Trip Generation and Modelling Assessment
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University of Warwick – 2033 Masterplan SPD

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Contents

Tables

Appendices

1 Introduction

Overview

1.1 This Report has been prepared by Steer, on behalf of the University of Warwick (the Applicant), to present the proposed trip generation methodology and modelling undertaken to support the Masterplan Supplementary Planning Document (SPD) for its Main Campus up to 2033.

1.2 The proposed trip generation and modelling has been subject to extensive scoping with Coventry City Council (CCC), Warwickshire County Council (WCC), National Highways (NH) and Transport for West Midlands (TfWM) officers.

1.3 The approach is consistent with the methodology completed as part of the University's recent Science and Engineering Precinct (STEM) application (CCC ref. PL/2023/0002402/OUTM), which is currently awaiting determination. All authorities accepted the trip generation and modelling outputs within the STEM application and highways mitigation is not expected to form part of the Section 106 Agreement for the STEM application.

Assessment Summary

Floorspace Assumptions

1.4 The proposed development comprising the SPD is summarised in **Table 1.1**, shown in gross internal area (GIA). These include the:

- Outline permission for Warwick Social Sciences (WSS) for up to 32,000 sqm GIA Use Class F1(a). As agreed with the local authorities, this utilised 19,457 sqm residual floorspace from the Capital Plan Hybrid (CPH) Permission (ref: OUT/2018/2115) alongside a commitment by the University in the associated section 106 Agreement, to vacate 12,600 sqm within an Existing Social Sciences Building elsewhere on Main Campus.
- The hybrid application for the Science and Engineering Precinct (STEM) (ref: PL/2023/0002402/OUTM pending determination) for up to a net additional 17,946 sqm GIA Use Class F1(a).

Table 1.1: Proposed Works

Proposed Works	Use Class F1(a) GIA sqm
Demolition / Vacant	38,093
New Build / Refurbish	81,354
Net Additional SPD	**+43,261**
Capital Plan Hybrid (CPH) Residual	*-19,457*
Actual Additional SPD	*23,804*

1.5 To provide additional robustness and flexibility above the expected maximum floorspace, the SPD trip generation and modelling is based on an additional 31,000 sqm GIA Use Class F1(a) floorspace, 7,196 sqm above the actual expected additional floorspace of 23,804 sqm.

1.6 Alongside academic floorspace, the SPD proposes up to 1,200 student bedspaces within the Campus – a 16% increase from the existing 7,487 bedspaces. Furthermore, significant purpose-built student accommodation (PBSA) is planned to be delivered by private developers in the 'collar' surrounding the Campus. These additional bedspaces will enable students to walk or cycle to and across the Campus rather than using buses or private vehicles, which will provide significant benefits to capacity and congestion.

1.7 However, in order to consider a robust worst-case scenario as part of the traffic modelling, the additional bedspaces within and adjacent to the Campus (which will reduce external trips due to internalisation) will not be incorporated.

1.8 The quantum of development provides an upper limit of 31,000 sqm GIA for academic floorspace against which future applications can be considered. Where applications fall within the floorspace limit, there should be no need for additional traffic impact assessment. Furthermore, consideration should be given to the quantum of additional bedspaces that have been constructed to offset any additional floorspace above 31,000 sqm GIA.

Modelling Overview

1.9 Detailed assessment of the traffic impacts of the SPD has been completed using WCC's Kenilworth and Stoneleigh Wide Area (KSWA) model, a microsimulation model developed in Paramics (computer software) by SLR on behalf of WCC. A number of scenarios have been tested in accordance with WCC's Model Use Protocol (MUP).

1.10 The scenarios have been developed based on extensive traffic surveys completed in 2022 and 2023 surrounding the University and across the modelled extent. This ensures that current travel behaviours and traffic patterns are replicated within the models, including the lower car parking demand at the University since the implementation of blending learning and remote working post-pandemic.

1.11 Given the relatively modest uplifts in vehicle trips, it was agreed with all parties that assessment using the Coventry Area Strategic Model (CASM) would not be required.

Pre-Application Engagement

1.12 Since early 2022, the University has been regularly engaged with CCC, WCC, NH and TfWM to discuss the SPD and the STEM application, alongside detailed matters relating to sustainable transport and transport modelling.

1.13 Working sub-groups have met on a monthly or bi-monthly basis to collaboratively discuss and consider sustainable transport and transport modelling in relation to the SPD.

1.14 A 'Trip Generation and Modelling Scoping' document was issued to the authorities for comments in December 2023 which presented the approach used in the trip generation and modelling assessments.

1.15 Through this collaborative progress, agreement has been achieved by all highway authorities on key inputs to this Report, including the trip generation methodology, strategic modelling assessment and scenario testing.

Report Structure

1.16 The remainder of this Report is structured as follows:

- **Chapter 2 – Trip Generation:** Presents the agreed trip rates, mode shares and forecasts the SPD's multi-modal trip generation;
- **Chapter 3 – Active Travel and Public Transport Impact Assessment**: Presents the impact assessment on public transport, walking and cycling networks;
- **Chapter 4 – Highway Impact Assessment**: Summarises the traffic modelling methodology and outputs; and
- **Chapter 5 – Summary and Conclusion**: Summarises and concludes the Report.

2 Trip Generation

Introduction

2.1 This chapter presents the trip rates and mode shares to be applied to the 31,000 sqm Use Class F1(a) floorspace uplift assessed as part of the SPD. These were agreed as part of the STEM application and have been agreed as suitable for the SPD trip generation.

Person Trip Rates

2.2 The person trip rates to be used for the Use Class F1(a) floorspace proposed as part of the SPD are presented at **Table 2.1**. These are presented for undergraduates (UGs), postgraduates (PGs) and staff, as each group has different mode shares.

2.3 Trip rates for the morning and evening 3-hour peak periods have been derived to align with the KSWA model which assesses time periods of 07:00-10:00 and 16:00-19:00. It is these time periods during which capacity on the transport networks is at its most constrained and when additional trips are likely to have the greatest impact.

2.4 The person trip rates for each group are based on estimated maximum building occupancies within the new and refurbished buildings. The SPD buildings will comprise a blend of general teaching, specialist teaching, research labs and workplaces. Consequently, the person trips rates and mix of UGs, PGs and staff are suitable to be applied across the Campus as they cover a number of different uses and spaces.

2.5 Staff arrival and departure profiles are based on automatic number plate recognition (ANPR) data from staff car parks on 11th and 12th October 2022. Although this approach does not account for staff arriving by non-car modes, it is deemed to be a reasonable proxy to apply to all staff trips for the SPD as most staff currently travel by car.

2.6 UG and PG arrival and departure profiles are derived from an extensive wi-fi dataset for all weekdays between 17th and 30th October 2022 within the existing campus buildings. The same profile is assumed for UGs and PGs. It is not possible to disaggregate staff and students from the data; however, the majority of the data relates to students as their population is much greater than staff. Whilst there would be some departures during the morning peak period and some arrivals in the evening peak, it is not possible to disaggregate this within wi-fi dataset. For this reason, these are set at zero but would be negligible in volume and this would not materially alter the student trip rates.

Table 2.1: SPD Person Trip Rates (per 100 sqm GIA)

Time Period	Staff			UG			PG			Total		
	Arr	Dep	Tot	Arr	Dep	Tot	Arr	Dep	Tot	Arr	Dep	Tot
07:00 – 08:00	0.109	0.007	0.116	0.083	0.000	0.083	0.051	0.000	0.051	0.243	0.007	0.250
08:00 – 09:00	0.177	0.018	0.195	0.624	0.000	0.624	0.387	0.000	0.387	1.189	0.018	1.207
09:00 – 10:00	0.146	0.042	0.188	1.201	0.000	1.201	0.745	0.000	0.745	2.092	0.042	2.134
07:00 – 10:00	***0.432***	***0.067***	***0.499***	***1.908***	***0.000***	***1.908***	***1.184***	***0.000***	***1.184***	***3.524***	***0.067***	***3.591***
16:00 – 17:00	0.015	0.140	0.155	0.000	0.410	0.410	0.000	0.255	0.255	0.015	0.805	0.820
17:00 – 18:00	0.025	0.136	0.161	0.000	0.850	0.850	0.000	0.527	0.527	0.025	1.513	1.538
18:00 – 19:00	0.037	0.075	0.112	0.000	0.651	0.651	0.000	0.404	0.404	0.037	1.129	1.166
16:00 – 19:00	***0.077***	***0.351***	***0.427***	***0.000***	***1.911***	***1.911***	***0.000***	***1.186***	***1.186***	***0.077***	***3.447***	***3.524***
Daily	***0.791***	***0.791***	***1.583***	***3.187***	***3.187***	***6.375***	***1.978***	***1.978***	***3.956***	***5.957***	***5.957***	***11.914***

Person Trip Generation

2.7 **Table 2.2** presents the hourly and daily person trip generation that results from applying the rates in **Table 2.1** to the additional 31,000 sqm GIA Use Class F1(a).

Table 2.2: SPD Person Trip Generation (31,000 sqm GIA)

Time Period	Staff			UG			PG			Total		
	Arr	Dep	Tot	Arr	Dep	Tot	Arr	Dep	Tot	Arr	Dep	Tot
07:00 – 08:00	34	2	36	26	0	26	16	0	16	75	2	78
08:00 – 09:00	55	5	60	194	0	194	120	0	120	369	5	374
09:00 – 10:00	45	13	58	372	0	372	231	0	231	649	13	662
07:00 – 10:00	***134***	***21***	***155***	***591***	***0***	***591***	***367***	***0***	***367***	***1,092***	***21***	***1,113***
16:00 – 17:00	5	43	48	0	127	127	0	79	79	5	249	254
17:00 – 18:00	8	42	50	0	263	263	0	163	163	8	469	477
18:00 – 19:00	12	23	35	0	202	202	0	125	125	12	350	362
16:00 – 19:00	***24***	***109***	***132***	***0***	***592***	***592***	***0***	***368***	***368***	***24***	***1,069***	***1,092***
Daily	***245***	***245***	***491***	***988***	***988***	***1,976***	***613***	***613***	***1,226***	***1,847***	***1,847***	***3,693***

Note: May not sum due to rounding.

Mode Shares

2.8 The Transport Assessment for the STEM application used mode shares derived from the University's 2022 Travel Survey.

2.9 The assessment within this Report for the SPD uses mode shares derived from the more recent 2023 Travel Survey collected in October and November 2023. The results for UGs, PGs and staff are summarised in **Table 2.3**. There was a record number of 3,317 responses to the 2023 survey, with the highest ever student engagement with 1,350 responses.

Table 2.3: 2023 Mode Shares

Mode	UG	PG	Staff
Car Driver (no passengers)	6.2%	9.7%	58.5%
Car Share as Driver	4.6%	1.6%	5.7%
Car Share as Passenger	2.8%	0.5%	3.3%
Bus	41.7%	42.2%	12.0%
West Midlands Bus on Demand	0.5%	2.7%	0.8%
Cycle - Own Bike	6.2%	7.6%	11.4%
Cycle - West Midlands Cycle Hire	0.4%	-	0.1%
Walk	35.7%	32.4%	4.0%
Train	1.8%	3.0%	3.4%
Motorcycle or Moped	-	-	0.4%
Taxi	-	0.3%	0.5%
Total	**100%**	**100%**	**100%**

Multi-Modal Trip Generation

2.10 Applying the 2023 mode shares to the additional SPD daily trips in **Table 2.2** forms the daily multi-modal trip generation in **Table 2.4**.

Table 2.4: SPD Net Additional Multi-Modal Daily Trips (One-Way)

Mode	UG	PG	Staff	Total
Car Driver (no passengers)	62	60	143	**265**
Car Share as Driver	45	10	14	**69**
Car Share as Passenger	28	3	8	**39**
Bus	412	259	29	**700**
West Midlands Bus on Demand	5	17	2	**24**
Cycle - using my own bike	62	46	28	**136**
Cycle - West Midlands Cycle Hire	4	0	0	**4**
Walk	353	199	10	**562**
Train	17	18	8	**44**
Motorcycle or moped	0	0	1	**1**
Taxi	0	2	1	**3**
Total	**988**	**613**	**245**	**1,847**

2.11 Applying the mode shares to the morning and evening 3-hour trip rates (presented in **Table 2.1**) forms **Table 2.5** for UGs, **Table 2.6** for PGs and **Table 2.7** for staff. **Table 2.8** presents the total additional peak period trips expected to be generated by the SPD.

2.12 As mentioned in **Chapter 1**, this worst-case multi-modal trip generation does not account for the significant benefits that would be realised as a result of the planned student bedspaces on Campus and within the 'collar' surrounding Campus.

2.13 Additional peak bus trips are estimated to be four per minute which, when distributed across the multiple routes and services, are likely to have a negligible impact on bus capacity and passenger delay. Further detail on the distribution of bus trips is provided in **Chapter 3**.

2.14 The SPD is expected to generate less than two additional vehicle movements per minute during the busiest peak hour (09:00-10:00), which is unlikely to be perceptible. Further detail on highway modelling and impacts is provided in **Chapter 4**.

Delivery and Servicing Trips

2.15 Deliveries and servicing are a large generator of vehicle movements on Campus. The STEM application proposes to consolidate delivery and servicing activity primarily in a new servicing area accessed from Gibbet Hill Road, with activity relocated from existing piecemeal servicing areas across the STEM site.

2.16 As part of delivering the SPD, the University will continue to apply principles of remodelling, reducing, rerouting and retiming of delivery and servicing activity across the Campus. This will be achieved through implementation of a hub and spoke servicing network with a new consolidation centre on the Campus periphery which would allow for a large proportion of campus deliveries to be processed the 'last mile'.

2.17 Consequently, the SPD is likely to result in some reduction in the volume and alternate routing of delivery and servicing vehicles across the Campus.

Table 2.5: UG Multi-Modal Trip Generation

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Car Driver (no passengers)	2	-	12	-	23	-	-	8	-	16	-	13
Car Share as Driver	1	-	9	-	17	-	-	6	-	12	-	9
Car Share as Passenger	1	-	5	-	11	-	-	4	-	7	-	6
Bus	11	-	81	-	155	-	-	53	-	110	-	84
West Midlands Bus on Demand	-	-	1	-	2	-	-	1	-	1	-	1
Cycle - using own bike	2	-	12	-	23	-	-	8	-	16	-	13
Cycle - West Midlands Cycle Hire	0	-	1	-	2	-	-	1	-	1	-	1
Walk	9	-	69	-	133	-	-	45	-	94	-	72
Train	-	-	3	-	7	-	-	2	-	5	-	4
Motorcycle or moped	-	-	-	-	-	-	-	-	-	-	-	-
Taxi	-	-	-	-	-	-	-	-	-	-	-	-
Total	**26**	**-**	**194**	**-**	**372**	**-**	**-**	**127**	**-**	**263**	**-**	**202**

Table 2.6: PG Multi-Modal Trip Generation

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Car Driver (no passengers)	2	-	12	-	22	-	-	8	-	16	-	12
Car Share as Driver	-	-	2	-	4	-	-	1	-	3	-	2
Car Share as Passenger	-	-	1	-	1	-	-	-	-	1	-	1
Bus	7	-	51	-	97	-	-	33	-	69	-	53
West Midlands Bus on Demand	-	-	3	-	6	-	-	2	-	4	-	3
Cycle - using own bike	1	-	9	-	17	-	-	6	-	12	-	9
Cycle - West Midlands Cycle Hire	-	-	-	-	-	-	-	-	-	-	-	-
Walk	5	-	39	-	75	-	-	26	-	53	-	41
Train	-	-	4	-	7	-	-	2	-	5	-	4
Motorcycle or moped	-	-	-	-	-	-	-	-	-	-	-	-
Taxi	-	-	-	-	1	-	-	-	-	-	-	-
Total	**16**	**-**	**120**	**-**	**231**	**-**	**-**	**79**	**-**	**163**	**-**	**125**

Table 2.7: Staff Multi-Modal Trip Generation

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Car Driver (no passengers)	20	2	32	3	26	8	3	25	4	25	7	14
Car Share as Driver	2	-	3	-	3	1	-	2	-	2	1	1
Car Share as Passenger	1	-	2	-	1	-	-	1	-	1	-	1
Bus	4	-	7	1	5	2	1	5	1	5	1	3
West Midlands Bus on Demand	-	-	-	-	-	-	-	-	-	-	-	-
Cycle - using own bike	4	-	6	1	5	1	1	5	1	5	1	3
Cycle - West Midlands Cycle Hire	-	-	-	-	-	-	-	-	-	-	-	-
Walk	1	-	2	-	2	1	-	2	-	2	-	1
Train	1	-	2	-	2	-	-	1	-	1	-	1
Motorcycle or moped	-	-	-	-	-	-	-	-	-	-	-	-
Taxi	-	-	-	-	-	-	-	-	-	-	-	-
Total	**34**	**4**	**55**	**5**	**45**	**13**	**5**	**43**	**8**	**42**	**12**	**23**

Table 2.8: Total Multi-Modal Trip Generation

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Car Driver (no passengers)	23	1	56	3	72	8	3	41	4	57	7	38
Car Share as Driver	3	-	14	-	23	1	-	10	-	17	1	13
Car Share as Passenger	2	-	8	-	13	-	-	5	-	10	-	7
Bus	21	-	138	1	258	2	1	91	1	184	1	140
West Midlands Bus on Demand	1	-	5	-	9	-	-	3	-	6	-	5
Cycle - using own bike	7	-	27	1	46	1	1	19	1	34	1	25
Cycle - West Midlands Cycle Hire	0	-	1	-	2	-	-	1	-	1	-	1
Walk	16	-	110	-	210	1	-	73	-	149	-	114
Train	2	-	9	-	15	-	-	6	-	11	-	8
Motorcycle or Moped	-	-	-	-	-	-	-	-	-	-	-	-
Taxi	-	-	1	-	1	-	-	-	-	1	-	-
Total	**75**	**2**	**369**	**5**	**649**	**13**	**5**	**249**	**8**	**469**	**12**	**350**

3 Active Travel and Public Transport Impact Assessments

Impact on Active Travel Infrastructure

3.1 The approach of the SPD is to reduce non-essential vehicle use on roads within the heart of the Campus and relocated car parks to the periphery over time to free up more space for pedestrians and cyclists. The Campus will offer a much better environment with more cohesive, permeable, legible, direct, safe and accessible pedestrian and cycle routes that are guided by distinctive and inclusive wayfinding and placemaking principles.

3.2 The University will continue to work with CCC, WCC, TfWM and their partners such as Sustrans, to deliver new and improved active travel connections to Coventry city centre, Kenilworth, Leamington, Canley and Tile Hill stations.

3.3 The SPD's impact on active travel infrastructure within the Campus and in its surrounds will be of significant benefit not only to University staff and students but also local communities.

Impact on Public Transport Infrastructure

Rail Network

3.4 Most rail passengers are likely to use Tile Hill, Canley or Coventry stations, and would access those stations on foot, by cycle or by bus.

3.5 The additional rail trips (88 two-way daily trips) are unlikely to have a material impact on line loadings or station capacities and are comfortably within the typical daily variation of passenger flows in these locations.

Bus Network

3.6 To assess the SPD's possible impacts on the bus network, Steer has undertaken desktop GIS catchment analysis to estimate route choice for staff and students based on 22/23 academic year postcode data, route directness and journey time. Whilst 23/24 academic year postcode data is available, 22/23 has been used to maintain a consistent approach with that used in the STEM Transport Assessment.

3.7 Details of existing bus services are summarised in **Table 3.1**, which serve stops across the Campus.

Table 3.1: University of Warwick Bus Services

Service	Route	Peak Freq. (bph)	Operator
U1	Warwick Gates Shops – Leamington – University	3	Stagecoach
U2	Leamington – University	4	
2/2A	Westwood Business Park – Cannon Park Shops – Canley – Tile Hill South – Coventry	1	National Express
11	Coventry Station – Earlsdon – University – Kenilworth – Leamington	3	
12X	Pool Meadow Bus Station – Coventry Station – University	9	
14	The Campus – Tile Hill Rail Station – Coventry	2	
14A	Coventry – Eastern Green – Tile Hill Station – Campus	1	
41	Radford – Eastern Green – Tile Hill – University – Kenilworth – Leamington	Early morning only – both arrive at 0540	
42	Keresley – Radford – Little Heath – Willenhall Lane – Green Lane – University		
60	Arena Park Retail – Willenhall – University – Westwood Academy	1	Stagecoach
87	Coventry – Cannon Park – Canley – Solihull	2	
87A	Coventry – Cannon Park – Canley – Solihull	1	
Total	-	**27**	-

3.8 The outputs of Steer's GIS analysis are presented in **Table 3.2**. It should be noted that routes 41 and 42 only serve the Campus once per day at 05:40 and so they are excluded from the analysis.

Table 3.2: Assumed Student and Staff Bus Route Choice (based on postcode analysis)

Route	From	Students	Staff
U1/U2	S	44%	14%
2/2A	N	5%	3%
11	N	12%	25%
	S	2%	13%
12X	N	27%	11%
14	N	8%	16%
14A	N	0%	0%
60	N	2%	15%
87	N	0%	2%
87A	N	0%	3%

3.9 Applying the additional bus trips in **Table 2.8** to the assumed route choices in **Table 3.2** results in the bus passenger trip distribution in **Table 3.3**.

3.10 Only the busiest hours have been presented with consideration given to inbound morning services and outbound evening services, which are typically the most congested. On average across all buses, during the busiest hour (09:00-10:00), there will be an additional 8.6 passengers with the highest increase on the U1/U2 with almost 16 additional passengers.

3.11 This assessment is based on 22/23 postcode data and recent enrolment and bus usage data shows a notable decrease in students living in Leamington Spa compared to previous years and an increase student living in Coventry city centre and in PBSAs on the collar of Campus. Consequently, this analysis overstates the number of additional passengers likely to use services to and from Leamington Spa. The actual impacts would be kept under monitoring as part of the Framework S106 and through regular discussions with the Monitor and Manage Transport Sub Board.

3.12 The 14 bus was subsidised by the University for two years and introduced in partnership with National Express. Since September 2022 it has operated successfully without subsidy, and the success of this service is not an exception to the norm for those who serve the University.

3.13 The additional bus trips from the SPD, likely to be realised on a phased basis up to 2033, would be kept under regular review with between the University and bus operators to ensure a shared understanding of evolving opportunities and challenges across the network.

3.14 This forms a key component of the Framework S106 with ‘Monitor and Manage’ elements, and the University is keen to continue utilising its very strong partnerships with National Express and Stagecoach to maintain an efficient, convenient bus network serving the Campus for its staff and students.

Table 3.3: Bus Passenger Trip Impact Assessment

Route	Direction	Peak Frequency (bph)	08:00-09:00		09:00-10:00		16:00-17:00		17:00-18:00		18:00-19:00	
			Arr	Add. Pax/Bus	Arr	Add. Pax/Bus	Dep	Add. Pax/Bus	Dep	Add. Pax/Bus	Dep	Add. Pax/Bus
U1/U2	S	7	58	8.3	111	15.9	38	5.5	79	11.3	60	8.6
2/2A	N	1	7	7.2	14	13.7	5	4.8	10	9.7	7	7.4
11	N	3	17	5.6	30	10.1	11	3.7	22	7.3	16	5.5
	S	3	4	1.3	7	2.3	3	0.9	5	1.6	4	1.2
12X	N	9	36	4.0	69	7.7	24	2.7	49	5.5	38	4.2
14	N	2	11	5.5	20	9.9	7	3.7	14	7.1	11	5.4
14A	N	1	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
60	N	1	3	3.0	5	4.6	2	2.1	3	3.5	2	2.5
87	N	2	0	0.2	1	0.4	0	0.1	1	0.3	0	0.2
87A	N	1	1	0.9	1	1.4	1	0.6	1	1.0	1	0.8
Total	**-**	**30**	**138**	**4.6**	**258**	**8.6**	**91**	**3.0**	**184**	**6.1**	**140**	**4.7**

4 Highway Impact Assessment

Introduction

4.1 The SPD's additional vehicle movements are summarised in **Table 4.1**, as presented in **Table 2.8**.

Table 4.1: Forecast Additional Vehicle Trips

Mode	07:00 – 08:00		08:00 – 09:00		09:00 – 10:00		16:00 – 17:00		17:00 – 18:00		18:00 – 19:00	
	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep	Arr	Dep
Car Driver (no Pax)	23	1	56	3	72	8	3	41	4	57	7	38
Car Share as Driver	3	0	14	0	23	1	0	10	0	17	1	13
Taxi	0	0	1	0	1	0	0	0	0	1	0	0
Total	**26**	**2**	**70**	**4**	**96**	**8**	**3**	**51**	**5**	**75**	**7**	**51**

4.2 A detailed assessment of the traffic impacts of the SPD has been completed using WCC's KSWA model. Given the relatively modest uplifts in vehicle trips, it was agreed with all parties that assessment using CCC's CASM would not be required.

4.3 The modelling approach has been subject to extensive discussion with all authorities and an independent review by AECOM on behalf of NH. The approach has subsequently been agreed with all authorities prior to the models being run and is in accordance with WCC's MUP.

4.4 The following are appended and should be reviewed alongside this chapter:

- **Appendix A** – SLR's 'Results Covering Note' (May 2024)
- **Appendix B** – Queue Length Plots
- **Appendix C** – Journey Time Plots

4.5 The full modelling spreadsheet outputs have been provided to the transport authorities and can be provided to the public upon request.

Assessment Scenarios

4.6 The SPD covers the next ten years to 2033, reflecting the University's Capital Plan for future investment in new buildings and infrastructure. There are five specific projects, two of which are already in the planning process (WSS and STEM), which are expected to open on a phased basis up to 2033.

4.7 The SPD has been tested in both Reference Case scenarios and the Local Plan scenario as follows:

1. 2023 Base Model
2. 2029 Reference Case
3. 2029 Reference Case + SPD
4. 2037 Reference Case
5. 2037 Reference Case + SPD
6. 2029 Local Plan
7. 2029 Local Plan + SPD
8. 2029 Reference Case + SPD (Pre-Pandemic Sensitivity Test)
9. 2037 Reference Case + SPD (Pre-Pandemic Sensitivity Test)
10. 2029 Local Plan + SPD (Pre-Pandemic Sensitivity Test)

4.8 The Reference Case scenarios include all developments with planning permission and those awaiting determination with officer recommendation for approval.

4.9 The Local Plan scenarios include ambitious growth in housing and employment sites, with associated traffic generation, which is unlikely to be realised up to 2033 when the Masterplan opens. This should be borne in mind when reviewing the outputs.

4.10 The following time periods have been assessed:

- Weekday AM (07:00 to 10:00)
- Weekday PM (16:00 to 19:00)

Sensitivity Tests

4.11 The University is committed to delivering blended learning and encouraging remote working for the long term. It is these measures which have, in part, resulted in lower car parking utilisation across the Campus. However, the authorities raised concerns during pre-application discussions as to what the impact of the SPD would be if University car parking demand returned to pre-pandemic levels.

4.12 Therefore, sensitivity tests have been completed assuming University-related vehicle trips are at pre-pandemic maximum levels, with maximum car parking utilisation across the Campus as tested for the CPH Permission. The SPD's additional vehicle trips have been added on top of the CPH maximum trips.

4.13 The University and Steer consider that these sensitivity test scenarios are unlikely to be realised and limited weight should be afforded to the impacts of such scenarios.

Vehicle Routing Assumptions

4.14 The following key vehicle routing assumptions have been made as part of the SPD assessment:

- The STEM development proposes Lord Bhattacharyya Way to be converted to one-way eastbound working from the Gibbet Hill Road/Scarman Road roundabout. All traffic will exit from central Campus to Gibbet Hill Road at the University Road roundabout just to the south of the University Interchange.
- The STEM development will result in the removal of Car Parks 9 & 10 and there are no immediate plans for these parking spaces to be re-provided elsewhere within the Campus. These car parks comprise 253 spaces for staff only and are accessed via a single junction on Lord Bhattacharyya Way.
- Existing traffic parking in Car Parks 9 & 10 has been reassigned equally to Lynchgate Car Park, Kirby Corner Car Park and Car Park 15, which are car parks within Main Campus with adequate capacity to accommodate the displaced parking.
- Additional forecast traffic from the SPD (see **Table 4.1**) has been assigned equally to Lynchgate Car Park, Kirby Corner Car Park and Car Park 15, which also have adequate capacity to accommodate the additional parking demand from the SPD.
- Around 25 daily delivery and servicing vehicles are expected to use the proposed Gibbet Hill Road servicing area which forms part of the STEM development. This equates to around three vehicles per hour and the access would be left-in only so would not delay Gibbet Hill Road through-traffic. Consequently, the proposed access has not been incorporated in the models and the associated delivery and servicing trips have been retained as using Lord Bhattacharyya Way.

Model Results

4.15 The detailed modelling outputs, prepared by SLR, have been reviewed by Steer and the relevant results presented in accordance with WCC's MUP.

4.16 The full modelling spreadsheet outputs have been provided to the transport authorities and can be provided to the public upon request.

Key Network Performance Indicators

4.17 Key statistics are presented in **Table 4.2** (AM peak period) and **Table 4.3** (PM peak period) which demonstrate the overall network operation in terms of average delay, average speed and the number of completed trips.

4.18 These indicate that the models do not lock up or experience significant changes in delay, speed or completed vehicle movements across the different scenarios as a result of the SPD's additional traffic or inclusion of the pre-pandemic University demand.

Signalised Junction Optimisation

4.19 SLR has optimised signalised junctions across the modelled area in the Reference Case scenarios to rebalance green time on certain approaches, improving the flow of traffic and reducing total delay.

4.20 No further optimisation has been necessary in the 'with SPD' scenarios, indicating the limited highway network impact that results from the SPD.

Table 4.2: Key Network Performance Indicators – AM Peak Period (07:00-10:00)

Statistic	2023 Base Model	2029 Ref. Case	2029 Ref. Case + SPD	2029 Ref. Case + SPD (Sensitivity)	2037 Ref. Case	2037 Ref. Case + SPD	2037 Ref. Case + SPD (Sensitivity)	2029 Local Plan	2029 Local Plan + SPD	2029 Local Plan + SPD (Sensitivity)
Mean Delay (s)	455	518	518	519	584	582	581	530	528	532
Mean Speed (kph)	52	48	48	48	44	44	44	47	47	47
Completed Trips (vehs)	105,642	113,587	113,828	113,866	117,603	117,790	117,917	114,033	114,174	114,533

Table 4.3: Key Network Performance Indicators – PM Peak Period (16:00-19:00)

Statistic	2023 Base Model	2029 Ref. Case	2029 Ref. Case + SPD	2029 Ref. Case + SPD (Sensitivity)	2037 Ref. Case	2037 Ref. Case + SPD	2037 Ref. Case + SPD (Sensitivity)	2029 Local Plan	2029 Local Plan + SPD	2029 Local Plan + SPD (Sensitivity)
Mean Delay (s)	485	592	602	597	668	672	669	613	614	620
Mean Speed (kph)	47	42	41	41	38	38	38	40	40	40
Completed Trips (vehs)	117,994	126,011	126,103	126,310	129,793	129,903	130,090	126,540	126,706	127,135

Queue Lengths

4.21 Analysis of queue lengths has been undertaken of key junctions in the vicinity of the University and the following comparison criteria have been applied:

- **No significant change**
- **Criteria 1 (beneficial)** decrease of more than 25 vehicles
- **Criteria 2 (moderate)** increase of 5 to 10 vehicles
- **Criteria 3 (severe)** increase of 10 to 20 vehicles
- **Criteria 4 (very severe)** increase of more than 20 vehicles

4.22 Criteria 2-4 and their descriptions accord with WCC's guidance; however, increased queues of more than 10 would not necessarily be considered by the Applicant to constitute a 'severe' impact.

4.23 Queue length changes, measured in vehicles, have been reviewed across both three-hour modelled periods for all scenarios and are presented diagrammatically in **Appendix B**. Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion. This presents a worst-case scenario as, in most instances, it is only one arm of the junction that experiences the queue length change.

4.24 The following key observations can be made in relation to the peak hours (08:00-09:00 and 17:00-18:00):

- The 2029 Reference Case assessments (comparing Scenarios 2 and 3) indicate that:
  - During the AM peak hour:
    - Junction 48 Arm C: Gibbet Hill Road northbound at the junction by the University Interchange increase from 26 to 37 vehicles.
    - Junction 50 Arm D: Gibbet Hill Road at the A429 junction increase from 70 to 86 vehicles.
  - During the PM peak hour:
    - Junction 10 Arm B: A45 westbound at the A429 junction increase from 21 to 37 vehicles.
    - Junction 42 Arm C: Sir Henry Parkes Road northbound at the Charter Avenue junction increase from 51 to 75 vehicles.
    - Junction 43 Arm A: A45 off-slip at the Charter Avenue junction increase from 43 to 56 vehicles.
    - Junction 44 Arm B: Westwood Heath Road at the Cromwell Lane junction increase from 36 to 58 vehicles.
    - Junction 46 Arm C: Kirby Corner Road at the Lynchgate Road junction increase from 65 to 87 vehicles.
    - Junction 49 Arm B and Junction 50 Arm C: A429 Kenilworth Road northbound increase by 15 vehicles at both the Cannon Hill Road and Gibbet Hill Road junctions.

- The 2037 Reference Case assessments (comparing Scenarios 4 and 5) indicate that:
  - During the AM peak hour:
    - Junction 13 Arm D: A45 eastbound off-slip at the Stivichall Interchange increase from 56 to 69 vehicles.
  - During the PM peak hour:
    - Junction 10 Arm B: A45 westbound at the A429 junction increase from 50 to 60 vehicles.
    - Junction 40 Arm B: Charter Avenue westbound at the Wolfe Road junction increase from 30 to 45 vehicles.
    - Junction 44 Arm C: Cromwell Lane northbound at the Westwood Heath Road junction increase from 15 to 28 vehicles.
    - Junction 46 Arm C: Kirby Corner Road at the Lynchgate Road junction increase from 38 to 52 vehicles.
    - Junction 49 Arm B: A429 Kenilworth Road at the Cannon Hill Road junction increase from 20 to 44 vehicles.
    - Junction 57 Arm B: Coventry Road northbound at the Rowley Road junction increase from 47 to 62 vehicles.
    - Junction 77 Arm A: A429 Coventry Road southbound at the junction with Upper Spring Lane increase from 32 to 53 vehicles.
    - Junction 102 Arm A: Bericote Road at the A452 Kenilworth Road junction from 67 to 79 vehicles.
    - Junction 102 Arm B: A452 Kenilworth Road at the Bericote Road junction increase from 89 to 102 vehicles.
- The 2029 Local Plan assessments (comparing Scenarios 6 and 7) indicate that:
  - Compared with the queue length changes of the 2029 Reference Case assessments, there would be limited additional queuing around the Kings Hill development.
- The 2029 Reference Case sensitivity test (comparing Scenarios 2 and 8) and the 2037 Reference Case sensitivity test (comparing Scenarios 4 and 9) indicate that:
  - Compared with the queue length changes of both core Reference Case assessments, there would be limited additional queuing as a result of the SPD.

Journey Times

4.25 Analysis of journey time impacts have been undertaken of key routes in the vicinity of the University and the following comparison criteria have been applied:

- **No significant change** between an increase of 5% and a decrease of 15%
- **Criteria 1 (beneficial)** decrease of more than 15%
- **Criteria 2 (moderate)** increase of 5 to 10%
- **Criteria 3 (severe)** increase of 10 to 20%
- **Criteria 4 (very severe)** increase of more than 20%

4.26 Criteria 2-4 and their descriptions accord with WCC's guidance; however, increased journey times of more than 10% would not necessarily be considered by the Applicant to constitute a 'severe' impact.

4.27 Journey time changes have been reviewed across both three-hour modelled periods for all scenarios and are presented diagrammatically in **Appendix C**.

4.28 The following key observations can be made in relation to the peak hours (08:00-09:00 and 17:00-18:00):

- The 2029 Reference Case assessments (comparing Scenarios 2 and 3) indicate that:
  - During the AM peak hour there are no material impacts.
  - During the PM peak hour:
    - Route 6 Section 4 westbound (on Coventry Road between Stoneleigh Road and Stoneleigh village) journey times increase from 734 to 815 seconds (11%). This is primarily a result of additional queueing at Junctions 59 and 60 within Stoneleigh village.
    - Route 9 Section 1 northbound (on the B4115 between the A46 and the A452) journey times increase from 148 to 237 seconds (61%).
- The 2037 Reference Case assessments (comparing Scenarios 4 and 5) indicate that:
  - During the AM peak hour there are no material impacts.
  - During the PM peak hour:
    - Route 12 Section 2 eastbound (on Rowley Road between Coventry Road and the A45 Tollbar End) journey times increase from 398 to 480 seconds (20%). This is primarily a result of additional queueing at Junction 16 (Orchard Way).
- The 2029 Local Plan assessments (comparing Scenarios 6 and 7) indicate that:
  - Compared with the percentage impacts of the 2029 Reference Case assessments, there would be limited additional journey time impacts as a result of the SPD.
- The 2029 Reference Case sensitivity test (comparing Scenarios 2 and 8) and the 2037 Reference Case sensitivity test (comparing Scenarios 4 and 9) indicate that:
  - Compared with the percentage impacts of both core Reference Case assessments, there would be limited additional journey time impacts as a result of the SPD.

Summary and Conclusion

4.29 As is known to WCC, CCC, NH and TfWM, there are areas of congestion and delay across parts of the modelled network within the 2029 and 2037 Reference Case scenarios, prior to the addition of the very limited traffic from the SPD.

4.30 The modelled network is highly sensitive to additional traffic and consequently, modest changes in demand can have disproportionate impacts.

4.31 The SPD's additional vehicle trips, less than two additional vehicle movements per minute during the busiest morning and evening peak hours, are comfortably within the typical daily variation of link flows across the local highway network.

4.32 The modelling results demonstrate some increase in queuing. However, these are not considered to be of material concern to the operation of the SRN in the area or the local highway networks under the authority of CCC and WCC. In addition, due to the size of the KSWA model, the observed deviations in queueing can be attributed to variance between the seed runs within the model.

4.33 Given the limited impacts of the SPD it is not considered necessary to undertake detailed sifting analysis on the queue length, journey time or link flow data.

4.34 Based on the results summarised above, the assessed floorspace uplift associated with SPD will not require highway mitigation within any of the Reference Case or Local Plan scenarios. Furthermore, the SPD would not have an unacceptable safety impact or severe residual cumulative impact on the local highway network or SRN.

4.35 However, a 'Monitor and Manage Transport Sub Board' has been set up comprising representatives from the University and authorities to monitor, review, co-ordinate and implement the monitor and manage set of principles in relation to all future University development activities, the SPD and associated S106 obligations.

5 Summary and Conclusion

Summary

5.1 This Report has been prepared by Steer to review the transport impacts of the SPD comprising an uplift in Use Class F1(a) floorspace of 31,000 sqm GIA. This is a worst-case scenario providing additional robustness and flexibility above the actual expected maximum floorspace of 23,804 sqm proposed by the SPD.

5.2 Furthermore, the robust assessment does not consider the significant benefits to capacity and congestion that would be realised on the highway and bus networks from the planned delivery of 1,200 additional student bedspaces within the Campus, nor the significant PBSA planned by private developers in the 'collar' surrounding the Campus.

5.3 At a Campus-wide level, car parking is significantly underutilised and there is ample capacity in car parks across Main Campus to offset the loss of car parking as part of SPD and to accommodate additional parking demand that may be generated by the floorspace uplift proposed by the SPD.

5.4 Trip generation has been subject to extensive discussions with the transport authorities, with the approach agreed and incorporated within both the detailed public transport and highway assessments contained in this Report.

5.5 Additional bus trips would be concentrated on certain routes and the University will continue to work closely with bus operators, CCC, WCC and TfWM to ensure that adequate bus capacity is provided along key corridors as the SPD and its constituent developments are built and occupied over the next decade.

5.6 Additional vehicle trips are less than two vehicles per minute during the busiest peak hours, which is not a material change. However, the highway network in WCC's KSWA models is highly sensitive and generous growth assumptions up to 2037 without the SPD. Consequently, the very minor uplift in vehicle trips and some re-assignment of traffic results in additional queueing and journey times in some locations.

5.7 The SPD is supported by a Framework S106 with 'Monitor and Manage' elements and funding which set out a framework of ongoing monitoring and trigger points which, if met, can be drawn down and implemented in response to changes in travel behaviour.

Conclusion

5.8 The SPD will have a limited impact on the highway and public transport networks. It will significantly reduce car dominance and road danger across the Campus, with a range of public transport, shared mobility, pedestrian and cycle improvements forming key components of the University's Capital Plan to 2033.

Appendices

A SLR's 'Results Covering Note' (May 2024)

VM220566 University of Warwick Masterplan Modelling

Results Spreadsheet Overview

VM220566.TN001

Introduction

1. Vectos Microsim (VM) has been assisting Steer and The University of Warwick (UoW) in the collation of evidence to support the assessment of the University Masterplan SPD proposals (Phase 2). Vectos have been instricuted to modelled the transport effects of Phase 2 using the existing Kenilworth and Stoneleigh Wide Area (KSWA) Paramics model and in line with the requirements set out within Warwickshire County Councils modelling Protocol for Development.

2. Initial scenarios have been set up and model outputs collected. In order to collate the outputs and all comparison between scenarios a bespoke results spreadsheet has been prepared. The intention of this note is to provide an explanation of what is contained within the results spreadsheet and how the numbers are collected and compiled.

Interpretation/Grading

3. At times, within the spreadsheets, grading has been adopted to allow the classification of results based on the relative changes. This is adopted within the Queue Overview and Journey Time Overview tab whereby a grade is assigned based on the difference observed between scenarios selected by the user.

4. The grading is provided for information purposes only. The scale adopted within the spreadsheets is adjustable and can be changed by the user at any time.

5. It should not be assumed that the grading adopted within the spreadsheet is representative of the opinion of the Local Authority. VM would recommend that if there is an intention to report classification within a Transport Assessment or similar, that the criteria is discussed and agreed separately with the Local Authority.

6. The remainder of this Note sets out the measures which are presented within the accompanying results spreadsheet.

Vectos
36 Great Charles Street
Birmingham
B3 3JY

0121 2895 610

vectos.co.uk

Number of runs.

7. All results are based on a minimum of the average of 10 runs per time period, per scenario. The following time periods have been reported within the accompanying spreadsheet:

- AM: 07:00 – 10:00
- PM: 16:00 – 19:00

Model Scenarios

8. The following scenarios have been reported within the results spreadsheets:

Scenario	*Description*
2023 Base Model	2023 Core model calibrated/validated
2029 Reference Case	Inclusive of the 2029 Committed Developments
2029 Reference Case + SPD	As above + SPD proposals
2037 Reference Case	Inclusive of the 2037 Committed Developments
2037 Reference Case + SPD	As above + SPD proposals
2029 Local Plan Reference	Inclusive of 2029 Committed development and Local Plan Allocations
2029 Local Plan Reference +SPD	As above + SPD proposals
2029 Reference Case + Dev - 100% CPH	As per 2029 Reference Case + SPD plus CPH Sensitivity
2037 Reference Case + Dev - 100% CPH	As per 2037 Reference Case + SPD plus CPH Sensitivity
2029 Local Plan + SPD - 100% CPH	As 2029 Local Plan Reference +SPD plus CPH Sensitivity

Network Statistics

9. This tab provides a high level overview of network performance across all modelled scenarios.

10. Network statistics are based on all of the completed trips within each modelled period, using the Paramics trips-all file which contains details of all completed trips.

11. The presented statistics are based on the average time taken for each trip and the average speed of these trips.

12. Details of the network statistics and how they are calculated are given below:

Network Average Journey Time

13. Network average journey time gives the average journey time (seconds) it takes for a vehicle to complete its' assigned trip through the model.

14. This is calculated by averaging the journey times of all completed trips in each model run. These results are then averaged across all runs.

Network Mean Speed

15. Network Mean Speed is the average speed (kilometres per hour) of vehicles completing their trip during the modelled period.

16. The average journey length for each run is calculated from the trips-all files by averaging the length of all completed trips. This is then averaged across all runs and then divided by Network Mean Delay in order to give Network Mean Speed.

Total Completed Trips

17. Total Completed Trips (veh) is the number of trips that have completed during the simulation period. Higher levels are expected in the development scenarios due to the addition of the site. Significant drops in numbers compared to the Base Case would indicate issues with congestion in the model.

Journey Time Overview

18. This tab (**JT Overview**) provides a summary of the average journey time recorded on each journey time section defined within the model. Comparisons of these values across scenarios therefore provides an indication of delay.

19. Two scenarios can be compared across all time periods. The scenarios to be compared can be selected at the top of the worksheet, using the drop-down menus in the yellow cells.

Data Collection

20. Paramics reports the average time (in seconds) that it takes for vehicles to travel along the length of a route.

21. The average journey time is reported hourly for each route in each model run. These results are then averaged across all runs to provide the results presented in this tab.

Results

22. The journey time (seconds) for each route is presented for both the selected scenarios, broken down by hour.

23. The % Diff column gives the difference as a percentage change in journey time between the two scenarios selected.

24. The Criteria column gives a grading to routes where there is a notable change in delay between the two scenarios.

25. Four criteria are given as a generic assessment of the change in journey time between the two scenarios selected:

- Criteria 1 – Journey time has decreased by more than 15%
- Criteria 2 – Journey time has increased by between 5 to 10%
- Criteria 3 – Journey time has increased by between 10 to 20%
- Criteria 4 – Journey time has increased by more than 20%

26. These criteria are only an indicator of where notable changes in delay have occurred and should not be solely used to determine if a change in delay is acceptable or not. Agreement should be sought with the Local Authority before any criteria are relied upon.

27. If required the criteria can be changed by altering the percentage values in the grey cells in the below table. The values of -999 and 999 should be kept fixed in order to ensure that extreme changes in delay are accurately categorised.

Journey Time (JT) by Route

28. This tab presents the journey time for one route (or section of route) for a selected time period and presents these times for all of the modelled scenarios in a single graph and table. Where a route is bi-directional the times for each direction is presented separately.

29. The route, time period and section, or complete route, can be selected in the yellow cells at the top of the worksheet.

30. Again, the sections most likely to be affected by the development are summarised in a list to help focus a review of the data.

Data Collection

31. The data collection method mirrors that which is adopted for the Journey time overview tab. The only difference between the two tabs is that the route tab allows for specific comparisons and produces figure based on the selections.

Results

32. Journey times for each scenario are presented in tabular format with an accompanying histogram.

Queue Overview

33. The queueing overview tab presents the average maximum queue length (in vehicle numbers) recorded on all assessed junction approaches in each modelled hour.

34. Two scenarios can be compared across all time periods. The scenarios to be compared can be selected at the top of the worksheet, using the drop-down menus in the yellow cells.

Data Collection

35. Paramics reports queue lengths based on queue routes that are coded into the model. These queue routes usually are propagated upstream from the assessed approach until another assessed junction in reached. For this reason, the queue lengths can be limited to the distance between the assessed junctions and the outputs may need to be reviewed with this in mind.

36. Queues are measured in number of vehicles and reflects the longest single lane queue (and not the sum across several lanes). The maximum for each hour is reported for each model run, which can occur at any point throughout the hour. The maximum queue for each hour is averaged across all runs to calculate the queue lengths presented in the results spreadsheet. Where approaches contain multiple lanes, the maximum queue length is based on the longest queue observed in any lane and is not the sum of the queues across the multiple lanes.

Results

37. The average maximum queue length (vehicles) for each approach is presented for the selected scenarios, broken down by hour.

38. The Diff (veh.) column shows the change in queue length from scenario 1 to scenario 2.

39. The Criteria column gives a grading to routes where there is a substantial change in delay between the two scenarios.

40. Four criteria are given as a generic assessment of the change in queue length from scenario 1 to scenario 2:

- Criteria 1 – Queue Length has decreased by more than 10 vehicles
- Criteria 2 – Queue Length has increased by between 5 and 10 vehicles
- Criteria 3 – Queue Length has increased by between 10 and 20 vehicles
- Criteria 4 – Queue Length has increased by more than 20 vehicles

41. These criteria are only an indicator of where notable changes in queueing have occurred and should not be solely used to determine if a change in queue length is acceptable or not. Agreement should be sought with Local Authority before any criteria are relied upon.

42. If required the criteria can be changed by altering the values in the grey cells in the below table, the values of -999999 and 9999999 should be left to ensure that extreme changes in queue length are reported within the correct criteria.

Queues by Junction

43. This tab presents the maximum queue lengths (vehicles) for all approaches to the selected junction across all scenarios for a given time period. This tab also presents the traffic flows which are recorded as entering the junction from each approach, as well as the sum of all traffic entering the junction (i.e., junction throughput).

44. As noted, throughput (measured in vehicles) is presented alongside the queueing results. Throughput is presented for each approach as well as total junction throughput which comprises the sum of all traffic movements entering the junction per arm.

45. The assessed junction and period can be toggled at the top of the tab using the drop-down menu in the yellow cells.

46. A list of local junctions is provided to help focus the review of this data, but it is not necessarily exhaustive.

Data Collection

47. The method of queue data collection is consistent with that which is adopted for the collection of queue data presented within the Queue Overview tab.

48. The throughput information is collected through the measurement of vehicles which travel across the approach links to each junction. The total number of vehicles traversing a link is summarised per run on an hourly basis and the average of all runs is then presented.

Results

49. Maximum queue lengths are presented for each approach across all of the scenarios in a data table. These results are also presented as a bar chart to allow for easy comparison between scenarios and for presentation within reports.

50. Throughput is presented for each approach across all of the scenarios in a data table, with an additional column for total junction throughput. Two histograms are also provided, one showing throughput by arm and one showing total junction throughput.

Link Flow Results

51. This tab presents the average flow (vehicles) and Speed (mph) at a set of defined links across the model network representing notable locations across the network.

52. Results are presented for all scenarios for a given time period and link. The location and time period can be selected at the top of the worksheet using the drop-down menu within the yellow cells.

53. A figure is included within this tab referencing the location of all the assessed links.

Data Collection

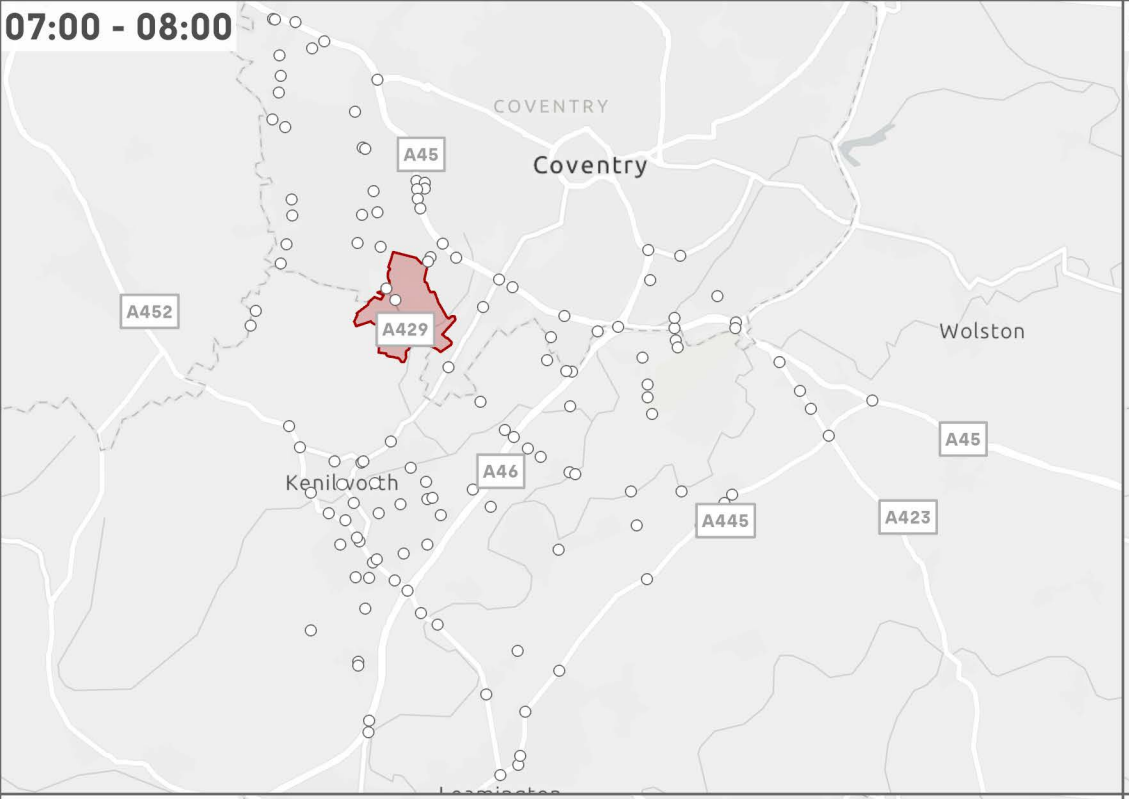
54. Average link flows for each link are reported by Paramics for each hour of each model run. These results are then averaged across all model runs to provide the results given here.

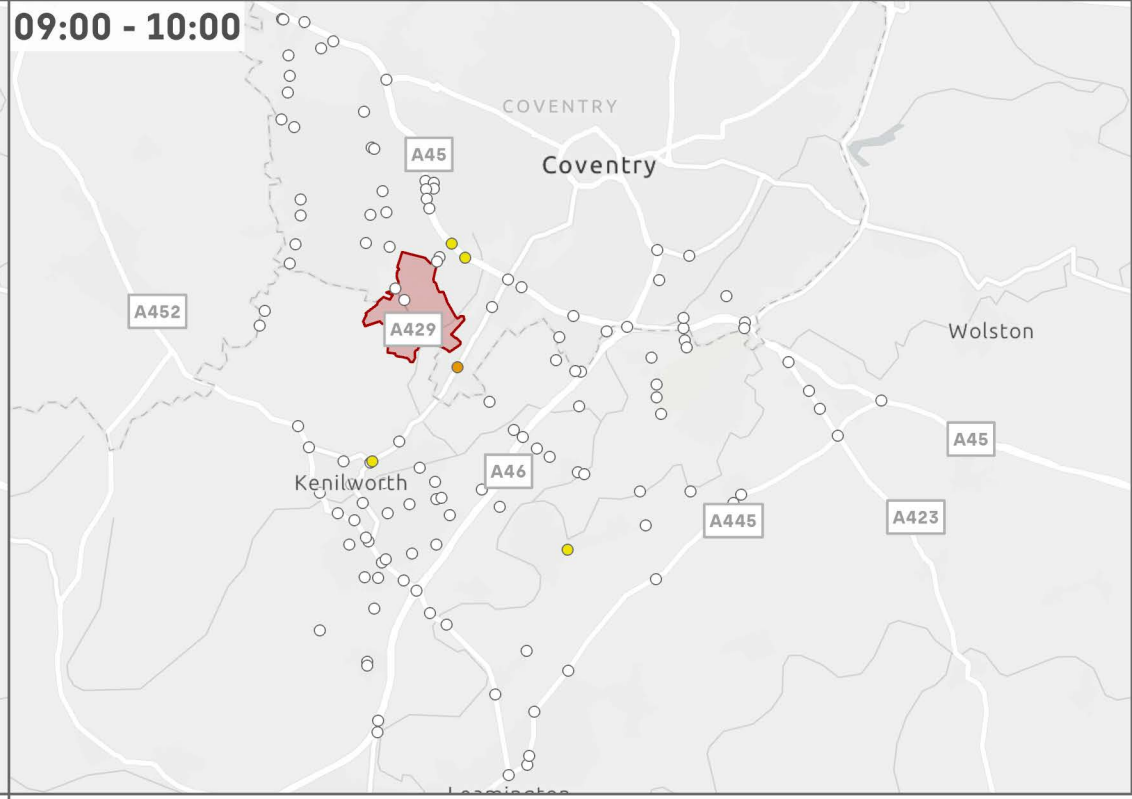
Results

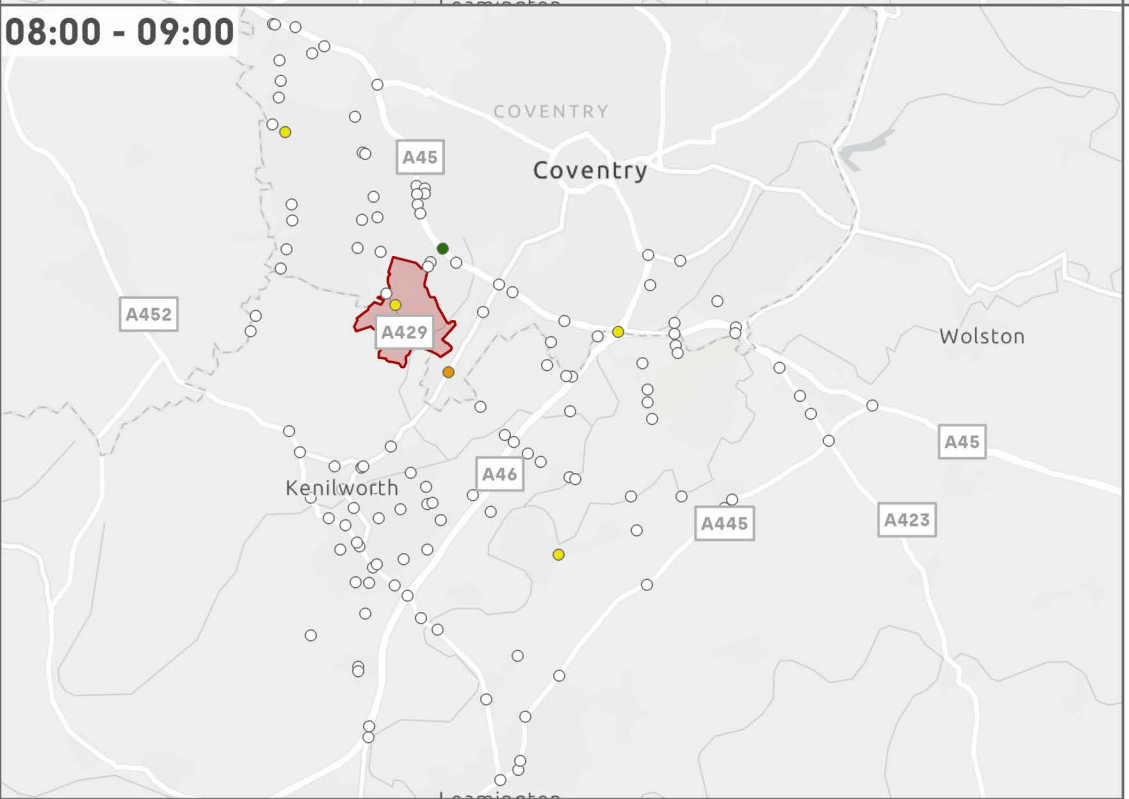
55. Flow/Speed results are presented for all scenarios. Results are presented for each direction on the link as well as two-way results. Two-way flow is the sum of both directions.

56. These results are also presented in three histograms, one for each direction and one for the two-way results.

B Queue Length Plots







University of Warwick - SPD

2029 Reference Case vs 2029 Reference Case + SPD

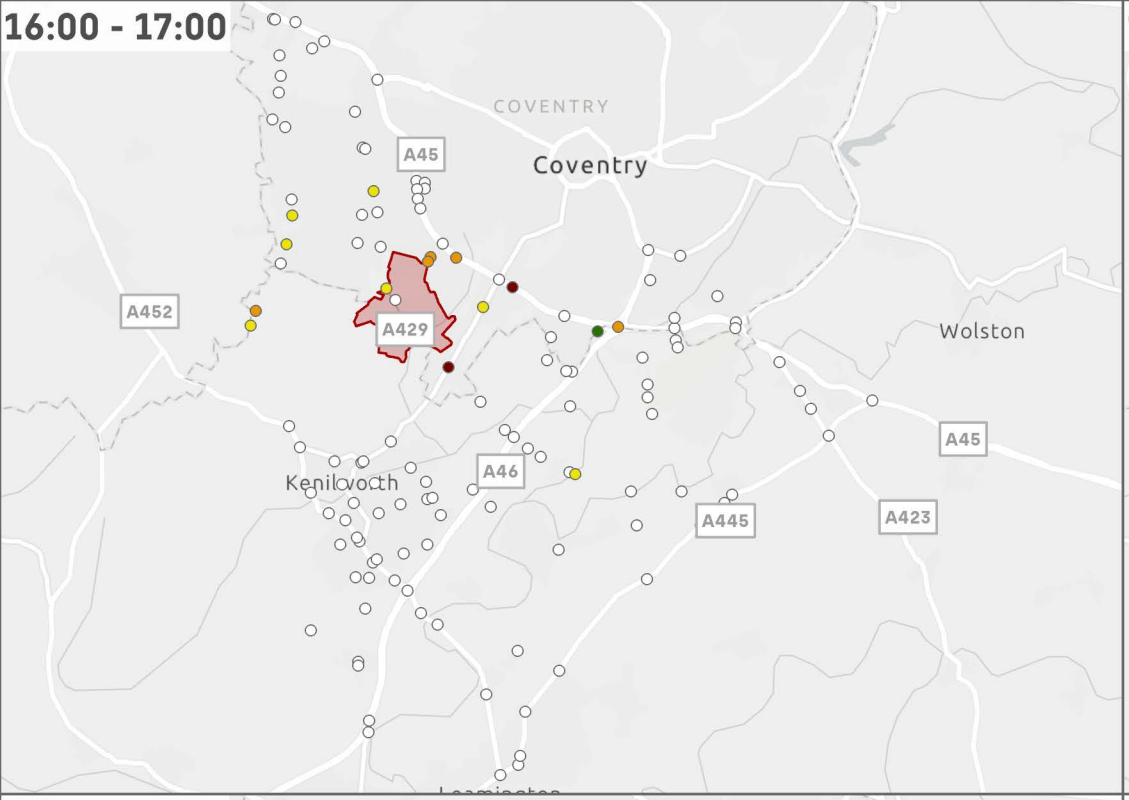
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

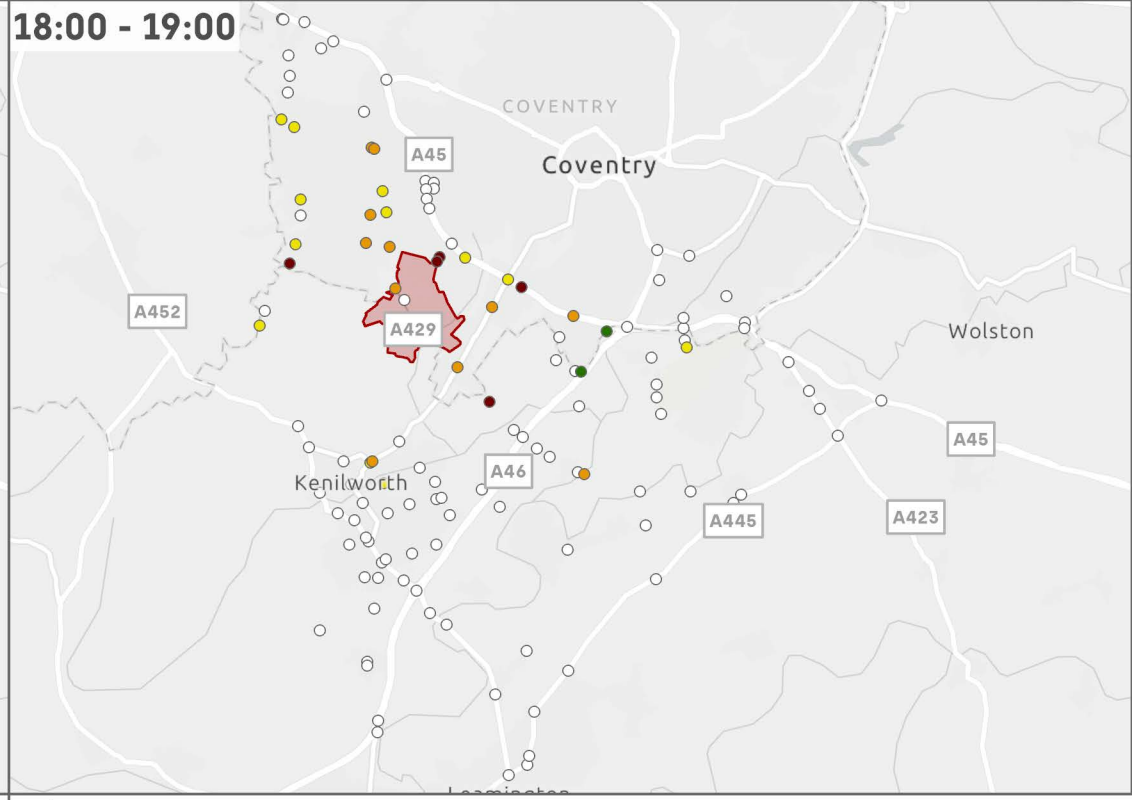
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

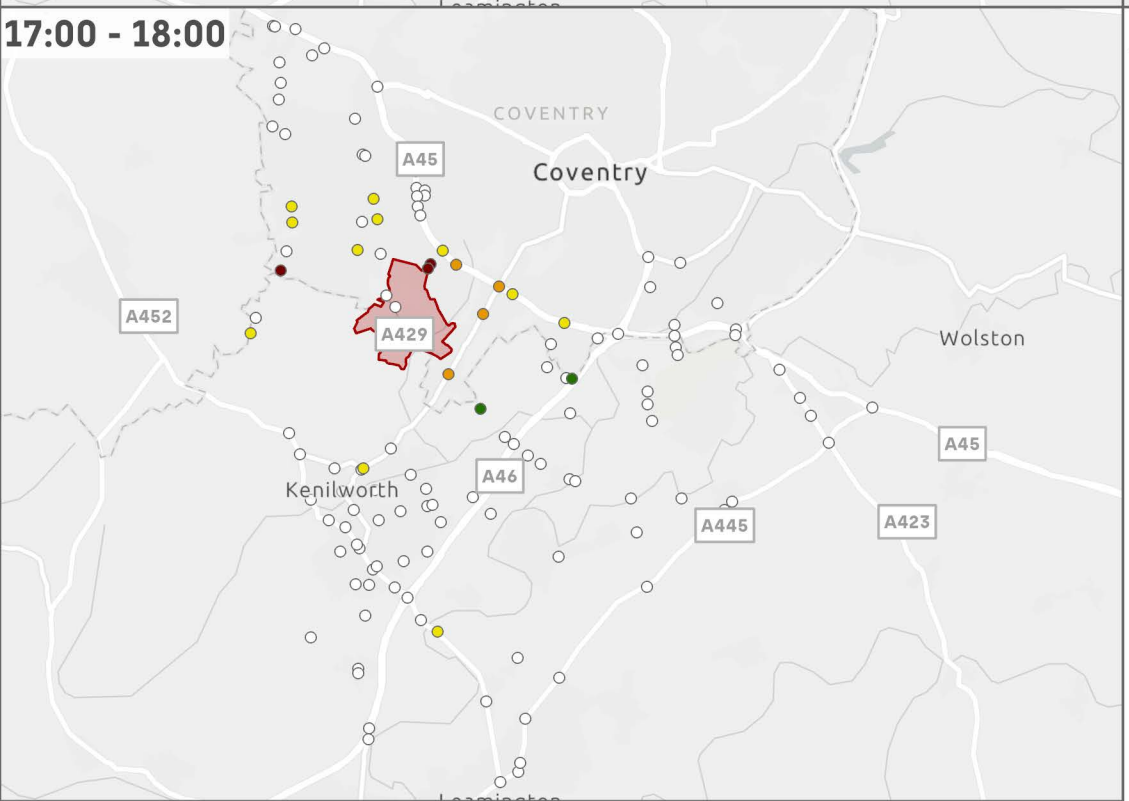
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2029 Reference Case vs 2029 Reference Case + SPD

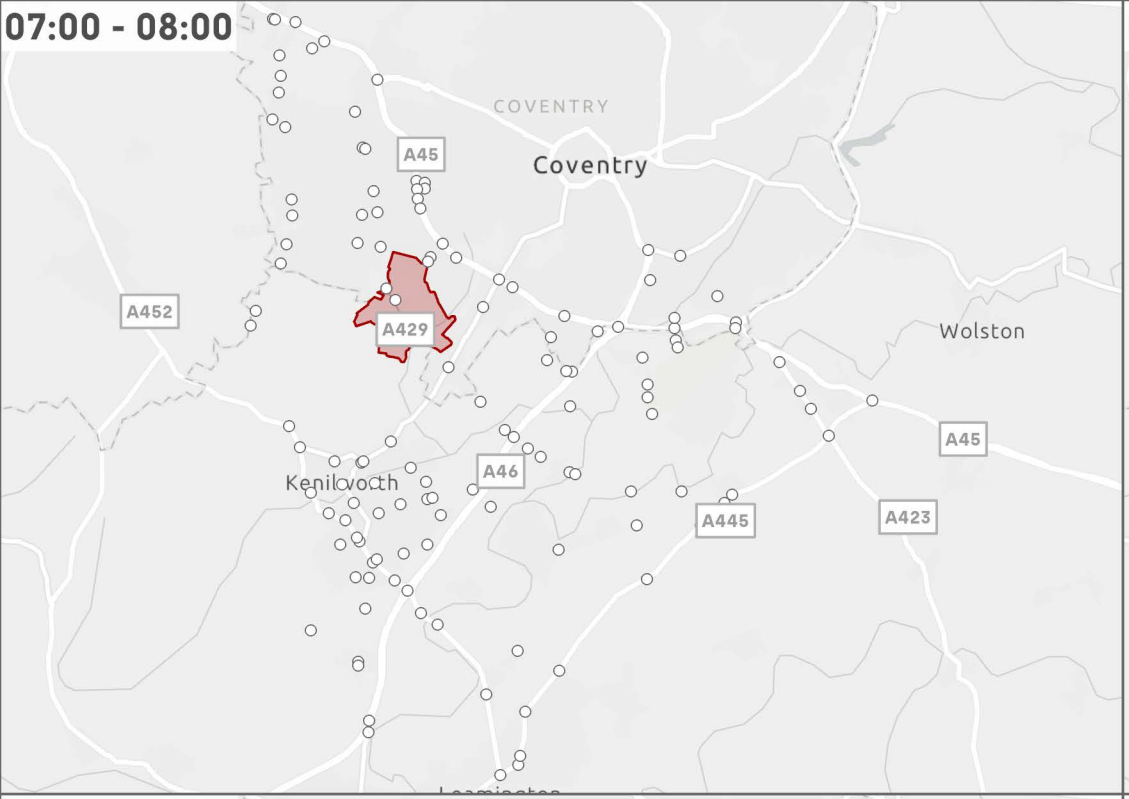
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

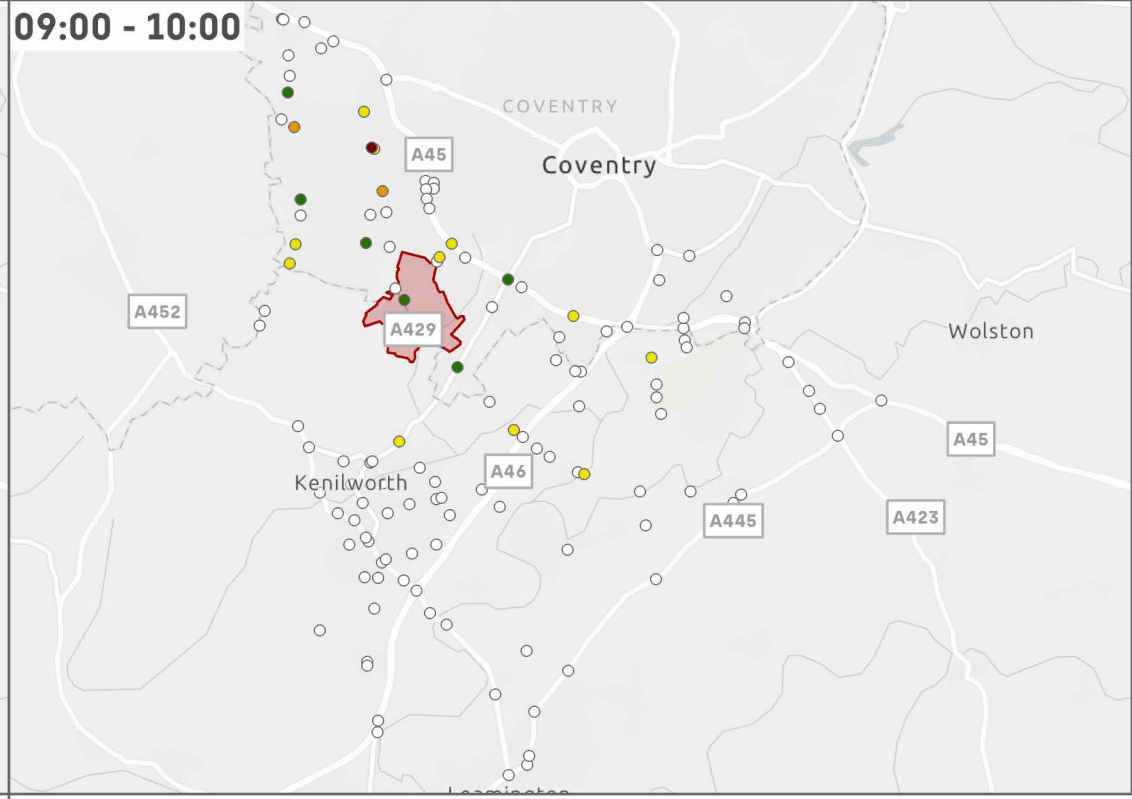
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

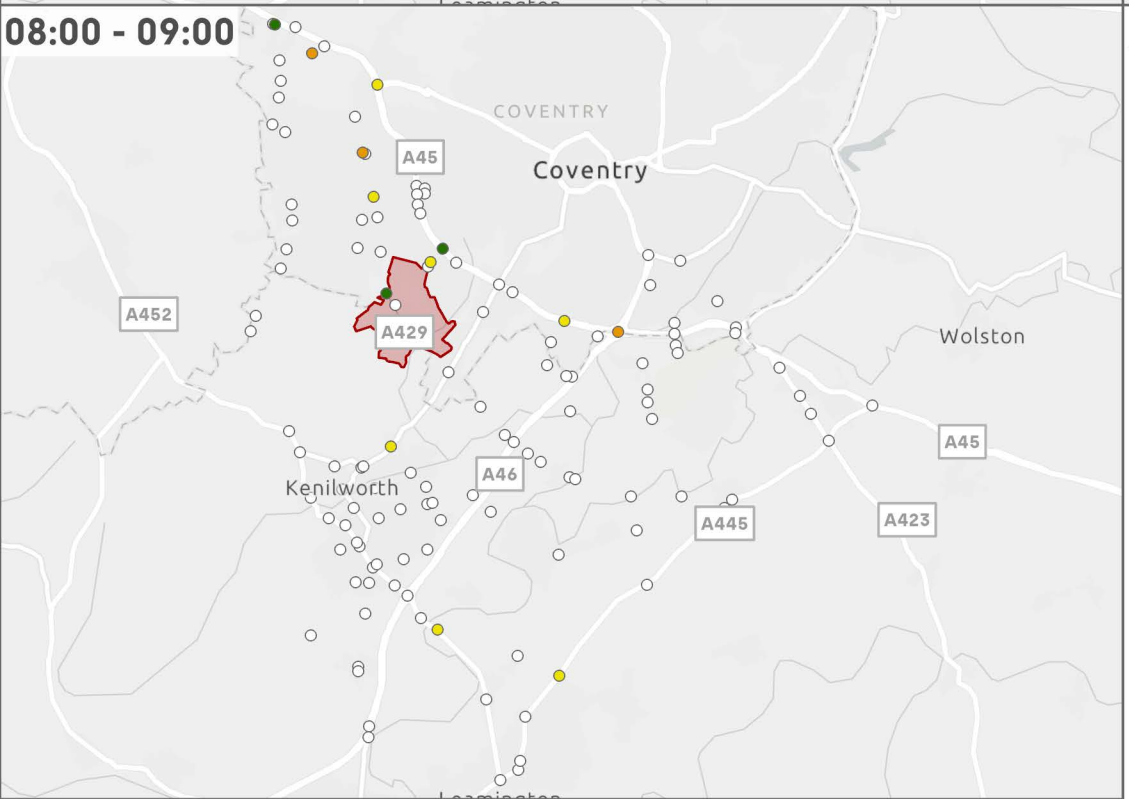
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2037 Reference Case vs 2037 Reference Case + SPD

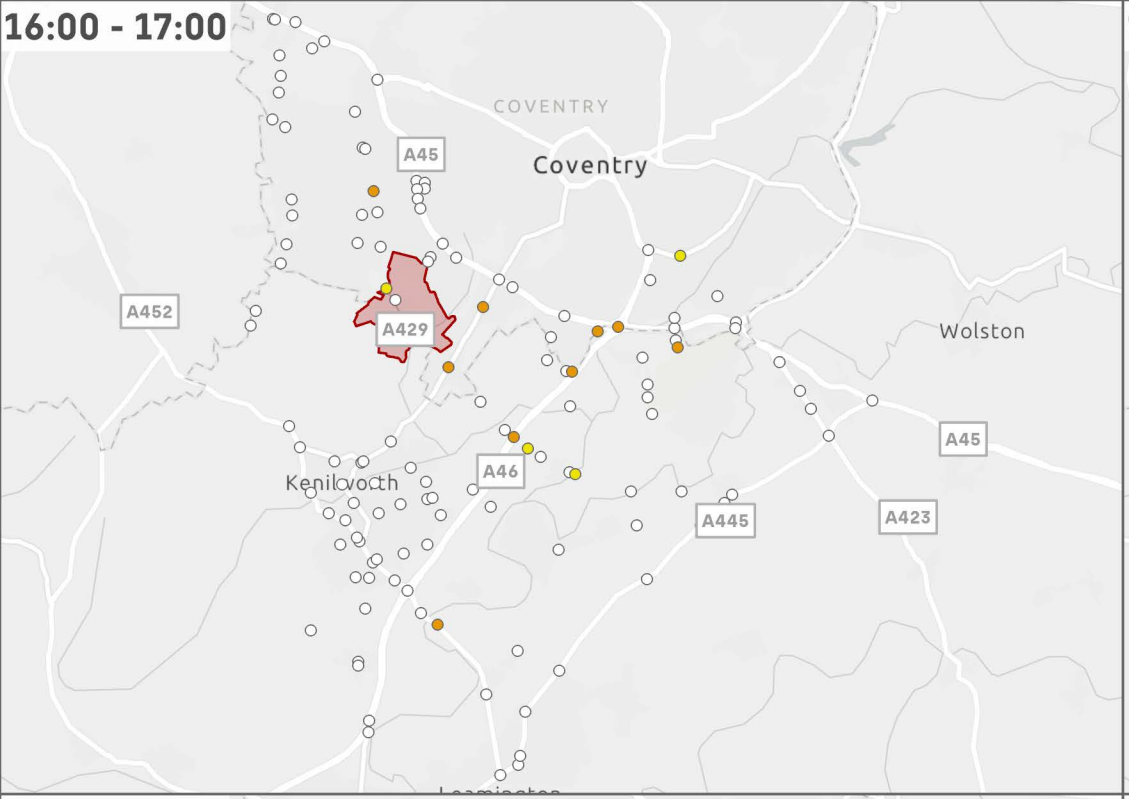
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

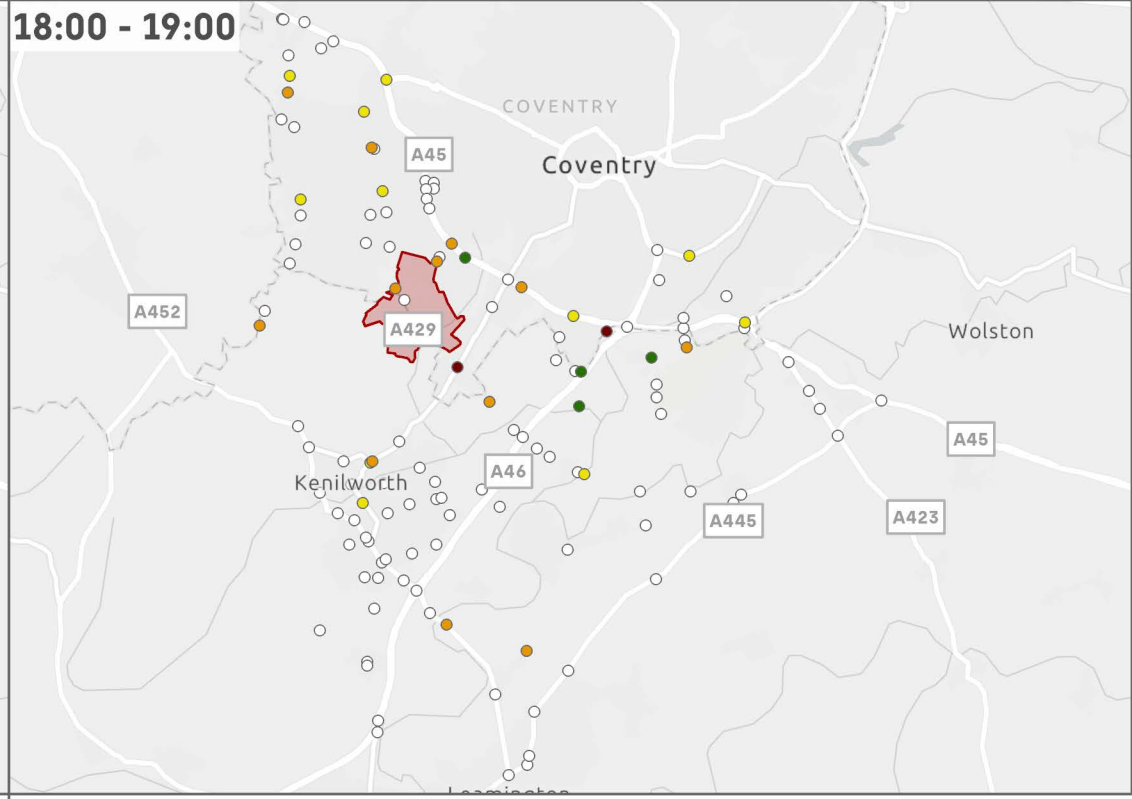
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

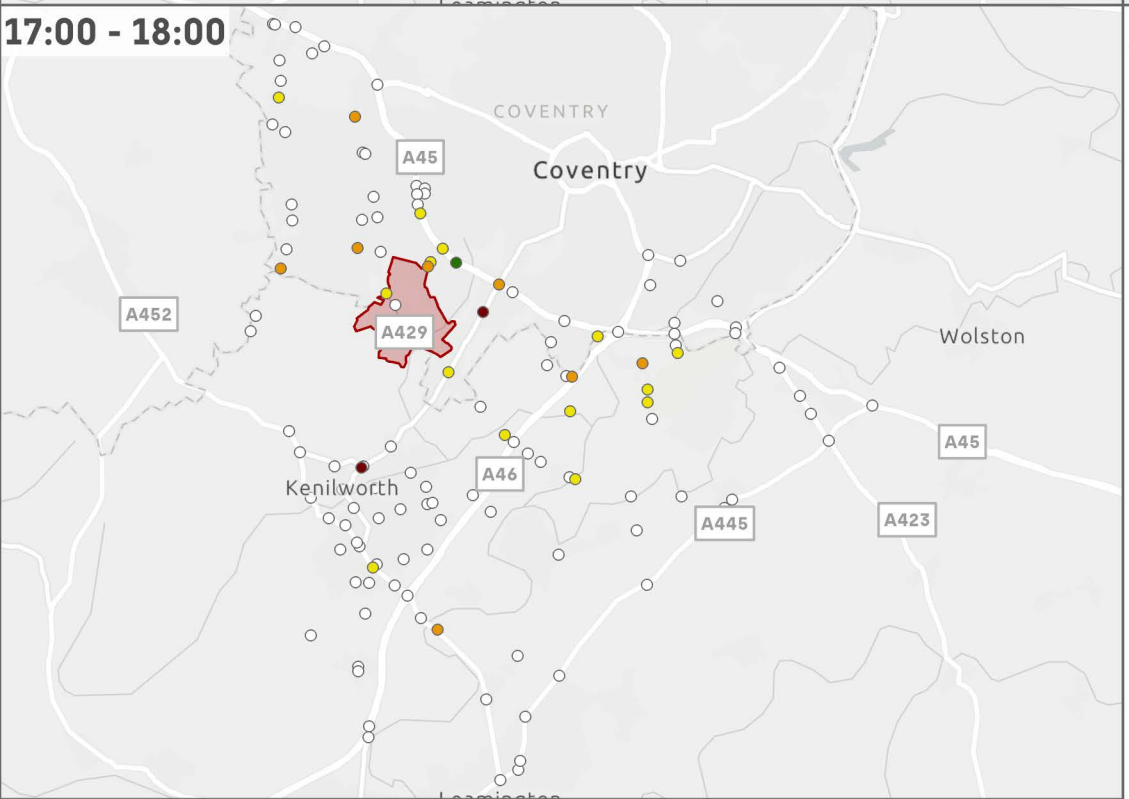
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2037 Reference Case vs 2037 Reference Case + SPD

- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

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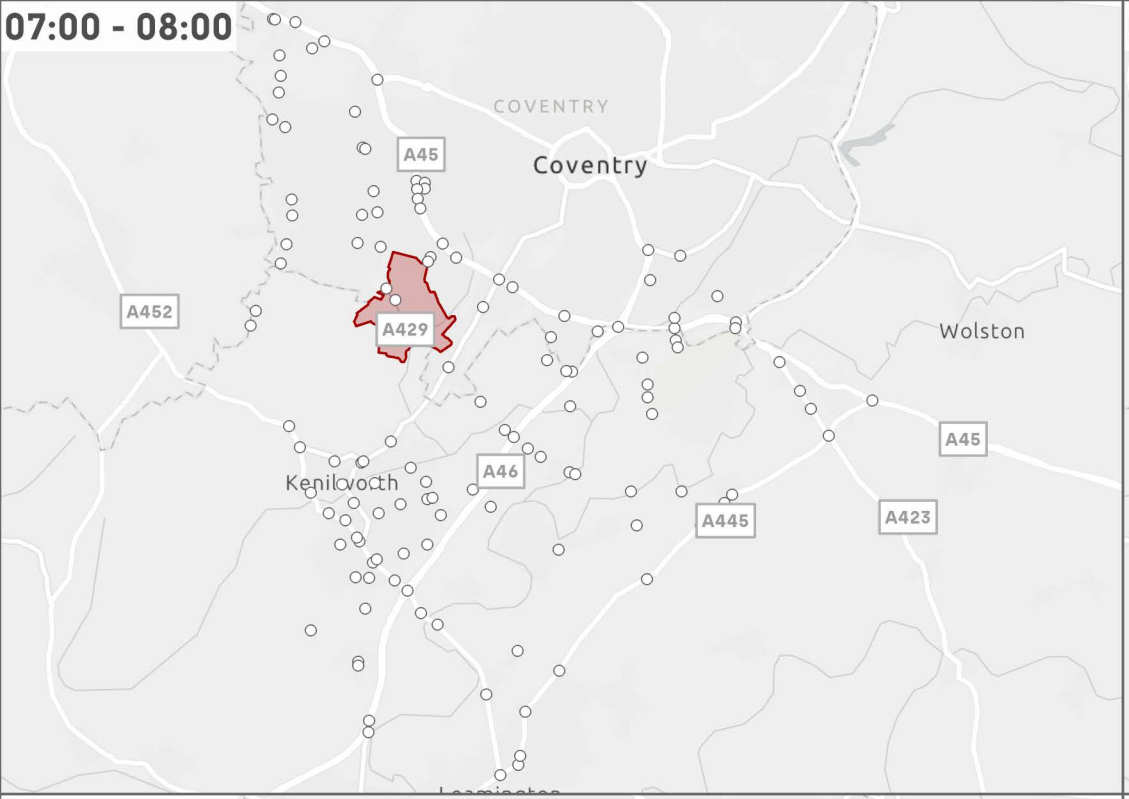
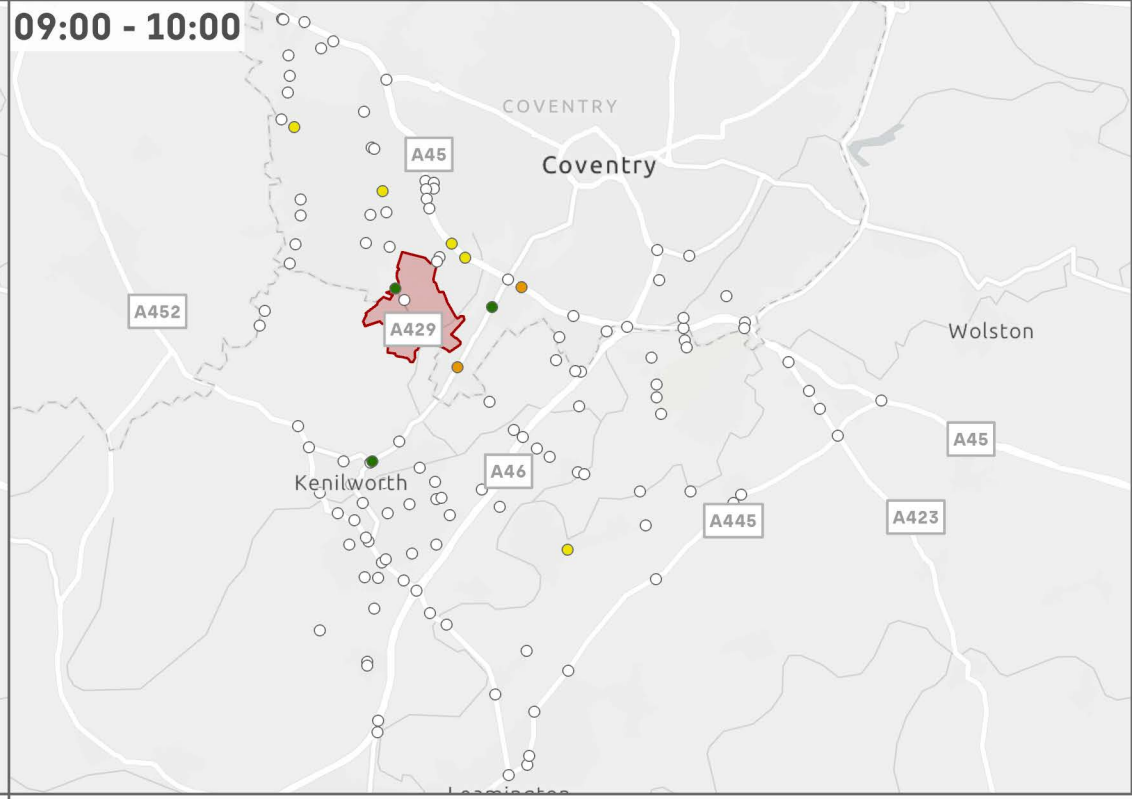
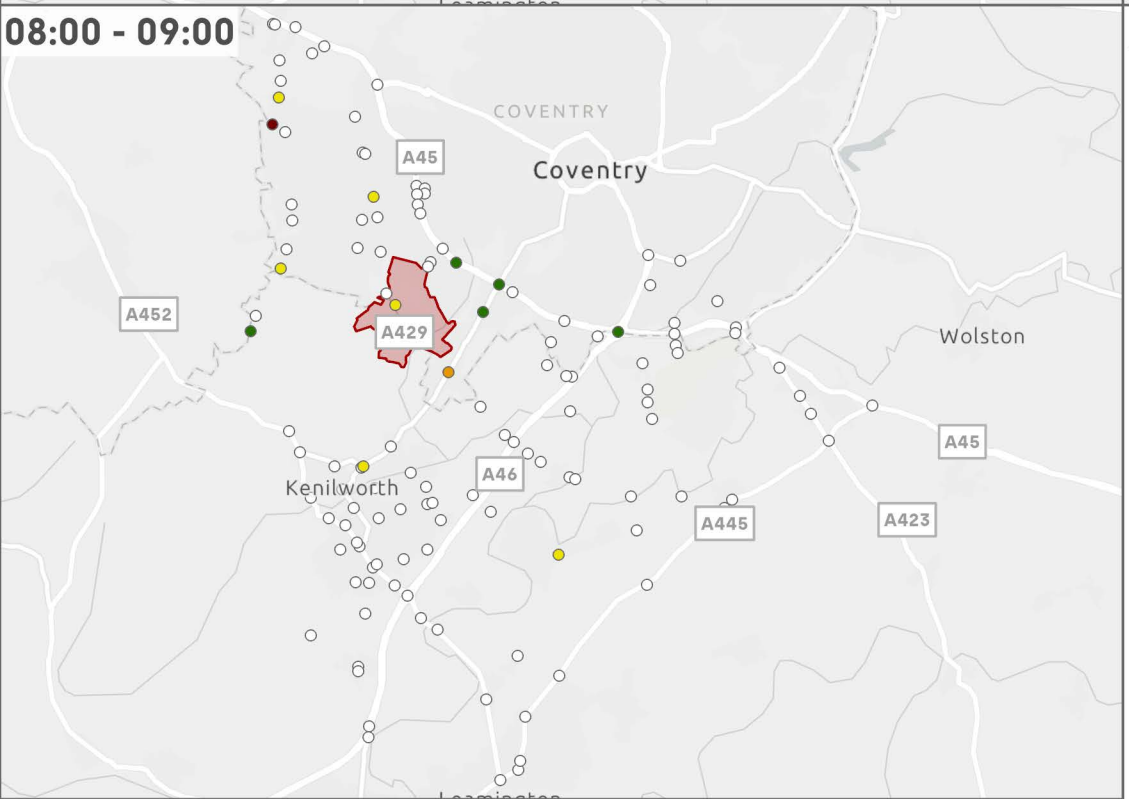
Kilometres

steer







University of Warwick - SPD

2029 Local Plan vs 2029 Local Plan + SPD

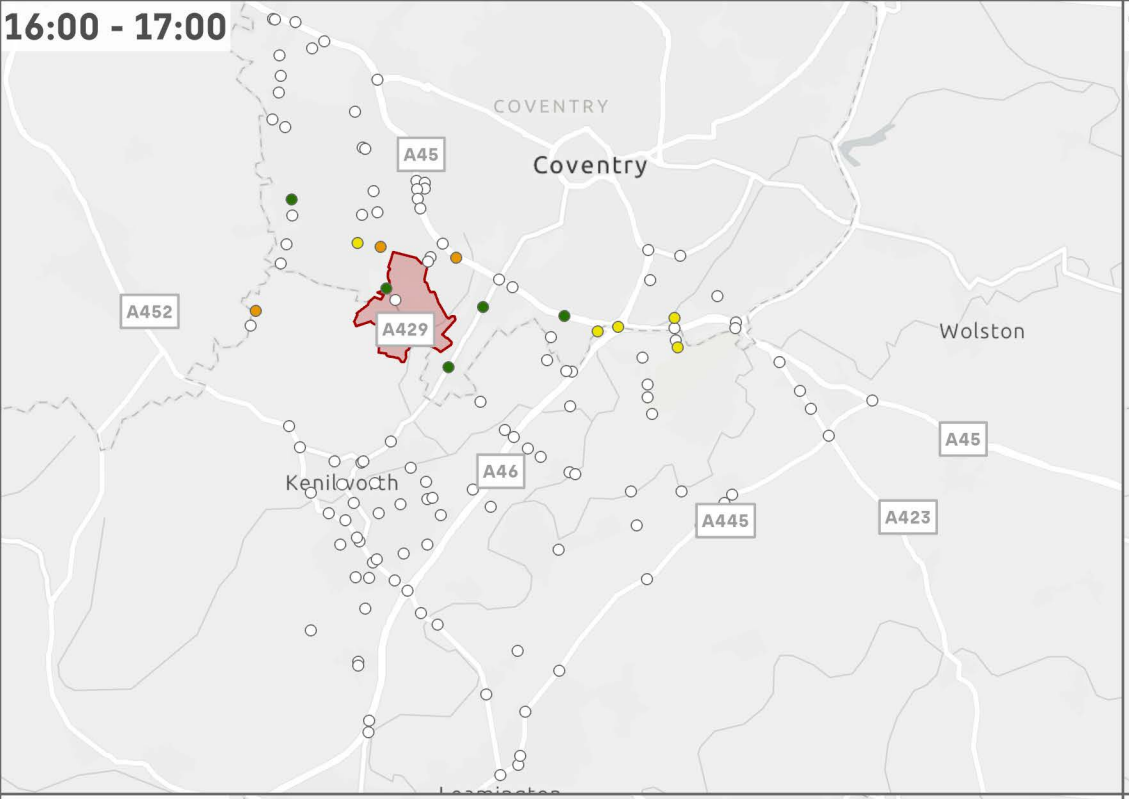
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

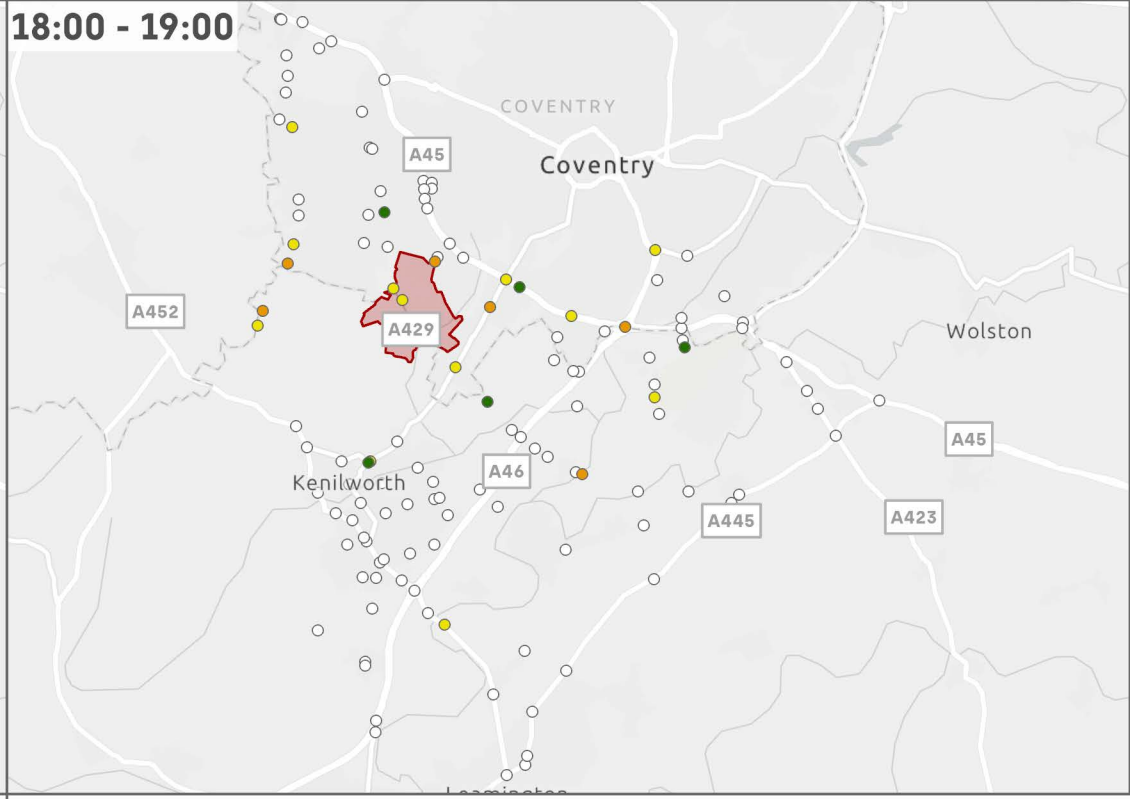
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

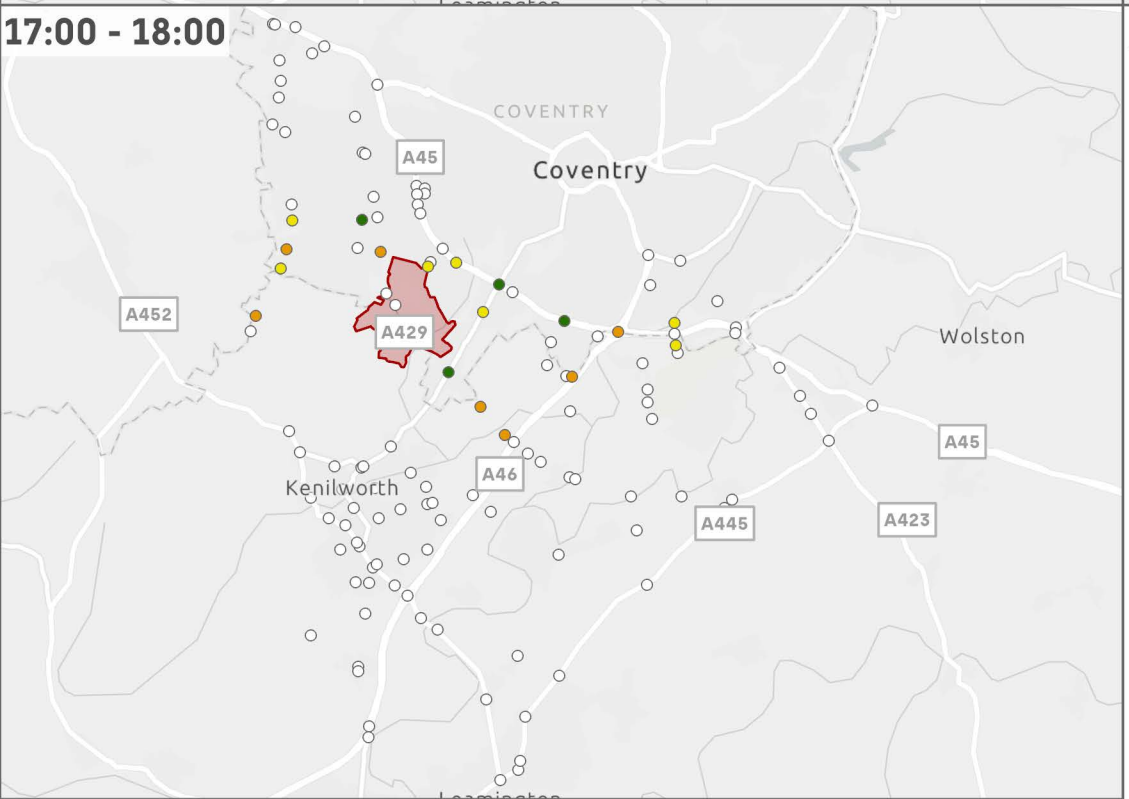
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2029 Local Plan vs 2029 Local Plan + SPD

- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

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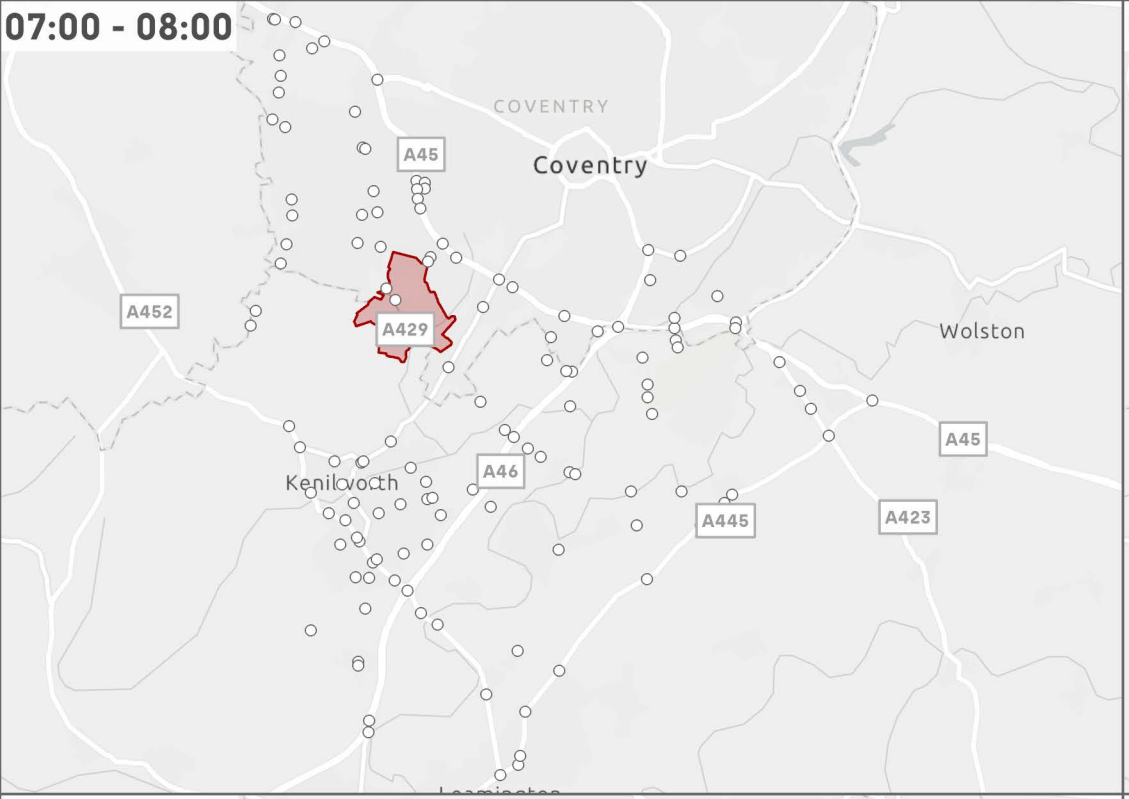
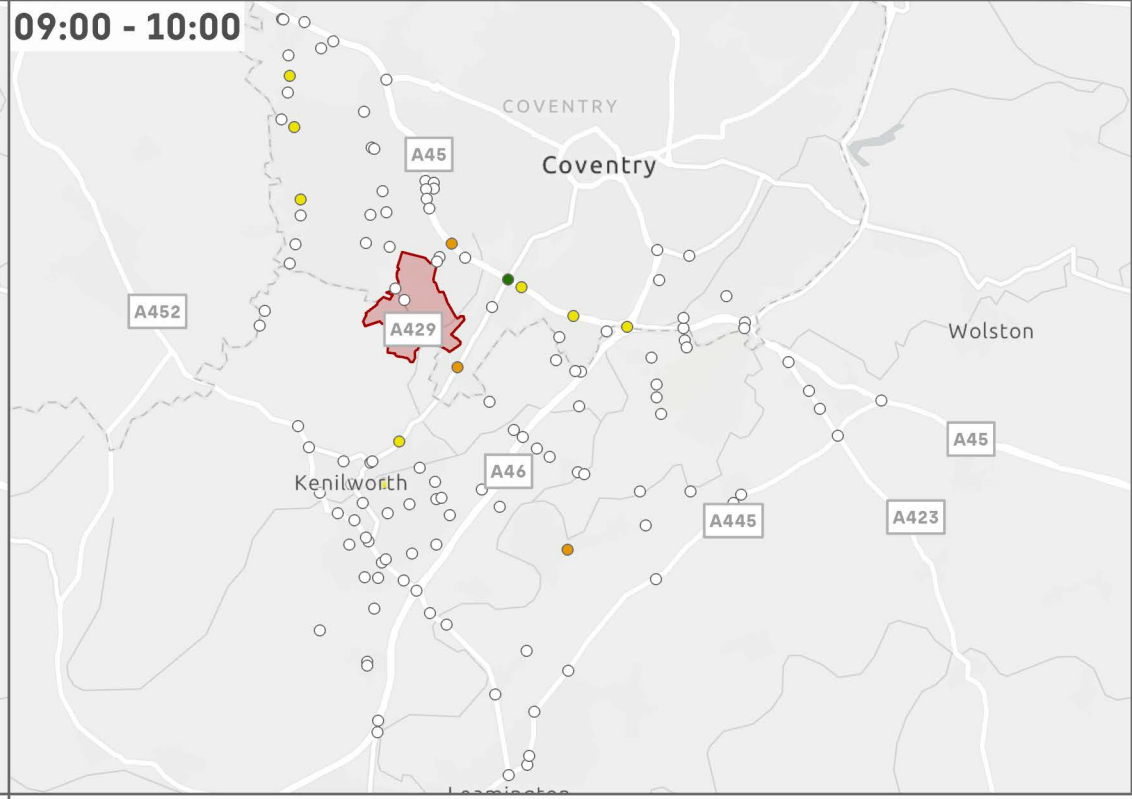
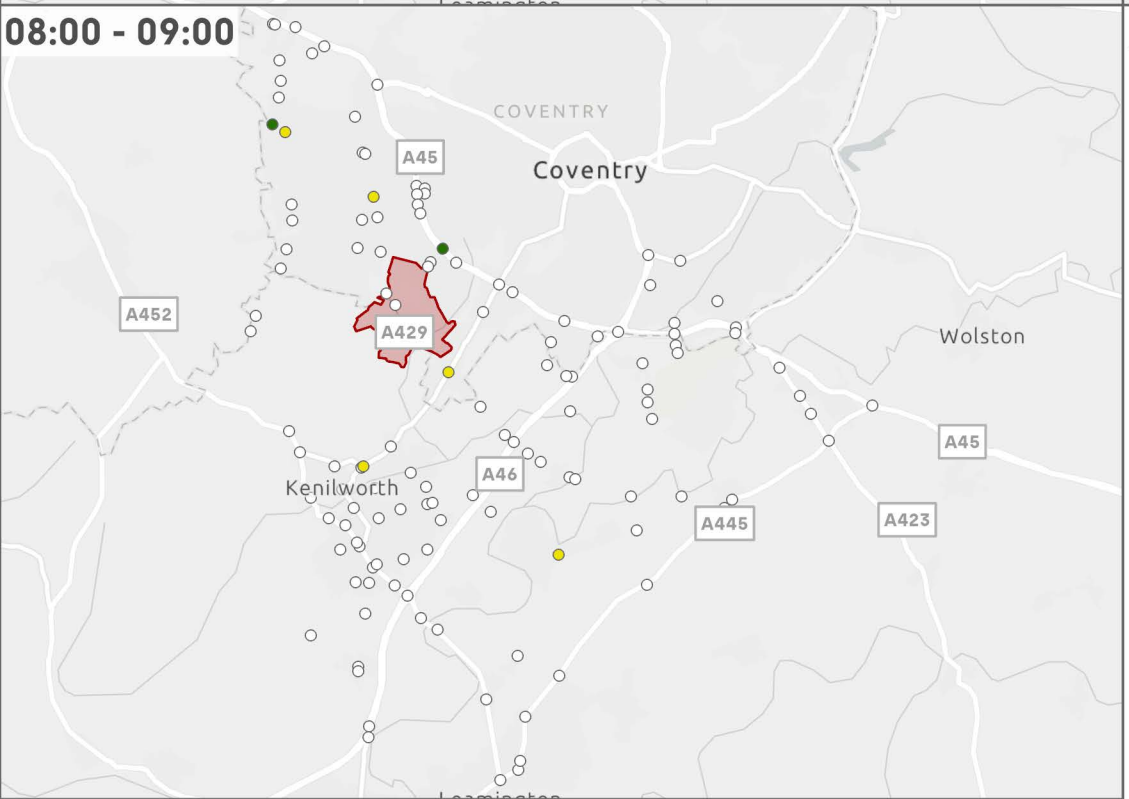
Kilometres

steer







University of Warwick - SPD

2029 Reference Case vs 2029 Reference Case + Dev - 100% CPH

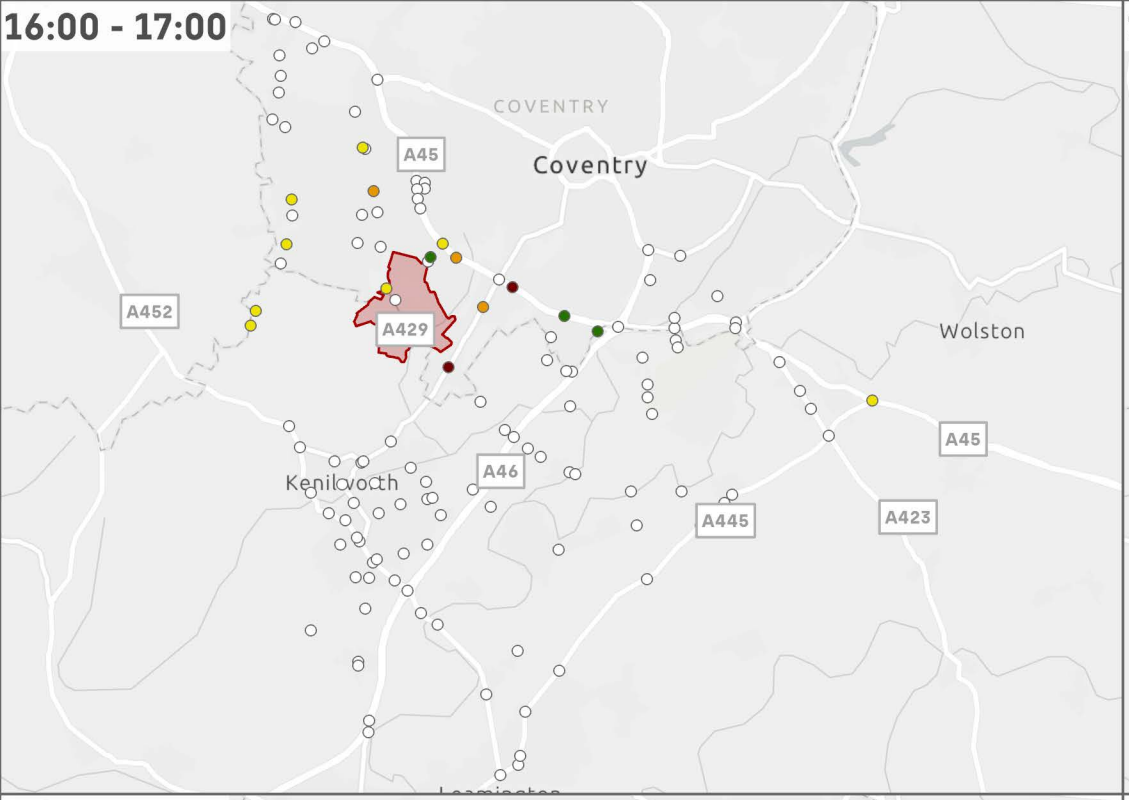
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

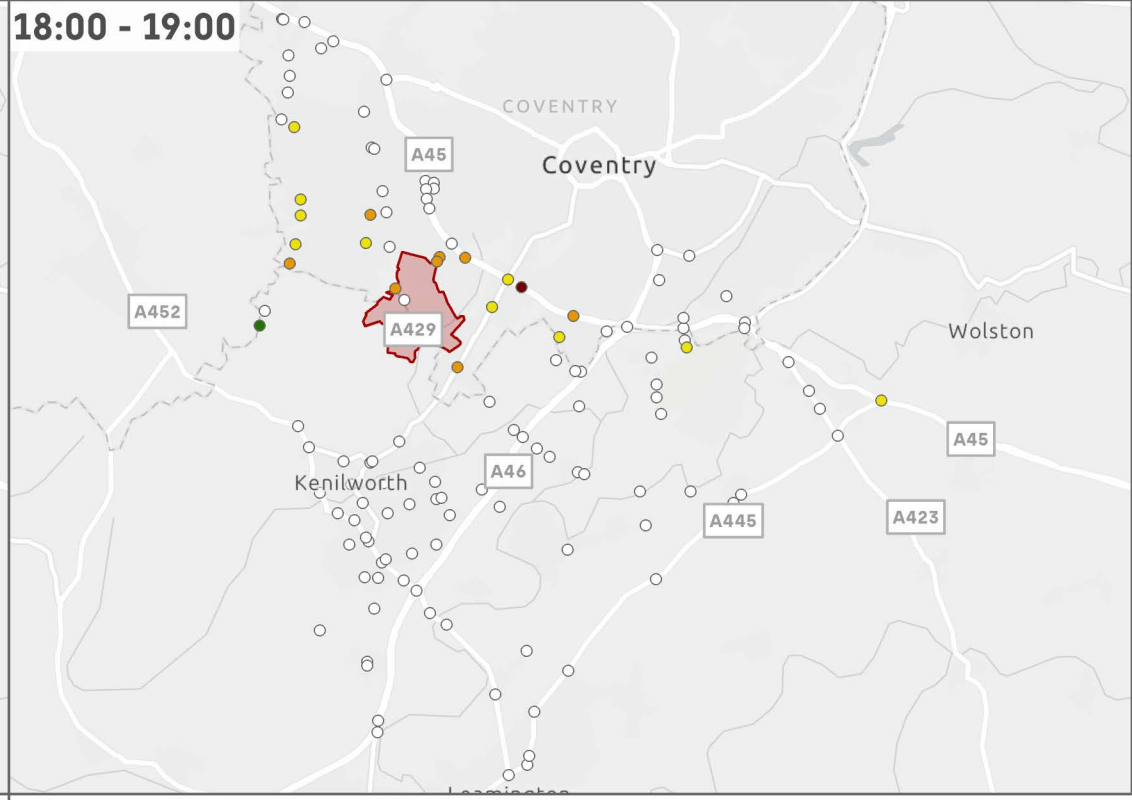
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

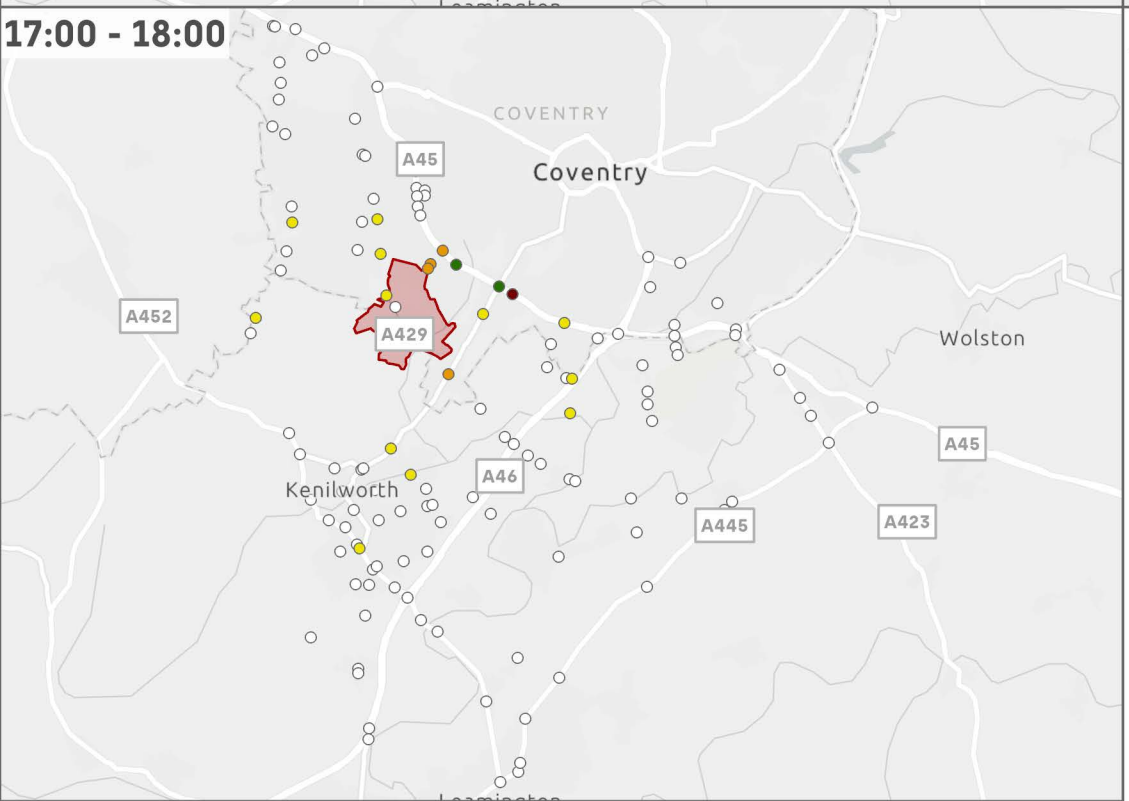
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2029 Reference Case vs 2029 Reference Case + Dev - 100% CPH

- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
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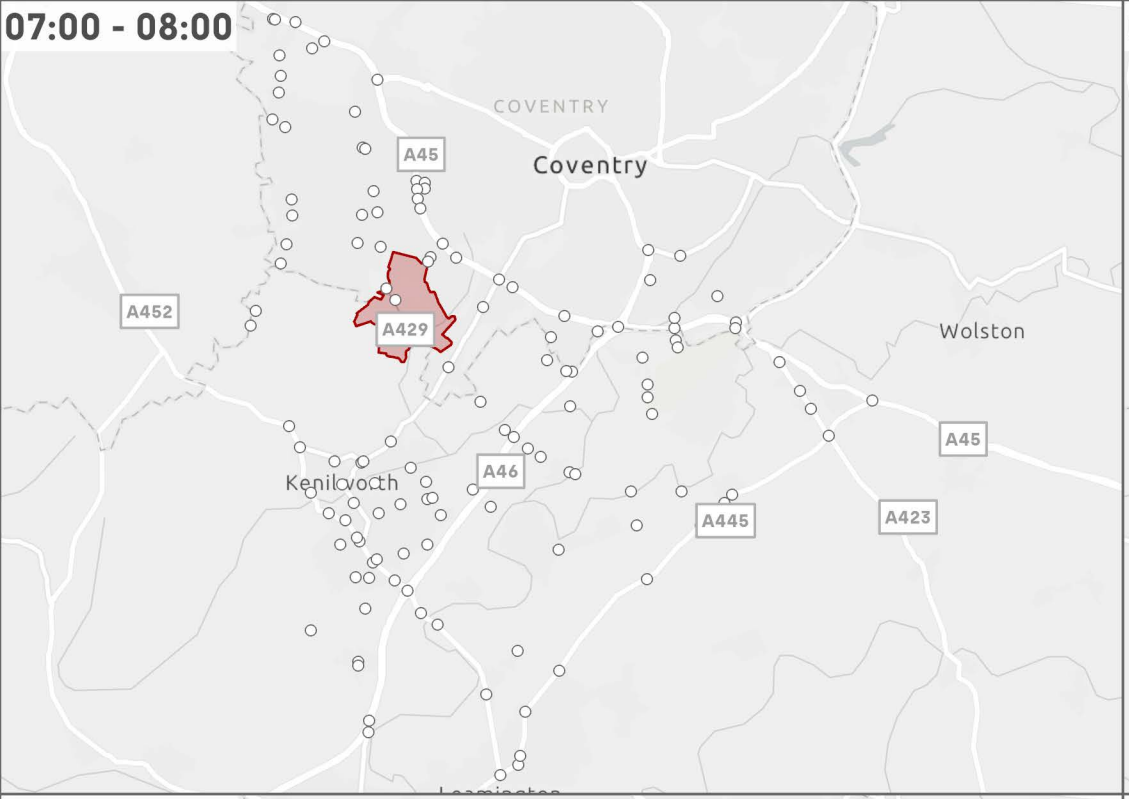
- Criteria 4: Increase of more than 20 vehicles

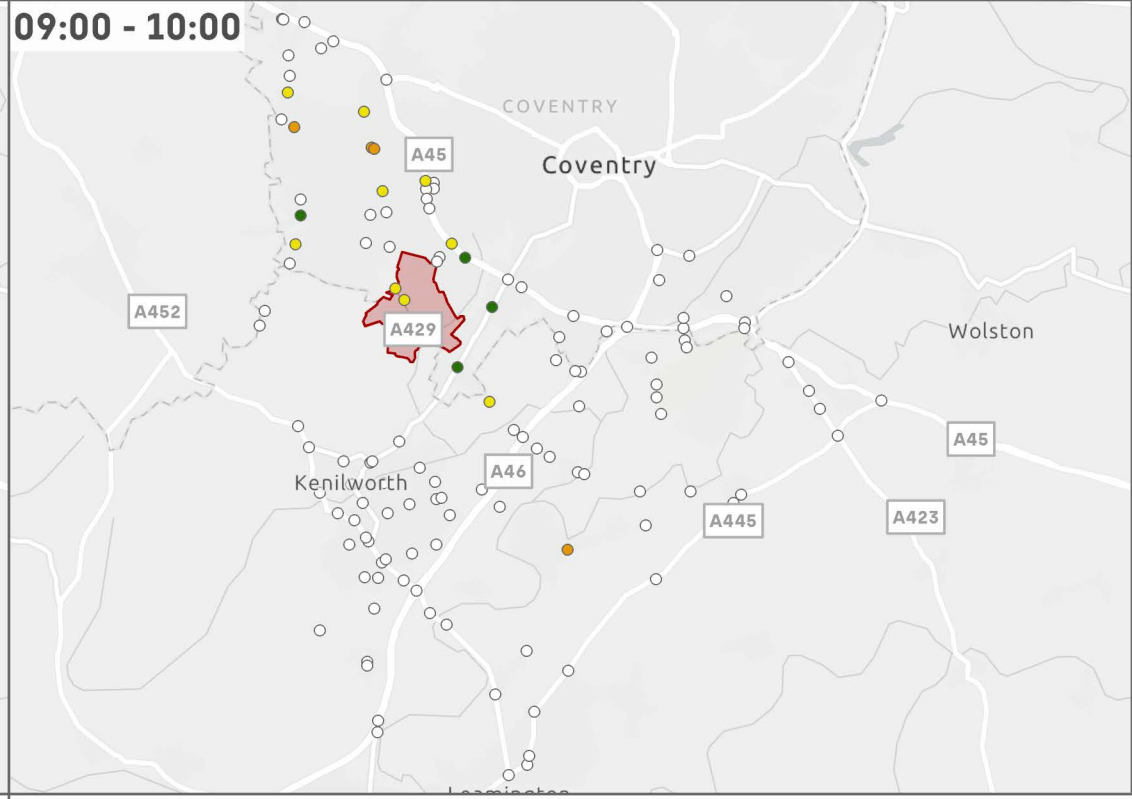
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

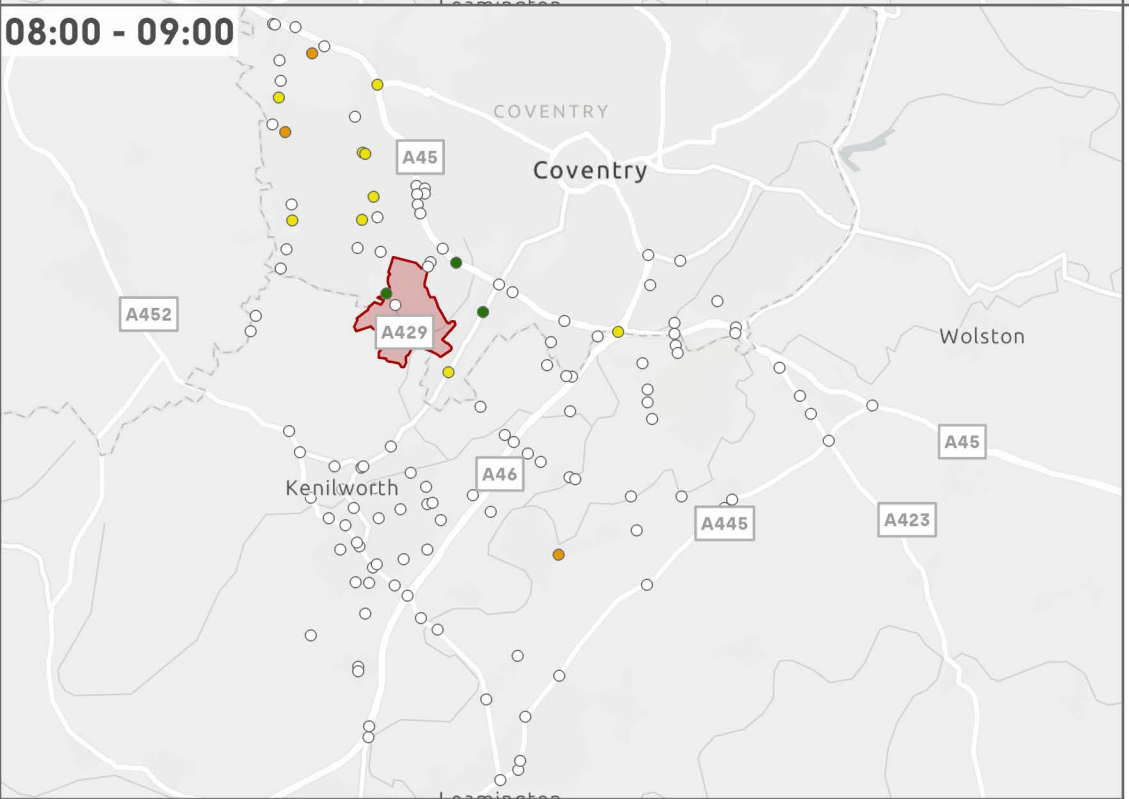
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2037 Reference Case vs 2037 Reference Case + Dev - 100% CPH

- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
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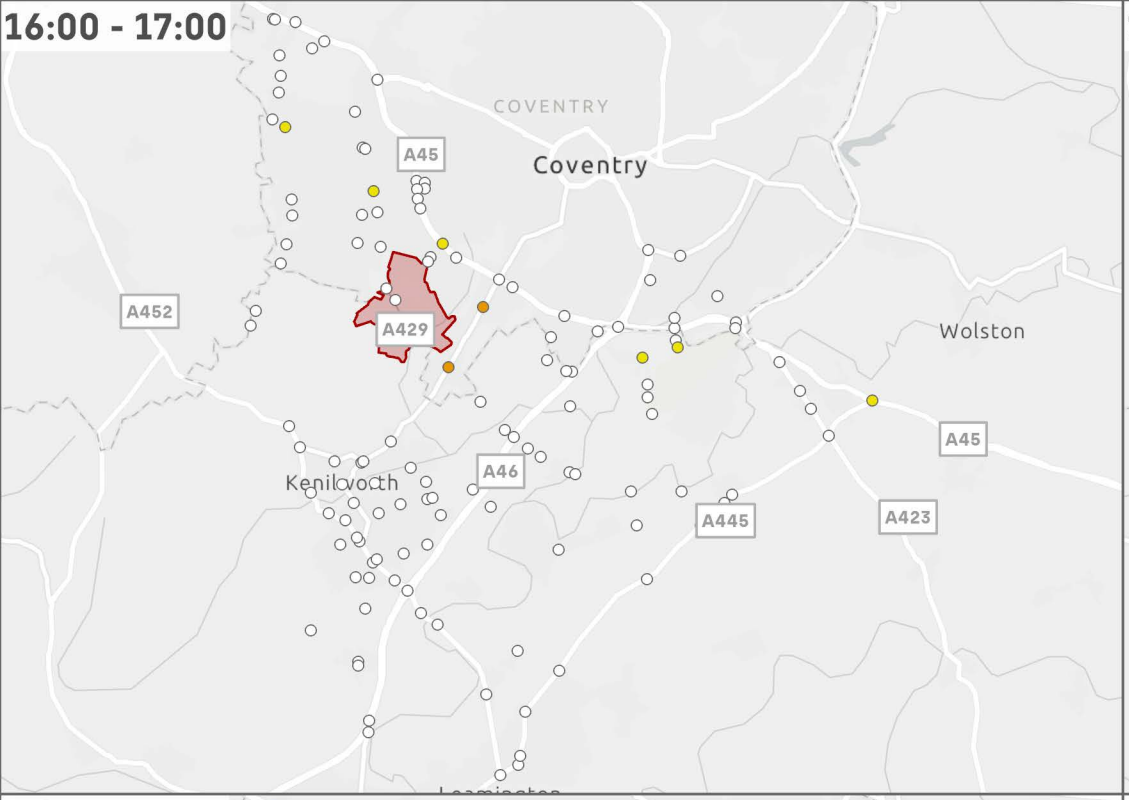
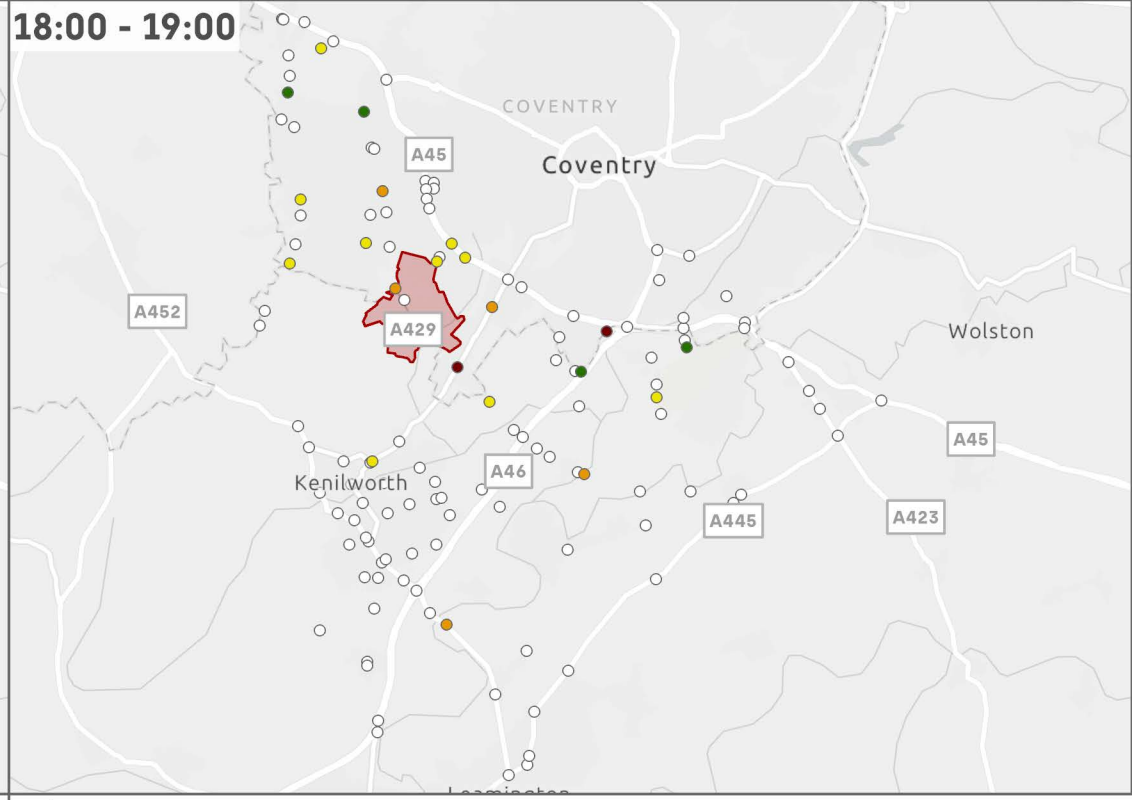
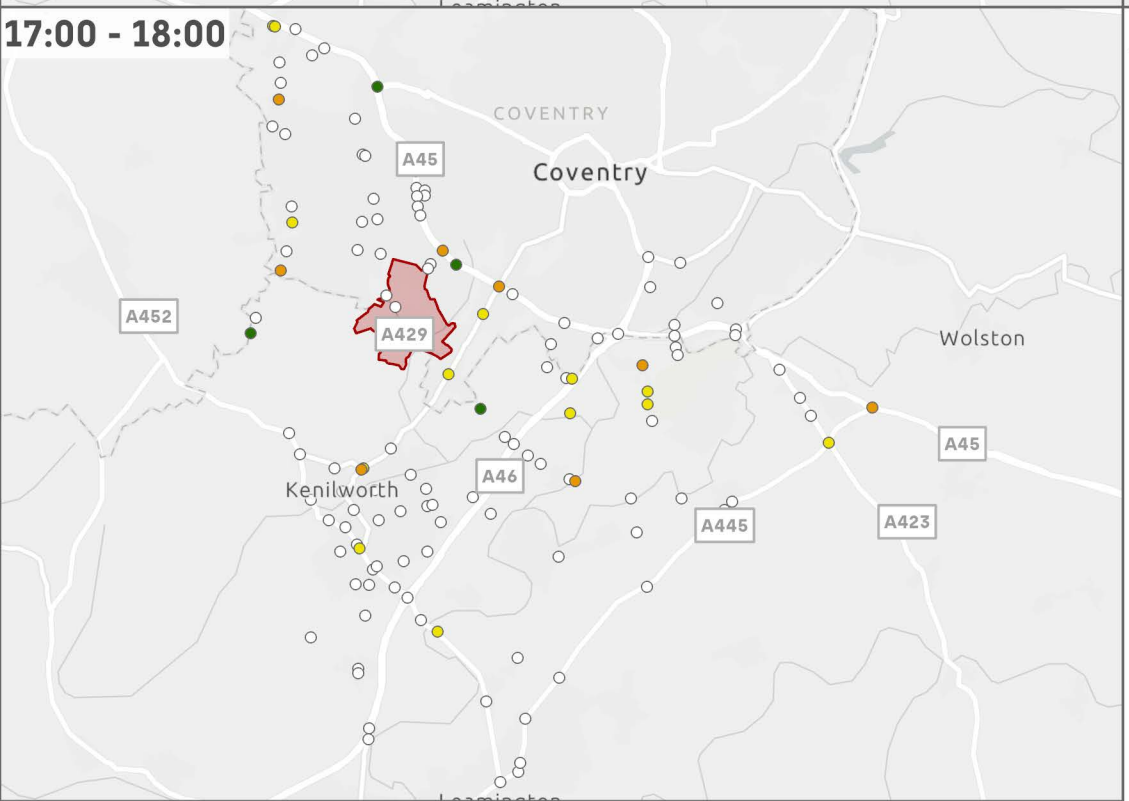
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2037 Reference Case vs 2037 Reference Case + Dev - 100% CPH

- Limited Change
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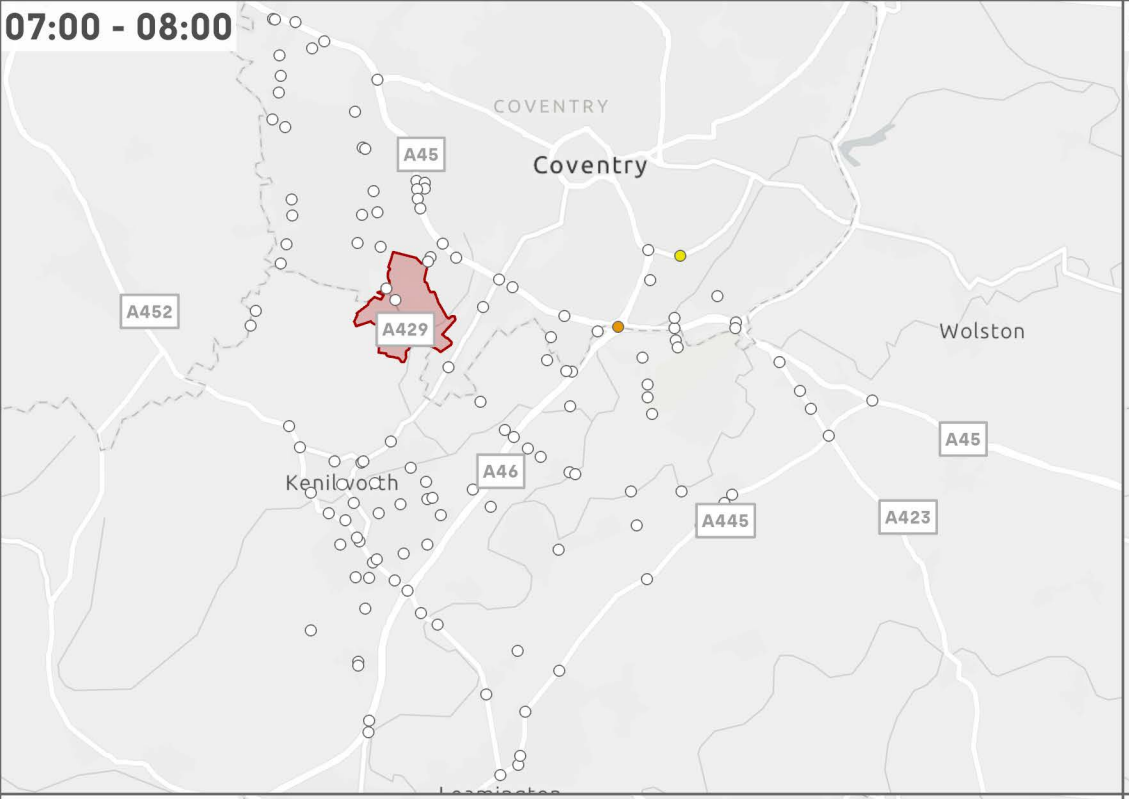
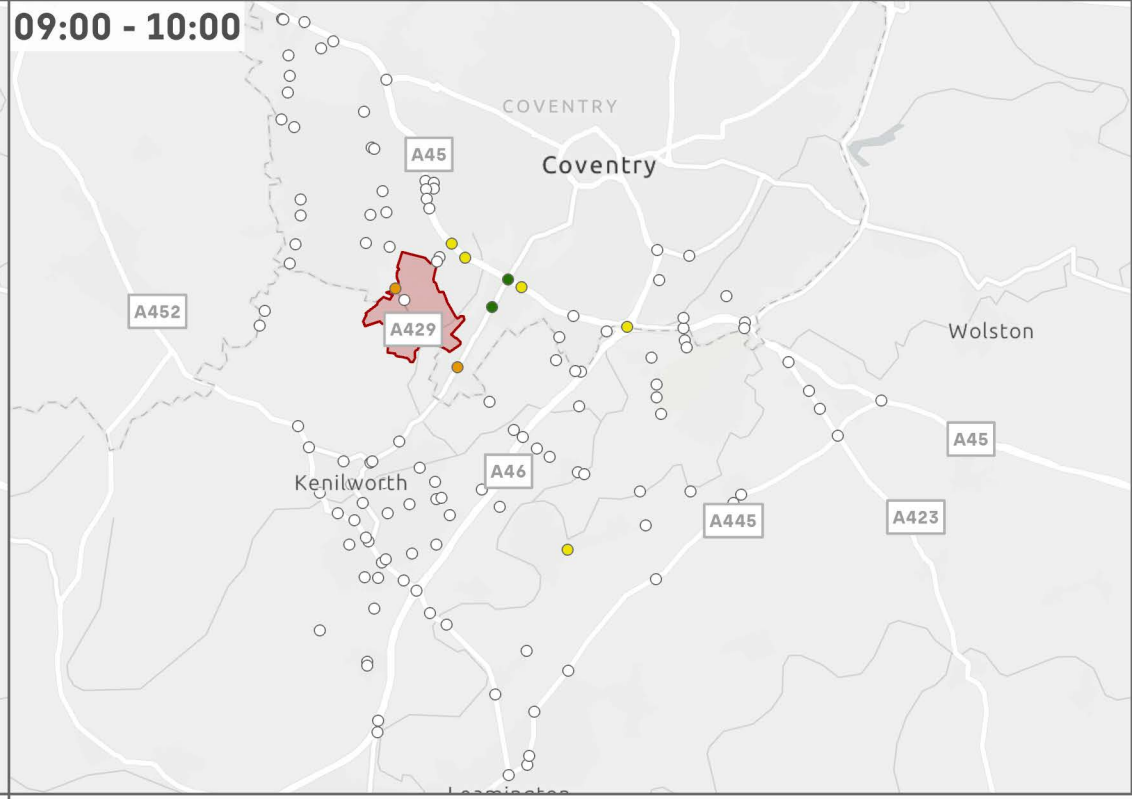
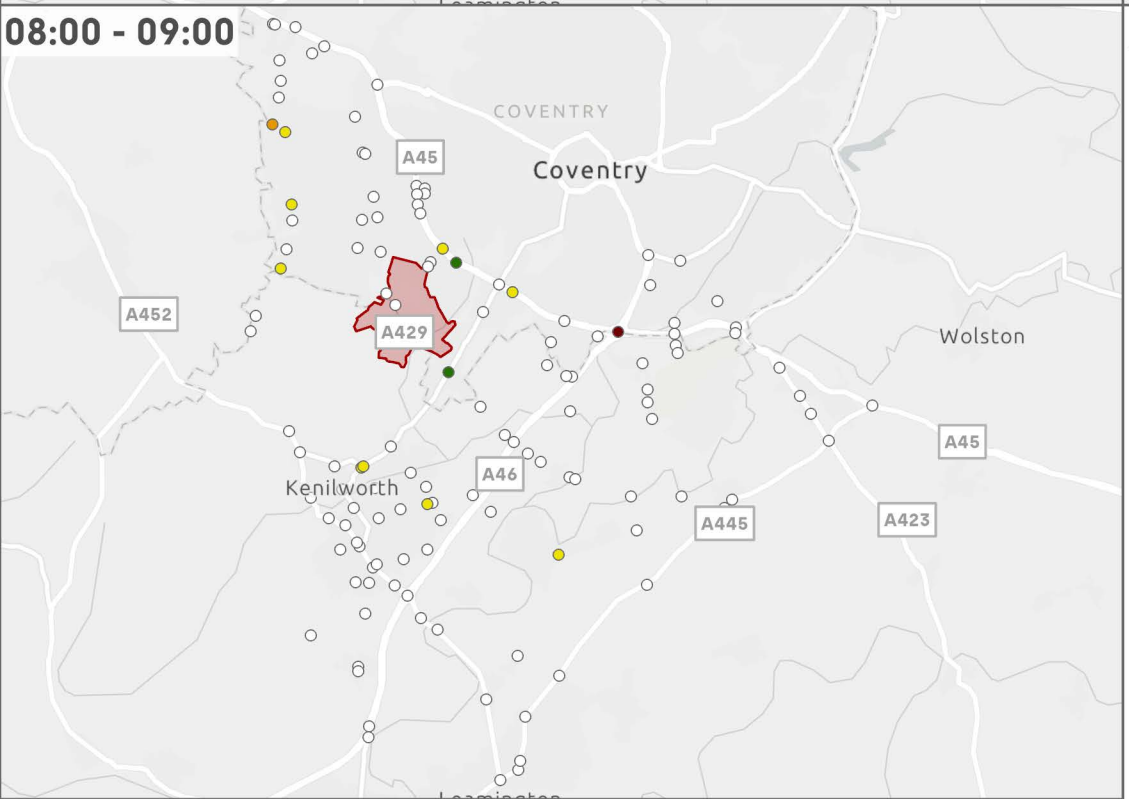
0 1 2 3 4 5 Kilometres

steer







University of Warwick - SPD

2029 Local Plan Reference vs 2029 Local Plan + SPD - 100% CPH

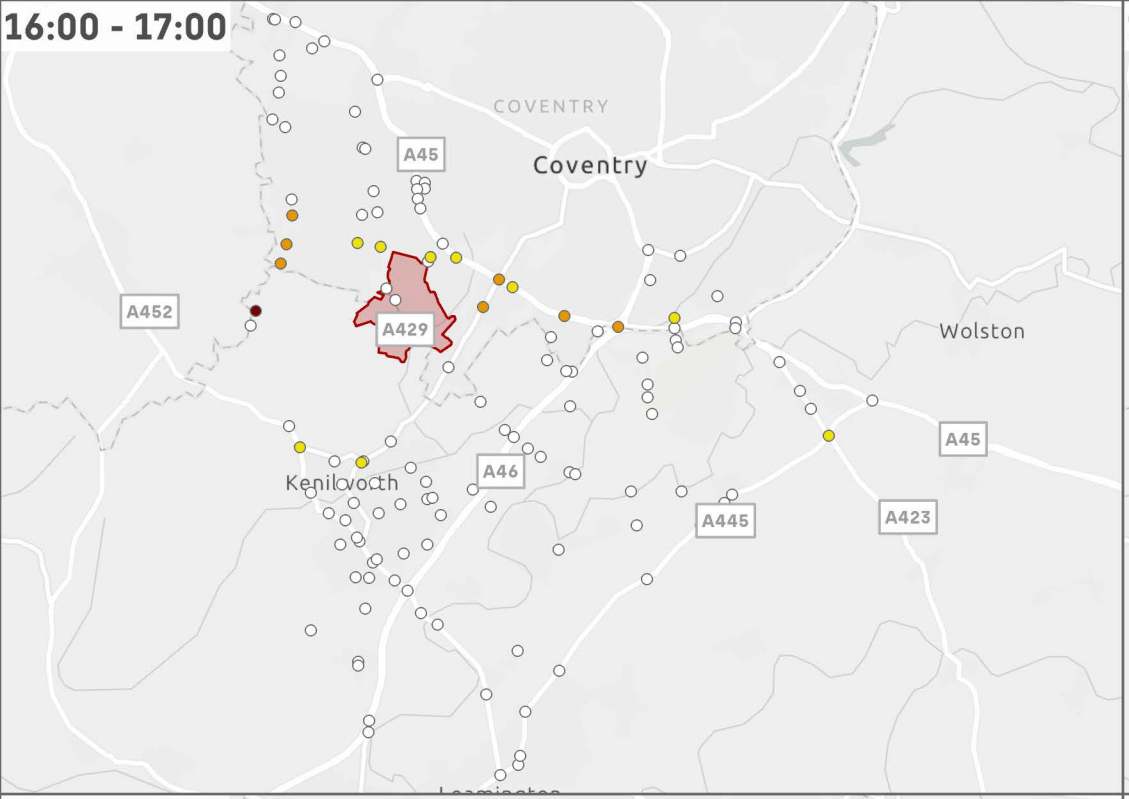
- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
- Criteria 2: Increase of 5 to 10 vehicles
- Criteria 3: Increase of 10 to 20 vehicles
- Criteria 4: Increase of more than 20 vehicles

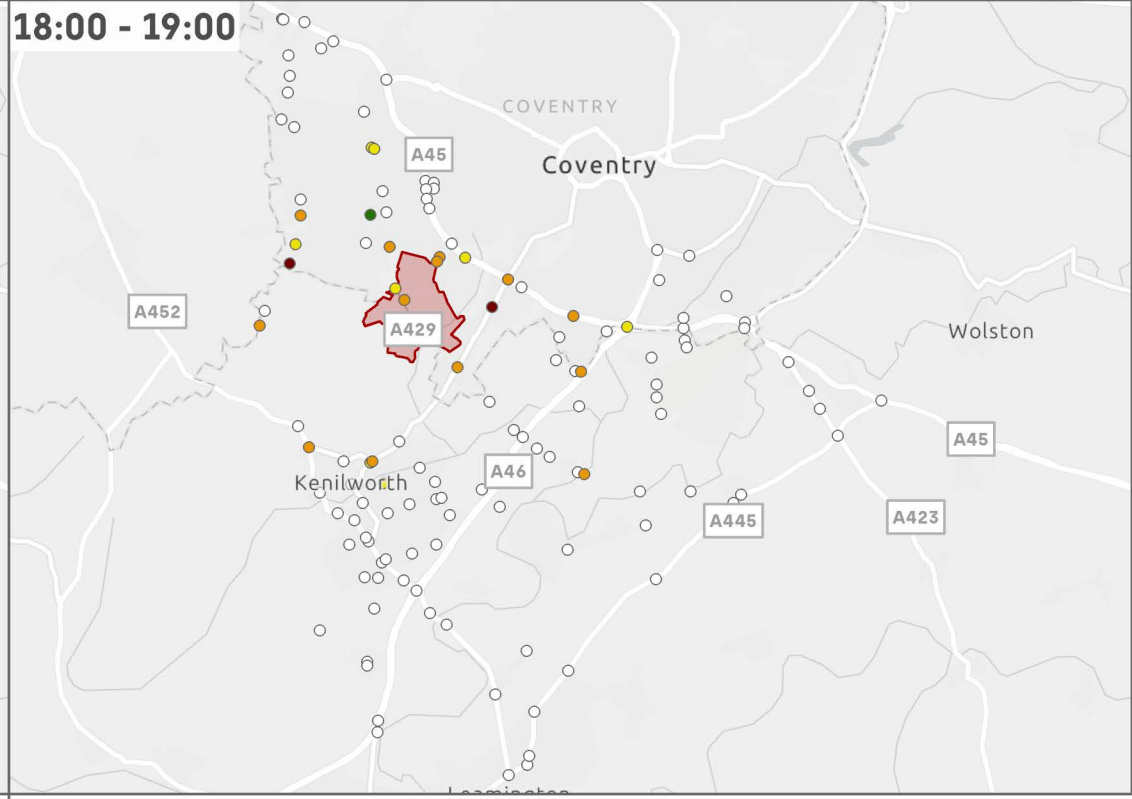
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

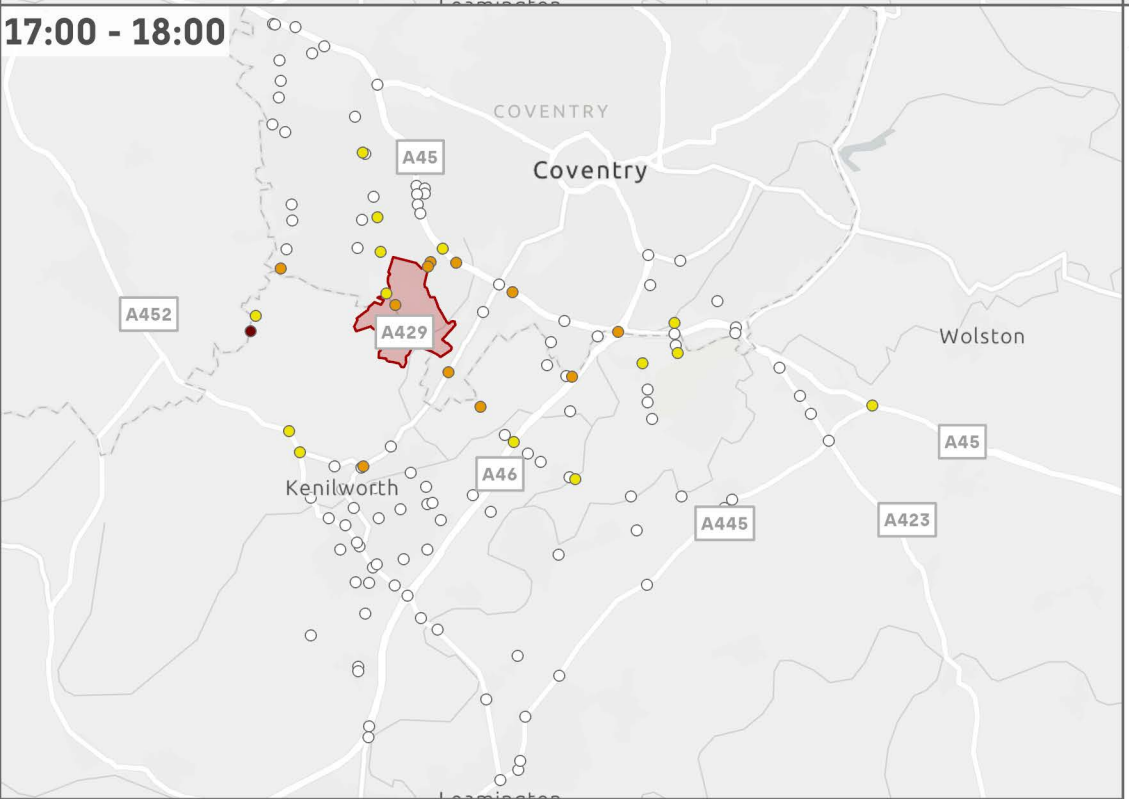
0 1 2 3 4 5

Kilometres

steer







University of Warwick - SPD

2029 Local Plan Reference vs 2029 Local Plan + SPD - 100% CPH

- Limited Change
- Criteria 1: Decrease of more than 25 vehicles
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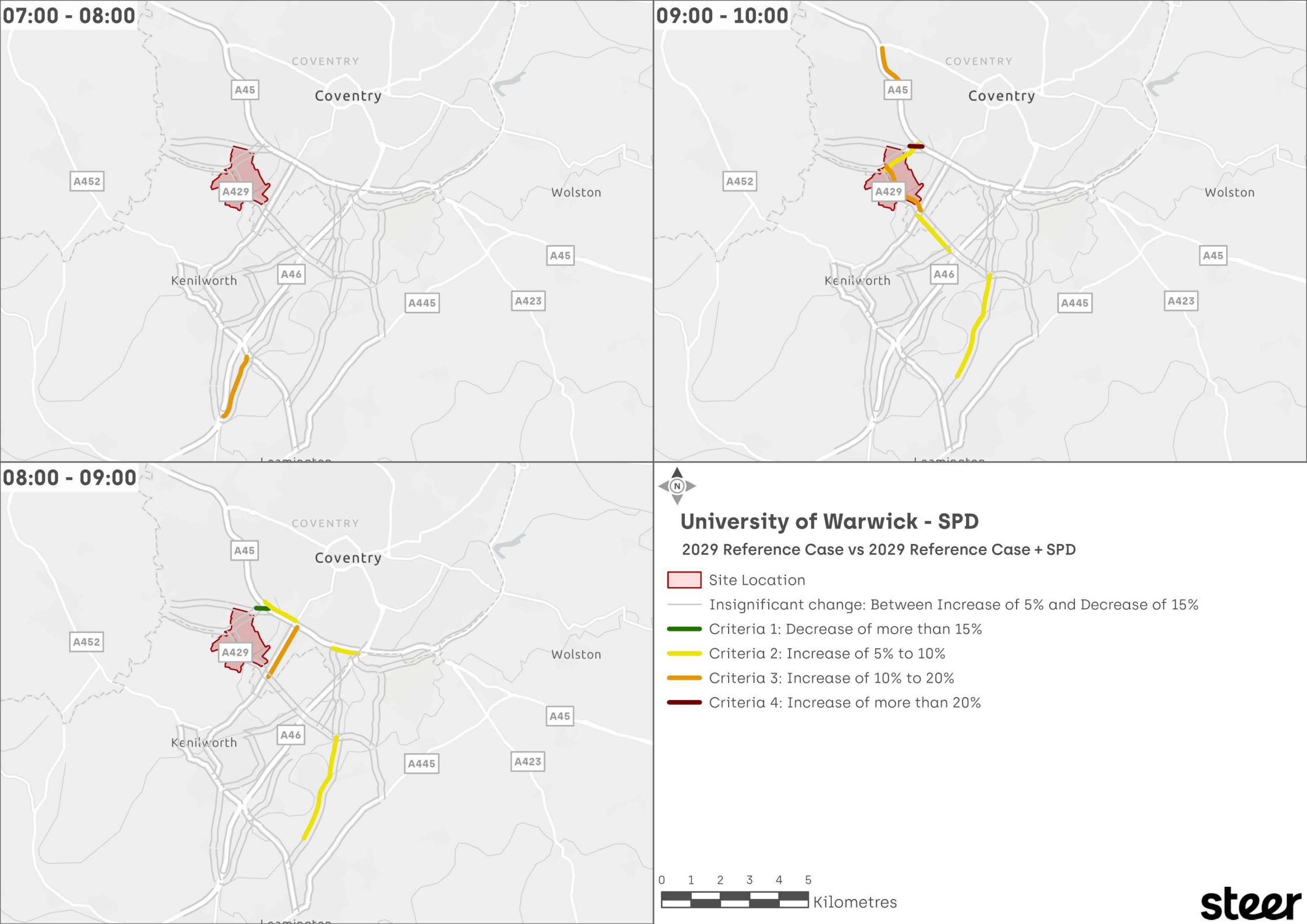
- Criteria 4: Increase of more than 20 vehicles

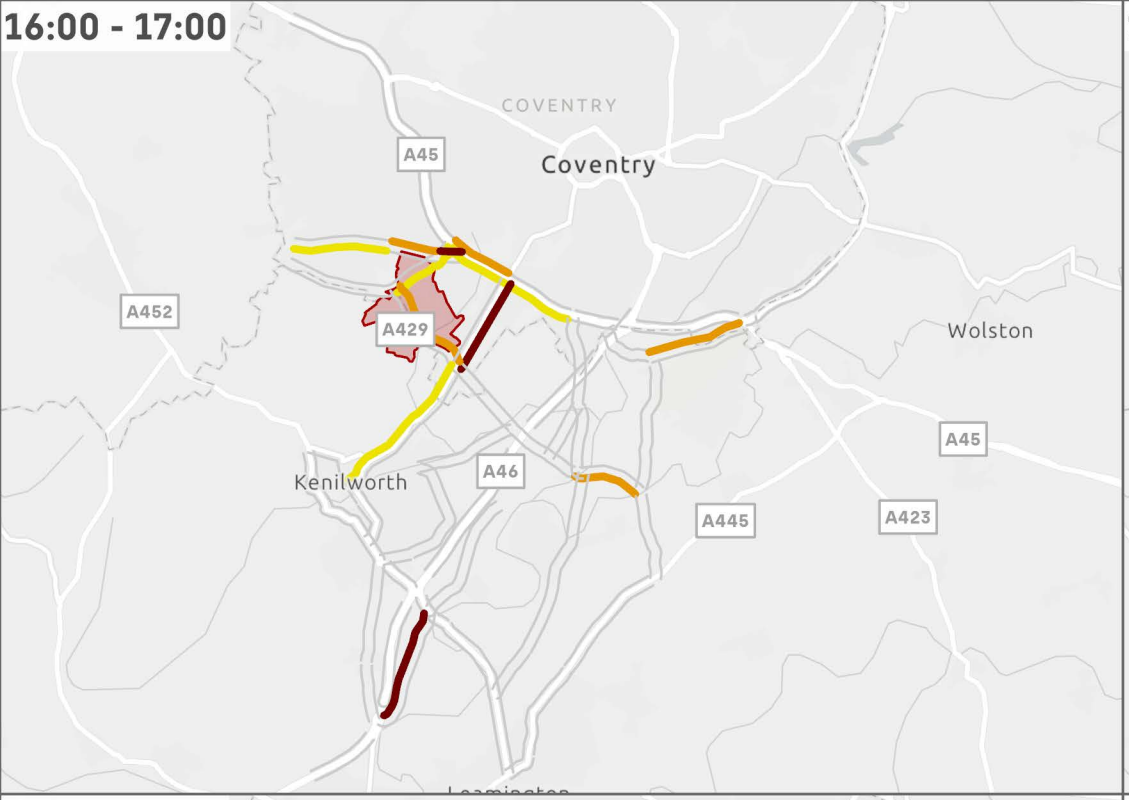
Note: Where a single arm at a junction experiences the prescribed change in queue length, the entire junction has been scored as that criterion

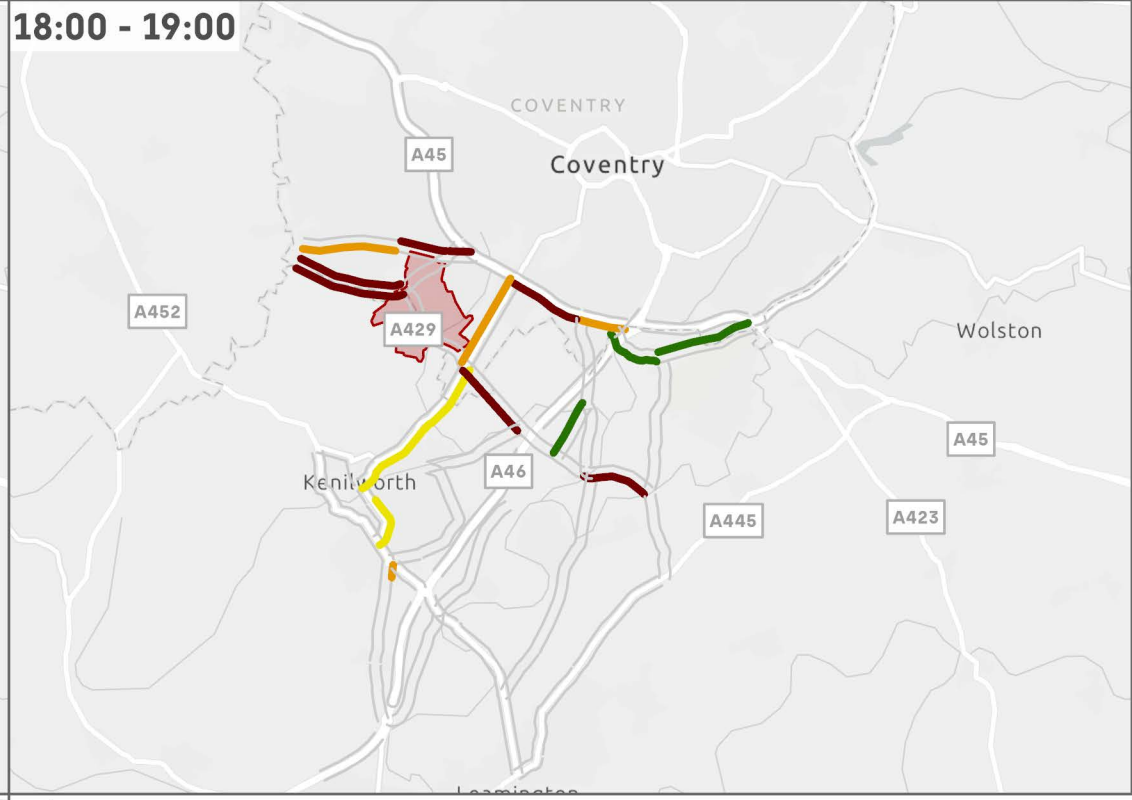
0 1 2 3 4 5 Kilometres

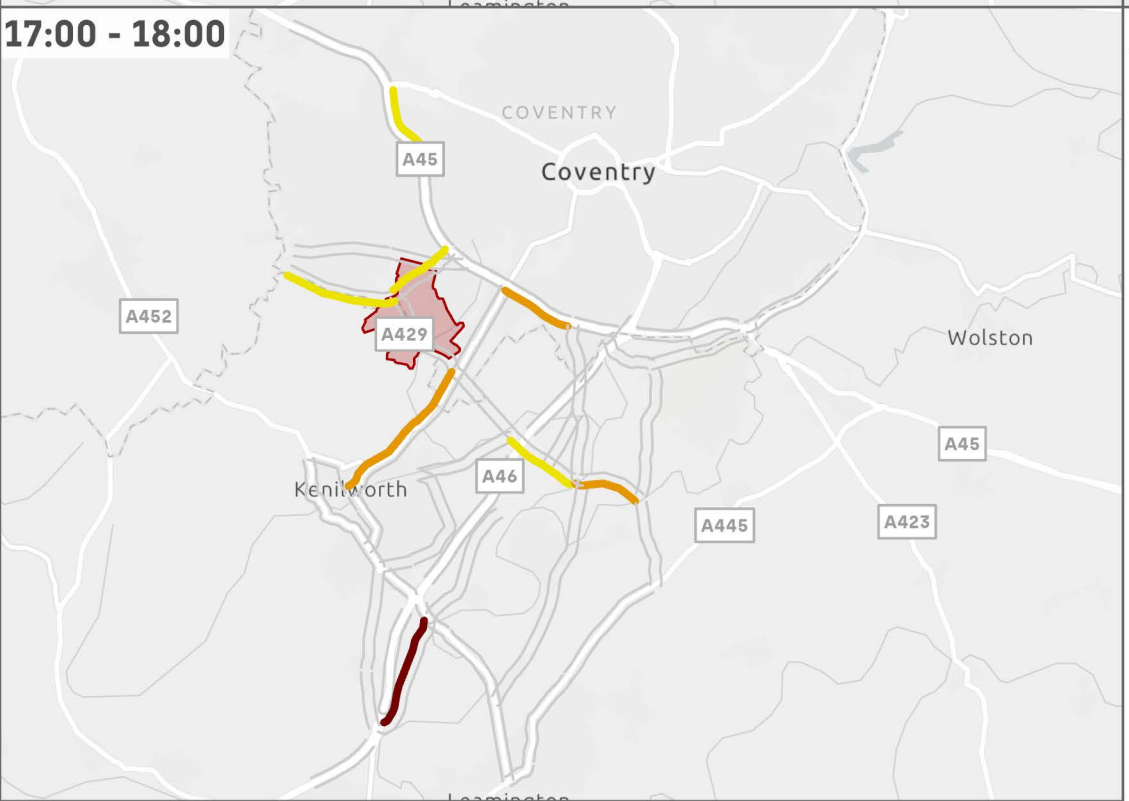
steer

C Journey Time Plots


07:00 - 08:00
09:00 - 10:00
08:00 - 09:00
COVENTRY
Coventry
Wolston
Kenilworth
A45
A452
A429
A46
A445
A423
University of Warwick - SPD
2029 Reference Case vs 2029 Reference Case + SPD
Site Location
Insignificant change: Between Increase of 5% and Decrease of 15%
Criteria 1: Decrease of more than 15%
Criteria 2: Increase of 5% to 10%
Criteria 3: Increase of 10% to 20%
Criteria 4: Increase of more than 20%
0 1 2 3 4 5
Kilometres
steer







University of Warwick - SPD

2029 Reference Case vs 2029 Reference Case + SPD

- Site Location
- Insignificant change: Between Increase of 5% and Decrease of 15%
- Criteria 1: Decrease of more than 15%
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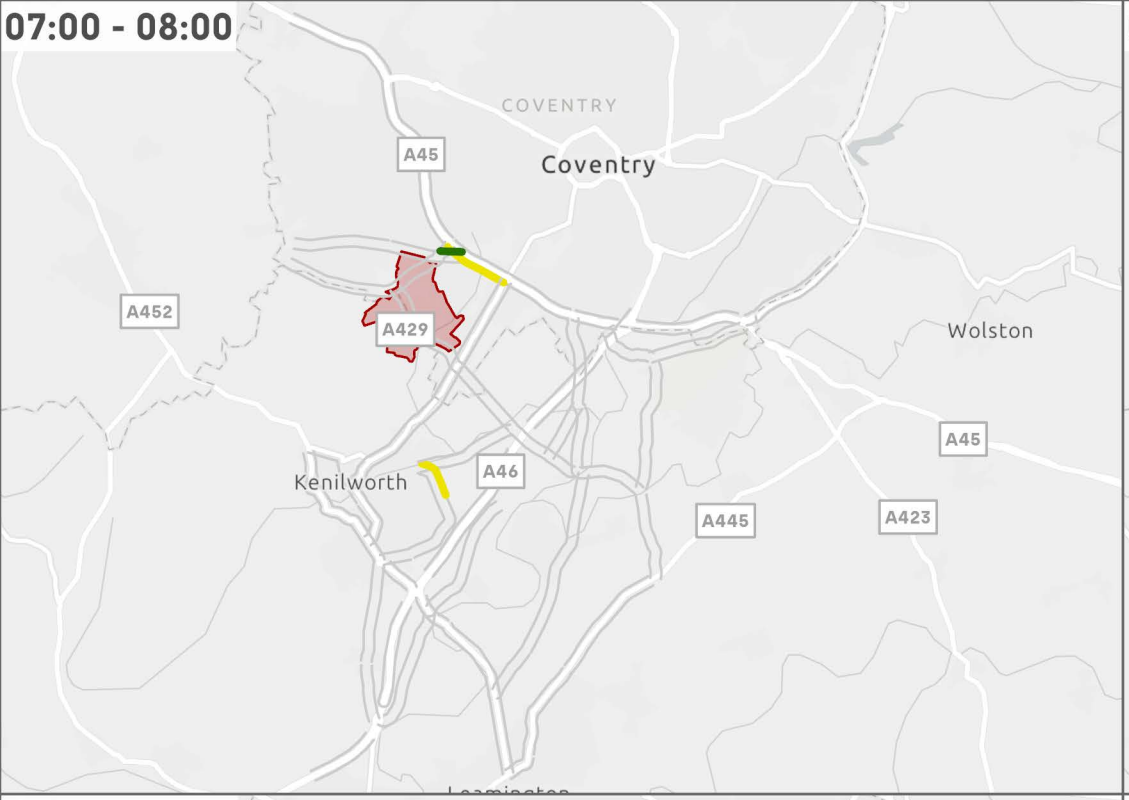
- Criteria 3: Increase of 10% to 20%
- Criteria 4: Increase of more than 20%

0 1 2 3 4 5 Kilometres

steer


07:00 - 08:00
COVENTRY
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Wolston
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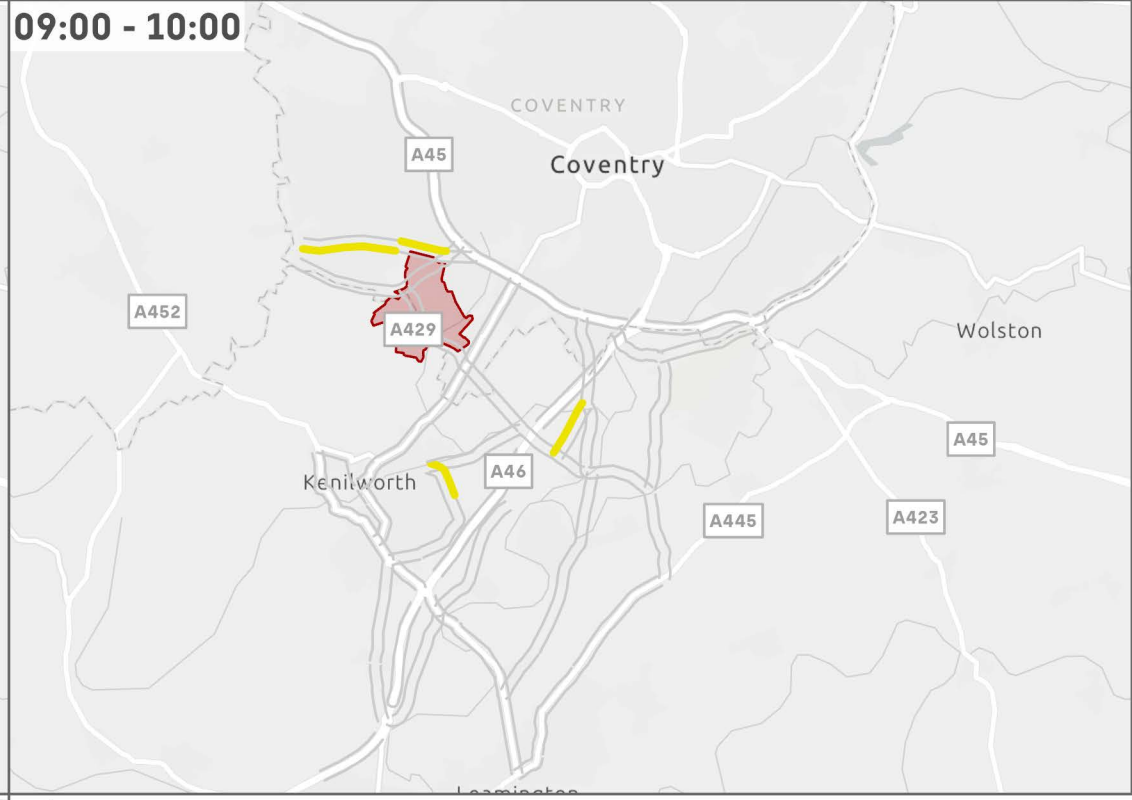
09:00 - 10:00
COVENTRY
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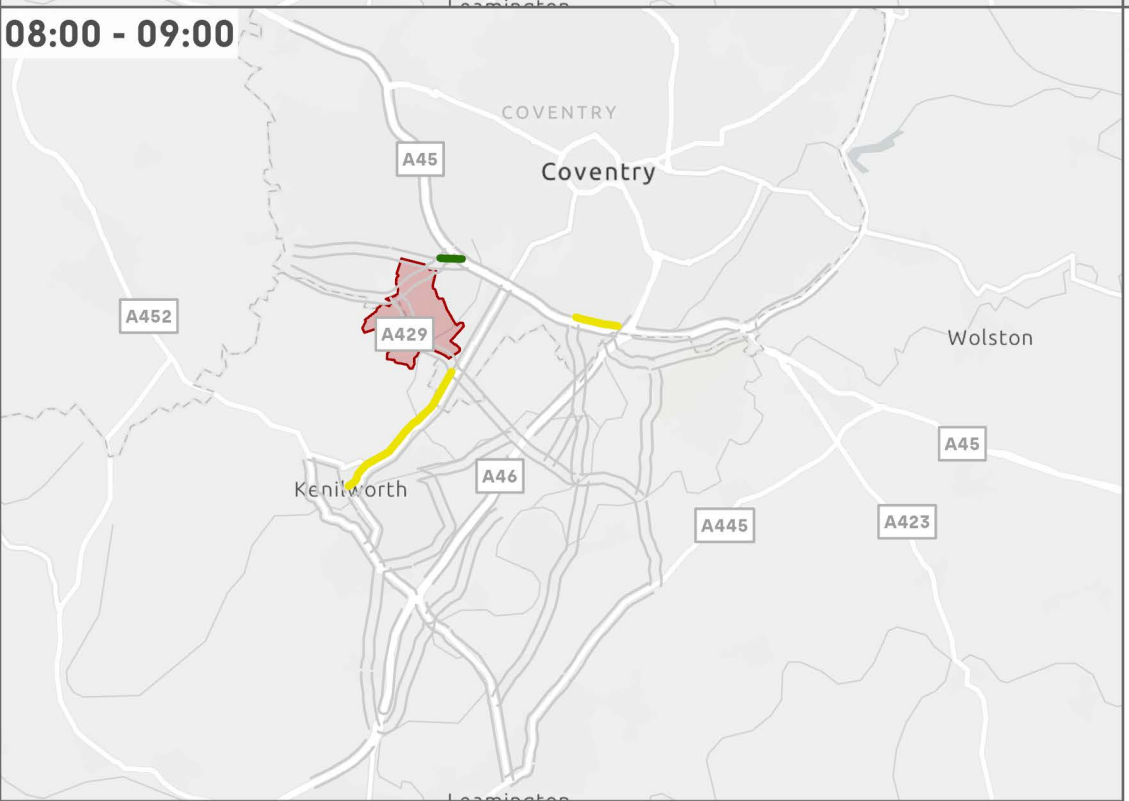
08:00 - 09:00
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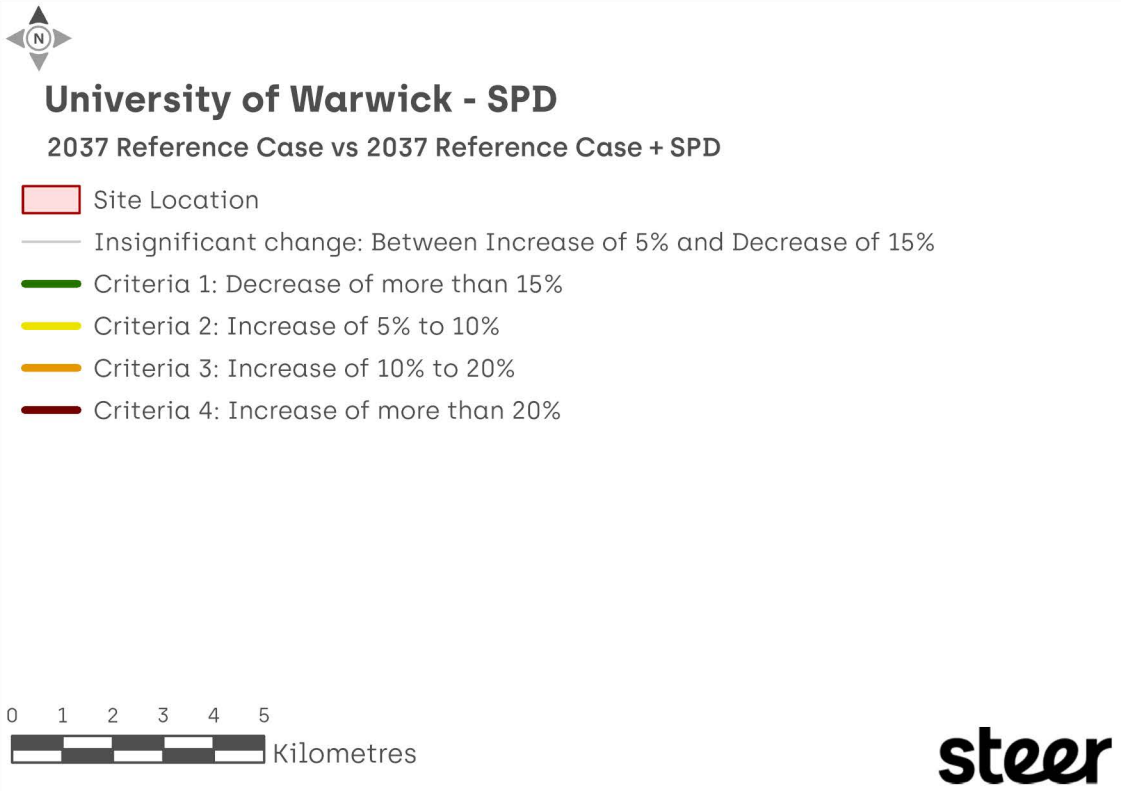
University of Warwick - SPD
2037 Reference Case vs 2037 Reference Case + SPD
Site Location
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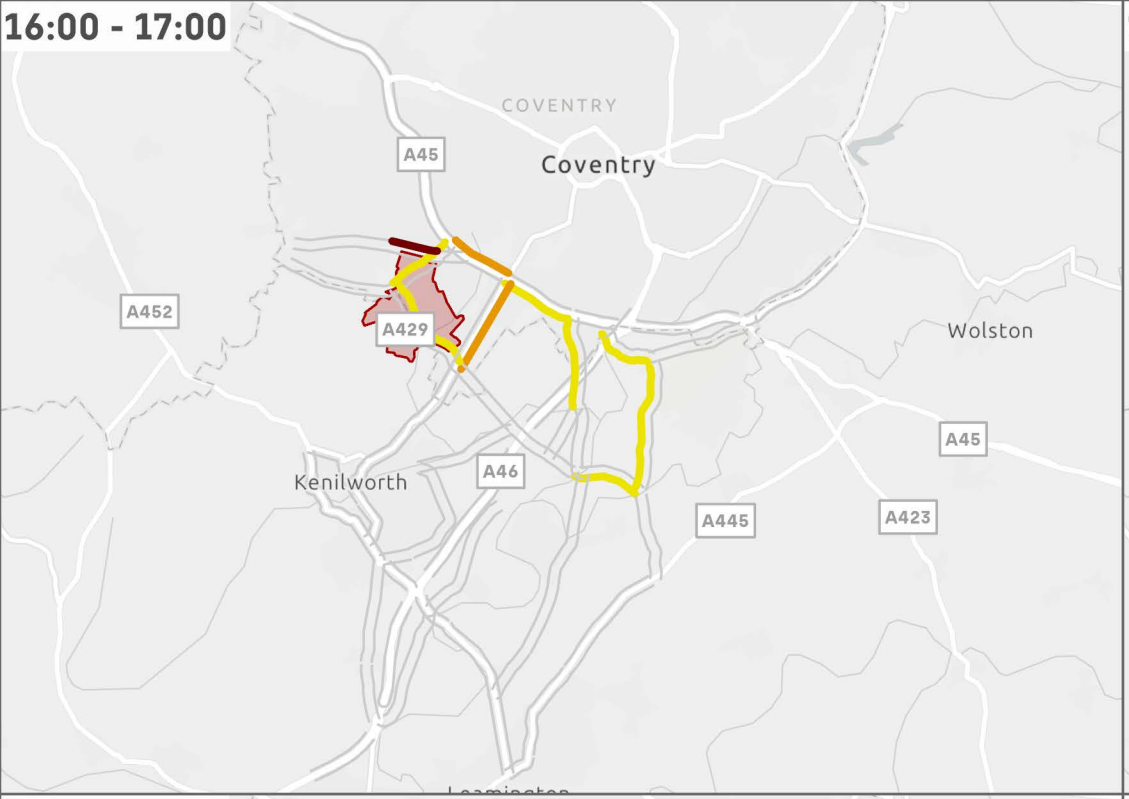
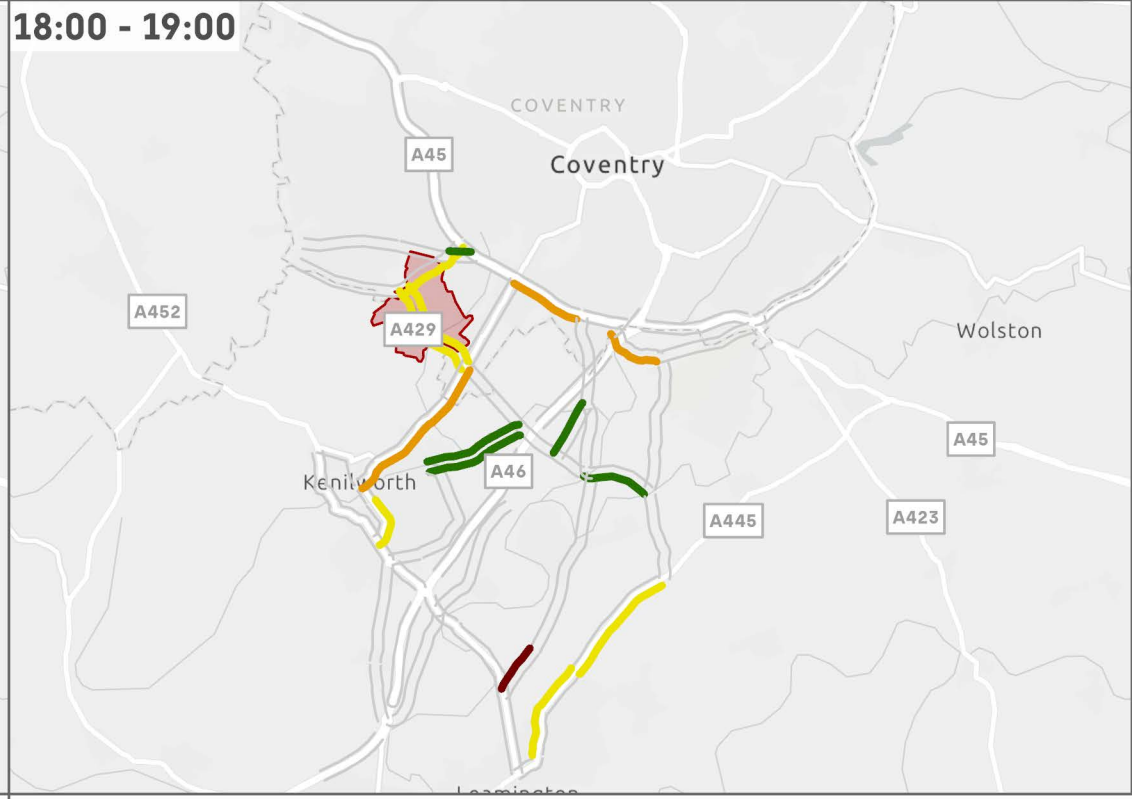
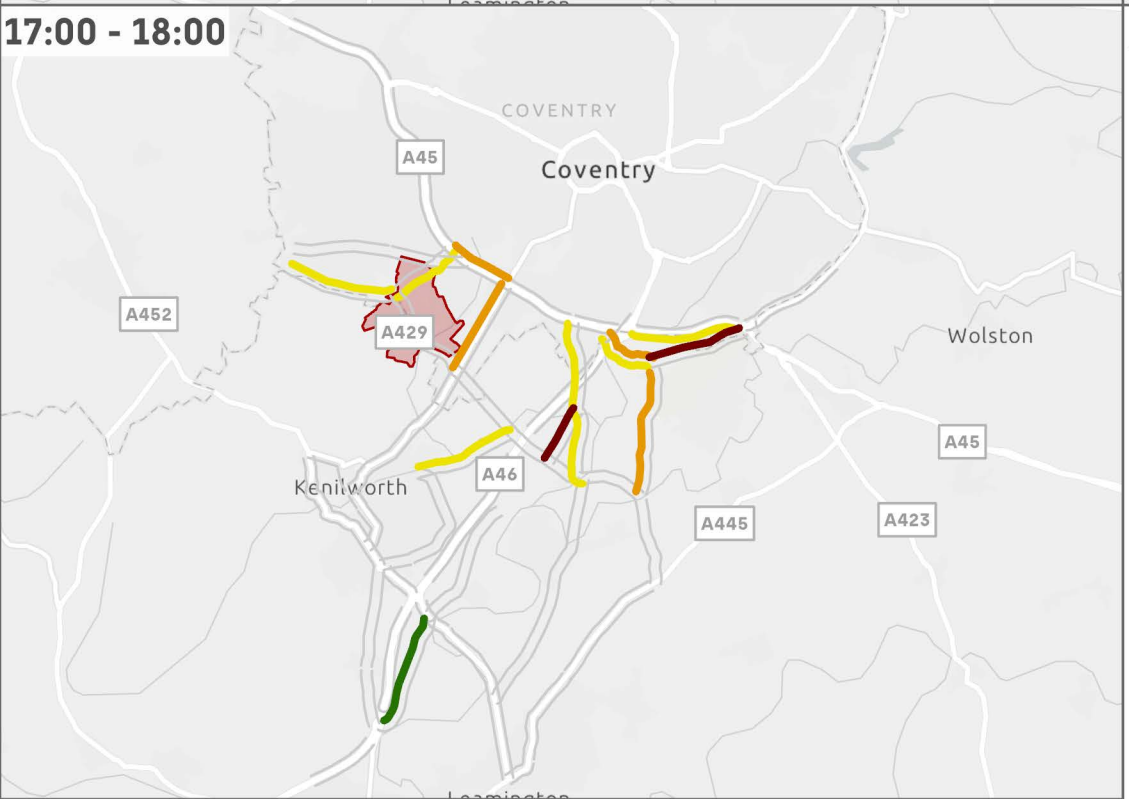
Criteria 4: Increase of more than 20%
0 1 2 3 4 5
Kilometres
steer







University of Warwick - SPD

2037 Reference Case vs 2037 Reference Case + SPD

- Site Location
- Insignificant change: Between Increase of 5% and Decrease of 15%
- Criteria 1: Decrease of more than 15%
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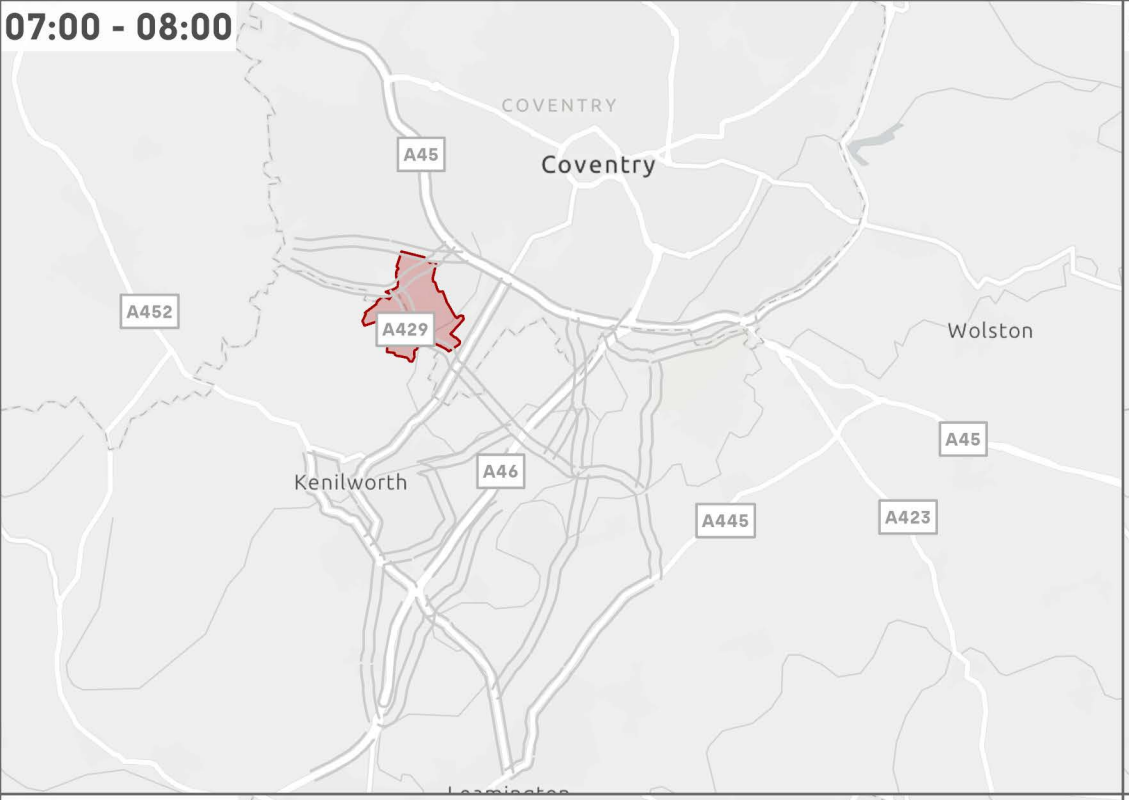
steer


07:00 - 08:00
COVENTRY
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Wolston
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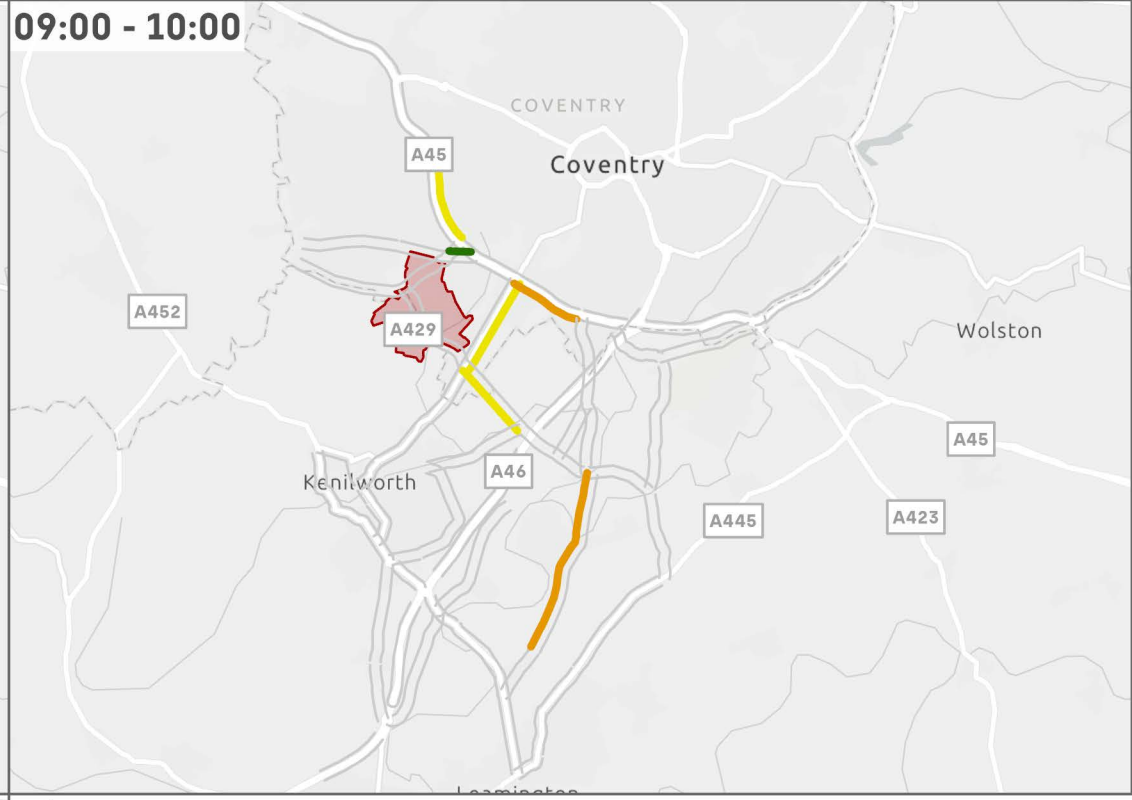
09:00 - 10:00
COVENTRY
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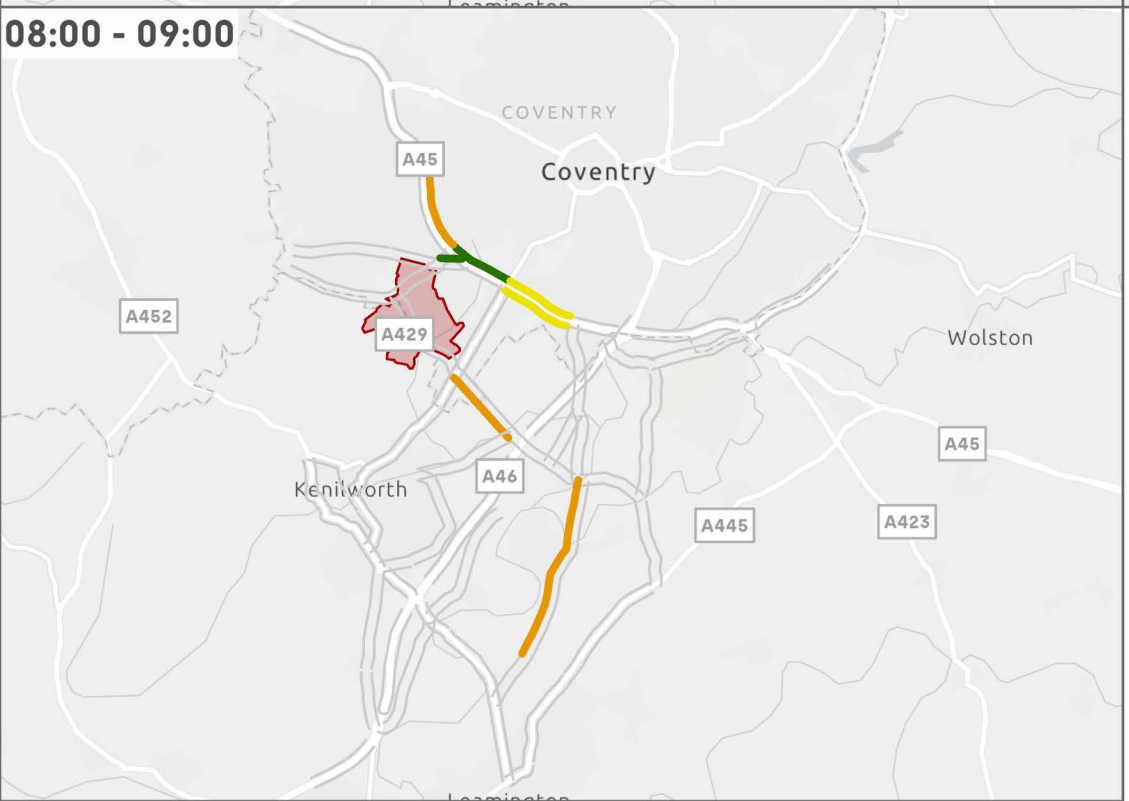
08:00 - 09:00
COVENTRY
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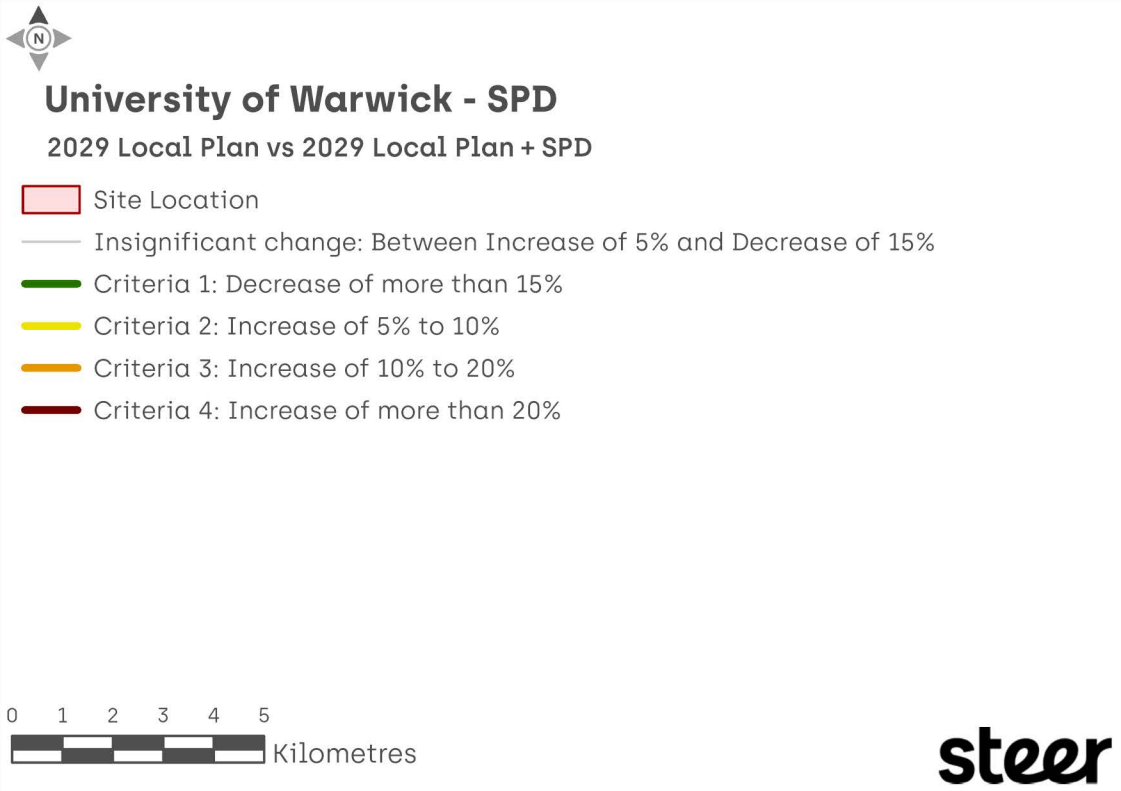
University of Warwick - SPD
2029 Local Plan vs 2029 Local Plan + SPD
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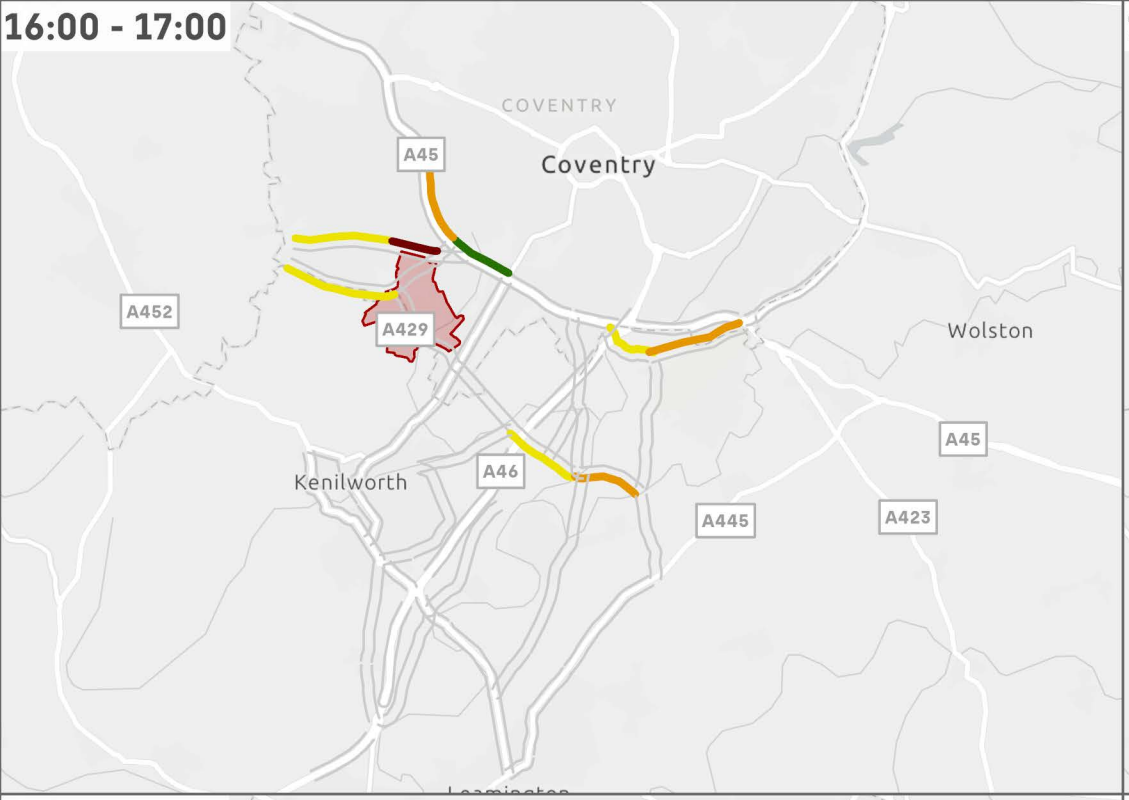
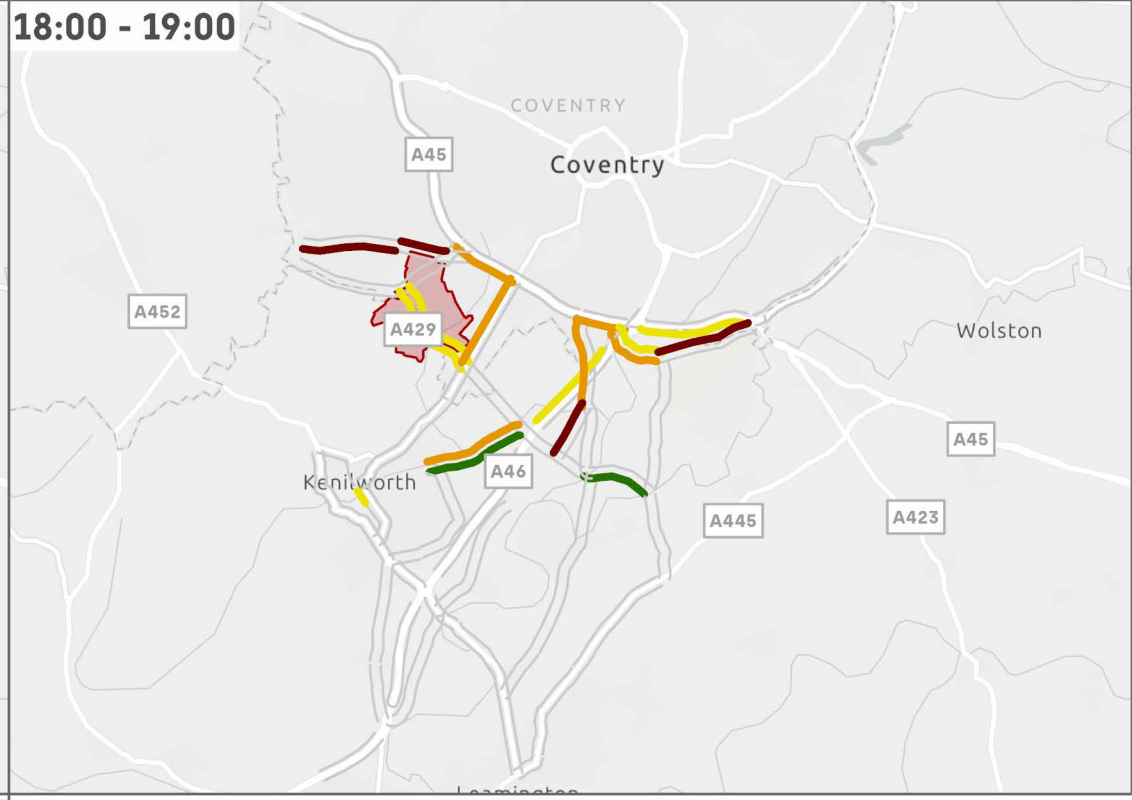
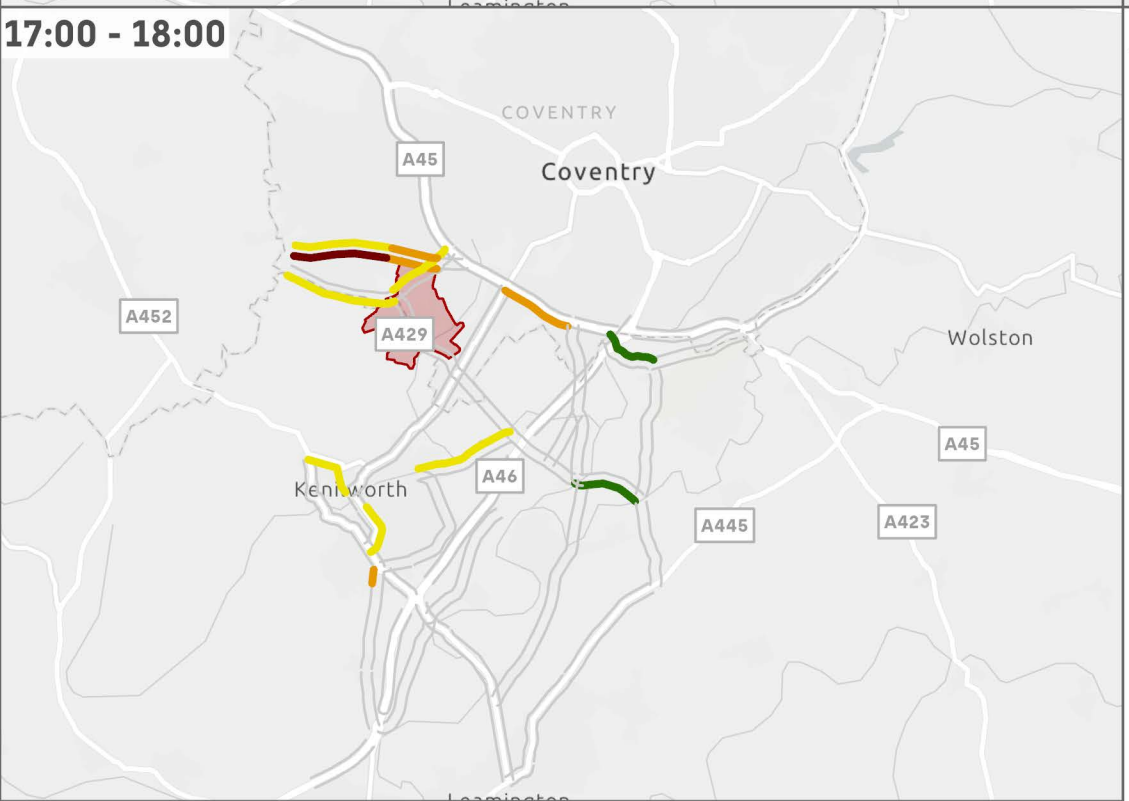
0 1 2 3 4 5
Kilometres
steer







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2029 Local Plan vs 2029 Local Plan + SPD

- Site Location
- Insignificant change: Between Increase of 5% and Decrease of 15%
- Criteria 1: Decrease of more than 15%
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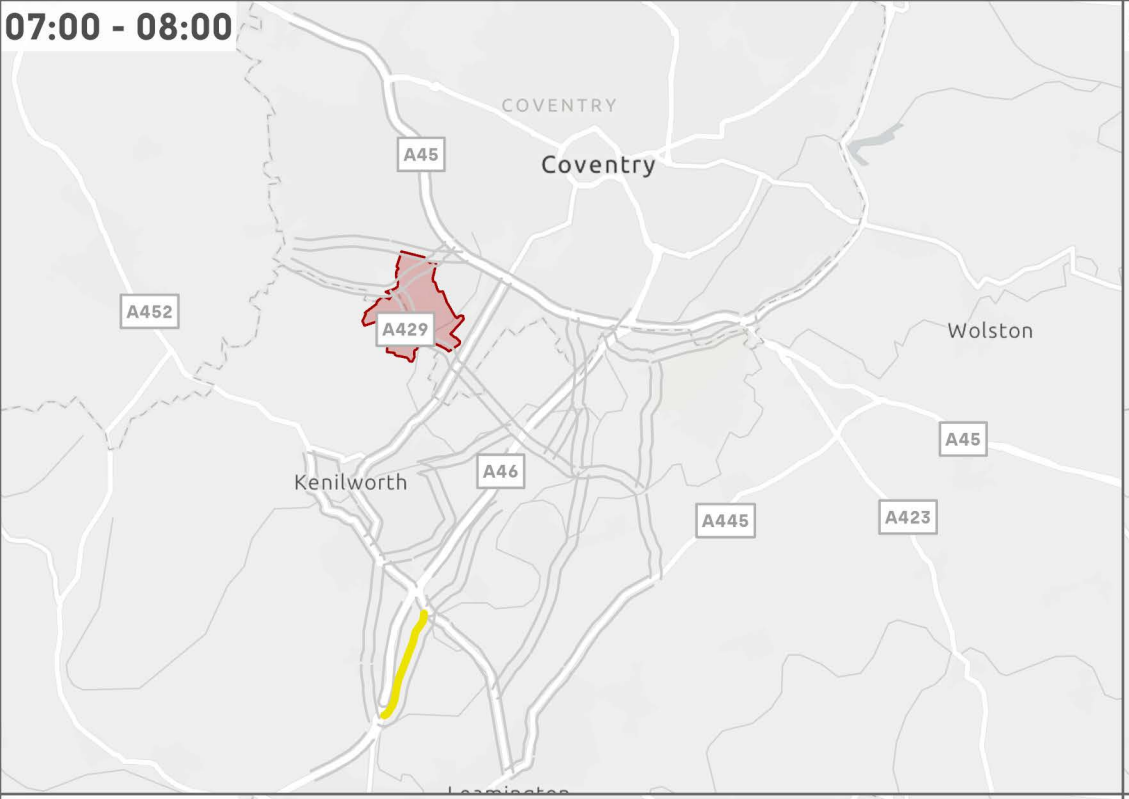
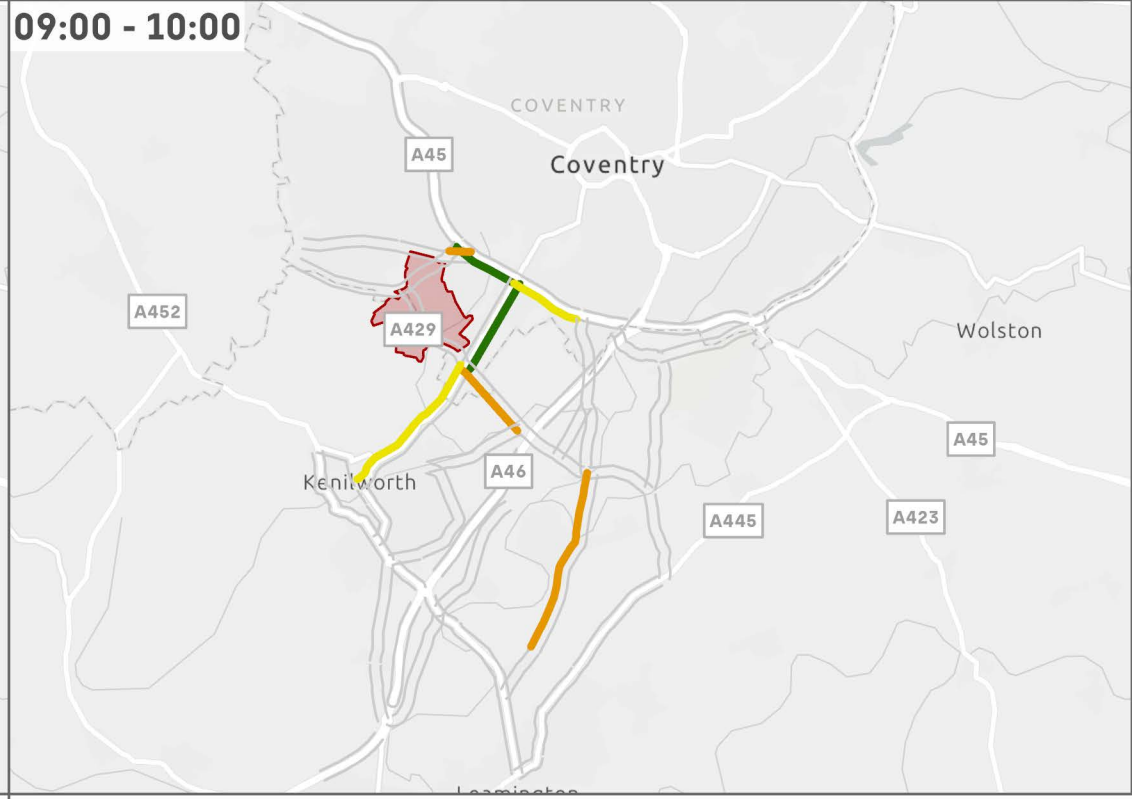
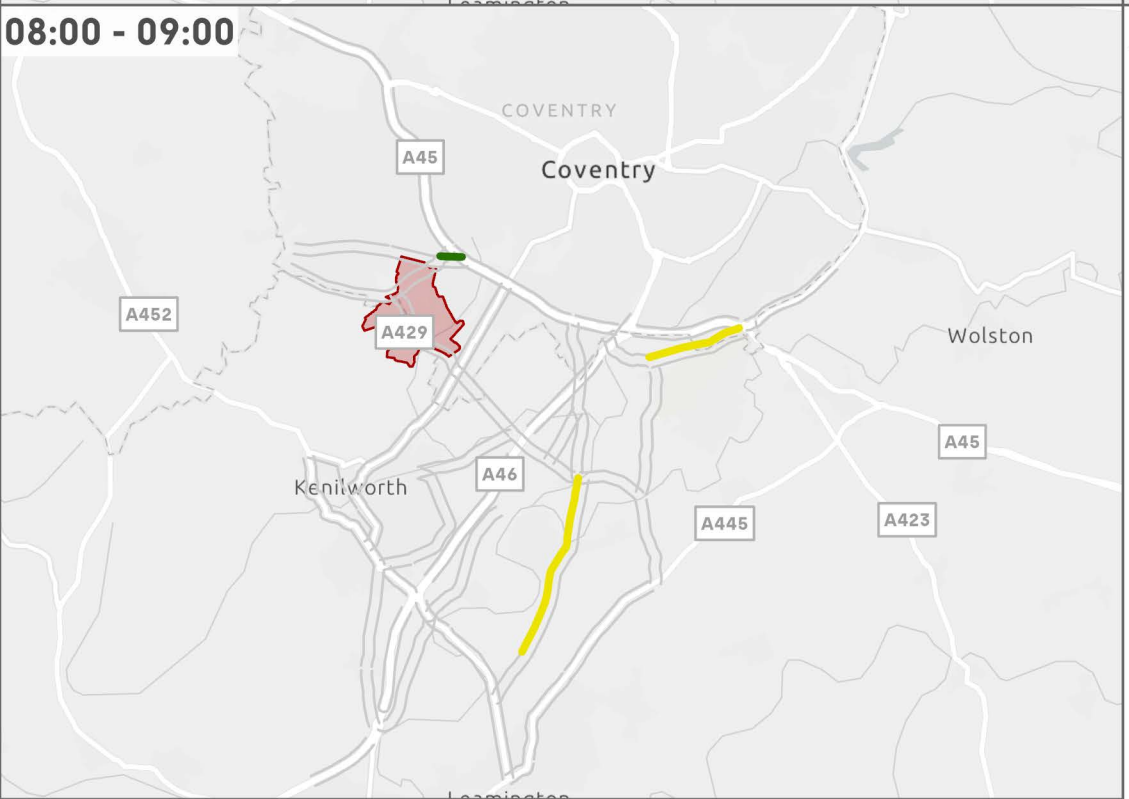
- Criteria 3: Increase of 10% to 20%
- Criteria 4: Increase of more than 20%

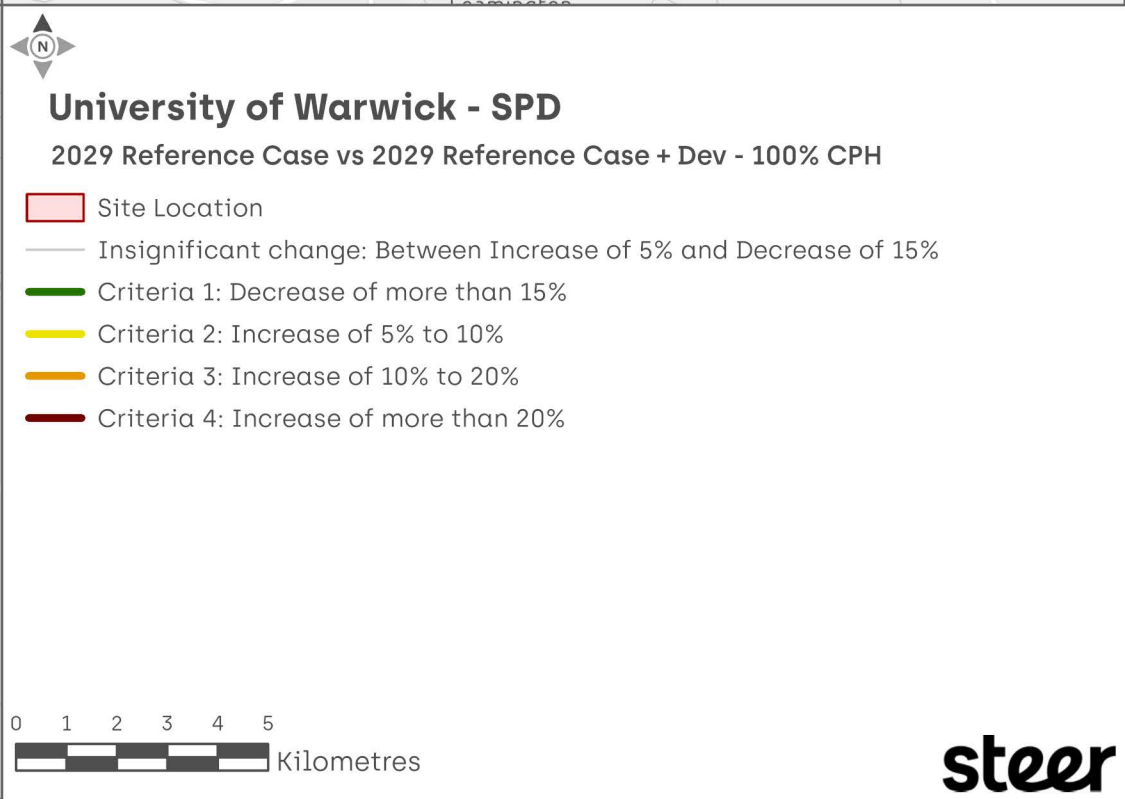
0 1 2 3 4 5 Kilometres

steer


07:00 - 08:00
COVENTRY
Coventry
A45
A452
A429
Wolston
A45
Kenilworth
A46
A445
A423


09:00 - 10:00
COVENTRY
Coventry
A45
A452
A429
Wolston
A45
Kenilworth
A46
A445
A423


08:00 - 09:00
COVENTRY
Coventry
A45
A452
A429
Wolston
A45
Kenilworth
A46
A445
A423


University of Warwick - SPD
2029 Reference Case vs 2029 Reference Case + Dev - 100% CPH
Site Location
Insignificant change: Between Increase of 5% and Decrease of 15%
Criteria 1: Decrease of more than 15%
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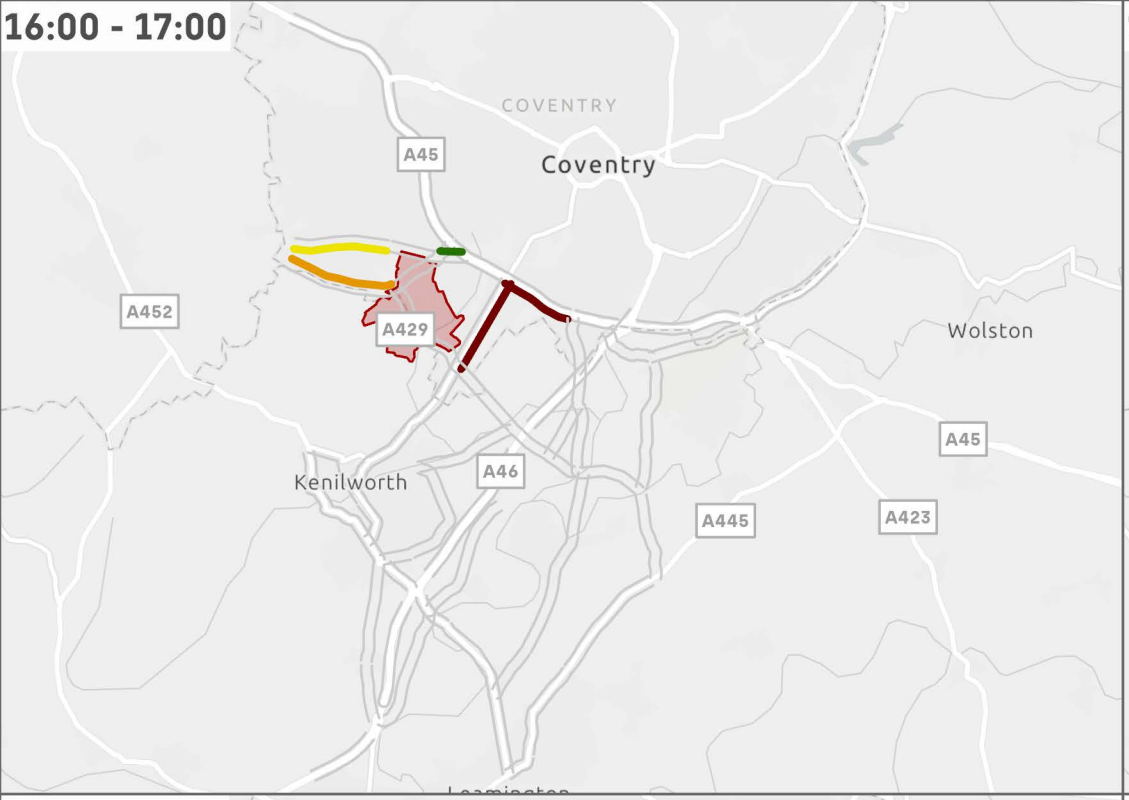
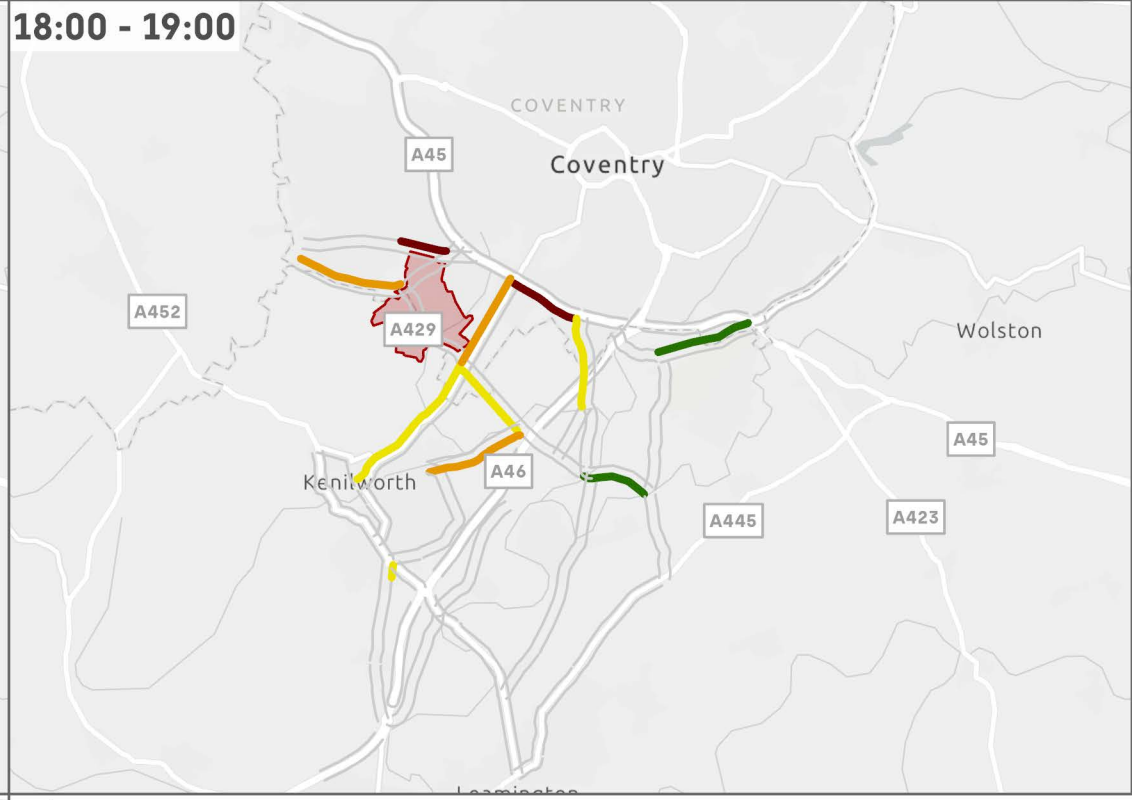
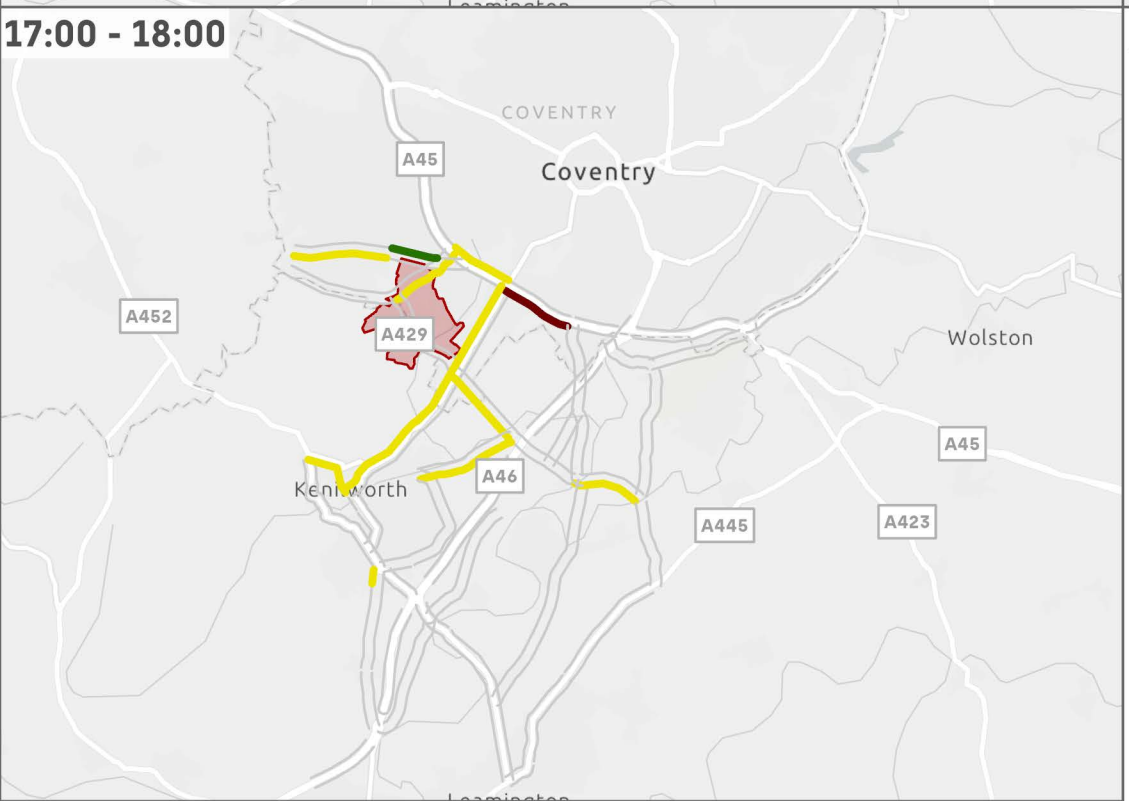
Criteria 3: Increase of 10% to 20%
Criteria 4: Increase of more than 20%
0 1 2 3 4 5
Kilometres
steer







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2029 Reference Case vs 2029 Reference Case + Dev - 100% CPH

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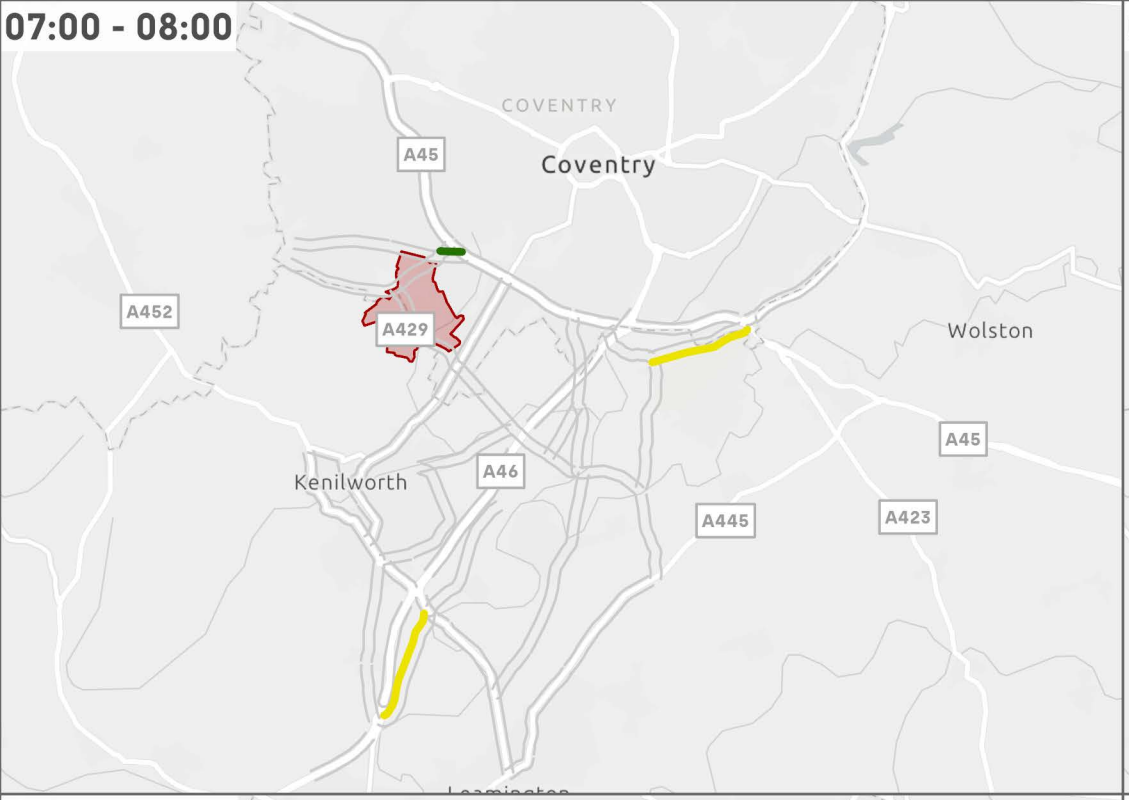
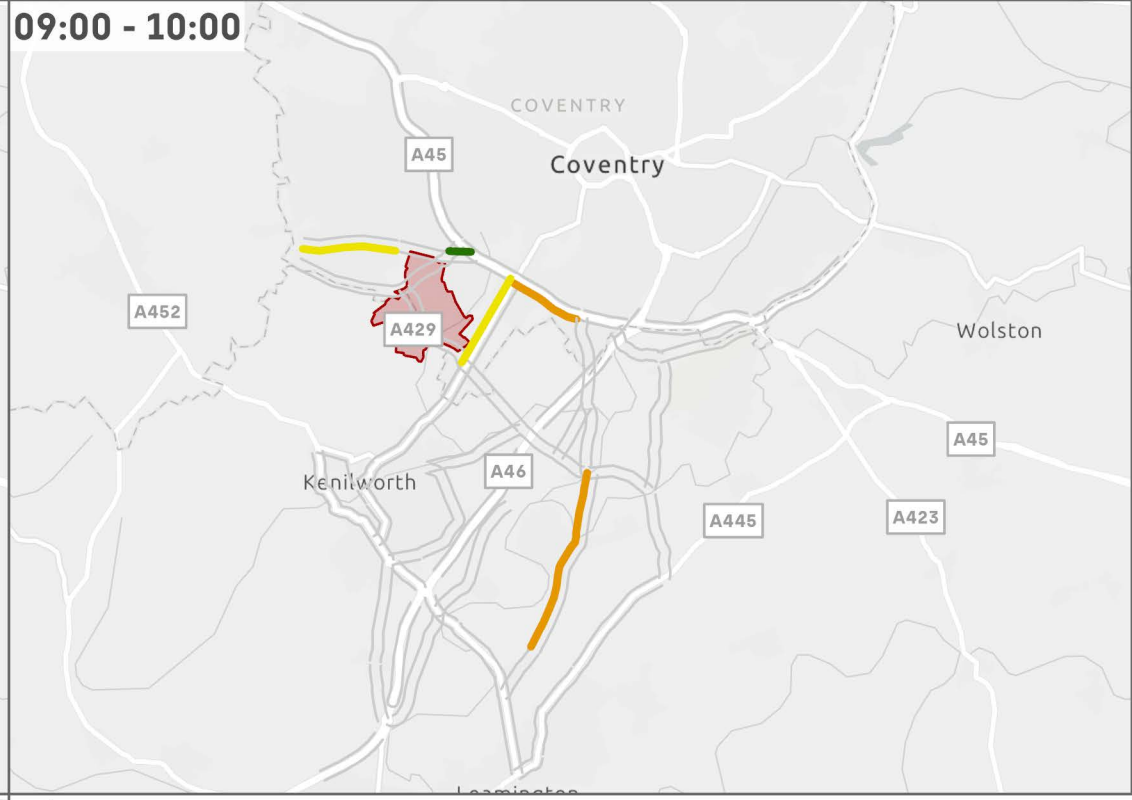
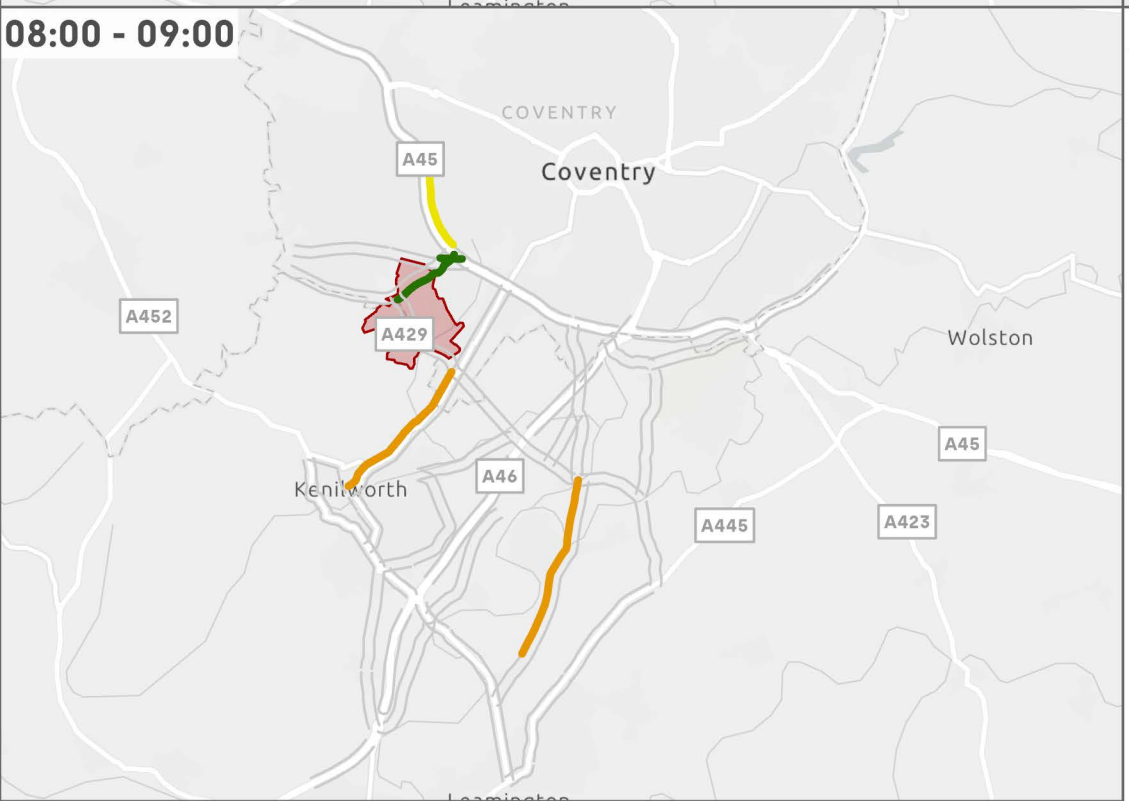
0 1 2 3 4 5 Kilometres

steer







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2037 Reference Case vs 2037 Reference Case + Dev - 100% CPH

- Site Location
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- Criteria 1: Decrease of more than 15%
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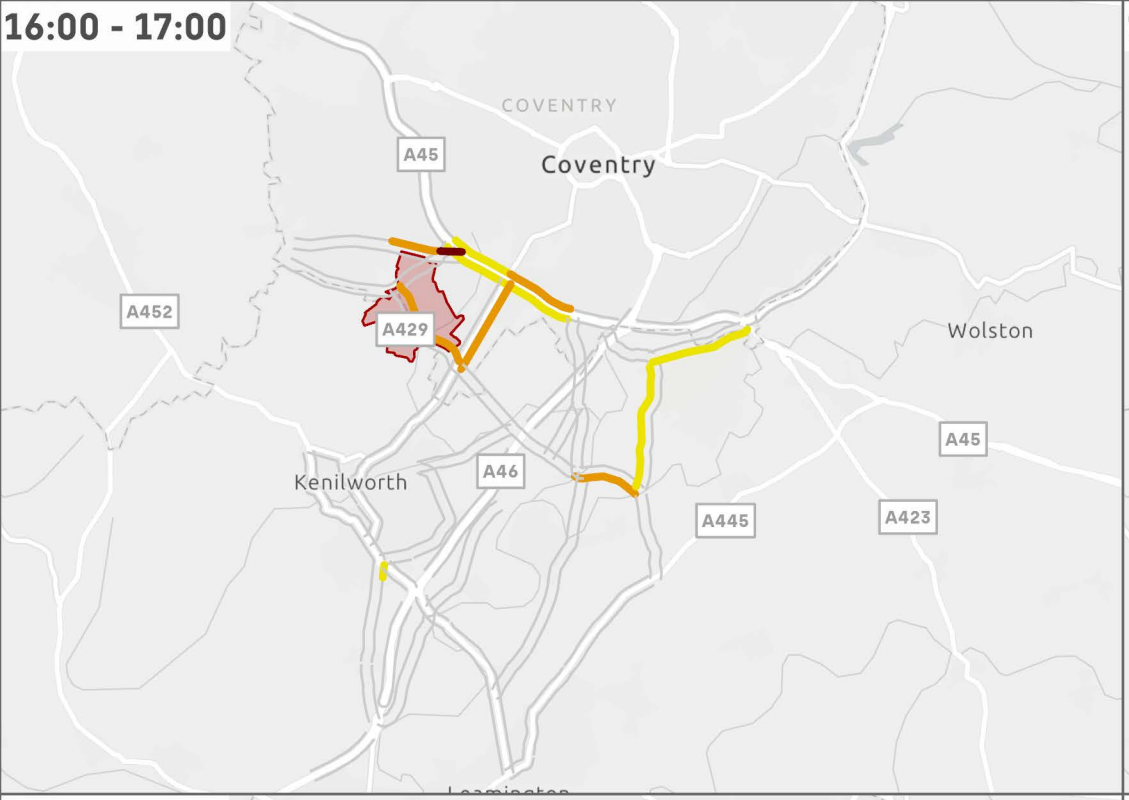
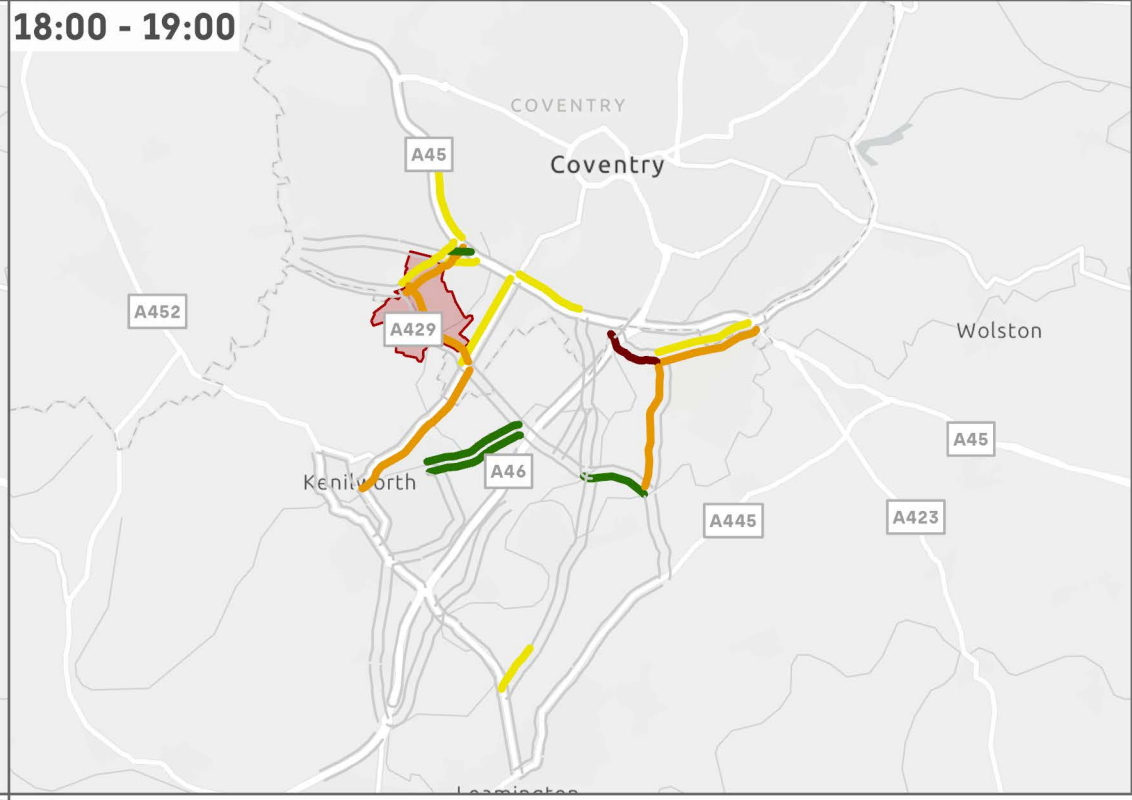
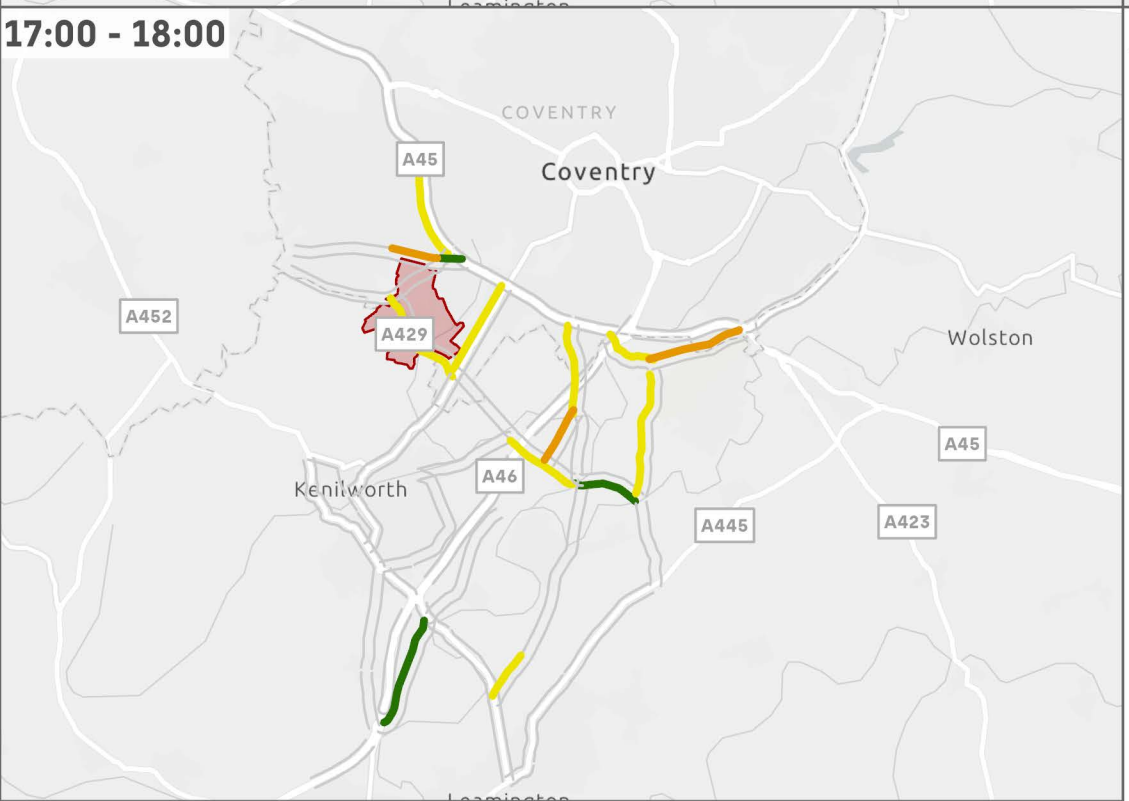
- Criteria 4: Increase of more than 20%

0 1 2 3 4 5 Kilometres

steer







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2037 Reference Case vs 2037 Reference Case + Dev - 100% CPH

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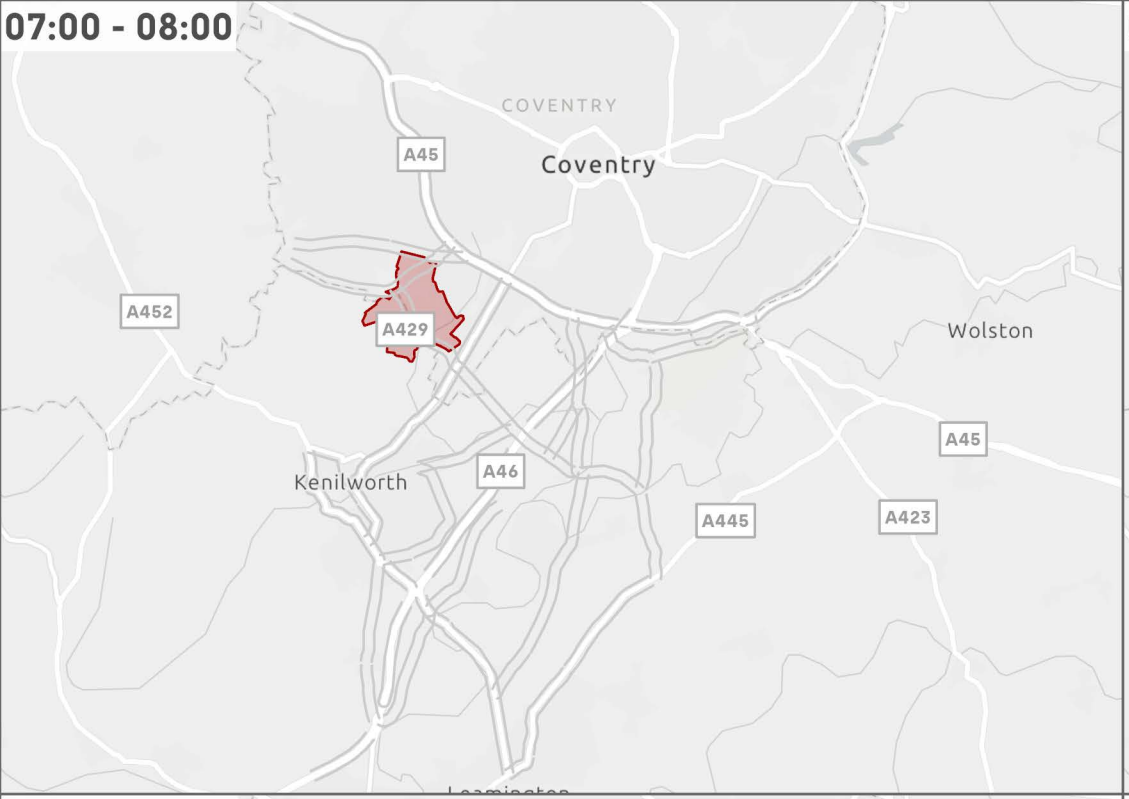
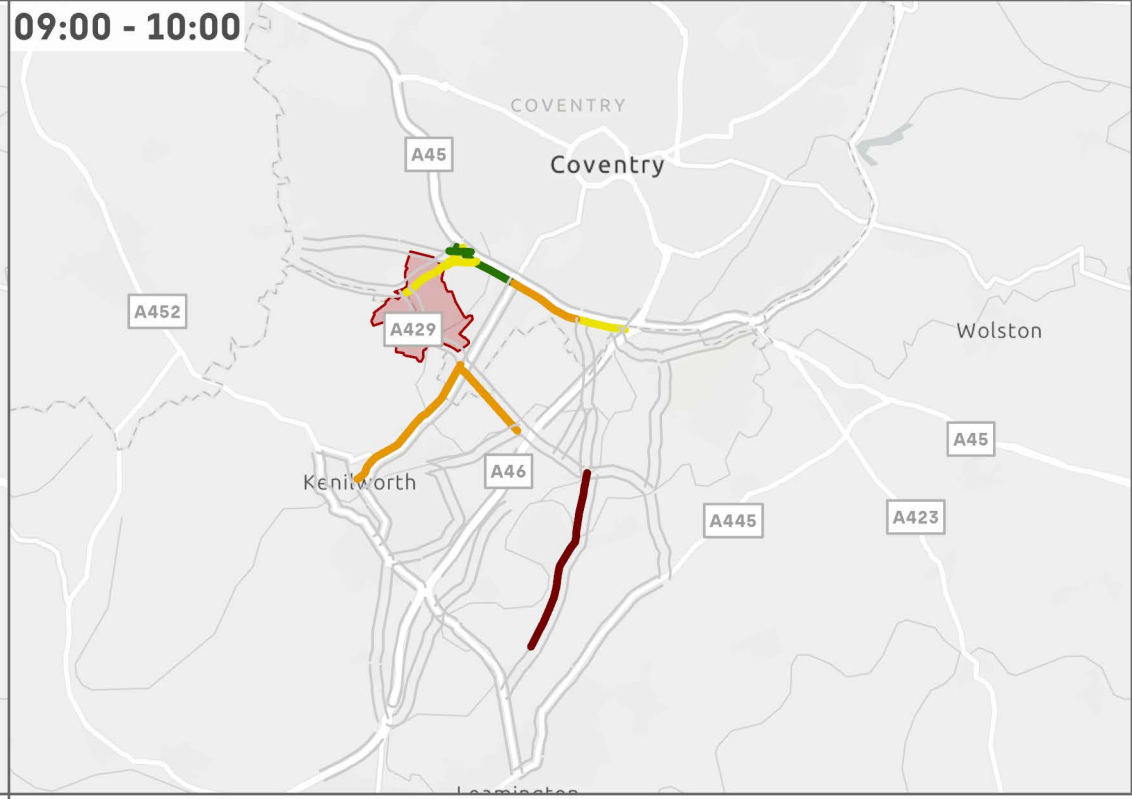
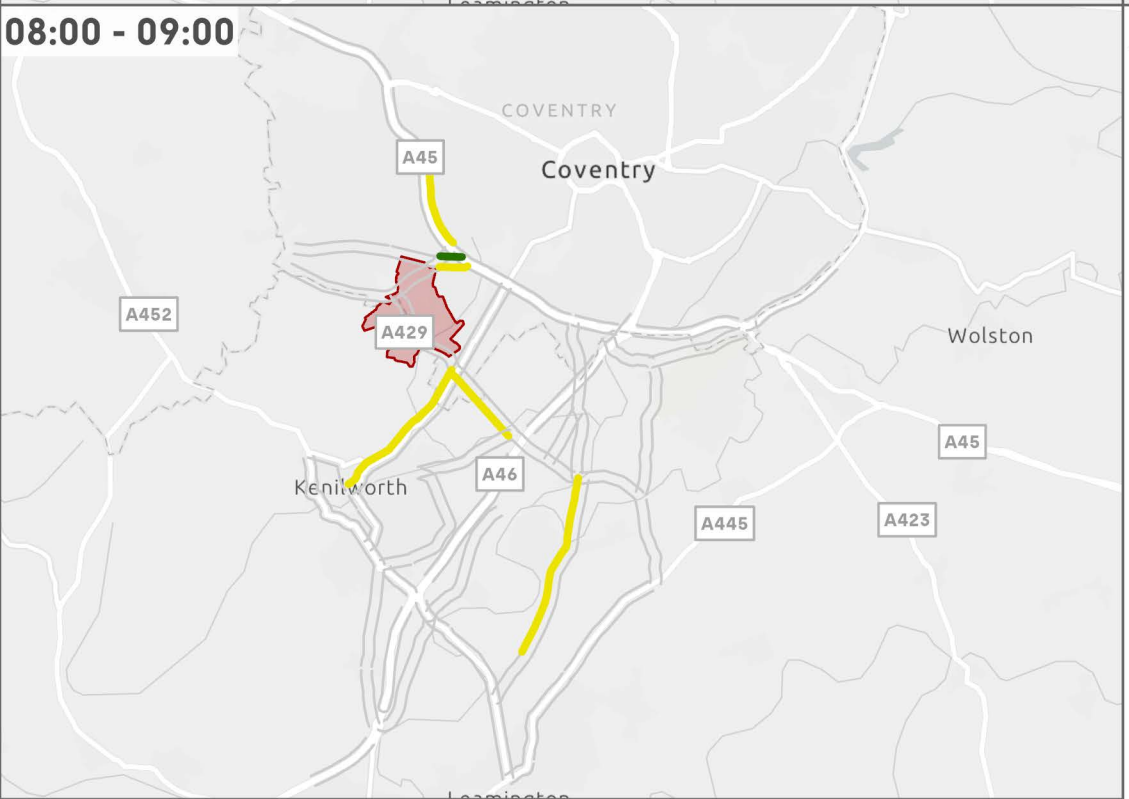
0 1 2 3 4 5 Kilometres

steer







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2029 Local Plan Reference vs 2029 Local Plan + SPD - 100% CPH

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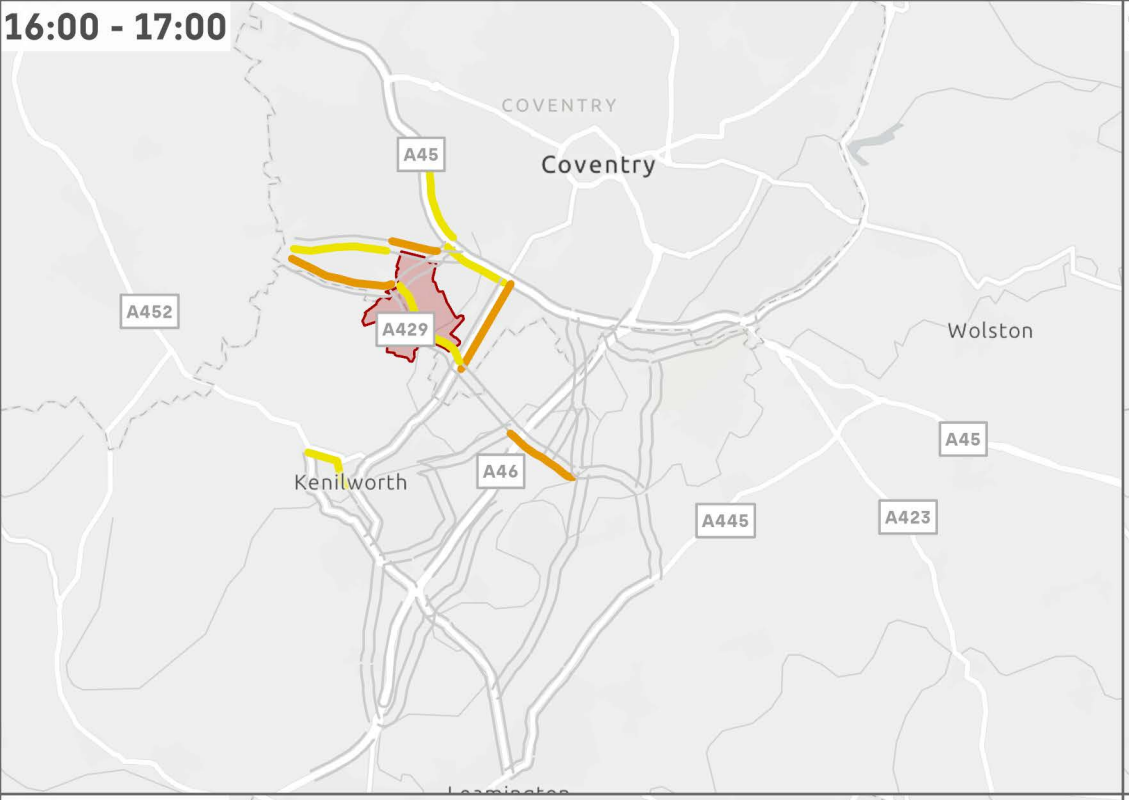
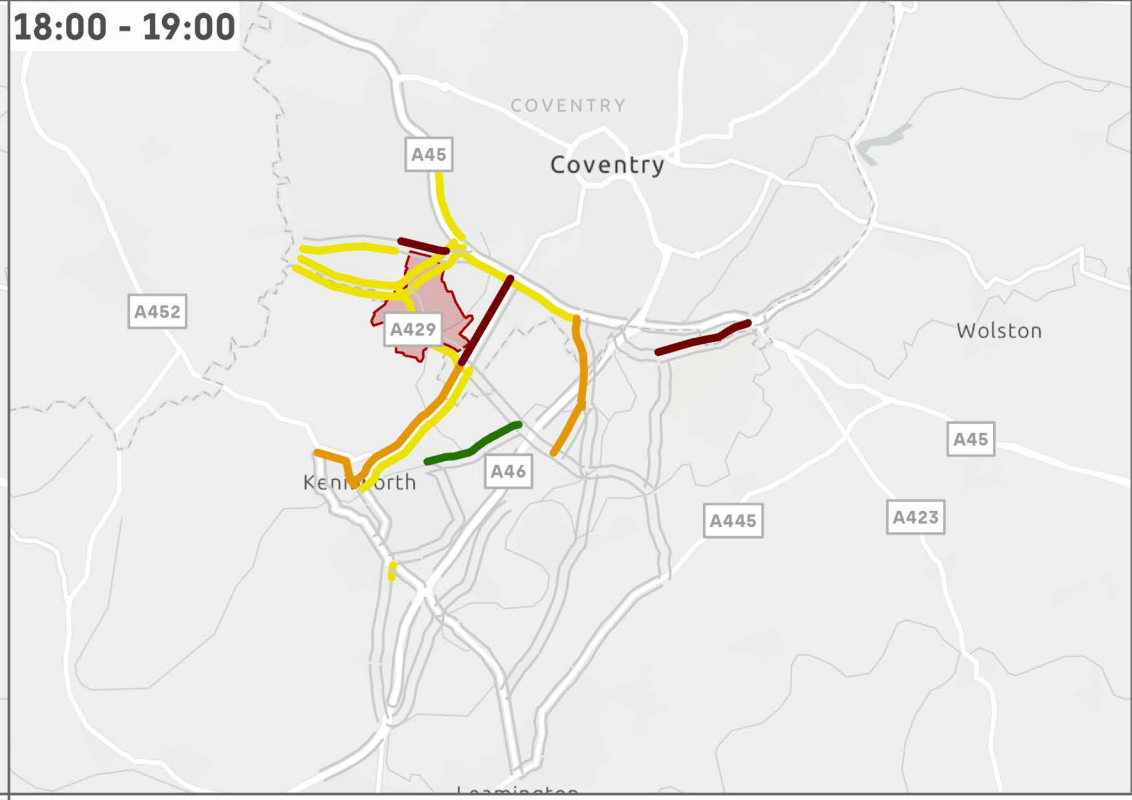
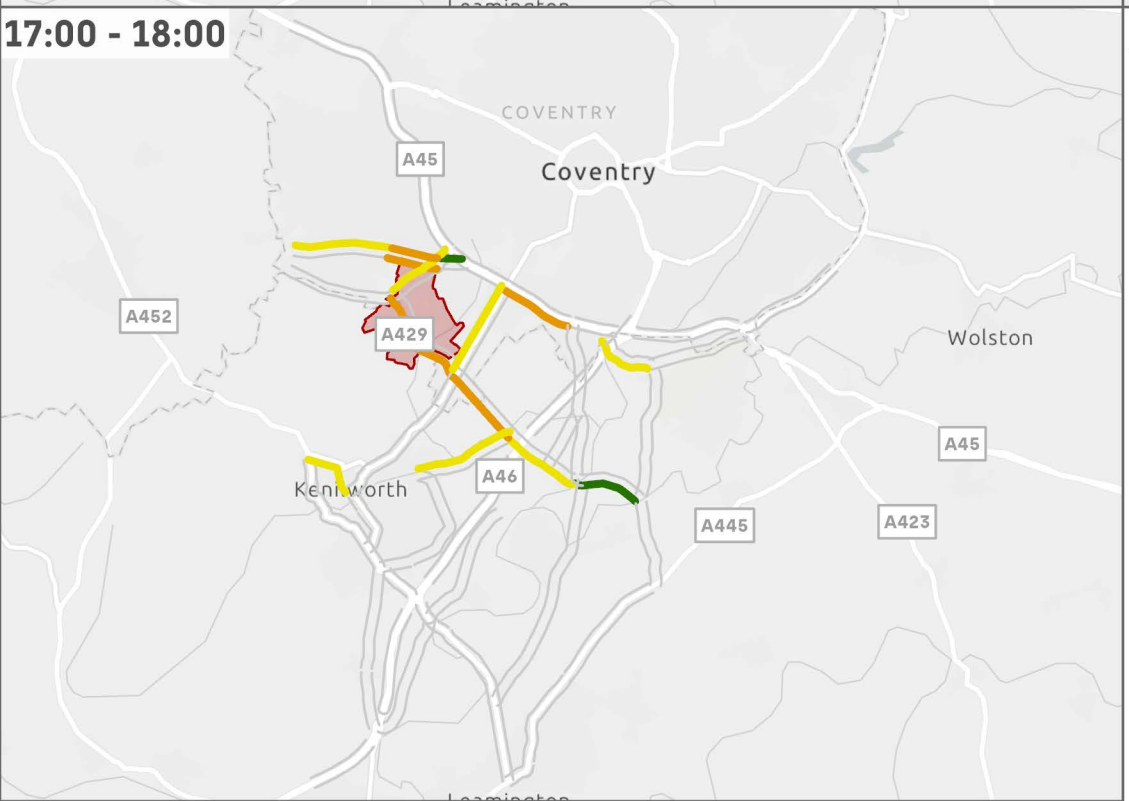
0 1 2 3 4 5 Kilometres

steer







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2029 Local Plan Reference vs 2029 Local Plan + SPD - 100% CPH

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- Criteria 3: Increase of 10% to 20%
- Criteria 4: Increase of more than 20%

0 1 2 3 4 5

Kilometres

steer

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