road	Housing	40	Housing	40
Premier Products	Housing	70	Housing	70
Land at Priors Farm Fields	Mixed Use	100	Mixed Use	100
Land at Oakhurst Rise	Housing	150	Housing	150
Land at Brockhampton Lane	Housing	25	Housing	25
Land at Stone Crescent	Housing	20	Housing	20
Lansdown Industrial Estate	Mixed Use	190	Mixed Use	190
Total Units		1,716		1,596

The difference between Option A and B is the proposed land use of the Land at Leckhampton site. Option A is proposed to be housing only incorporating 370 units. Option B envisages educational function as well with a secondary school of 900 pupils and 250 residential units.

A3

Brockhampton Lane

Arle Nurseries / Old Gloucester Road

Land at Stone Crescent

Christ College Site B

North Place & Portland Street

100-102 Prestbury Road

Premiere Products, Bouncers Lane

Priors Farm Fields

Former Monkscroft Primary School

Lansdown Industrial Estate

Lansdown Road

Leckhampton

Reeves Field

Lands off Oakhurst Rise

Uckington

St Marks

Cheltenham

Prestbury

Battledown

Charlton Kings

Up Hatherley

The Reddings

Leckhampton

Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Legend

Potential site allocations

Issue	Date	By	Chkd	Appd
F2	2017-12-08	BS	TS	AJ

Metres

0 295 590 1,180

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Client

Cheltenham Borough Council

Job Title

Cheltenham Plan Transport Assessment

All Sites

Scale at A3

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Job No	Drawing Status
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Drawing No	Issue
001	**F2**

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5 Modelling Methodology

5.1 Model Assignments

The CSV 2031 'Do Minimum' model matrices and network were used as the starting point for this project with development scenario models pivoting from them and assessed against them.

As a sensitivity test the modelling was also undertaken using the CSV model 2031 'DS7' matrices and network as a base.

The 2031 JCS Core 'Do Minimum' scenario incorporates:

- Committed approved JCS growth, including Strategic Allocations with planning permissions
- TEMPRO growth for those areas outside the JCS area
- Committed / delivered transport schemes
- The JCS proposed Strategic Allocations
- All unallocated Objectively Assessed Need JCS growth
- 'Do minimum' transport package (where funding has been allocated but not committed)

The 2031 JCS 'DS7' Scenario in addition to the DM assumptions incorporates further highway network mitigations.

Table 3 shows the model assignments undertaken for this assessment.

Table 3. Modelled Runs

JCS model base	Scenario	Time Period
Core (DM) Forecast	Do Minimum	AM
		PM
	Do Something - Option A	AM
		PM
	Do Something - Option B	AM
		PM
DS7' Sensitivity Test	Do Minimum	AM
		PM
	Do Something - Option A	AM
		PM
	Do Something - Option B	AM
		PM

5.2 Baseline Matrices

The CSV 2031 'Do Minimum' model matrices already incorporate some of the proposed development according to the received development log. The incorporated developments and the assigned traffic is shown in Table 4 below.

To ensure accurate assessment of Option A and Option B land uses, these trips were removed from the Do Minimum trip matrices to form a baseline for the assessment.

Table 4. Developments incorporated to CSV Saturn forecast model

CP Site	JCS Site name	Land Use	Units	AM Arrival Trips 2031	AM Departure Trips 2031	PM Arrival Trips 2031	PM Departure Trips 2031
North Place and Portland Place	North Place / Portland Street Car Park - CBC Development Site. Current Proposals may include 100+ Resid & Mixed Use (Retail e.g. Morrisons)	Residential	125	18	52	47	28
Lansdown Road	Talbot Road - Off A40 Lansdown Rd. Gloucestershire Constabulary HQ	Residential	90	13	37	34	20
Land at 100 – 102 Prestbury Rd	Prestbury Road/Windsor Street – Reserved matters for replacement of existing industrial buildings with new offices (B1), residential care accommodation (C2) and sheltered housing (C3). – 42 dwellings	Residential	42	3	9	8	5

5.3 Trip Generation

The Total number of trips generated by the development (both arriving and departing) was estimated using the trip rates used for the JCS studies and the industry standard TRICS where information was not available for the proposed land use. Trip distribution, route choice and the impact on the network was estimated using the Central Severn Vale (CSV) SATURN highways model.

Trips of residential developments were based on the rates used in JCS and listed in Table 5. Trips of the Sixth Form school proposed in Option B were calculated using TRICS trip rates shown in Table 6.

Table 5. Trip rates adapted from JCS (Trips/units)

Land Use	AM		PM	
	Origin	Destination	Origin	Destination
Mixed Private / Non-Private (Suburban Sites)	0.235	0.111	0.145	0.233
Mixed Private / Non-Private (Edge of Town Sites)	0.334	0.116	0.161	0.326

Table 6. TRIC Trip rates for Secondary School (Trips/pupils)

Land Use	AM		PM	
	Origin	Destination	Origin	Destination
EDUCATION/B - SECONDARY	0.096	0.162	0.039	0.031

The calculated number of trips for the two option assessed can be found in Table 7 and Table 8

These trip rates were used to produce trip volumes in Table 6 and Table 7 which would subsequently be added into the 2031 Do Minimum matrices to create 2031 Do Something matrices.

Table 7. Option A Development Trips

Site Name	Proposed Use	No. of Houses	Lead Trip Rates Land Use Category	AM			PM		
				Origin	Destination	All	Origin	Destination	All
Arle Nurseries / Old Gloucester Road	Housing	300	Mixed Private / Non-Private (Edge of Town Sites)	100	35	135	48	98	146
Land at former Monkscroft Primary School	Housing	60	Mixed Private / Non-Private (Suburban Sites)	14	7	21	9	14	23
Christ College Site B	Housing	100	Mixed Private / Non-Private (Suburban Sites)	24	11	35	15	23	38
Lansdown Road	Housing	68	Mixed Private / Non-Private (Suburban Sites)	16	8	24	10	16	26
Land at Leckhampton	Housing	370	Mixed Private / Non-Private (Edge of Town Sites)	124	43	167	60	121	180
Land at Reeves Field	Housing	80	Mixed Private / Non-Private (Suburban Sites)	19	9	28	12	19	30
North Place and Portland Place	Mixed Use	143	Mixed Private / Non-Private (Edge of Town Sites)	48	17	64	23	47	70
Land at 100 - 102 Prestbury Road	Housing	40	Mixed Private / Non-Private (Suburban Sites)	9	4	14	6	9	15
Premier Products	Housing	70	Mixed Private / Non-Private (Suburban Sites)	16	8	24	10	16	26
Land at Priors Farm Fields	Mixed Use	100	Mixed Private / Non-Private (Edge of Town Sites)	33	12	45	16	33	49
Land at Oakhurst Rise	Housing	150	Mixed Private / Non-Private (Suburban Sites)	35	17	52	22	35	57
Land at Brockhampton Lane	Housing	25	Mixed Private / Non-Private (Edge of Town Sites)	8	3	11	4	8	12
Land at Stone Crescent	Housing	20	Mixed Private / Non-Private (Suburban Sites)	5	2	7	3	5	8
Lansdown Industrial Estate	Mixed Use	190	Mixed Private / Non-Private (Suburban Sites)	45	21	66	28	44	72

Table 8. Option B Development Trips

Site Name	Proposed Use	No. of Units	Lead Trip Rates Land Use Category	AM			PM		
				Origin	Destination	All	Origin	Destination	All
Arle Nurseries / Old Gloucester Road	Housing	300	Mixed Private / Non-Private (Edge of Town Sites)	100	35	135	48	98	146
Land at former Monkscroft Primary School	Housing	60	Mixed Private / Non-Private (Suburban Sites)	14	7	21	9	14	23
Christ College Site B	Housing	100	Mixed Private / Non-Private (Suburban Sites)	24	11	35	15	23	38
Lansdown Road	Housing	68	Mixed Private / Non-Private (Suburban Sites)	16	8	24	10	16	26
Land at Leckhampton	Housing, Education	250, 900 pupils	Mixed Private / Non-Private (Edge of Town Sites), Secondary School	170	175	345	75	109	185
Land at Reeves Field	Housing	80	Mixed Private / Non-Private (Suburban Sites)	19	9	28	12	19	30
North Place and Portland Place	Mixed Use	143	Mixed Private / Non-Private (Edge of Town Sites)	48	17	64	23	47	70
Land at 100 - 102 Prestbury Road	Housing	40	Mixed Private / Non-Private (Suburban Sites)	9	4	14	6	9	15
Premier Products	Housing	70	Mixed Private / Non-Private (Suburban Sites)	16	8	24	10	16	26
Land at Priors Farm Fields	Mixed Use	100	Mixed Private / Non-Private (Edge of Town Sites)	33	12	45	16	33	49
Land at Oakhurst Rise	Housing	150	Mixed Private / Non-Private (Suburban Sites)	35	17	52	22	35	57
Land at Brockhampton Lane	Housing	25	Mixed Private / Non-Private (Edge of Town Sites)	8	3	11	4	8	12
Land at Stone Crescent	Housing	20	Mixed Private / Non-Private (Suburban Sites)	5	2	7	3	5	8
Lansdown Industrial Estate	Mixed Use	190	Mixed Private / Non-Private (Suburban Sites)	45	21	66	28	44	72

5.4 Development Zones and Matrices

The 14 development sites were assigned to 15 new zones in the CSV model. Each has been allocated to one new zone, except 'North Place and Portland Place' which were separated into two new zones. The developments and their model zone are listed in Table 8.

Table 9. Development Zone numbers

Zone No	Development
2580	Land at former Monkscroft Primary School
2610	Christ College Site B
2980	Lansdown Road
3520	Land at Reeves Field
3380	Land at 100 - 102 Prestbury Road
3440	Premier Products
3441	Land at Priors Farm Fields
3170	North Place
3290	Portland Street
3110	Land at Brockhampton Lane
2640	Land at Stone Crescent
2641	Lansdown Industrial Estate
3050	Land at Leckhampton
3480	Land at Oakhurst Rise
3710	Arle Nurseries / Old Gloucester Road

The development trips presented in Table 6 and Table 7 were added to these zones to create 2031 Do Something matrices using existing trip distribution from the Do Minimum CSV model

For the sensitivity tests using the JCS DS7 models, these vehicle trips were further reduced by 10% to take into account the public transport improvements proposed in DS7.

5.5 Do Something Network

Each new zone has been connected to the 2031 Do Minimum network and the 2031 DS7 network via existing spigot links where available, or alternatively by creating new ones. The added spigot links were connected into existing junctions adjacent to the development. All updates were incorporated using the network coding methodology as presented in the CSV model LMVR.

6 Modelling Results

This section presents a comparison of 2031 Do Minimum and DS7 link flows against 2031 Do Something Option A and Option B developments, followed by analysis of flow to capacity and delays for junctions.

6.1 Overall Development Impact

The highway assignment flows are shown in Appendix A. The Link flow differences between the Do Something and Corresponding Do Minimum scenarios can be seen in Appendix A.

The Do Minimum highway flow plots show the key Cheltenham radial routes of the A40, the A4019, the A46 and the A345 as well as the M5 to the west of Cheltenham carry the highest traffic volumes. The flow difference plots show modest flow increases across Cheltenham and on these key routes, with the greatest flow increases experienced in close proximity to the development sites.

6.2 Core Do Minimum PM Model Convergence

The initially provided Core PM models did not meet the WebTAG convergence criteria. The model ran until the maximum number of assignment-simulation iteration loops. At the 120th iteration, 92.32% of link flows differed by +/- 1% compared to the previous loop. The WebTAG requirement for convergence is 4 consecutive loops with at least 98% of links of link flows with difference of +/- 1% compared to the previous loop. This indicates the model is unstable in terms of route choice and corresponding link flows.

In order to improve the pm model reflecting the impact of the developments instead of unstable routing we have liaised with the Amey model development team. The received PM peak hour assignment stops running after 57 iteration, 98.36% of link flows differed by +/- 1% compared to the previous loop. This indicates that the updated PM peak model is stable in terms of route choice and robust enough for this study.

6.3 Selection of Junctions

The purpose of the study is to assess the impact of the proposed developments, therefore the criteria set used to identify junctions for further assessment is linked changes between the Do Something Options and the Do Minimum

The following criteria set was used to identify model nodes for further assessment:

- Node inbound traffic volume increase more than 20%, or
- Node delay is above 60s, or
- Node delay increase is above 30s, or
- Node V/C ratio is above 85%, or
- Node V/C ratio increase is above 20%.

Node delay is measure of junction operational efficiency. V/C is traffic volume divided by capacity and is a measure of congestion.

Following a query run on the models each node was reviewed to identify real junctions and exclude dummy nodes, zone loading link connections and pedestrian crossings.

6.3.1 Core Forecast

Junctions identified using the Core (DM) listed in Table 10 and Table 12. These predominantly correspond to junctions on key routes as identified by CBC. The impacted junctions for Core Option B were the same as those in Table 10.

The junctions selected via the Core (DM) Forecast is shown in Figure 2 below.

The magnitude of changes in modelled Node volumes, delays and Volume Capacity ratio caused by Option B is generally slightly higher than Option A. This is because the AM trips generated by the proposed school are higher than the alternative housing development's induced trip.

The modelled difference between Option A and Option B is not significant, mainly localised to the adjacent junctions of Leckhampton site.

Due to the difference being negligible, the junctions identified for both development scenarios are identical.

During extracting turning movements for detailed junction modelling unexpected volumes were discovered in the provided Saturn strategic models at Arle Court Roundabout. Despite auditing the strategic model is outside the scope of current commission, Arup investigated the reasons in order to feed accurate turning volumes to Phase 3 detailed junction modelling. The reason of the heavy turn from A40 West arm to B4063 and Fiddler's Green Lane is dual. On the one hand, there was a coding error in the provided Saturn strategic models, incorporating a third lane along A40 West arm starting from M5 off-slip. This third lane enabled traffic to turn left without any delays caused by the straight traffic's queue. The additional lane has been removed from both Do Minimum and Do Something

models to reflect more accurately the available infrastructure. On the other hand, the heavy turning traffic is generated by the West Cheltenham Cyber Park development proposed to be located at Fiddler's Green. The modelled trips assigned to this development is over 3000 vehicle in each peak period and using the A40 – Fiddler's Green Ln to access the site.

Due to the slight changes in the latest model an extra four junctions step over the threshold.

- Charlton Ln - Old Bath Rd
- A40 – Telstar way
- A46 Shrudington Rd - Old Coach Rd
- M5 - A46 Roundabout

These additional junctions are not carried forward to Phase 2 because,

- Charlton Ln - Old Bath Rd only flagged up because of the adjacent roundabout blocking back
- The last three are already congested in the DM models and have over 60 second delays
- None of them is a JCS critical or key junction

Table 10 shows the modelled parameters of the above-mentioned junctions.

Table 10. Modelled parameters of additional junctions

Junction	Flow		Delay (s)			V/C		
	A Change	B Change	DM	A Change	B Change	DM	A Change	B Change
Charlton Ln - Old Bath Rd	-2%	-3%	11	19	25	60%	25%	26%
A40 – Telstar way	1%	0%	95	16	16	62%	0%	0%
A46 Shrudington Rd - Old Coach Rd	0%	0%	78	21	1	85%	18%	0%
M5 - A46 Roundabout	0%	0%	127	9	-2	44%	0%	0%

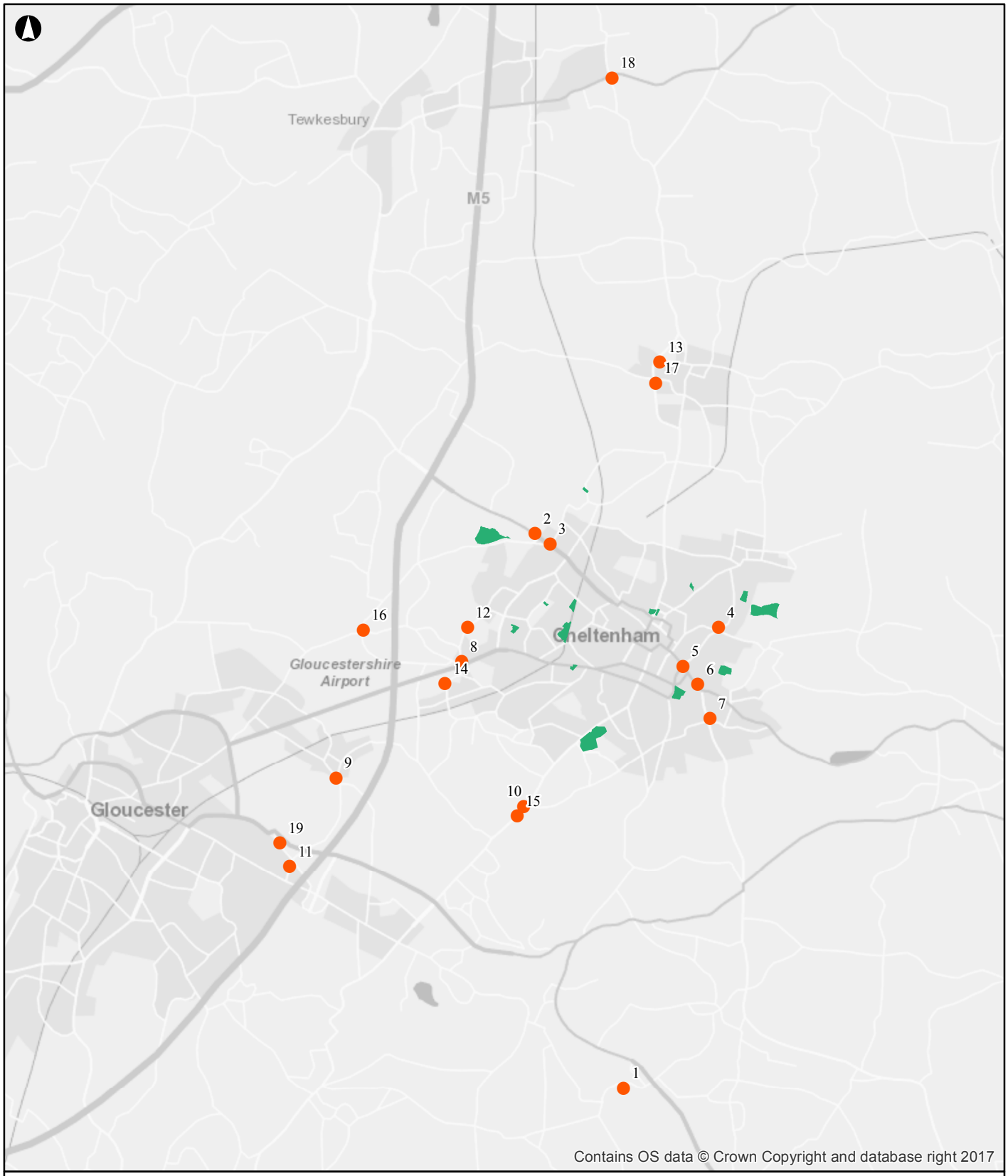
Table 11. Option A junctions for further assessment

No	Junction	Node	Option A									
			AM					PM				
			Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change	Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change
1	Junction with A417	1016	18%	2	0	6%	1%	3%	2	0	2%	0%
2	A4019 - Hayden Road	1367	-1%	118	1	36.96%	0%	0%	55	0	42%	0%
3	A4019 - Hayden Road - Manor Road	1394	1%	263	-3	59%	1%	0%	76	-1	63%	0%
4	Priors Road - Harp Hill - Hewlett Road	1430	2%	100	20	56%	1%	3%	23	2	66%	2%
5	Old Bath Road - London Road (A40)	1450	2%	58	1	64%	1%	2%	97	6	82%	2%
6	A40 - A435	1452	2%	94	0	84%	2%	2%	35	3	61%	1%
7	A435 - Moorend Road - Lyefield Road	1465	2%	95	8	66%	1%	1%	58	10	72%	1%
8	Arle Court Roundabout	2482	0%	2,272	43	103%	1%	7%	17	1	55%	3%
9	Drews Court - Paynes Pitch	3113	0%	164	1	83%	0%	0%	13	0	63%	0%
10	Shurdington Road - Leckhampton Lane	4355	0%	25	5	76%	1%	2%	18	2	66%	1%
11	Zoons Road - Churchdown Lane	4737	0%	263	-8	67%	0%	0%	6	0	48%	0%
12	Fiddlers Green Lane- Telstar Way	6003	1%	446	-4	72%	1%	1%	2,702	-21	152%	2%
13	A435 - Bramble Chase	7228	1%	81	8	74%	0%	0%	35	1	85%	0%
14	North Road West - Grovefield Way	7469	0%	55	4	44%	0%	3%	3	0	24%	1%
15	A46 - Church Lane	7963	0%	17	0	77%	0%	1%	38	10	60%	2%
16	Old Gloucester Road - Cheltenham Road B4063	8032	0%	675	29	104%	0%	2%	263	13	98%	2%
17	Stoke Orchard Road - A435	8060	1%	119	11	83%	1%	1%	43	2	87%	1%
18	A46 - B4079	8117	1%	165	12	94%	1%	0%	132	-3	93%	0%
19	A417 - Zoons Court (Zoons Court Roundabout)	8447	1%	54	-1	50%	0%	0%	7	0	42%	0%

Table 12. Option B junctions for further assessment

No	Junction	Node	Option B									
			AM					PM				
			Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change	Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change
1	Junction with A417	1016	24%	2	0	7%	1%	5%	2	0	2%	0%
2	A4019 - Hayden Road	1367	-1%	118	1	36.96%	0%	0%	55	0	42%	0%
3	A4019 - Hayden Road - Manor Road	1394	1%	263	-3	59%	1%	0%	77	0	63%	0%
4	Priors Road - Harp Hill - Hewlett Road	1430	2%	100	20	56%	1%	3%	23	2	66%	2%
5	Old Bath Road - London Road (A40)	1450	2%	58	1	64%	1%	2%	97	6	82%	2%
6	A40 - A435	1452	2%	94	0	84%	2%	2%	35	3	61%	1%
7	A435 - Moorend Road - Lyefield Road	1465	2%	95	8	66%	1%	0%	58	10	72%	1%
8	Arle Court Roundabout	2482	0%	2,272	43	103%	1%	6%	17	1	55%	3%
9	Drews Court - Paynes Pitch	3113	0%	164	1	83%	0%	0%	13	0	63%	0%
10	Shurdington Road - Leckhampton Lane	4355	0%	25	5	76%	1%	2%	18	2	66%	1%
11	Zoons Road - Churchdown Lane	4737	0%	263	-8	67%	0%	-1%	6	0	48%	-1%
12	Fiddlers Green Lane- Telstar Way	6003	1%	446	-4	72%	1%	1%	2,702	-21	152%	2%
13	A435 - Bramble Chase	7228	1%	81	8	74%	0%	0%	34	-1	85%	0%
14	North Road West - Grovefield Way	7469	0%	55	4	44%	0%	3%	3	0	24%	1%
15	A46 - Church Lane	7963	0%	17	0	77%	0%	1%	38	11	60%	2%
16	Old Gloucester Road - Cheltenham Road B4063	8032	0%	675	29	104%	0%	2%	263	13	98%	2%
17	Stoke Orchard Road - A435	8060	1%	119	11	83%	1%	0%	44	3	87%	0%
18	A46 - B4079	8117	1%	165	12	94%	1%	0%	132	-2	93%	0%
19	A417 - Zoons Court (Zoons Court Roundabout)	8447	1%	54	-1	50%	0%	0%	7	0	42%	0%

A4



19/02/2018 12:39:55

Legend

- Junctions flagged by Core Test
- Cheltenham Plan Sites

Metres

0 1,250 2,500 5,000

Junctions Recommended for further assessment using Core (DM) Forecast

Scale at A4

1:110,000

Issue	Date	By	Chkd	Appd
F2	2018-02-19	GJ	TS	AJ

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Job No **256784-00**

Drawing Status **For Issue**

Drawing No **002**

Issue **F2**

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6.3.2 DS7 Sensitivity Test

The impacted junctions identified using DS7 sensitivity test models are listed in Table 13 and Table 14.

The impacted Junction for DS7 Option A are a subset of those identified for the Core scenario. The impacted junctions for DS7 Option B were the same as those in Table 11.

The junctions selected via the DS7 Sensitivity Forecast are shown on Figure 3 below.

The magnitude of changes in modelled node volumes, delays and volume capacity ratio caused by Option B are generally slightly higher than Option A values. The modelled difference between Option A and Option B is not significant, mainly localised to the adjacent junctions of Leckhampton site.

Due to the difference being negligible, the junctions identified for both development scenarios are identical.

Table 13. DS7 Sensitivity test junctions for further assessment – Option A

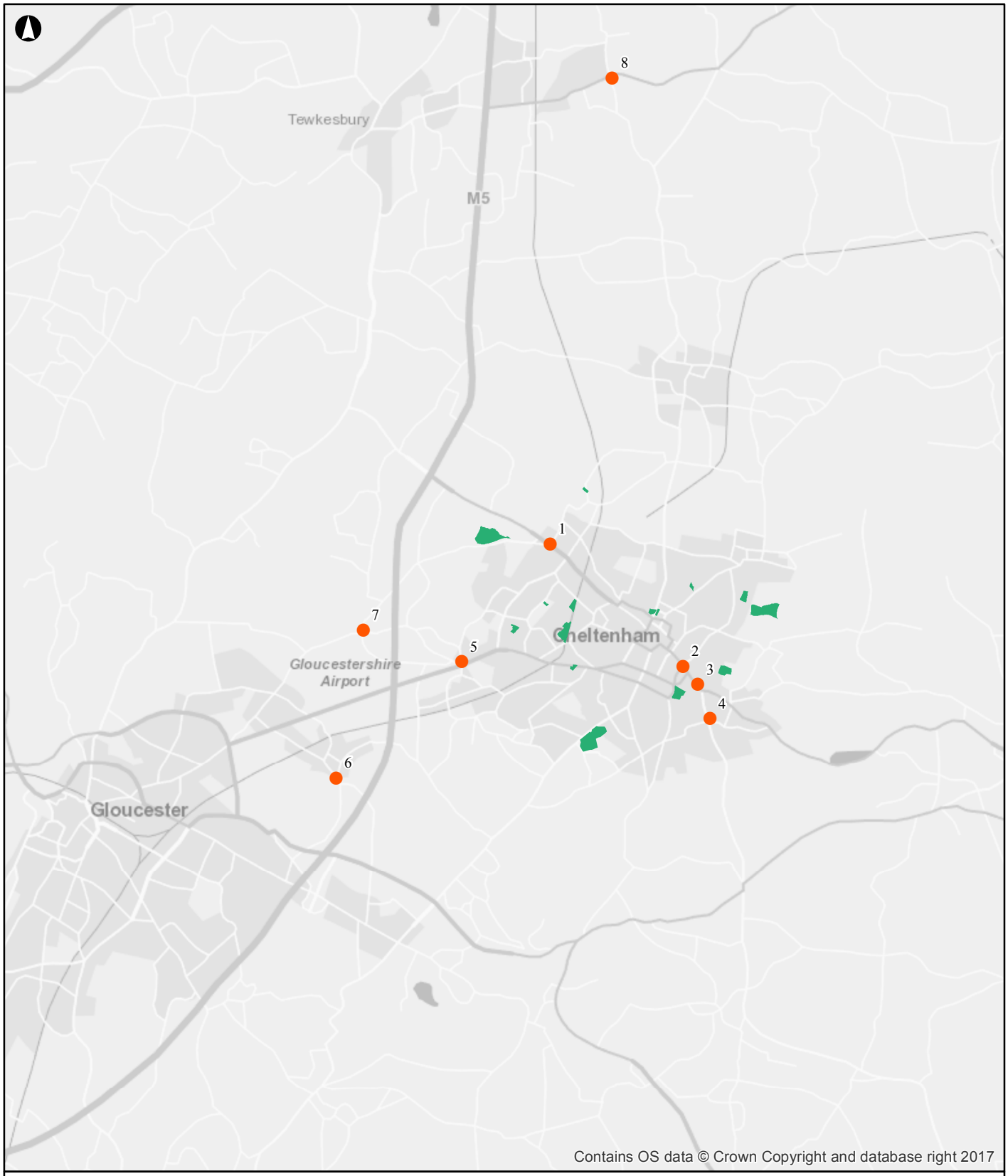
No	Junction	Node	Option A									
			AM					PM				
			Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change	Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change
1	A4019 - Hayden Road - Manor Road	1394	1%	160	6	72%	1%	1%	103	6	67%	0%
2	Old Bath Road - London Road (A40)	1450	1%	65	2	61%	1%	2%	107	10	82%	1%
3	A40 - A435	1452	2%	78	4	83%	2%	2%	29	2	60%	1%
4	A435 - Moorend Road - Lyefield Road	1465	2%	100	9	63%	2%	1%	40	6	72%	1%
5	Arle Court Roundabout	2482	0%	238	0	61%	0%	2%	75	6	62%	1%
6	Drews Court - Paynes Pitch	3113	0%	90	0	73%	0%	1%	16	1	73%	1%
7	Old Gloucester Road - Cheltenham Road B4063	8032	1%	124	6	90%	1%	1%	264	19	100%	1%
8	A46 - B4079	8117	0%	72	0	50%	0%	0%	49	0	54%	0%

Table 14. DS7 Sensitivity test junctions for further assessment – Option B

No	Junction	Node	Option B									
			AM					PM				
			Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change	Node Volume Change	Delay (With CP)	Delay Change	V/C (With CP)	V/C change
1	A4019 - Hayden Road - Manor Road	1394	1%	164	10	72%	1%	0%	103	6	67%	0%
2	Old Bath Road - London Road (A40)	1450	1%	65	2	61%	1%	2%	107	10	82%	1%
3	A40 - A435	1452	2%	80	7	83%	2%	2%	29	2	60%	1%
4	A435 - Moorend Road - Lyefield Road	1465	3%	105	13	63%	2%	1%	40	6	72%	1%
5	Arle Court Roundabout	2482	-1%	241	2	60%	-1%	2%	74	5	62%	1%
6	Drews Court - Paynes Pitch	3113	0%	90	0	73%	0%	1%	16	1	73%	1%
7	Old Gloucester Road - Cheltenham Road B4063	8032	3%	130	12	92%	3%	1%	265	20	100%	1%
8	A46 - B4079	8117	0%	72	-1	50%	0%	0%	49	0	55%	0%

A4

19/02/2018 12:39:58



Legend

- Junctions flagged by DS7 Test
- Cheltenham Plan Sites

Metres

0 1,250 2,500 5,000

Junctions Recommended for further assessment using DS7 Sensitivity Test

Scale at A4

1:110,000

Issue	Date	By	Chkd	Appd
F2	2018-02-19	GJ	TS	AJ

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Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
003	**F2**

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7 Conclusions and Recommendations

Using the future year 2031 Central Severn Vale (CSV) SATURN strategic highway model as provided by Gloucestershire County Council (GCC), the objective of Phase 1 of the commission is to identify junctions impacted by the proposed development in the 2031 forecast year as well as to monitor the impact on key junctions and corridors within Cheltenham. Having identified these junctions, the objective of Phase 2 will then be to undertake detailed junction modelling to inform junction design and consider the mitigation strategies that may be required as a result of development.

The junctions identified to be taken forward for detailed modelling in Phase 2 are shown in Table 15.

Table 15 Unique list of junctions for detailed analysis in Phase 2

No	Junction	Node
1	Junction with A417	1016
2	A4019 - Hayden Road	1367
3	A4019 - Hayden Road - Manor Road	1394
4	Priors Road - Harp Hill - Hewlett Road	1430
5	Old Bath Road - London Road (A40)	1450
6	A40 - A435	1452
7	A435 - Moorend Road - Lyefield Road	1465
8	Arle Court Roundabout	2482
9	Drews Court - Paynes Pitch	3113
10	Shurdington Road - Leckhampton Lane	4355
11	Zoons Road - Churchdown Lane	4737
12	Fiddlers Green Lane- Telstar Way	6003
13	A435 - Bramble Chase	7228
14	North Road West - Grovefield Way	7469
15	A46 - Church Lane	7963
16	Old Gloucester Road - Cheltenham Road B4063	8032
17	Stoke Orchard Road - A435	8060
18	A46 - B4079	8117
19	A417 - Zoons Court (Zoons Court Roundabout)	8447

There are no modelled junctions with significant volume, delay or V/C increases at the same time. The model shows relatively higher volume increase at junction with no or minimal delay.
Similarly, the provided forecast baseline model is already congested, and the highest modelled delays occur at already congested junctions. At these junctions, the additional traffic increase is minimal.

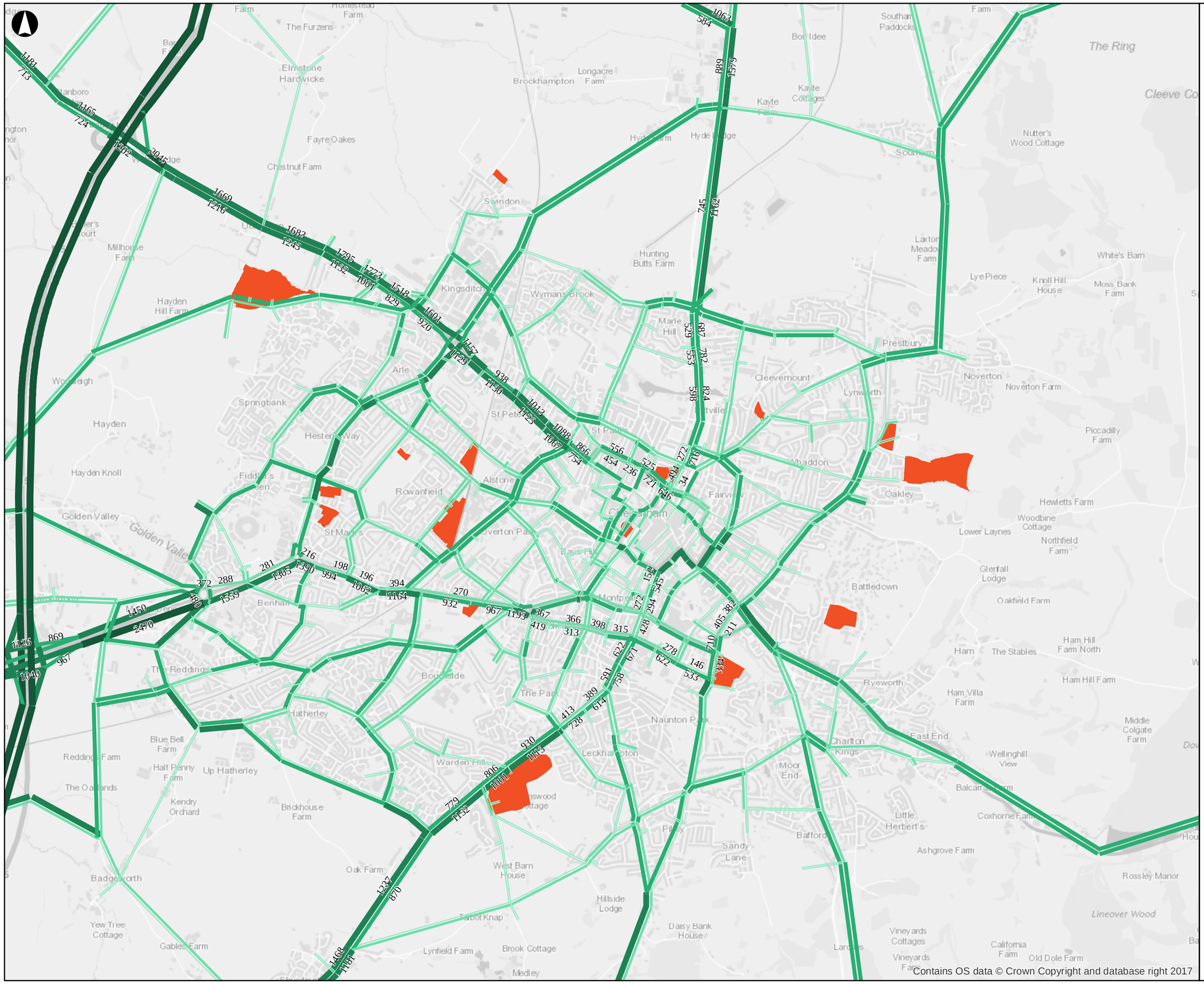
Future developments and related highway mitigation will complement each other; therefore, the Cheltenham Plan sites will be connected to a less congested network than is modelled in the Core (DM) forecast. The DS7 sensitivity test shows that the scale of the impact is even milder on a less congested network.

It can be anticipated that solutions to mitigate the development traffic along the selected junctions will be identified in Phase 2; however, this will become clear following detailed junction modelling.

Appendix A

Highway Assignment Flow and Difference Plots

A3



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Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

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Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
004	**F2**

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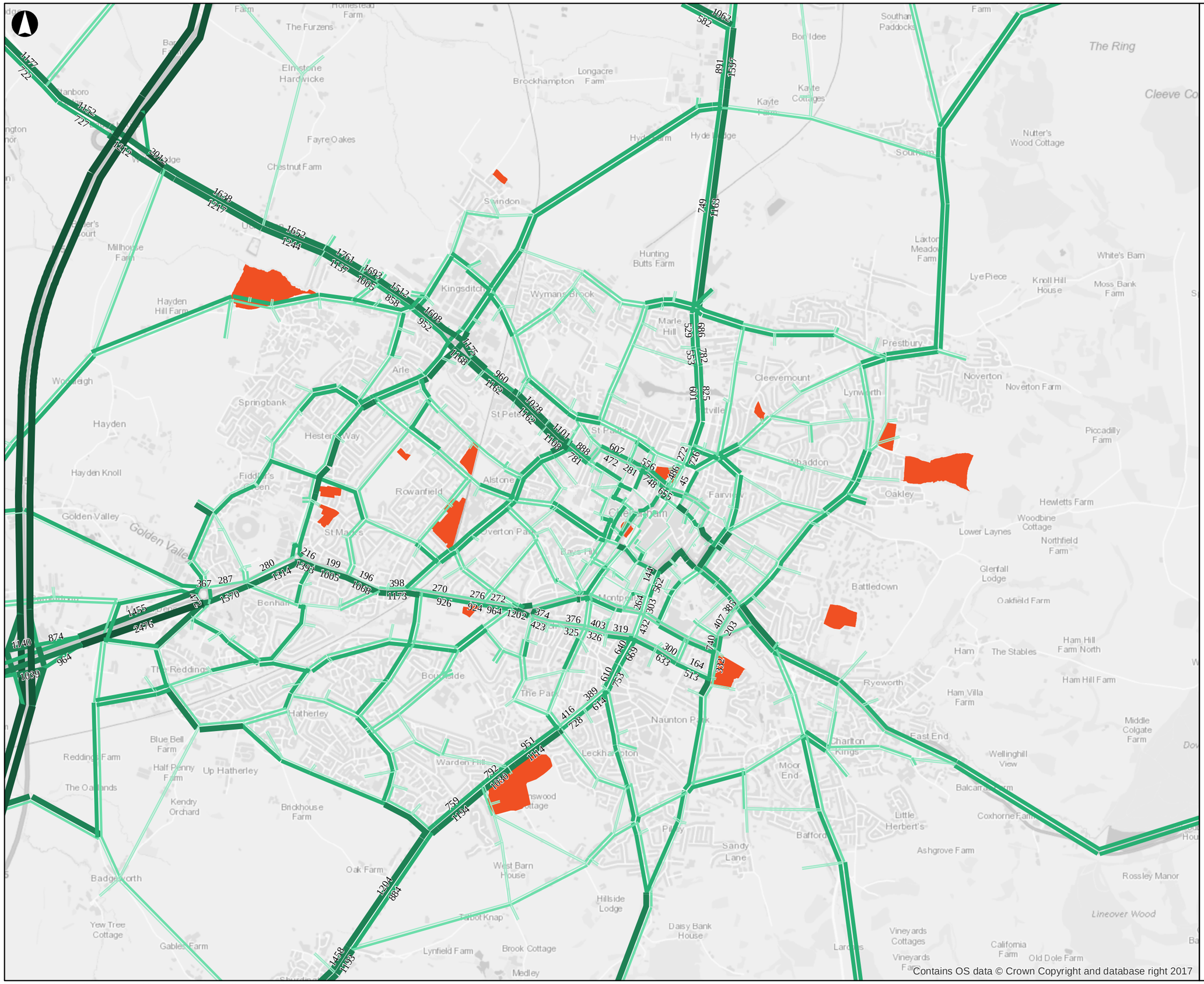
A3



Legend

Highway Flows [PCU/hr]

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

10/02/2018 12:23:14

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres
0 400 800 1,600

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Core (DM) Forecast
DS Option A - AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
005	**F2**

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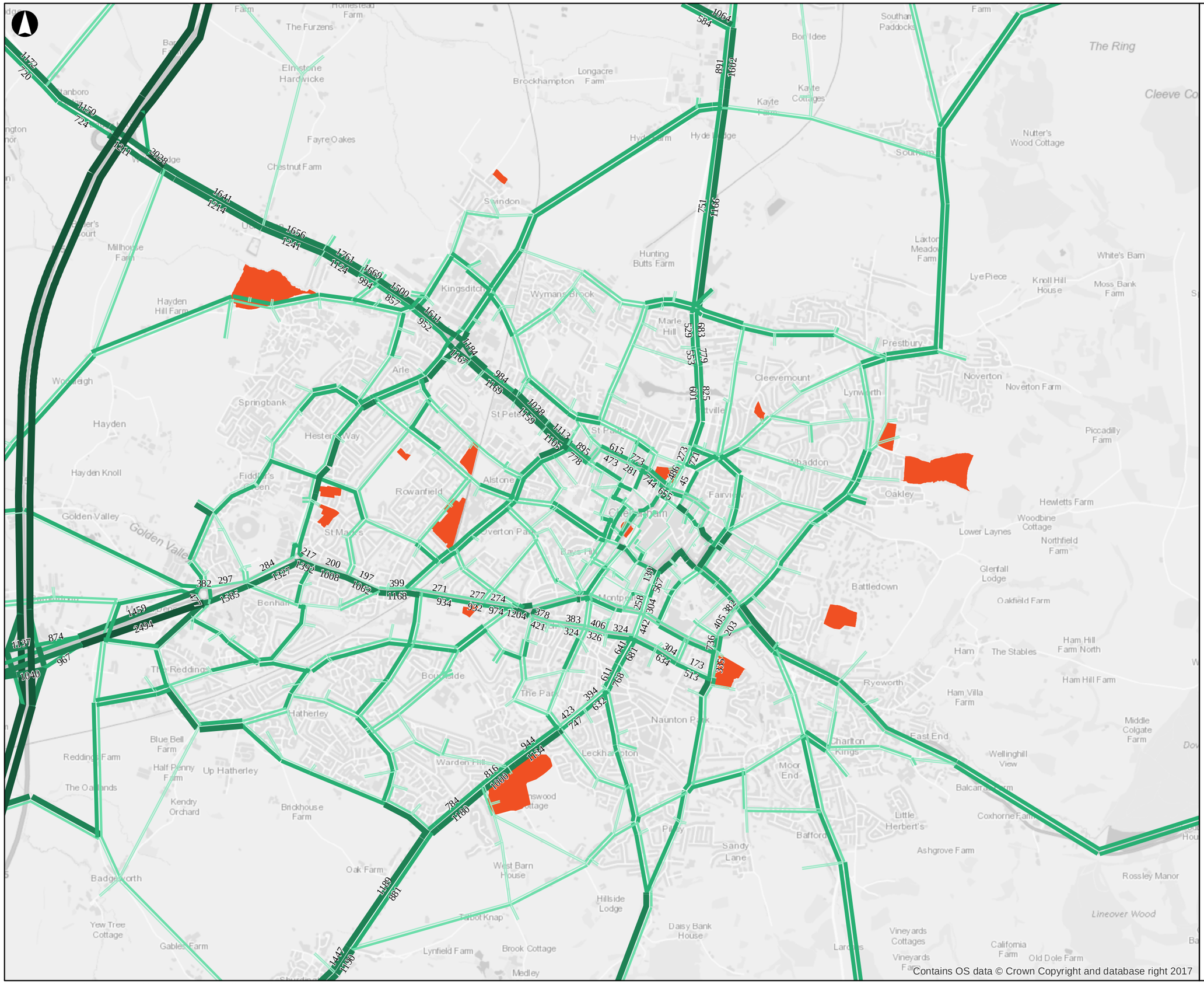

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Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

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DS Option B - AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
006	**F2**

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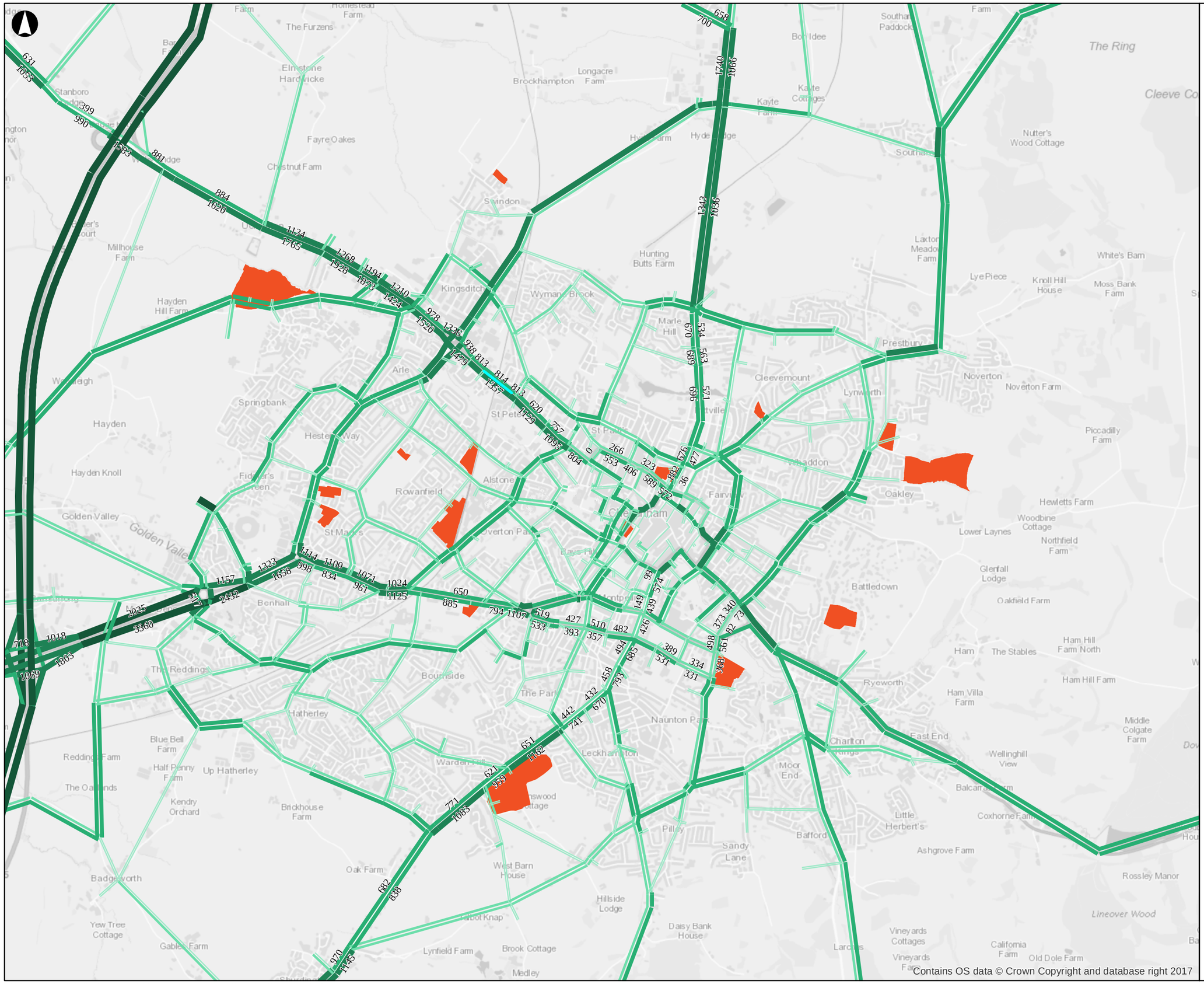
A3



Legend

DM_DS_Links.DMDM_PM

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

10/02/2018 12:25:07

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
007	**F2**

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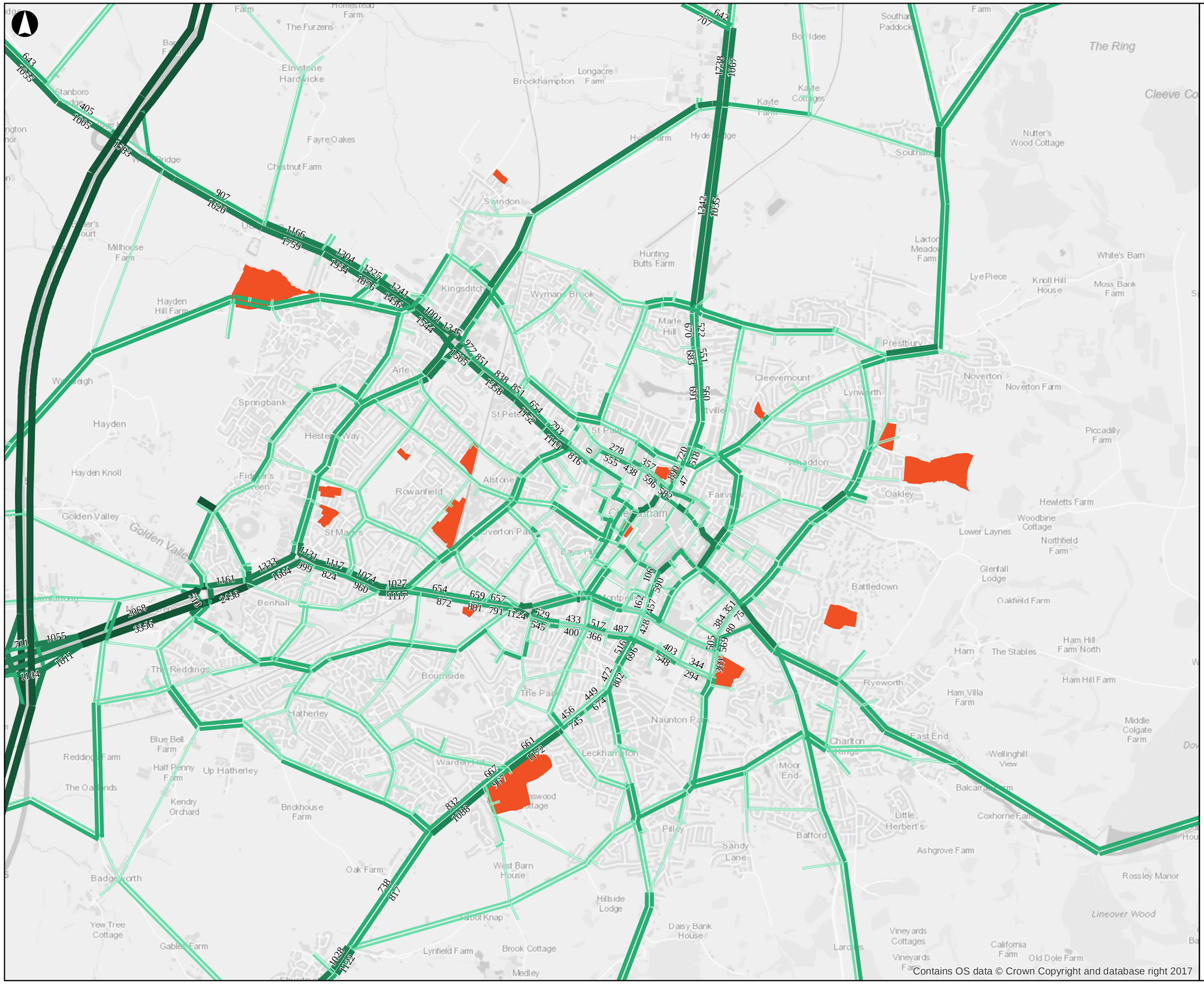

Legend

Highway Flows [PCU/hr]

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

10/02/2018 12:26:05

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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DS Option A - PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
008	**F2**

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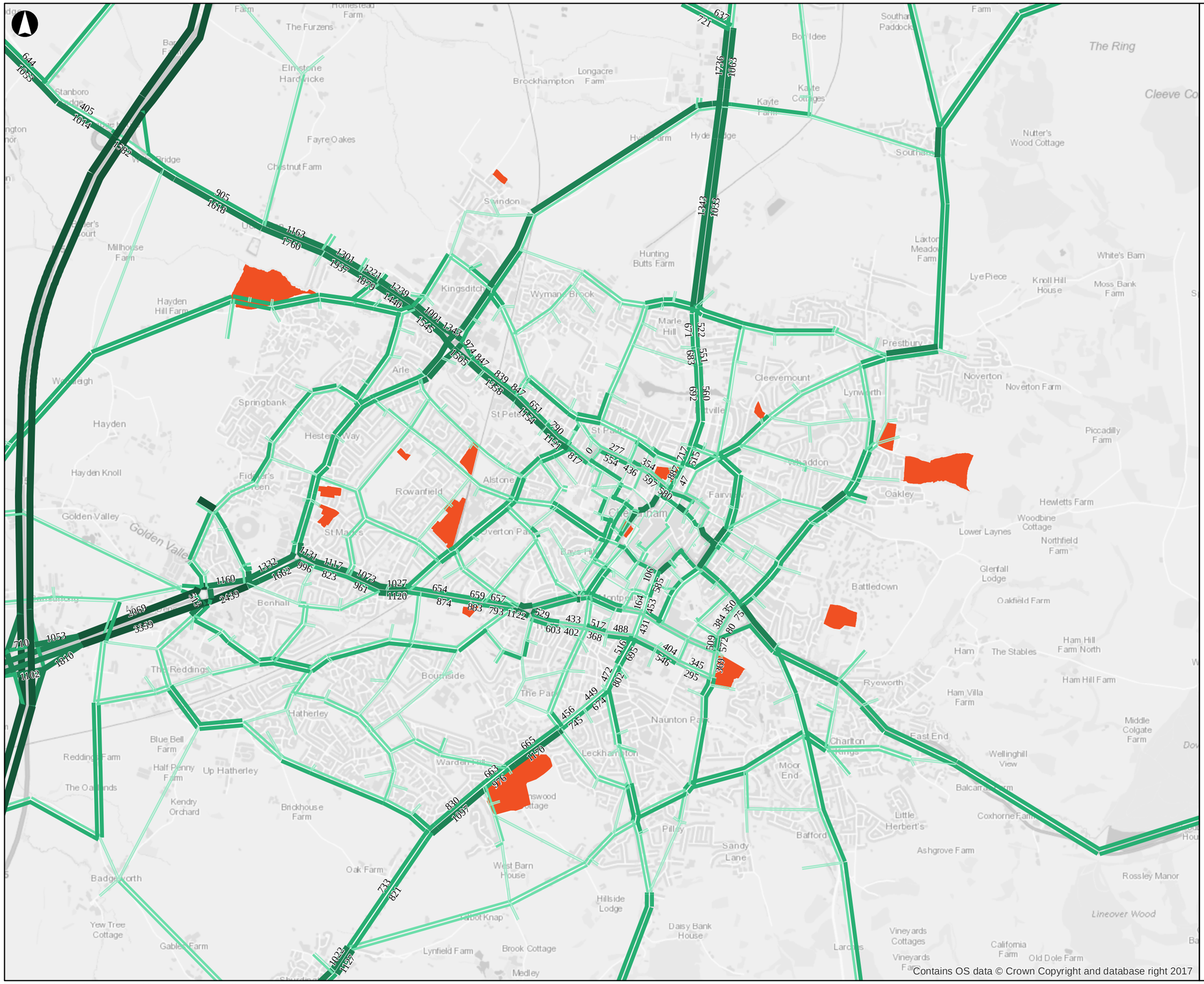

Legend

Highway Flows [PCU/hr]

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

10/02/2018 12:26:52

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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DS Option B - PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
009	**F2**

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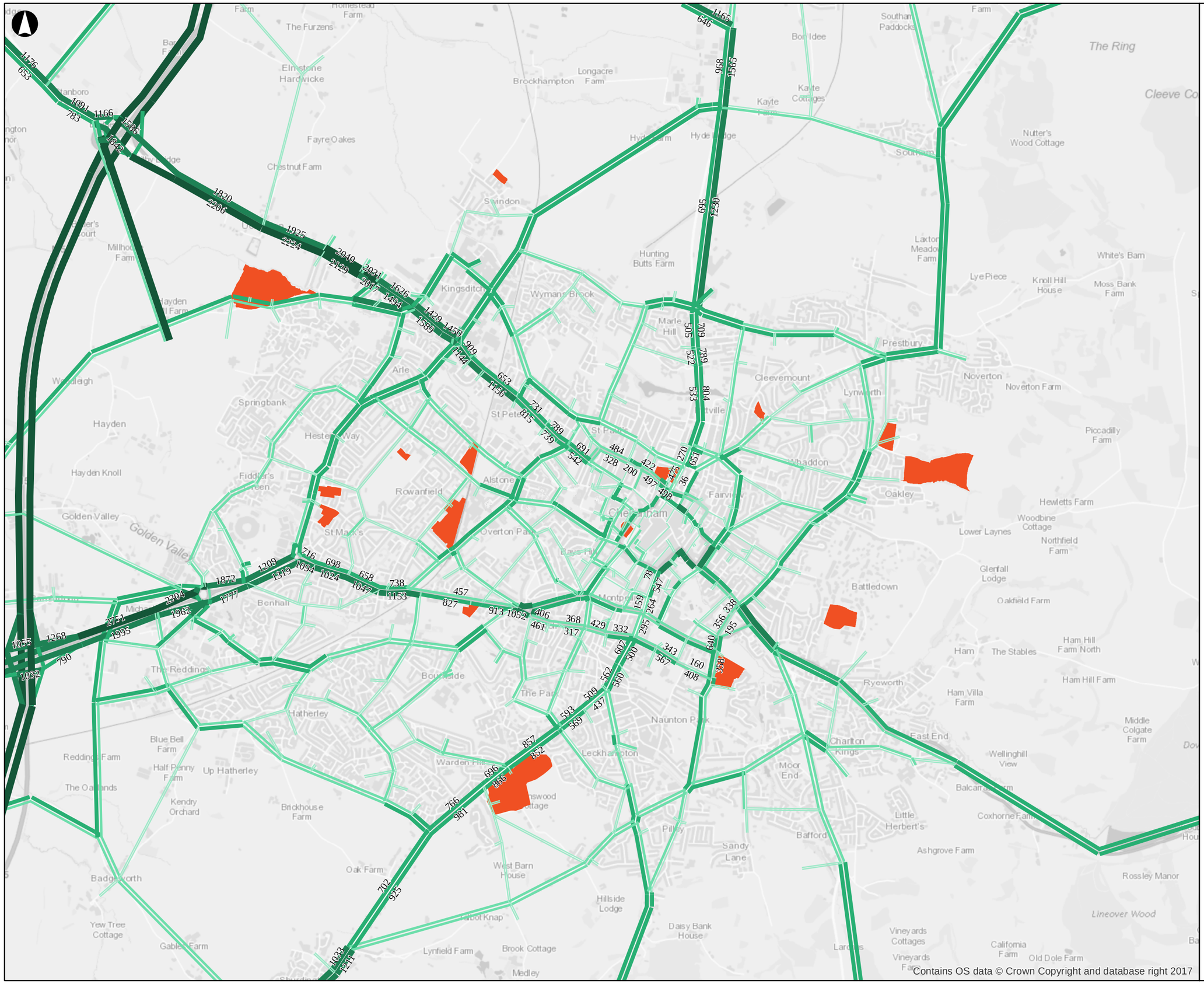

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Highway Flows [PCU/hr]

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

10/02/2018 12:27:39

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F2	2018-01-23	GJ	TS	AJ

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0 400 800 1,600

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DS7 Sensitivity Test
Do Minimum - AM Peak

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Job No	Drawing Status
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Drawing No	Issue
010	**F2**

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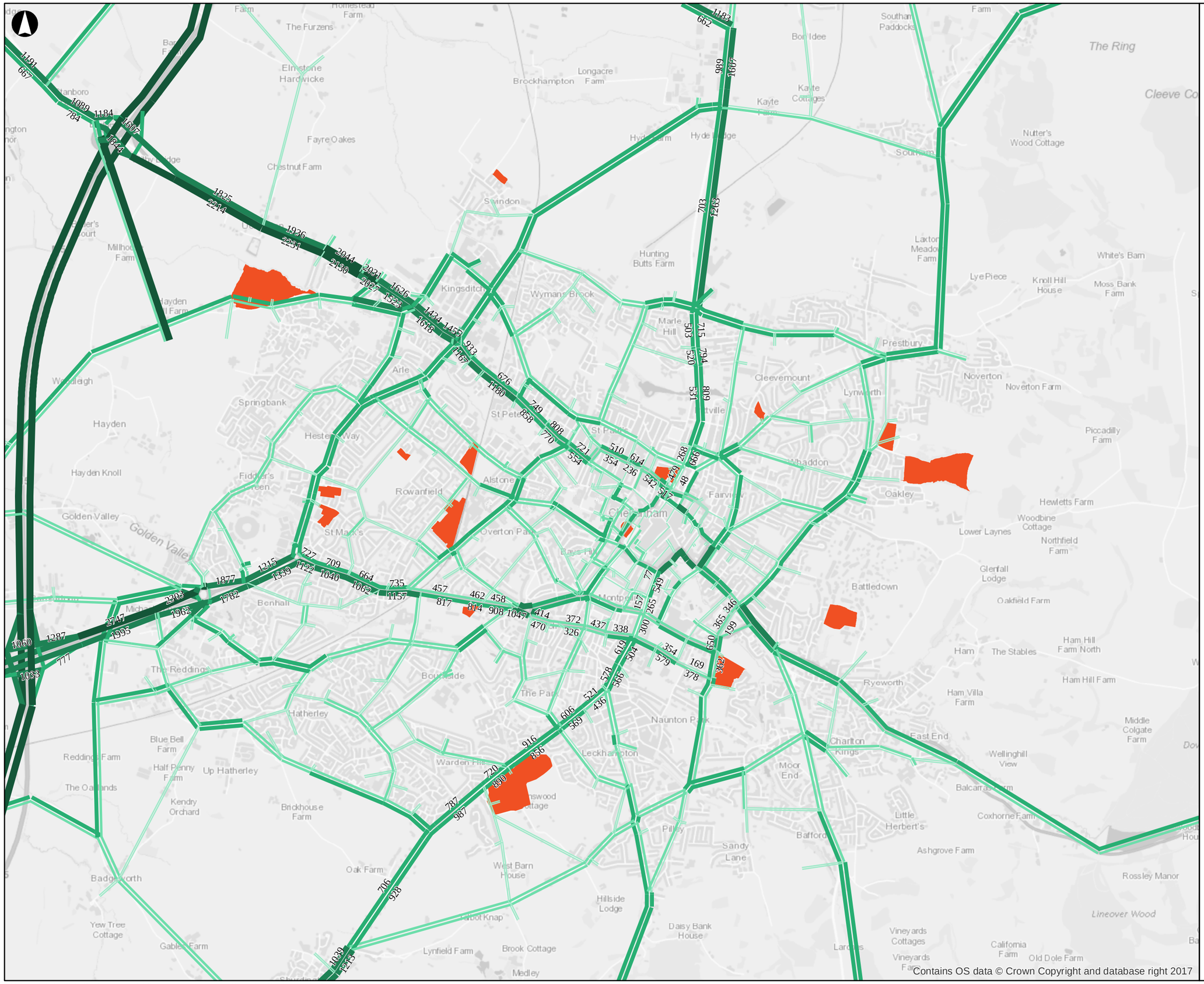

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Legend

Highway Flows [PCU/hr]

- 0-250 (pcu)
- 250-500 (pcu)
- 500-1000 (pcu)
- 1000-2000 (pcu)
- >2000 (pcu)
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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DS Option A - AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	For Issue

Drawing No	Issue
011	F2

19/02/2018 09:27:15

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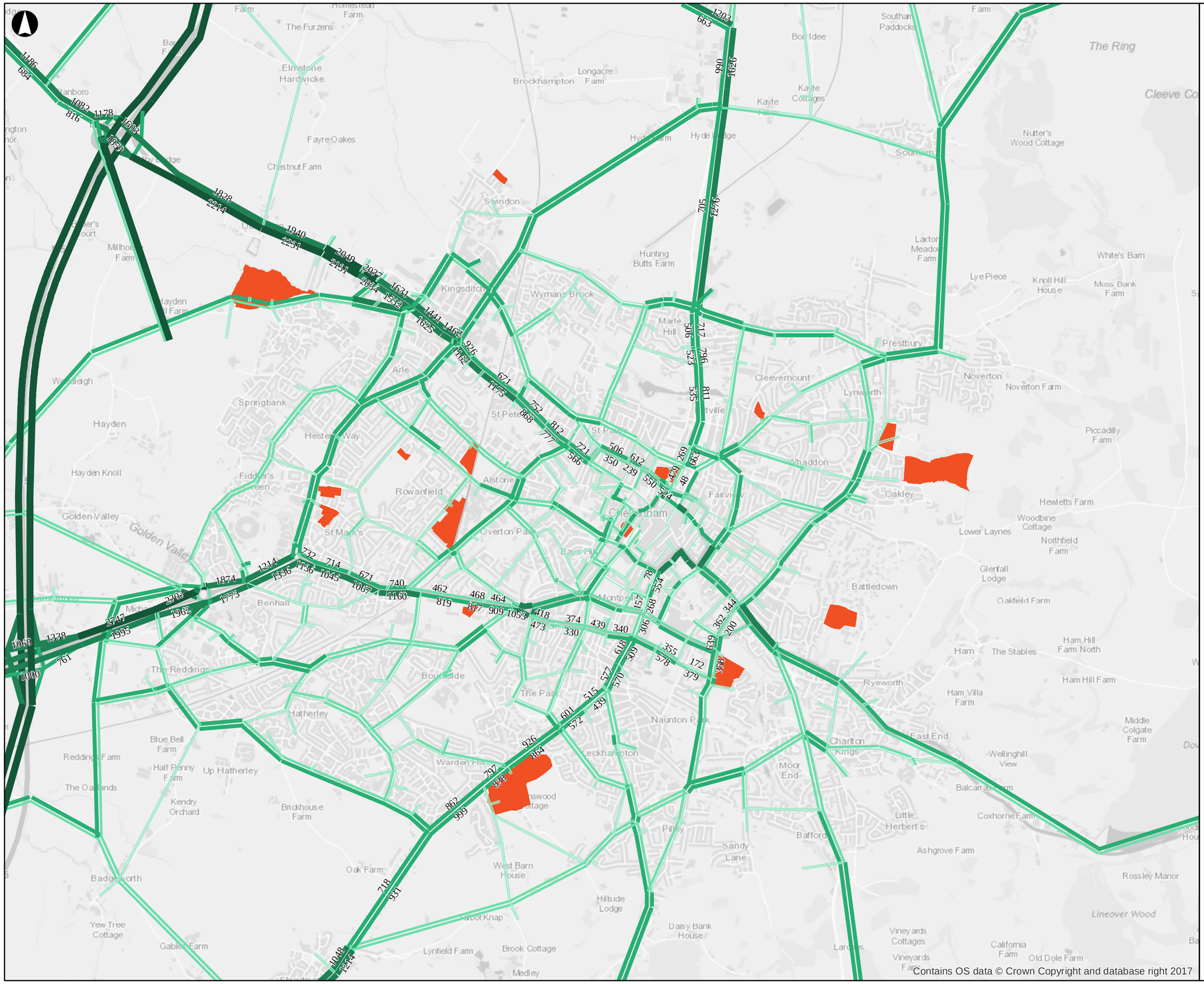
A3



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Issue	Date	By	Chkd	Appd
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2031 Highway Assignment Flows
DS7 Sensitivity Test
DS Option B - AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
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Drawing No	Issue
012	**F2**

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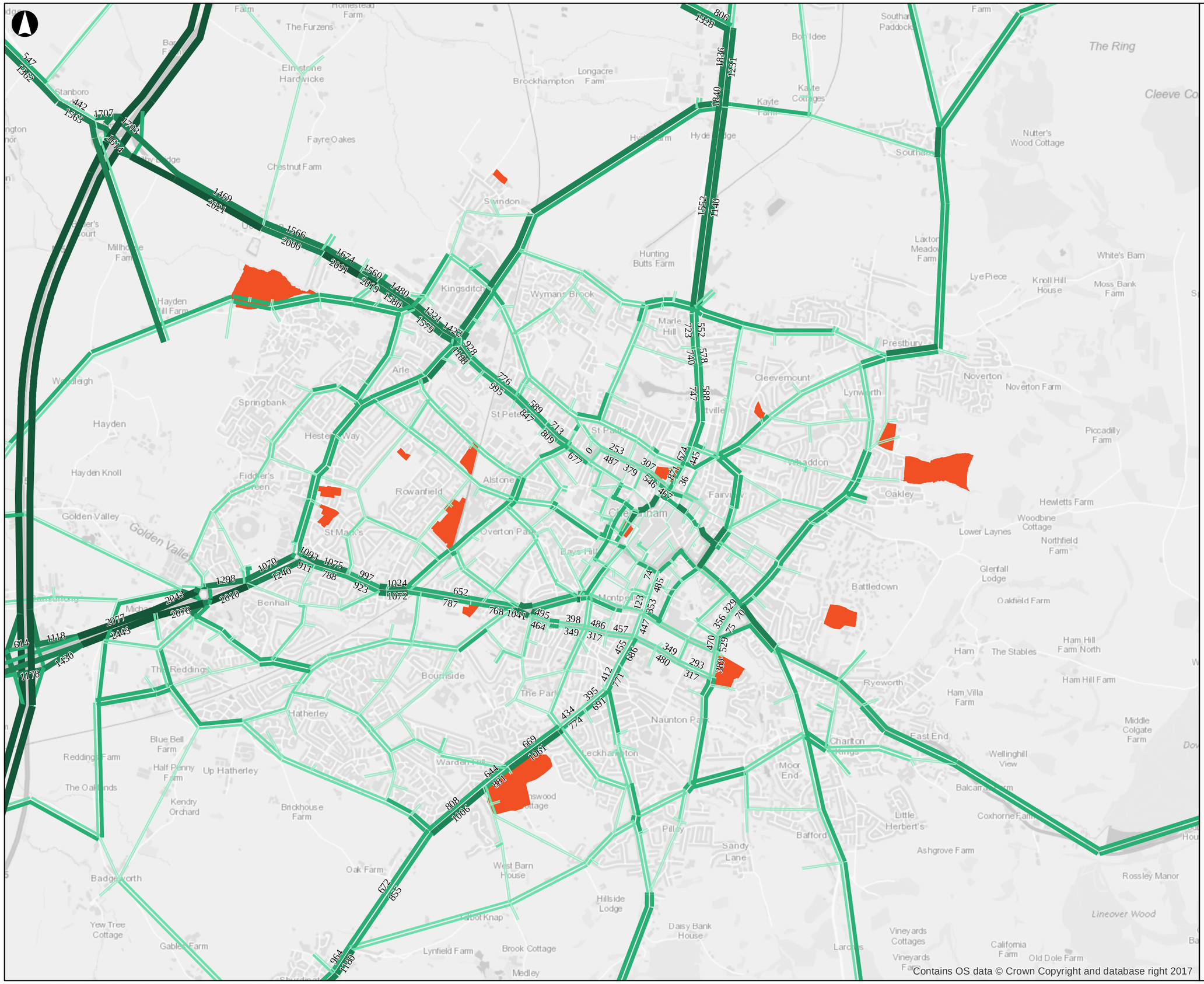

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2031 Highway Assignment Flows
DS7 Sensitivity Test
Do Minimum - PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
013	**F2**

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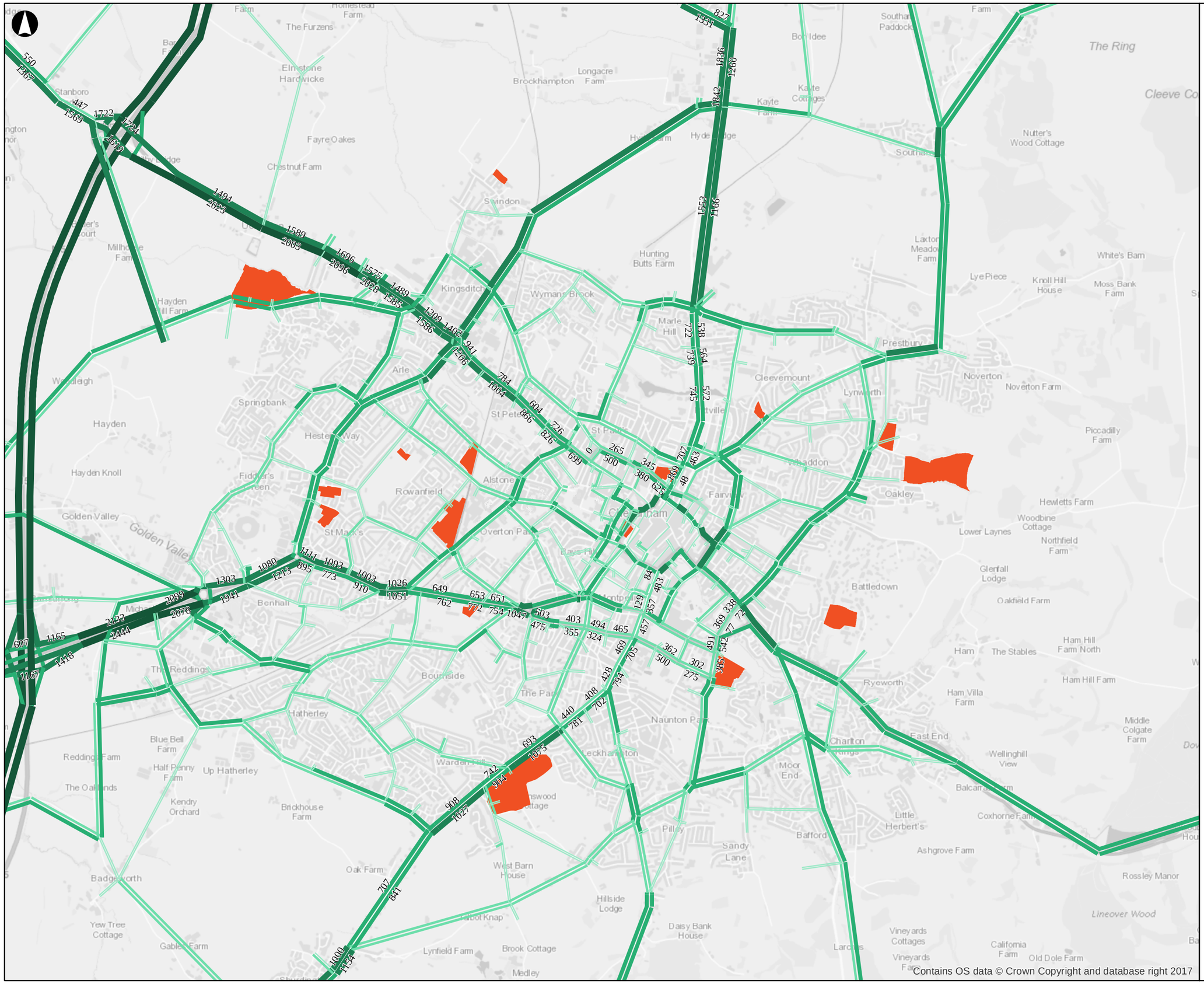

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DS7 Sensitivity Test
DS Option A - PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
014	**F2**

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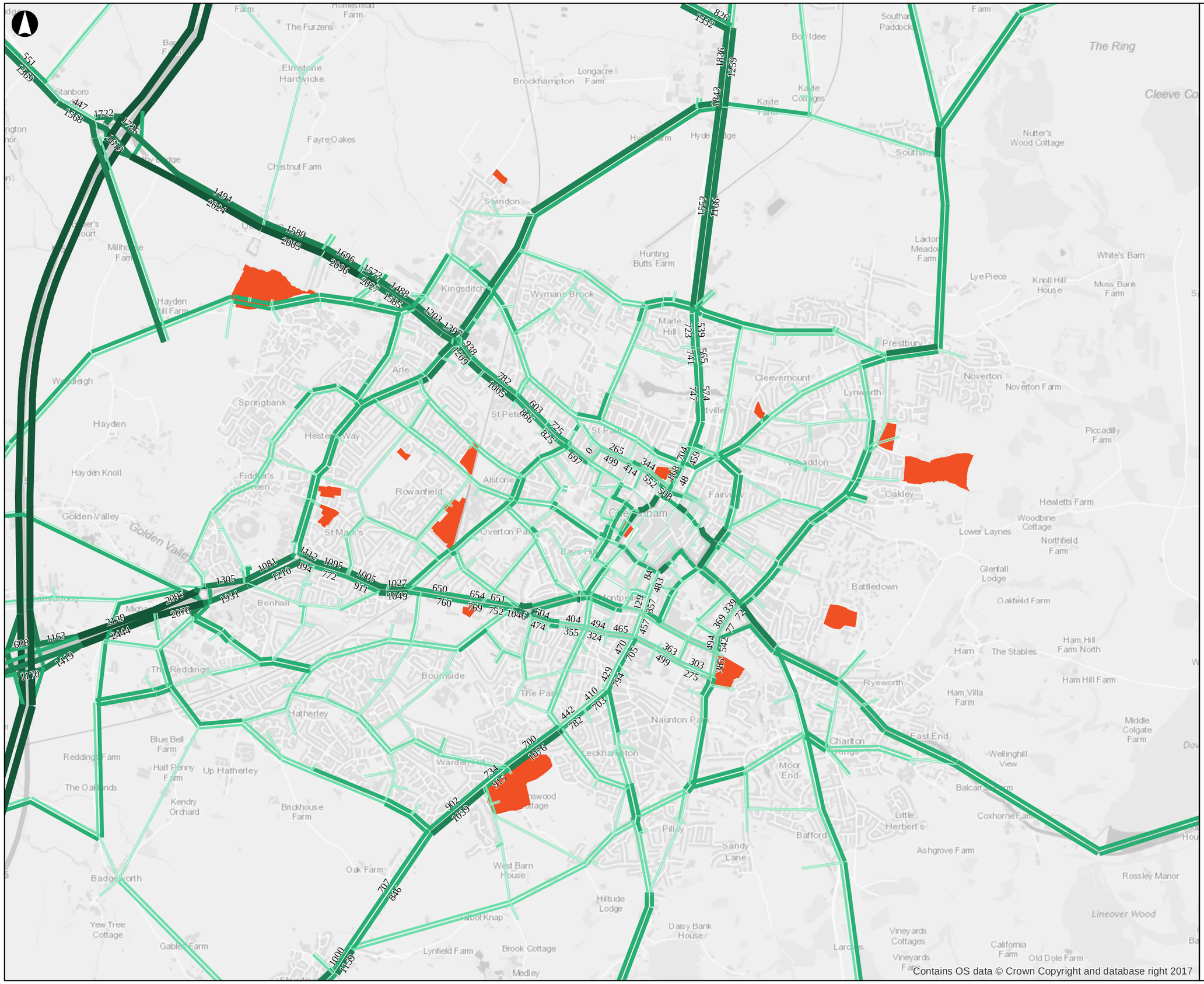

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DS7 Sensitivity Test
DS Option B - PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
015	**F2**

\\Global\Europe\Bristol\Jobs\256xxx\256784-00\4.30_Drgs\2_GIS\04_Map Documents\TRA_Transport\01_LinkFlows\CSV_Flows_DM_v2.mxd

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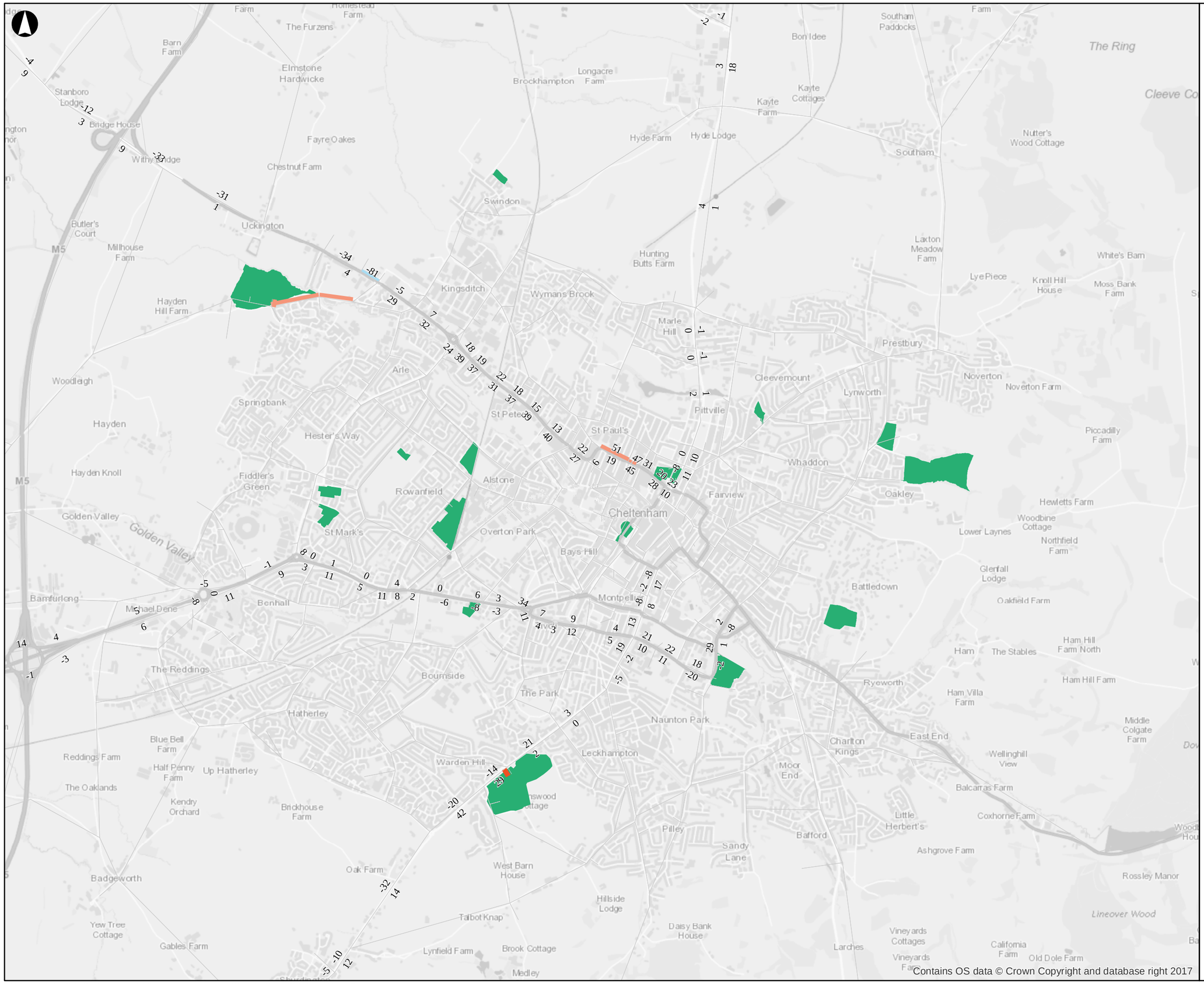
A3



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Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Client

Cheltenham Borough Council

Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
Core (DM) Forecast
Option A - DM
AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
016	**F2**

10/02/2018 12:46:14

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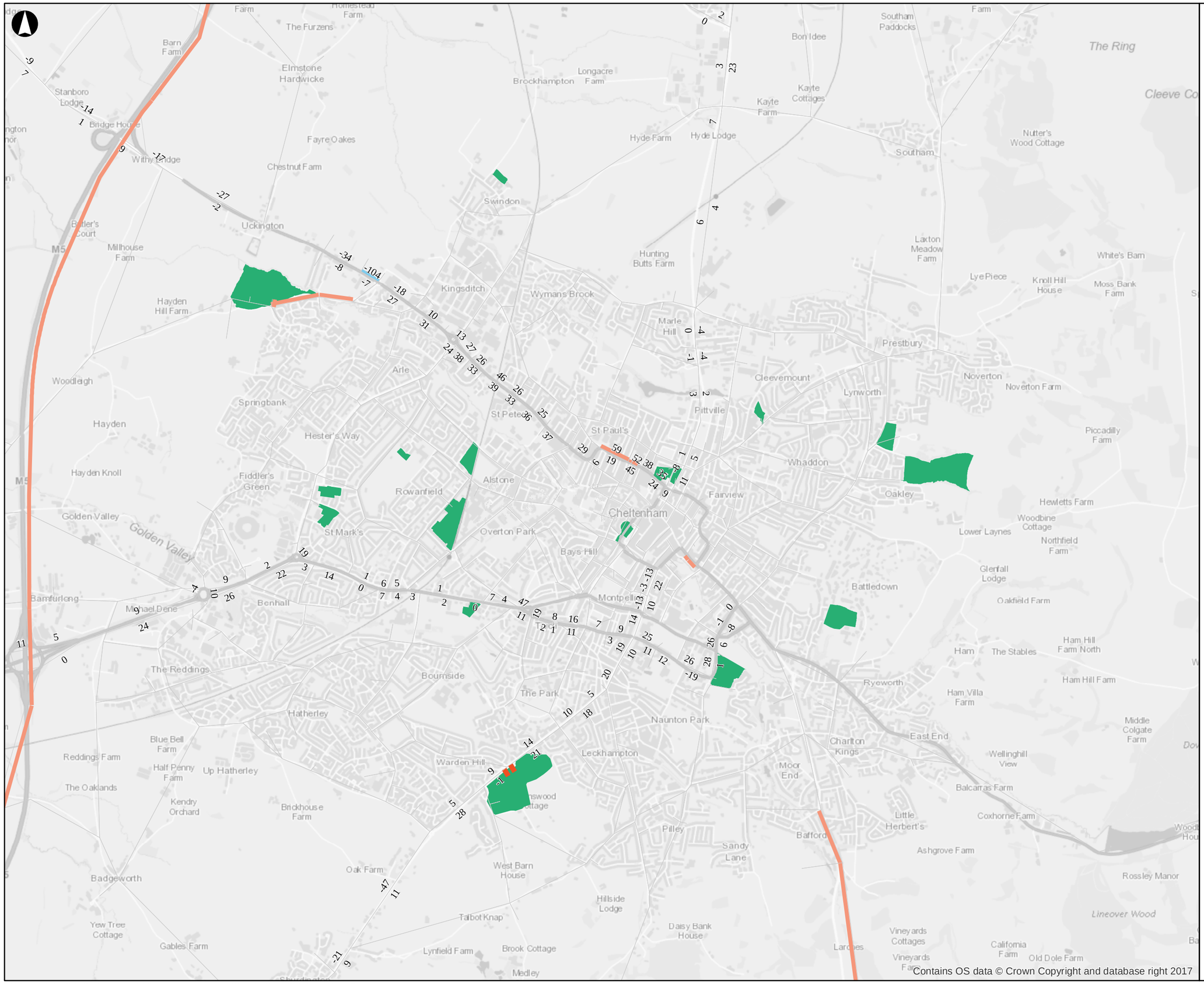

Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
Core (DM) Forecast
Option B - DM
AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
017	**F2**

10/02/2018 12:46:58

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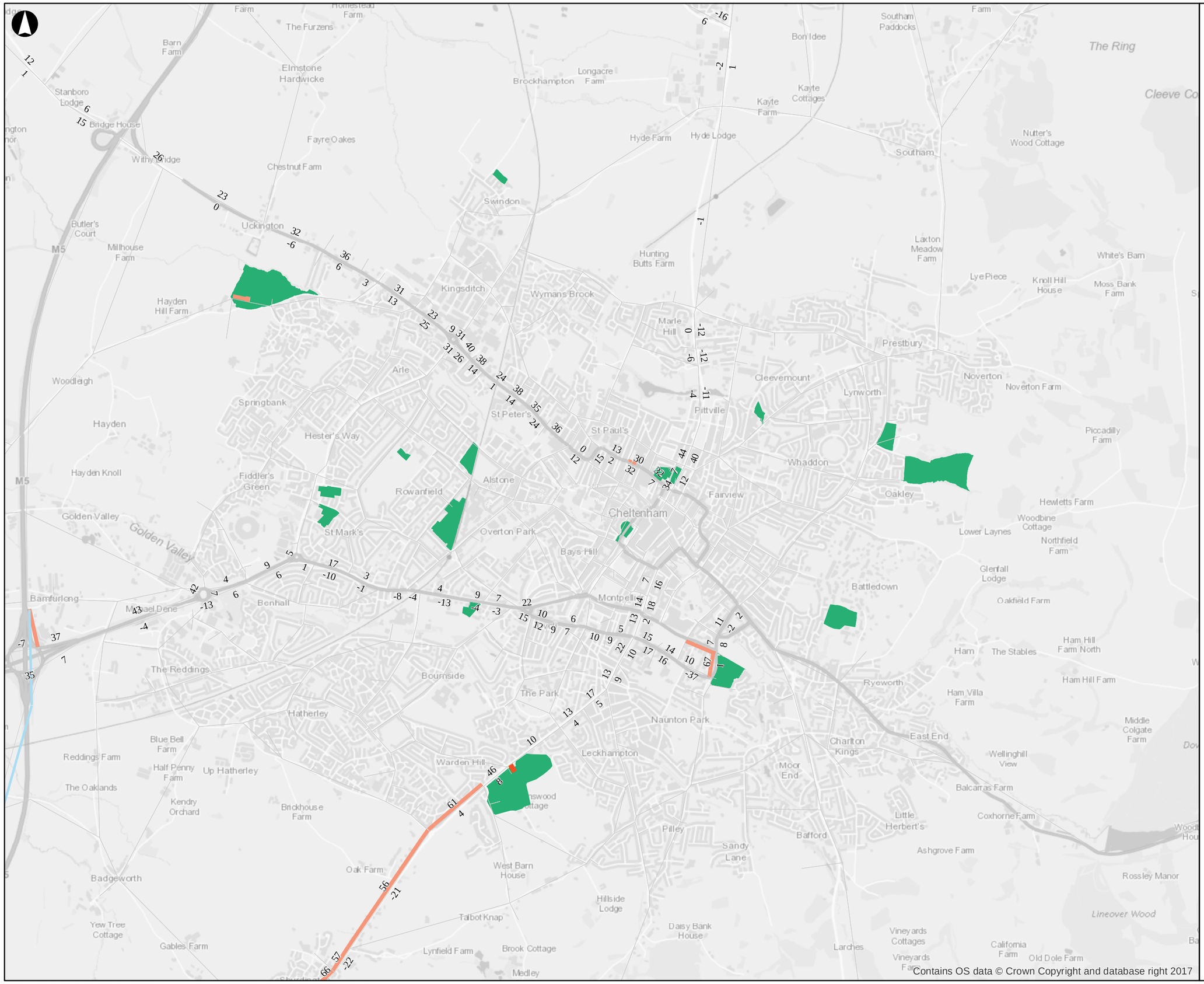
A3



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Legend

DM_DS_Links.DMADIFFPM

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

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2031 Highway Flows Difference
Core (DM) Forecast
Option A - DM
PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
018	**F2**

10/02/2018 12:47:37

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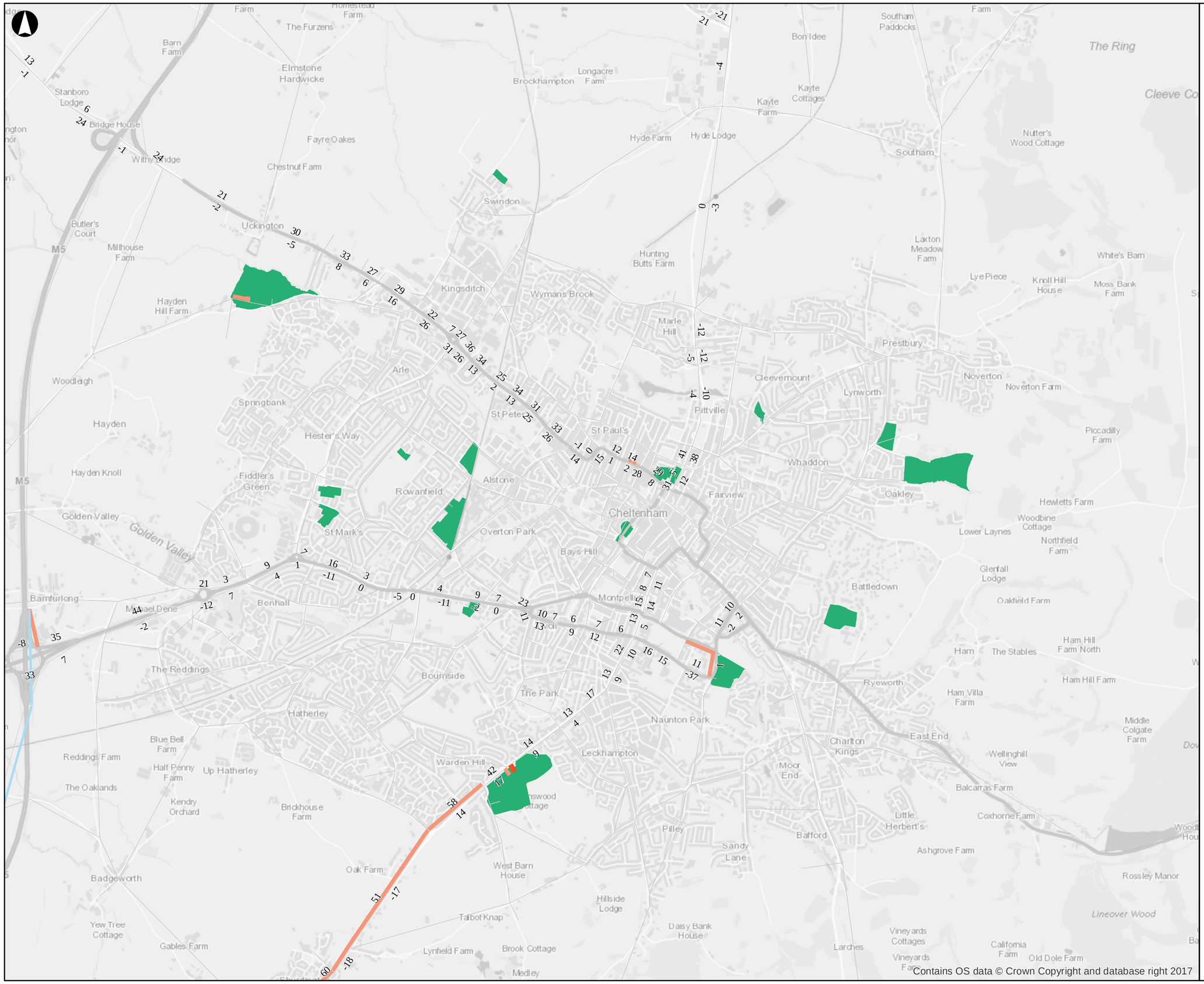
A3



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Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Cheltenham Borough Council

Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
Core (DM) Forecast
Option B - DM
PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
019	**F2**

10/02/2018 12:48:16

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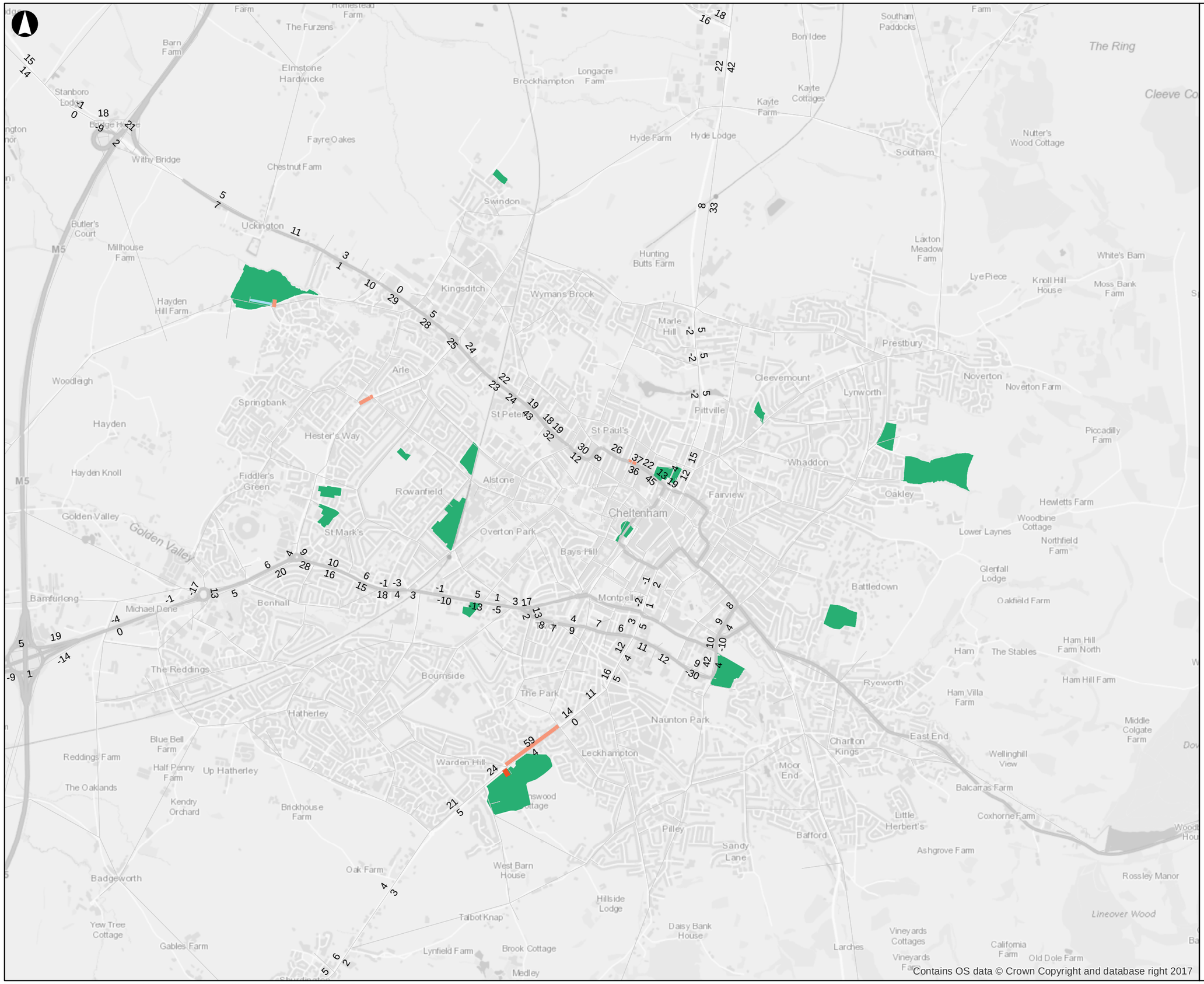
A3



Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
DS7 Sensitivity Test
Option A - DM
AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
020	**F2**

10/02/2018 12:48:55

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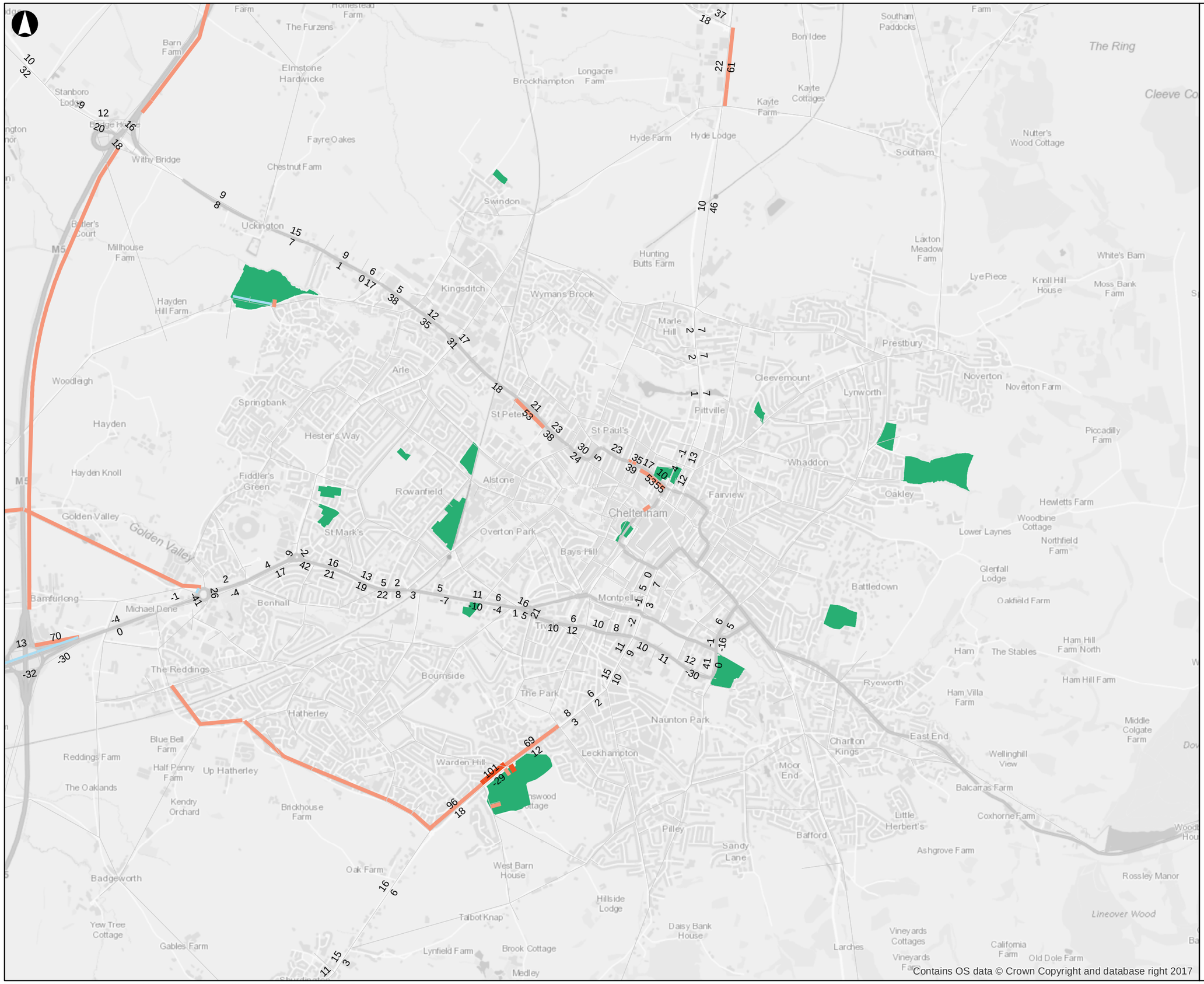
A3



Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

10/02/2018 12:49:41

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
DS7 Sensitivity Test
Option B - DM
AM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
021	**F2**

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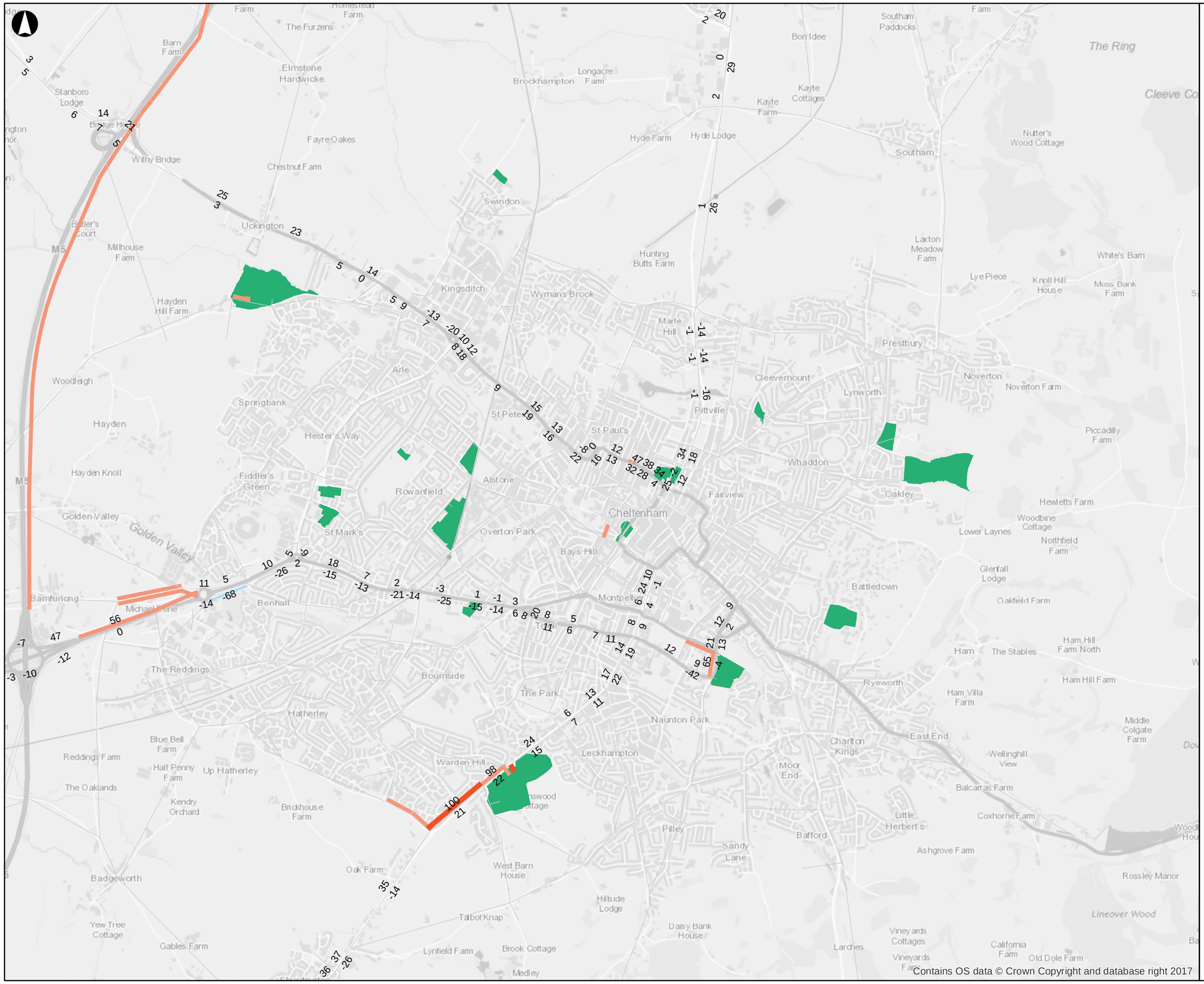
A3



Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

10/02/2018 12:50:25

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

Cheltenham Plan Transport Assessment

2031 Highway Flows Difference
DS7 Sensitivity Test
Option A - DM
PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
022	**F2**

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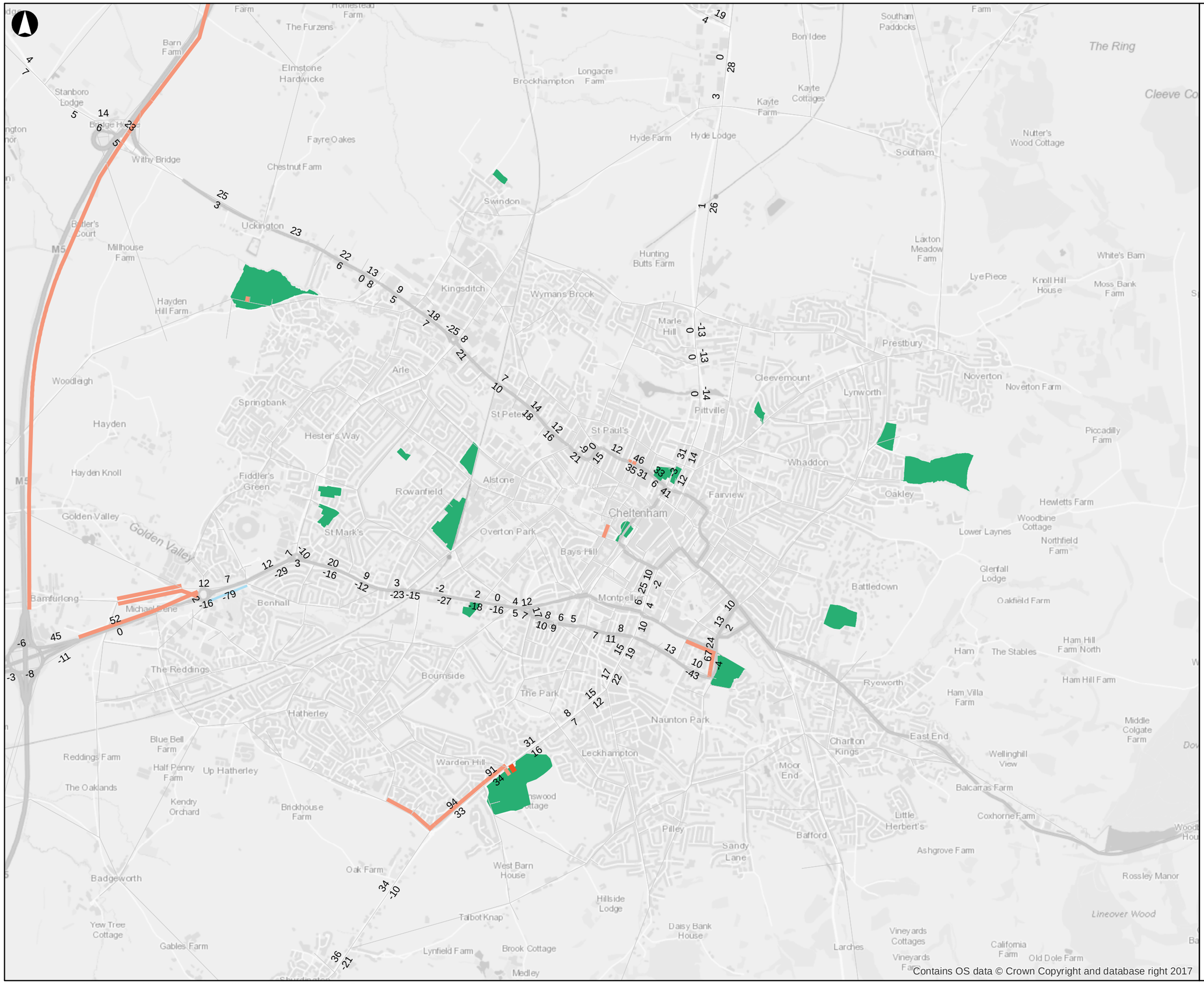

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Legend

Flow Difference [PCU/hr]

- -800
- -800 -400
- -400 -100
- -100 -50
- -50 +50
- +50 +100
- +100 +400
- +400 +800
- +800
- Cheltenham Plan Sites

10/02/2018 12:51:10

Issue	Date	By	Chkd	Appd
F2	2018-01-23	GJ	TS	AJ

Metres

0 400 800 1,600

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Job Title

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2031 Highway Flows Difference
DS7 Sensitivity Test
Option B - DM
PM Peak

Scale at A3

1:30,000

Job No	Drawing Status
256784-00	**For Issue**

Drawing No	Issue
023	**F2**

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