



Transport for London

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# PROPOSED EXPANSION OF THE ULTRA LOW EMISSION ZONE

## Highway Modelling and Impact Assessment





Transport for London

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Highway Modelling and Impact Assessment

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Transport for London

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# PROPOSED EXPANSION OF THE ULTRA LOW EMISSION ZONE

## Highway Modelling and Impact Assessment

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## **APPENDICES**

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### APPENDIX C

#### TASK B DIFFERENCE PLOTS

### APPENDIX D

#### TASK C DIFFERENCE PLOTS

### APPENDIX E

#### SATURN VERSIONS

# EXECUTIVE SUMMARY

On Monday 8<sup>th</sup> April 2019, the first London Ultra Low Emission Zone (ULEZ) was introduced. Diesel vehicles not conforming to Euro 6 emission standards and petrol vehicles not conforming to Euro 4 emission standards are now charged a daily fee to enter the central London area.

The ULEZ is proposed to be expanded in 2021 to include the area bounded by the North and South Circular roads. The ULEZ charge aims to improve air quality in central London by discouraging the use of the most highly polluting vehicles. The daily cost of entering the ULEZ area, £12.50 cars and £100 for HGV's and buses, is predicted to be high enough to change vehicular travel patterns of non-compliant vehicles. These changes are likely to be most pronounced near the border of the ULEZ, where trips can reroute to avoid the ULEZ charges.

The expansion of the ULEZ to the North and South Circular roads in 2021 is expected to affect traffic flows across the network; predominantly on the boundary road and immediately outside. WSP have been commissioned by TfL to undertake a traffic modelling study to forecast the potential impact of the ULEZ Expansion on the boundary roads and junctions, which will inform locations at which mitigation measures may be required to reduce the impact. This report summarises the work undertaken by WSP and the impacts generated by ULEZ extension.

The study extent assessed within this report is defined as the North and South Circular roads, plus a 2km buffer outside this boundary, as well as up to 5km along TLRN radial routes.

Before the assessment of the extended ULEZ was undertaken Tasks A, B and C were completed to generate updated LoHAM models for the assessment. The purpose of each task is outlined below:

- Task A: Impact of new SATURN version
- Task B: Incorporating latest LoHAM coding into existing LoHAM models
- Task C: Adding in future year schemes into LoHAM (including closure of Hammersmith bridge)

For each task detailed comparisons were undertaken to assess the impacts of the changes.

To highlight those links and junctions which see the largest impact as a result of the ULEZ extension to the North and South Circular, a set of thresholds have been agreed and used to identify the magnitude of impact of the scheme at each location in the study area. These thresholds, alongside other measures, have been used as success criteria in determining how successful each proposed mitigation is in reducing the impact of the ULEZ extension.

Across the study area with the implementation of the extended ULEZ there is a 5.1% reduction of non-compliant vehicles during the AM peak (8:00-9:00) entering the ULEZ boundary and a 6.2% reduction during the PM peak (17:00-18:00). However, the reduction in all vehicles is lower, 0.3% during the AM peak and 0.45 during the PM peak. This indicates that capacity released on the network as a result of the reduction in non-compliant vehicles is used by compliant vehicles.

Plots were generated to present the links and junctions which were both adversely and beneficially affected by the extended ULEZ. Those links and junctions which were classified as having moderate or significant adverse impacts, as defined within the thresholds agreed, were analysed in detail.

The detailed highway impact assessment was split into six areas as outlined below:

- A1. Chalkers Corner and A4 corridor to Chiswick Roundabout (South West London)
- A2. A24 corridor between Merton and Clapham (South London)
- A3. A2 corridor to Eltham and locations near Catford, Lewisham (South East London)
- A4. A40 corridor to Hanger Lane Gyratory and Wembley (West London)
- A5. A1 corridor to Brent Cross and Staples Corner (North London)
- A6. Crooked Billet Roundabout and Great Cambridge Roundabout (North East London)

The detailed analysis of the moderate and significant adverse impacts was a comprehensive process considering a range of investigations. In some instances, it was found that the impacts could not be directly attributed to the ULEZ extension but occurred as a result of convergence issues within LoHAM.

The junctions which WSP identified to be considered for mitigation measures are listed below by area.

- A1. Chalkers Corner and A4 corridor to Chiswick Roundabout (South West London)
  - **Chalkers Corner: A205 South Circular Road / A316 Lower Richmond Road / A316 Clifford Avenue**
  - If mitigation alone at Chalkers Corner is not enough to mitigate the adverse impacts around the A205 South Circular Road / A305 Upper Richmond Road West junction (and on surrounding residential roads), then mitigation at the **A205 South Circular Road / A305 Upper Richmond Road West junction** could be beneficial too.
  - **A205 South Circular Road / Vine Road / Priory Lane**
- A3. A2 corridor to Eltham and locations near Catford, Lewisham (South East London)
  - **A205 South Circular Road / Ha-Ha Road / Nightingale Place** where there is an increase in traffic flow on the south circular which generates increased delays.
  - The impacts on the **Catford Gyratory and A205 through the London Boroughs of Southwark and Lewisham** are a result of very small increases in vehicles; we would welcome TfL's views as to whether these warrant investigations into mitigation.
- A4. A40 corridor to Hanger Lane Gyratory and Wembley (West London)
  - **Hanger Lane Gyratory around the A406 North Circular Road / Brunswick Road**
- A6. Crooked Billet Roundabout and Great Cambridge Roundabout (North East London)
  - The impacts on the **Great Cambridge roundabout and Crooked Billet roundabout** are as a result of a very small increase in vehicles we would welcome TfL's views as to whether these warrant investigations into mitigation.

Mitigation measures at the following junctions were implemented into LoHAM in the form of signal updates in both the AM and PM peaks:

- A205 / Haha Road / Nightingale Place
- A205 / Vine Road / Priory Lane
- Chalkers Corner

The impacts of these updates were then assessed. Adverse impacts were found in the following areas:

■ **AM Peak**

- Area 1
  - A4 Great West Road west of Chiswick roundabout
- Area 2
  - A205 Upper Richmond Road / A219 / Putney High Street
  - A24 Upper Tooting Road around Tooting Bec London Underground Station
- Area 5
  - Tilling Way at Staples Corner

■ **PM Peak**

- Area 3
  - A2 / A205 Westhorne Avenue junction
  - A2 East Rochester Way / Riefield Road junction
  - A2 East Rochester Way around the Danson Underpass
- Area 6
  - A1003 Waterfall Road around the A1003 / Morton Way / Hampden Way roundabout
  - Palmers Road, Upper Park Road and Inverforth Road
  - A406 Pinkham Way (North Circular Road)
  - A406 Bowes Road (North Circular Road)

The impacts in Areas 3 in the PM peak and 5 in the AM peak remained from before mitigation measures were implemented, and were found not to be attributable to the ULEZ extension.

The adverse impacts in Areas 1, 2 and 6 were introduced after the signals were updated. These adverse impacts were investigated and were all found to be due to convergence issues in the LoHAM model, and therefore are not attributable to the ULEZ expansion.

## 2 BACKGROUND AND METHODOLOGY

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### 2.1 BACKGROUND

- 2.1.1. On Monday 8<sup>th</sup> April 2019, the first London Ultra Low Emission Zone (ULEZ) was introduced. Diesel vehicles not conforming to Euro 6 emission standards and petrol vehicles not conforming to Euro 4 emission standards are now charged a daily fee to enter the central London area.
- 2.1.2. The ULEZ is proposed to be expanded in 2021 to include the area bounded by the North and South Circular roads. The ULEZ charge aims to improve air quality in central London by discouraging the use of the most highly polluting vehicles. The daily cost of entering the ULEZ area, £12.50 cars and £100 for HGV's and buses, is predicted to be high enough to change vehicular travel patterns of non-compliant vehicles. These changes are likely to be most pronounced near the border of the ULEZ, where trips can reroute to avoid the ULEZ charges.
- 2.1.3. The expansion of the ULEZ to the North and South Circular roads in 2021 is expected to affect traffic flows across the network; predominantly on the boundary road and immediately outside. WSP have been commissioned by TfL to undertake a traffic modelling study to forecast the potential impact of the ULEZ Expansion on the boundary roads and junctions, which will inform locations at which mitigation measures may be required to reduce the impact.
- 2.1.4. The project will use existing modelling tools to analyse the impacts to the junctions in proximity to the ULEZ boundary, and to quantify the junction impacts and rank the scale of those impacts. TfL will design intervention methods to mitigate these impacts, which will then be assessed using a combination of modelling and non-modelling approaches.
- 2.1.5. The impacts of the expanded ULEZ are anticipated to be greatest in the opening year (2021). Impacts will diminish in the following years, with older non-ULEZ compliant vehicles removed from the network, a process likely to be accelerated by the introduction of the ULEZ. By 2031, non-compliant vehicles are predicted to be less than 3% of vehicles on the highway network.

### 2.2 REPORT STRUCTURE

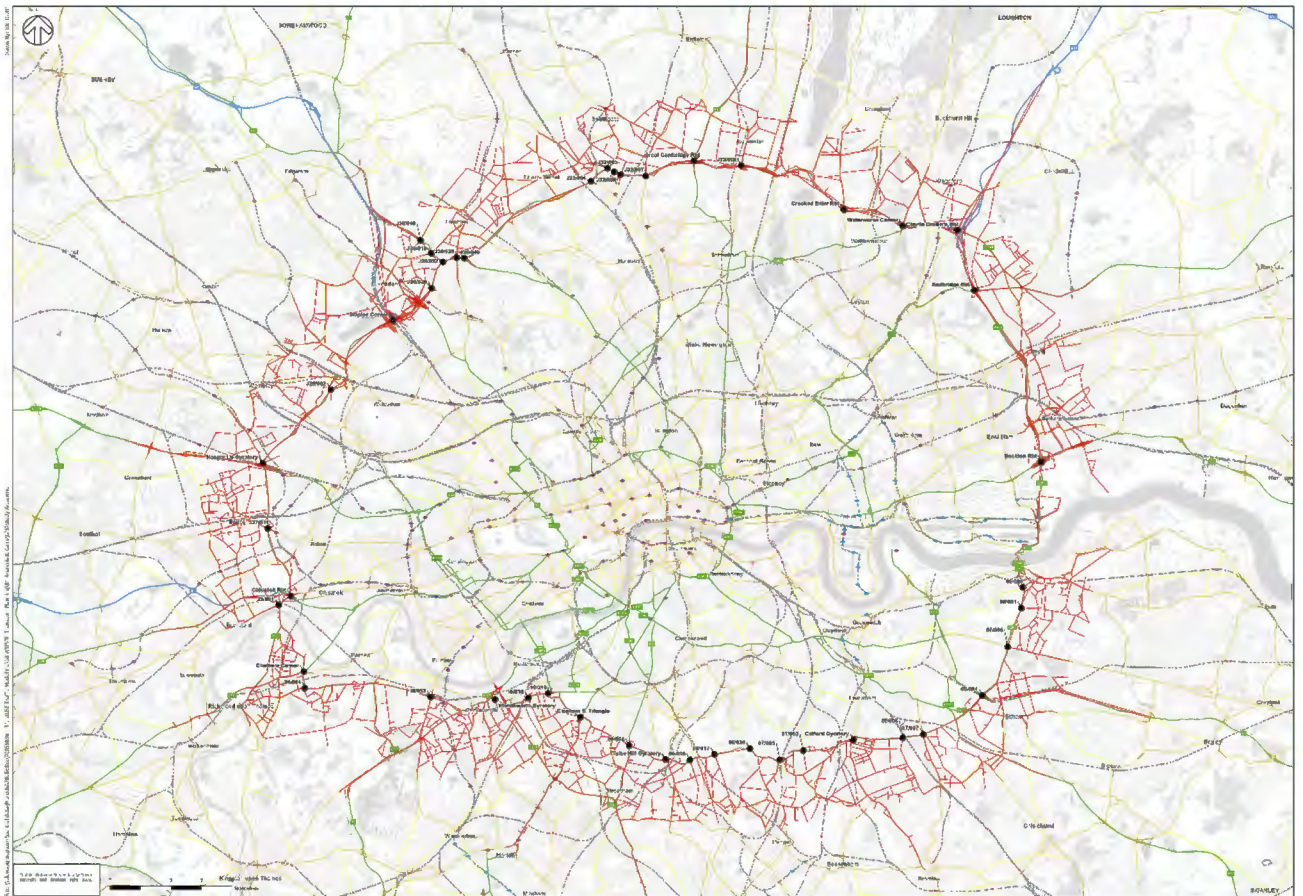
- 2.2.1. This report documents the strategic modelling work undertaken to identify the junction most affected by the extension of the ULEZ. It is structure into the following chapters:
- Chapter 3 Outlines the methodology adopted
  - Chapter 4 Summarises Task A to C which were undertaken
  - Chapter 5 Summarises the agreed thresholds of impacts and presents the highway impact assessment results of the ULEZ, identifying the key junctions which require mitigation
  - Chapter 6 Summarises the LoHAM model runs undertaken incorporating the proposed mitigations and the impacts

All the Appendices are referred to throughout the body of the report with the exception of Appendix E which summarises the impacts that the latest version of SATURN 11.5.04H+ from December 2019 and how this compares to the version used in our assessments, 11.5.03Y.

### 3 METHODOLOGY

#### 3.1 STUDY AREA

- 3.1.1. The study will assess the impact of ULEZ on links and junctions. Areas and corridors will also be assessed to understand the wider impact on journey times in areas where there are many impacts generating a larger cumulative effect.
- 3.1.2. The areas/corridors in scope of the assessment will include all TLRN and Highways routes intersecting the North and South Circular roads, as well as key arterial routes not on the TLRN.
- 3.1.3. The study extent is defined as the Inner ULEZ boundary road (typically the North and South Circular roads), plus a 2km buffer outside this boundary, as well as up to 5km along TLRN radial routes. The study area is shown in Figure 3-1.



**Figure 3-1: ULEZ Expansion Study Area**

## **EXISTING MODEL REVIEW**

- 3.1.4. The TfL LoHAM models were used to assess the ULEZ impacts. Comparisons have been made between 'expanded ULEZ model' against the 'central ULEZ model'. Modelling has been undertaken for 2021 AM and PM peak hours.
- 3.1.5. During the first stage of the project, the model was reviewed to ensure that any weaknesses within the existing model is identified and addressed.

## **HIGHWAY IMPACT ASSESSMENT**

- 3.1.6. Our analysis will identify junctions and links on the ULEZ boundary where the traffic delay deteriorates and improves. We will rank the impacts of the expanded ULEZ on the junction and link as negligible, minor, moderate and significant depending on the change in delay, volume/capacity (v/c) and the volume of vehicles affected. This ranking methodology has been agreed with TfL and is outlined in more detail in Chapter 4.
- 3.1.7. Junctions and links rated as moderate or significant adverse impact will be subjected to additional analysis to determine the root cause of the decrease in performance. This will provide additional detail on where mitigation might best be targeted to alleviate the negative impacts of ULEZ.
- 3.1.8. While the focus of this study is to examine impacts to the ULEZ boundary junctions, we will also identify broader locations where there is an impact on network performance. This analysis will be limited to an examination of changes to delay and flow within 2km buffer outside the ULEZ boundary.

## **MITIGATION DEVELOPMENT**

- 3.1.9. TfL will devise mitigation designs at identified junctions. WSP will provide support to TfL during this stage by undertaking rapid assessment of the mitigation measures utilising the ULEZ LoHAM. This process will ensure the mitigations are effective and will identify any wider impacts resulting from the improvements.
- 3.1.10. At the end of the mitigation development stage, LoHAM will be rerun once, incorporating all proposed mitigations. This will ensure that the proposed mitigation is effective and that together they do not generate any wider / secondary impacts. This can be found in Chapter 5 of this report.

## **MITIGATION ASSESSMENT**

- 3.1.11. Upon the completion of the Mitigation Development stage, we will work with TfL to identify the modelling priorities and determine an appropriate scope of work and the scale of mitigation proposed. Once the mitigations have been identified these will be assessed in micro-simulation models and will be reported on within the Micro-Simulation ULEZ Mitigation Assessment Report.



## 3.2 ASSUMPTIONS AND CAVEATS

- 3.2.1. The study includes the ULEZ boundary road (North and South Circular roads), plus a 2km buffer outside this boundary, as well as up to 5km along TLRN radial routes. It does not include areas inside the boundary road.
- 3.2.2. The modelling assumes the same levels of compliance, demand and charging regime as was used in TfL's ULEZ consultation modelling in 2017.
- 3.2.3. A highway impact assessment has been undertaken for the AM and PM peak hours in the ULEZ Expansion opening year (i.e. 2021).
- 3.2.4. The thresholds will apply to links and junctions only. Areas and corridors will only be assessed on a case-by-case basis to understand the wider impact on journey times if there are many smaller impacts to links that could have a larger cumulative effect on areas and corridors.
- 3.2.5. A +/-2% limit of change has been set on the threshold measures to account for 'model noise', therefore a change of between +2% and -2% will be deemed as 'no change'.
- 3.2.6. Initially, it is proposed that mitigation should be considered only where impact is deemed to be "moderate" or "significant" adverse.
- 3.2.7. The SATURN model will primarily be used to identify the list of impacted junctions, links and corridors for further analysis. Depending on the nature of the proposed mitigation, the SATURN model may also be used to strategically assess the effectiveness of the proposed mitigation. It is expected that more detailed modelling will be required (e.g. LINSIG, VISSIM) for some interventions.
- 3.2.8. If there is no significant change between the pre- and post-ULEZ Expansion scenario, e.g. a junction is already at capacity pre-ULEZ Expansion and remains the same post-ULEZ Expansion and therefore the scheme has not had a negative impact on the junction, it is assumed that mitigation measures will not be proposed or implemented for this area.
- 3.2.9. If junctions/links that have already been optimised as part of previous network improvement do not see a net benefit in introducing an intervention, mitigation will not be progressed.
- 3.2.10. The existing models to be used for the modelling were developed using an older version of SATURN. Since they were developed, new versions of the software have been released. The models must be updated to the latest software which is currently still in development, as the older version contained a significant no of bugs and errors. An assumption has been made that the new version is fit for purpose and more suitable than the old version, however, there is still a risk that bugs and errors are present in this version; the following caveat is an extract from the terms and conditions provided by Atkins in relation to using a version of SATURN that is still in development.
  - *"The software used for this assessment is a Beta version of SATURN provided by Atkins as part of the SATURNnext Programme. The software developer does not warrant nor represent that the software will meet the project's requirements, be free from errors or that all errors will be corrected during the project. The software is used at TfL's own risk and it is accepted that we are not working with a finished product."*
- 3.2.11. Following the checks and updates to be made to the existing models (including modelling of new committed schemes since the model was first produced) to increase the accuracy of the models for the 2021 scenario, it is assumed that models will then be as accurate as is reasonably practicable and will be fit for purpose.

## 4 TASKS A-C: REVIEW OF EXISTING MODELS

### 4.1 INTRODUCTION

- 4.1.1. This chapter sets out the steps taken to review the existing models, before the SATURN modelling and junction performance assessment was undertaken as part of the main commission.
- 4.1.2. The checks have been completed at a strategic level, i.e. key junctions on the North and South Circular, links within a 2km annulus around the North and South Circular and on all links part of TLRN routes approaching the North and South Circular out to 4-5km.
- 4.1.3. As part of Task B however, coding changes introduced as part of the 2018 LoHAM update were identified on all links within a 2km distance inside *and* outside of the North and South Circular, so that the coding implemented into the updated LoHAM models is consistent within a 2km radius either side of the North and South Circular.

### 4.2 AVAILABLE MODELS

- 4.2.1. Table 4-1 sets out the LoHAM models that are available to use and those that have been supplied to WSP by TfL.
- 4.2.2. Models 5 and 6 are still under development as part of the Production 4 (P4) update, although the coding in Model 5 was provided to WSP by TfL so that appropriate P4 updates could be brought into Models 3 and 4.

**Table 4-1: Existing LoHAM Models**

ID	Description	SATURN Version	Model Version	SATURN Network	Base Year	Development Year	ULEZ	CCZ	CCZ ULEZ
1	2012 LoHAM	11.3.12W	LoHAM 3.08	P3	2012	Latest P3 pack	x	✓	x
2	2021 LoHAM Reference Case	11.3.12W	LoHAM 3.08	P3	2012	Latest P3 pack	x	✓	x
3	2021 LoHAM ULEZ Model (Central ULEZ)	11.5.02T beta	LoHAM 3.08 ULEZ	P3	2012	2017	x	✓	✓
4	2021 LoHAM ULEZ Model (Inner ULEZ)	11.5.02T beta	LoHAM 3.08 ULEZ	P3	2012	2017	✓	✓	✓
5	2016 LoHAM CCZ ( <i>under development</i> )	TBC	TBC	P4	2016	2018	x	✓	x
6	2021 Ref LoHAM CCZ + ULEZ ( <i>under development</i> )	TBC	TBC	P4	2016	2018	x	✓	✓

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## 4.3 TASK A: CHECKS BETWEEN SATURN VERSION ASSIGNMENTS

### PURPOSE

- 4.3.1. The purpose of Task A was to make sure there is no material impact from assigning the existing Models 3 and 4 in a new version of SATURN (11.5.03Y). Models 3 and 4 must be assigned in 11.5.03Y, as the older version of SATURN (11.5.02T) contained a significant number of bugs.
- 4.3.2. In addition, the Task A was completed to ensure that the new models compare well with the current reference case model (Model 2), noting that the Inner ULEZ is included in Model 4, but not in the original reference case model (Model 2) i.e. that there is minimal model noise.

### ANALYSIS

- 4.3.3. To complete Task A, WSP assigning the existing Models 3 and 4 in the new version of SATURN (11.5.03Y) and compared:
- Model 3 assigned in (11.5.03Y) against Model 3 assigned in (11.5.02T)
  - Model 4 assigned in (11.5.03Y) against Model 4 assigned in (11.5.02T)
- 4.3.4. Actual flow, demand flow, Volume over Capacity (V/C) and delay plots were produced in ArcMap to showcase these comparisons Appendix A. If any of these comparisons flagged up concerning differences, we would then have looked for coding errors in the models and have carried out further investigations, as appropriate. This turned out not to be a necessary step.
- 4.3.5. In the AM peak, there were only a few isolated locations where flow, V/C or delay changes occurred, with the most significant changes in delay near the Chiswick Roundabout and south of the Wandsworth Gyratory. The biggest V/C changes were around Chalkers Corner and the Wandsworth Gyratory, but the changes were of an acceptable magnitude given the algorithm change in SATURN. The flow and delay differences were also in an acceptable range and gave no cause for concern.
- 4.3.6. In the PM peak, there were some delay differences just to the west of the Crooked Billet Roundabout and near the Chiswick Roundabout. The biggest change in V/C occurred on Watford Way, near the M1, and at Chiswick roundabout. There were some isolated instances of re-routing in the PM peak, but once again, this was minor and not widespread, given no cause for concern.

### CONCLUSION

- 4.3.7. In conclusion, the differences between the assignments were relatively minor and gave no cause for concern. There was no significant re-routing of traffic because of the different assignment algorithms in each version of SATURN and therefore, Models 3 and 4 will be assigned in SATURN version 11.5.03Y for the duration of the ULEZ Expansion project.

## 4.4 TASK B – INCORPORATING P4 UPDATES INTO EXISTING P3 MODELS

### PURPOSE

- 4.4.1. The purpose of Task B was to ensure Models 3 and 4 are as up to date as they can be, so that TfL is not open to challenge when the new P4 models are released at the end of 2019.

### ANALYSIS

- 4.4.2. Using the latest available P4 model (Model 5), WSP identified the updates that TfL had made as part of their migration from P3 to P4 models and incorporated those changes into the P3 models (Models 3 and 4) if the change were in a 2km radius either side of the North and South Circular. Plots were produced to show the links and nodes where coding changes were made, see Appendix B.
- 4.4.3. Once the coding changes had been applied to Models 3 and 4, WSP compared:
- Link free flow speed and link capacity changes between:
    - P3 models (with P4 changes incorporated) vs P3 models (without P4 changes)
- 4.4.4. Appendix C shows comparisons of actual flow (page 1), demand flow (page 2), link V/C (page 3) and link delay (page 4) between:
- Model 4 (without P4 changes) vs Model 3 (without P4 changes)
  - Model 4 (with P4 changes incorporated) vs Model 3 (with P4 changes incorporated)
- 4.4.5. In both instances, the changes displayed on the plots are relative to Model 3.

### CONCLUSION

- 4.4.6. In conclusion, the differences in actual flow, demand flow, V/C and delay were acceptably consistent between the comparisons of the original and updated models (Models 4 vs Models 3). The link free flow speed and capacity changes are also relatively minor between the original and updated models.

## 4.5 TASK C – PRODUCTION OF FINAL P3 MODELS

### PURPOSE

- 4.5.1. The purpose of Task C was to ensure Models 3 and 4 are as up to date as they can be, so that TfL is not open to challenge when the new P4 model are released at the end of 2019.

### ANALYSIS

- 4.5.2. TfL identified junctions which saw changes implemented between 2016 and 2019, as well as key junctions where there are planned changes to be implemented between 2019 and 2021. They also identified the 2016 to 2021 Reference Case changes that were not previously coded into Models 3 or 4 and provided WSP with a list of schemes to code into the new P3 models (Models 3 and 4). These are shown in Table 4-2 along with details of each scheme.

**Table 4-2: Forecast Schemes Coded in Task C**

Scheme	Description	Area Affected	Add / Amend / Remove
<b>Cycle Superhighway 9 (CS9)</b>	Segregated cycle route from Hammersmith to Hounslow, crossing the A205 at Kew Bridge	A205 junctions with Kew Bridge and Wellesley Road	Add and amend to reflect latest design
<b>Brent Cross</b>	Brent Cross at North Circular junction with A5, M1, A41 Hendon way, as well as further local improvements. The coding is related to the Brent Cross shopping centre development, which is indefinitely suspended. Coding to be reverted	Brent Cross / Staples Corner	Revert coding
<b>Hammersmith Bridge</b>	Closure of Hammersmith Bridge to all vehicles to reflect ongoing bridge closure (cycles allowed)	Hammersmith Bridge	Add closure
<b>Charlie Browns Roundabout</b>	Signalised pedestrian crossings added approximately 15m from roundabout, on all arms and directions	Charlie Browns Roundabout	Add pedestrian crossings
<b>Rosendale Road / Thurlow Park Road</b>	The scheme added cycle phases to the side roads and therefore increased the lost time to accommodate early release of cyclists. Demand dependency is considered in the signal timings	Rosendale Road / Thurlow Park Road	Amend to reflect latest proposed signal timings
<b>A406 / Brent Street / Golders Green Road</b>	The scheme added signalised pedestrian crossings to the northern side of the junction, one of which is separately controlled as a stream	A406 / Brent Street / Golders Green Road	Amend to reflect latest proposed signal timings

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- 4.5.3. WSP coded these schemes into the final P3 models, reassigned them and completed checks of actual flow, demand flow, V/C and delay, as shown on plots Appendix D.

## CONCLUSION

- 4.5.4. In conclusion, the changes due to the ULEZ extension in flow, V/C and delay within the study area were very consistent with those in the previous models. These final models (from Task C) will be taken forwards to the highway impact assessment.

## 5 HIGHWAY IMPACT ASSESSMENT

### 5.1 INTRODUCTION

5.1.1. This chapter starts with a high-level overview of those links and junctions which see the largest impacts due to the implementation of the ULEZ extension. It finishes with a detailed look at why some links and junctions will experience a moderate or significant impact because of the extension.

### 5.2 IMPACT THRESHOLDS

5.3 To highlight those links and junctions which see the largest impact as a result of the ULEZ extension to the North and South Circular, a set of thresholds have been used to identify the magnitude of impact of the scheme at each location in the study area. These thresholds, alongside other measures, have again been used as success criteria in determining how successful each proposed mitigation is in reducing the impact of the ULEZ extension.

5.4 The proposed thresholds are based on established guidance, including:

- TfL modelling guidance (Sub-regional Highway Assignment Models Guidance on Model Use, version 2.6, June 2017);
- Institute of Environmental Management & Assessment (IEMA) guidance; and
- Design Manual for Roads and Bridges (DMRB): Volume 11 (Environmental Assessment).

5.4.1. The thresholds are split into two categories (junctions and links), with a range of values defined for each category. The magnitude of impact is categorised according to national guidance as shown in Table 5-1. Magnitudes are defined for each impact measure, either adverse or beneficial. Beneficial changes are highlighted to show any areas where a positive impact has occurred post-ULEZ expansion.

**Table 5-1: Magnitude of Impact and Descriptors**

Magnitude of impact	Typical criteria descriptors
Major	• Loss of resource and/or quality and integrity of resource; severe damage to key characteristics, features or elements (Adverse).
	• Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality (Beneficial).
Moderate	• Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements (Adverse).
	• Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality (Beneficial).
Minor	• Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements (Adverse).
	• Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring (Beneficial).
Negligible	• Very minor loss or detrimental alteration to one or more characteristics, features or elements (Adverse).
	• Very minor benefit to or positive addition of one or more characteristics, features or elements (Beneficial).
No change	• No loss or alteration of characteristics, features or elements; no observable impact in either direction.

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5.4.2. Table 5-2 sets out the impact thresholds and magnitude definitions.

**Table 5-2: Impact Thresholds**

Assessed Element	Impact Measure	Impact	No Change	Negligible	Minor	Moderate	Significant	
Links	Actual Flow (% change)	Adverse	0%*	Between +2% and +10%	Between +10% and +30%	Between +30% and +60%	Greater than +60%	
		Beneficial		Between -2% and -10%	Between -10% and -30%	Between -30% and -60%	Less than -60%	
	Volume over Capacity (v/c threshold change)	Adverse	0%* difference between "with" and "without ULEZ extension" scenarios	v/c <80% in both "with" and "without ULEZ extension" scenarios and v/c increases from "without ULEZ extension" scenario	Scheme causes link to go from v/c <80% to v/c 80-90%*	Scheme causes link to go from v/c <90% to v/c 90-100%*	Scheme causes link to go from v/c <100% to v/c >100%*	
		Beneficial		v/c <80% in both "with" and "without ULEZ extension" scenarios and v/c decreases from "without ULEZ extension" scenario	Scheme causes link to go from v/c 80-90% to v/c <80%*	Scheme causes link to go from v/c 90-100% to v/c <90%*	Scheme causes link to go from v/c >100% to v/c <100%*	
	Volume over Capacity (% point change)	Adverse	0%*	Between +2% and +5%	Between +5% and +10%	Between +10% and +15%	Greater than +15%	
		Beneficial		Between -2% and -5%	Between -5% and -10%	Between -10% and -15%	Less than -15%	
	Total Vehicle Hours Delay (% change)	Adverse	0%*	Between +2% and +10%	Between +10% and +30%	Between +30% and +60%	Greater than +60%	
		Beneficial		Between -2% and -10%	Between -10% and -30%	Between -30% and -60%	Less than -60%	
	Junctions	Volume over Capacity (v/c threshold change)	Adverse	0%* difference between "with" and "without ULEZ extension" scenarios	v/c <80% in both "with" and "without ULEZ extension" scenarios and v/c increases from "without ULEZ extension" scenario	Scheme causes junction to go from v/c <80% to v/c 80-90%*	Scheme causes junction to go from v/c <90% to v/c 90-100%*	Scheme causes junction to go from v/c <100% to v/c >100%*
			Beneficial		v/c <80% in both "with" and "without ULEZ extension" scenarios and v/c decreases from "without ULEZ extension" scenario	Scheme causes junction to go from v/c 80-90% to v/c <80%*	Scheme causes junction to go from v/c 90-100% to v/c <90%*	Scheme causes junction to go from v/c >100% to v/c <100%*
Volume over Capacity (% point change)		Adverse	0%*	Between +2% and +5%	Between +5% and +10%	Between +10% and +15%	Greater than +15%	
		Beneficial		Between -2% and -5%	Between -5% and -10%	Between -10% and -15%	Less than -15%	
Total Vehicle Hours Delay (% change)		Adverse	0%*	Between +2% and +10%	Between +10% and +30%	Between +30% and +60%	Greater than +60%	
		Beneficial		Between -2% and -10%	Between -10% and -30%	Between -30% and -60%	Less than -60%	

5.4.3. The impact measures are defined as follows:

- Actual Flows % (SATURN): % change in the vehicular flow on a road or through a junction.
- Volume over capacity % (SATURN): a measure of traffic demand at a junction relative to the junction's capacity. Measured both in terms of a threshold banding and the absolute change in %.
- Total vehicle hours delay (SATURN): delay per vehicle (converted to hours) multiplied by the number of vehicles per hour.

5.4.4. Where an impact is deemed to be "Moderate" or "Significant" adverse, it has been investigated further in the next section to determine the root cause of the decrease in performance. An adaptable approach has been applied with regards to the level of assessment undertaken for each location identified as adversely affected. For example, some locations on the network have been identified as critical and a small increase in capacity could push them over the edge leading to functionality issues. These junctions have required a more detailed assessment to provide additional detail on where mitigation might best be targeted to alleviate the negative impacts of the intervention.

5.4.5. Mitigation will be considered by TfL where impact is deemed to be "Moderate" or "Significant" adverse. However, for areas where there is no significant change between the pre- and post-ULEZ Expansion scenario, e.g. a junction is already at capacity pre-ULEZ Expansion and remains the same post-ULEZ Expansion and therefore the scheme has not had a negative impact on the junction, mitigation measures will not be proposed or implemented for this area.



## 5.5 HIGH-LEVEL OVERVIEW

- 5.5.1. From here on in, the two models being assessed will be referred to as the Do Minimum (DM) and Do Something (DS) models, with the DM not containing the ULEZ extension (only the central London ULEZ) and the DS containing the ULEZ extension (and the central London ULEZ).
- 5.5.2. The total amount of PCUs entering the ULEZ extension in the DM and DS is detailed in Table 5-3. It shows that there is a relatively modest decrease in PCU trips entering the ULEZ of 5-6%. While this looks like a small reduction, the trip matrix used in DM and DS is exactly the same and therefore it's only taking into account the changes in route choice as a result of the ULEZ.
- 5.5.3. While there is a decrease of around 700 non-compliant PCU trips entering the ULEZ, the total demand only decreases by 200-300 PCUs. This indicates that compliant trips are utilising the capacity freed up by the re-routed non-compliant trips.

**Table 5-3: Change in demand entering ULEZ boundary (PCUs)**

	Non-Compliant Vehicles			All Vehicles		
	DM	DS	Diff. (DS - DM)	DM	DS	Diff. (DS - DM)
<b>AM Peak</b>	14,513	13,778	-735 (5.1%)	81,936	81,719	-217 (0.3%)
<b>PM Peak</b>	11,518	10,808	-710 (6.2%)	66,034	65,741	-293 (0.4%)

- 5.5.4. The change in non-compliant and total trips on links into the ULEX are shown in Figure 5-1 and Figure 5-2 for the AM peak, and Figure 5-3 and Figure 5-4 for the PM peak. Changes of less than 5 PCUs are not displayed.
- 5.5.5. During the AM peak there is reductions of up to 66 PCUs trips on links entering the ULEZ, however when considering the change in total trips this is reduced to a maximum decrease of 29 PCUs. There is a concentration of reductions in non-compliant entrances in the south-west corner of the ULEX, from Clapham through to Chiswick. Other notable trip reductions are at Neasden Underpass, Eastern Avenue, Newham Way and at Sidcup Road / Rochester Way Relief Road.



**Figure 5-1: Change in Non-Compliant Trips Entering the ULEX – AM Peak**

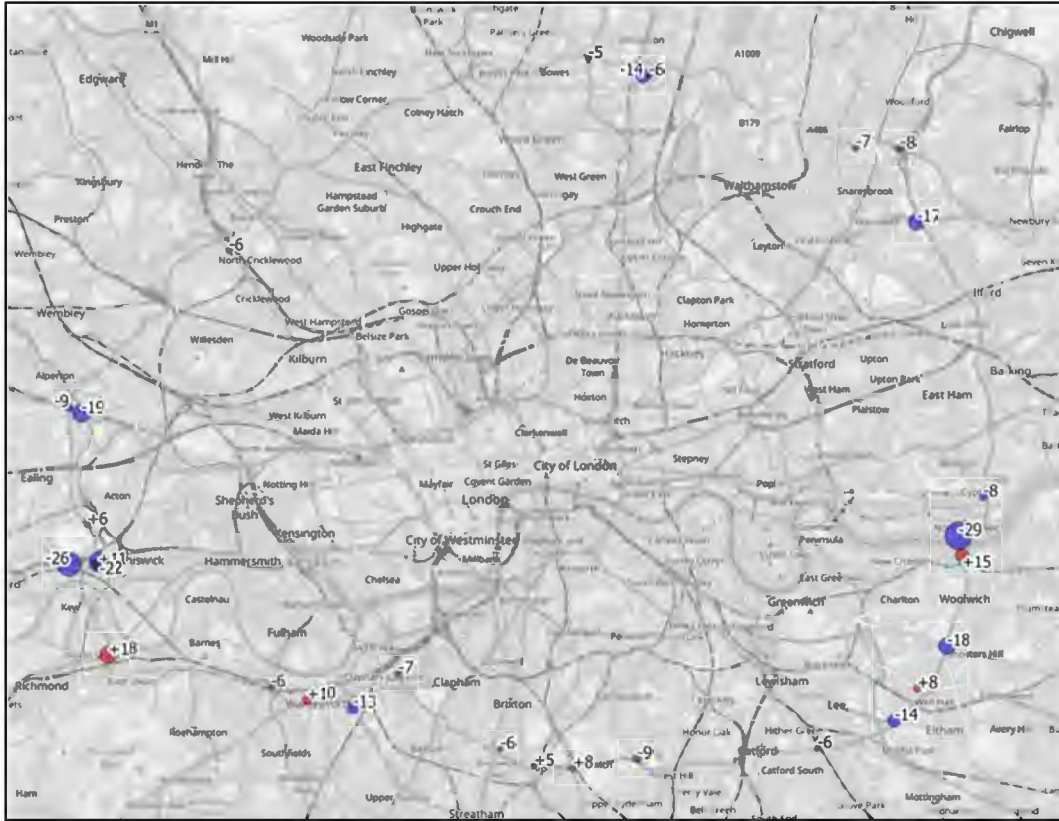
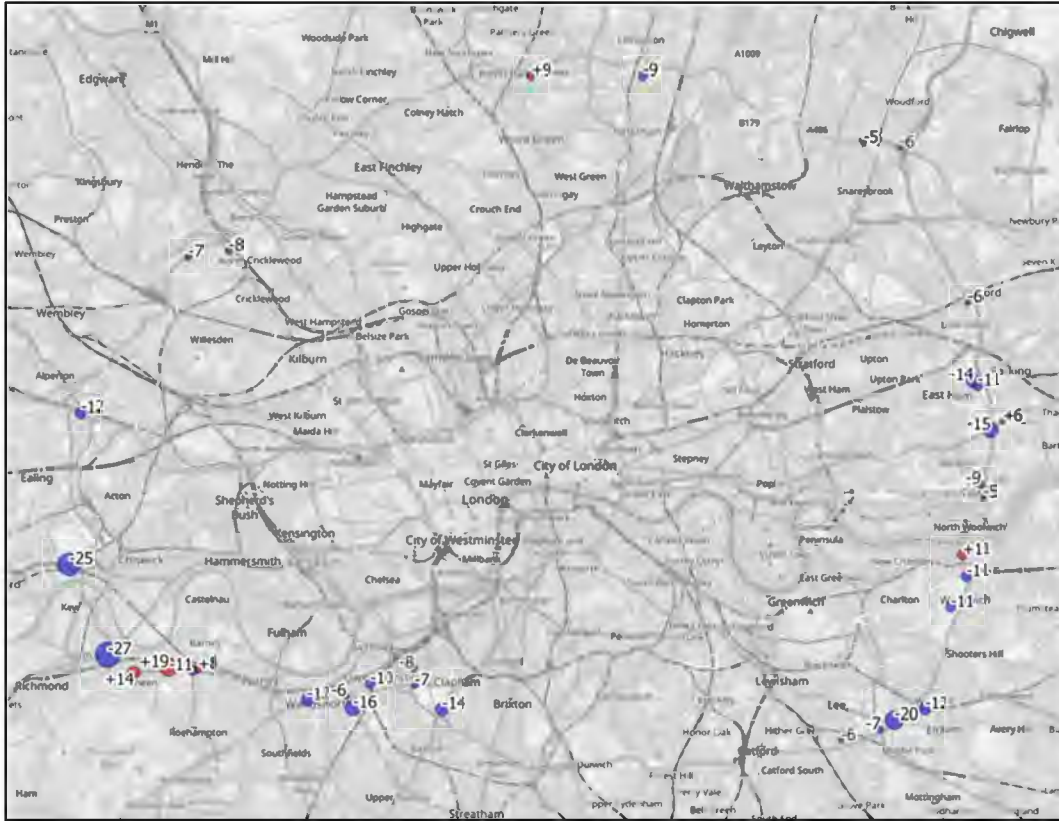


Figure 5-2: Change in Total Trips Entering the ULEZ – AM Peak

5.5.6. During the PM peak there are reductions of up to 78 PCUs trips on links entering the ULEZ, however when considering the change in total trips this is reduced to a maximum decrease of 27 PCUs. There is a concentration of reductions in non-compliant entrances in the south-west corner of the ULEX, from Clapham through to Chiswick. Other notable trip reductions are at Bounds Green Road, Eastern Avenue, Newham Way, and at Sidcup Road / Rochester Way Relief Road.



**Figure 5-3: Change in Non-Compliant Trips Entering the ULEZ – PM Peak**



**Figure 5-4: Change in Total Trips Entering the ULEZ – PM Peak**

- 5.5.7. Table 5-6 and Table 5-7 show the number of junctions and links which are impacted as a result of the ULEZ in line with the thresholds table.
- 5.5.8. Figure 5-5 and Figure 5-8 display the locations of the adversely affected links and junctions and Figure 5-6 and Figure 5-9 the beneficially affected in the AM and PM peaks.
- 5.5.9. Overall there are the following adversely affected junction and links which have been classified as moderate and significant:
- AM Peak
    - 44 Links
    - 9 Junctions
  - PM Peak
    - 31 Links
    - 14 Junctions
- 5.5.10. The location of these links and junctions are illustrated in Figure 5-7 and Figure 5-10.



**Table 5-4: AM Peak Number of Links and Junctions by Impact Threshold**

Assessed Element	Impact Measure	Impact	No Change	Negligible	Minor	Moderate	Significant	Total	
Links	Actual Flow (% change)	Adverse	6019	360	58	10	14	6775	
		Beneficial		283	27	1	3		
	Volume over Capacity (w/c threshold change)	Adverse	6624	74	3	4	4	6775	
		Beneficial		57	2	5	2		
	Volume over Capacity (% point change)	Adverse	6609	72	13	6	4	6775	
		Beneficial		49	7	4	11		
	Total Vehicle Hours Delay (% change)	Adverse	5448	603	108	20	20	6775	
		Beneficial		489	65	11	11		
	Total number of unique links exhibiting a "Significant" impact across all impact measures							Adverse	23
								Beneficial	16
	Total number of unique links exhibiting a "Moderate" or "Significant" impact across all impact measures						Adverse		44
							Beneficial		27
	Total number of unique links exhibiting a "Minor", "Moderate" or "Significant" impact across all impact measures					Adverse			163
						Beneficial			92
Junctions	Volume over Capacity (w/c threshold change)	Adverse	3037	20	1	1	1	3077	
		Beneficial		14	0	2	1		
	Volume over Capacity (% point change)	Adverse	3036	20	3	1	0	3077	
		Beneficial		7	4	4	2		
	Total Vehicle Hours Delay (% change)	Adverse	2669	188	29	2	6	3077	
		Beneficial		159	15	5	4		
	Total number of unique junctions exhibiting a "Significant" impact across all impact measures							Adverse	6
								Beneficial	4
	Total number of unique junctions exhibiting a "Moderate" or "Significant" impact across all impact measures						Adverse		9
							Beneficial		10
Total number of unique junctions exhibiting a "Minor", "Moderate" or "Significant" impact across all impact measures					Adverse			37	
					Beneficial			24	



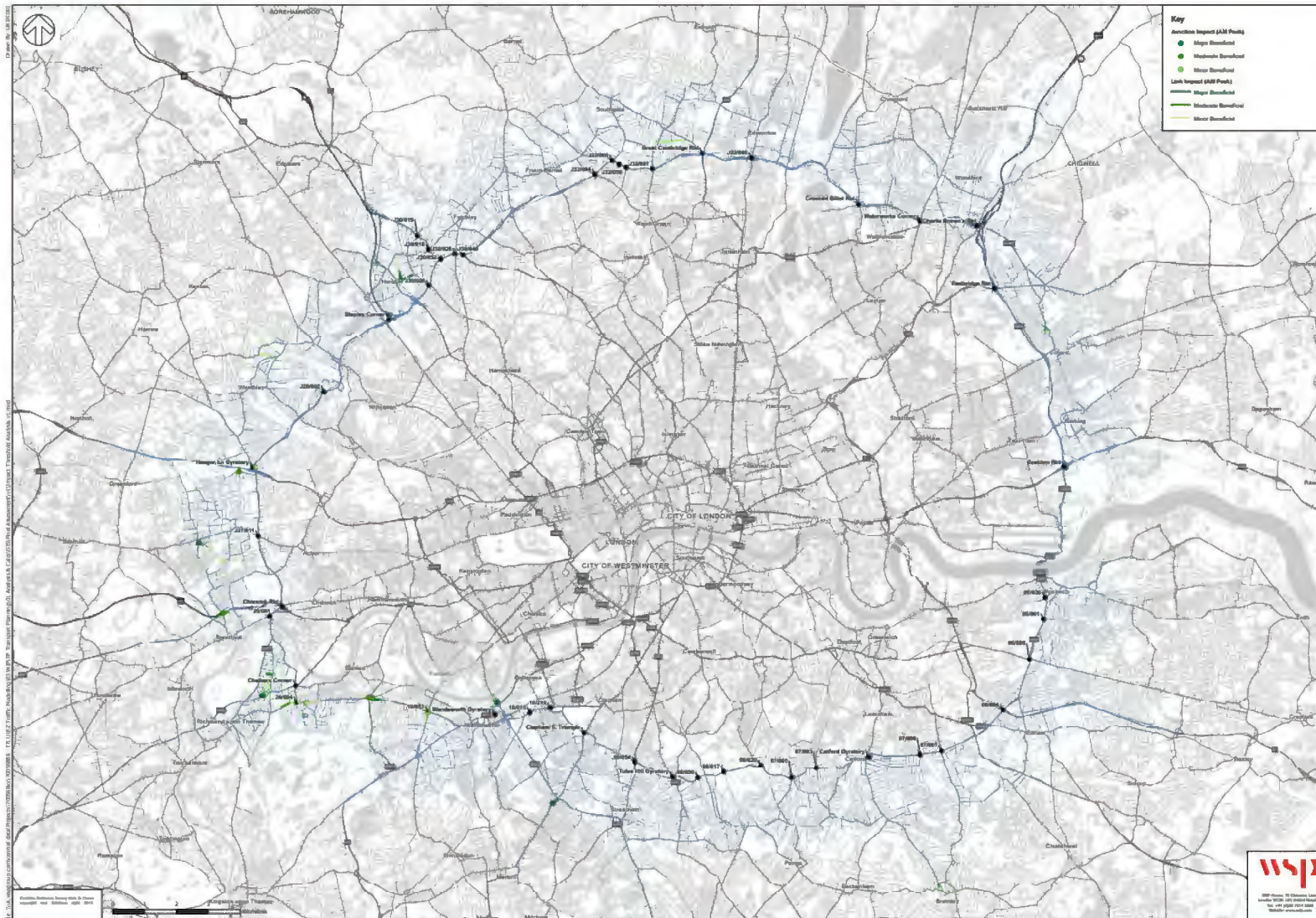
**Table 5-5: PM Peak Number of Links and Junctions by Impact Threshold**

Assessed Element	Impact Measure	Impact	No Change	Negligible	Minor	Moderate	Significant	Total	
Links	Actual Flow (% change)	Adverse	6133	314	26	2	6	6775	
		Beneficial		275	17	0	2		
	Volume over Capacity (w/c threshold change)	Adverse	6693	44	5	3	2	6775	
		Beneficial		22	4	0	2		
	Volume over Capacity (% point change)	Adverse	6676	49	5	1	9	6775	
		Beneficial		26	4	2	3		
	Total Vehicle Hours Delay (% change)	Adverse	5555	560	77	13	14	6775	
		Beneficial		490	58	4	4		
	Total number of unique links exhibiting a "Significant" impact across all impact measures							Adverse	16
								Beneficial	7
	Total number of unique links exhibiting a "Moderate" or "Significant" impact across all impact measures						Adverse	31	
							Beneficial	12	
	Total number of unique links exhibiting a "Minor", "Moderate" or "Significant" impact across all impact measures					Adverse	112		
						Beneficial	73		
Junctions	Volume over Capacity (w/c threshold change)	Adverse	3055	13	2	0	0	3077	
		Beneficial		7	0	0	0		
	Volume over Capacity (% point change)	Adverse	3051	11	4	0	3	3077	
		Beneficial		6	0	0	2		
	Total Vehicle Hours Delay (% change)	Adverse	2684	189	27	6	8	3077	
		Beneficial		140	20	3	0		
	Total number of unique junctions exhibiting a "Significant" impact across all impact measures							Adverse	9
								Beneficial	2
	Total number of unique junctions exhibiting a "Moderate" or "Significant" impact across all impact measures						Adverse	14	
							Beneficial	4	
	Total number of unique junctions exhibiting a "Minor", "Moderate" or "Significant" impact across all impact measures					Adverse	41		
					Beneficial	23			



**Figure 5-5: AM Peak Adverse Impact**





**Figure 5-6: AM Peak Beneficial Impact**



**Figure 5-7: AM Peak Significant and Moderate Adverse Impact**



**Figure 5-8: PM Peak Adverse Impact**



**Figure 5-9: PM Peak Beneficial Impact**



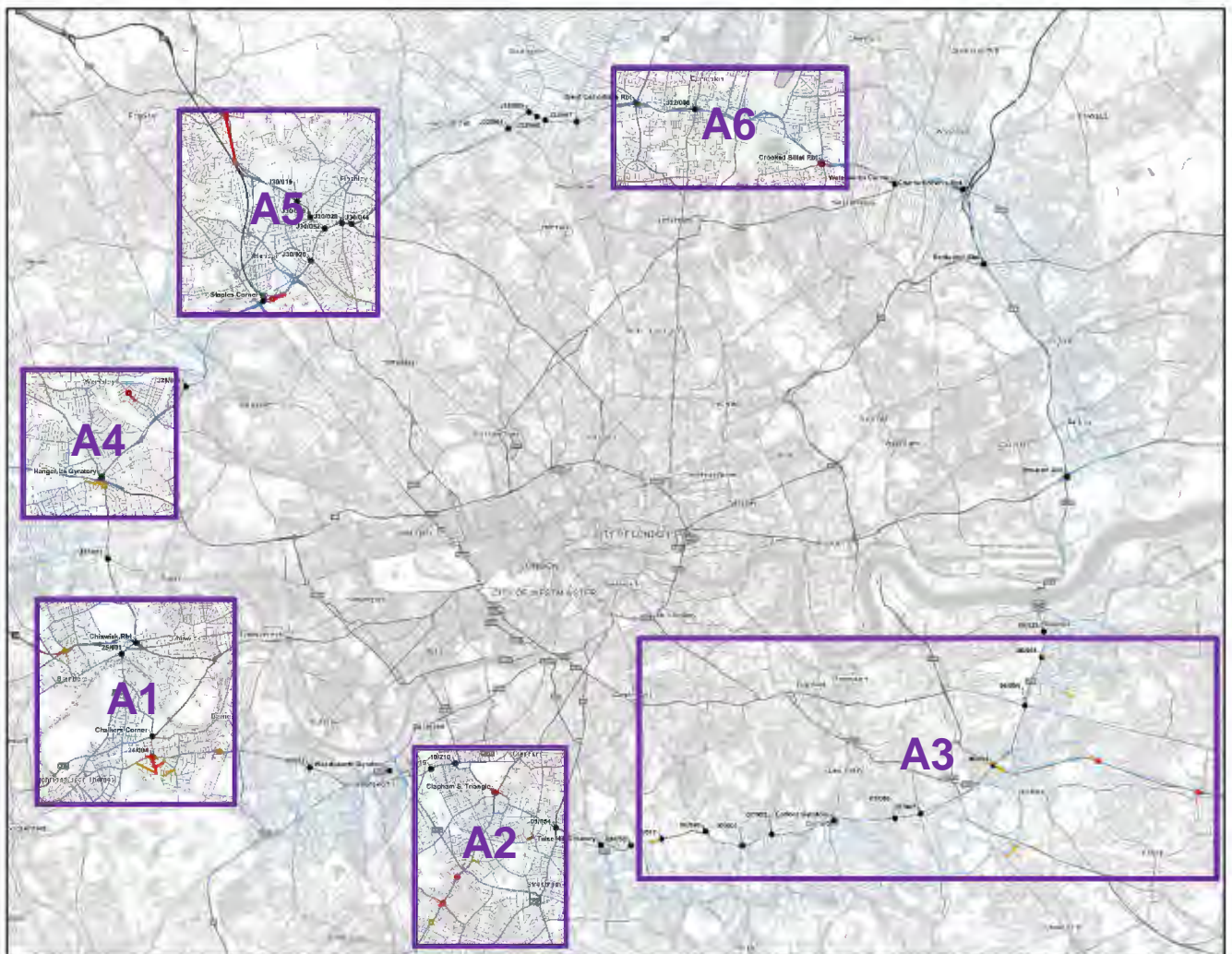
**Figure 5-10: PM Peak Significant and Moderate Adverse Impact**

## 5.6 DETAILED HIGHWAY IMPACT ASSESSMENT

5.6.1. Figure 5-11 shows, to assess the moderate and significant adverse impacts of the ULEZ extension, the locations with any moderate or significant adverse impacts have been grouped into six areas, namely:

- A1. Chalkers Corner and A4 corridor to Chiswick Roundabout (South West London)
- A2. A24 corridor between Merton and Clapham (South London)
- A3. A2 corridor to Eltham and locations near Catford, Lewisham (South East London)
- A4. A40 corridor to Hanger Lane Gyrotory and Wembley (West London)
- A5. A1 corridor to Brent Cross and Staples Corner (North London)
- A6. Crooked Billet Roundabout and Great Cambridge Roundabout (North East London)

5.6.2. A discussion of the impacts in each of these areas follows, beginning with Area 1.



**Figure 5-11: Locations of Moderate or Significant Adverse Impacts** (AM and PM peak impacts combined)

## A1. CHALKERS CORNER AND A4 CORRIDOR TO CHISWICK ROUNDABOUT

5.6.3. Area 1 has been subdivided into three sub-areas:

- 1a) Chalkers Corner
- 1b) Priests Bridge
- 1c) A4 corridor to Chiswick Roundabout

5.6.4. Figure 5-12 and Figure 5-13 show the links and junctions which have a moderate or significant adverse impact in the AM and PM peak hours in each area.

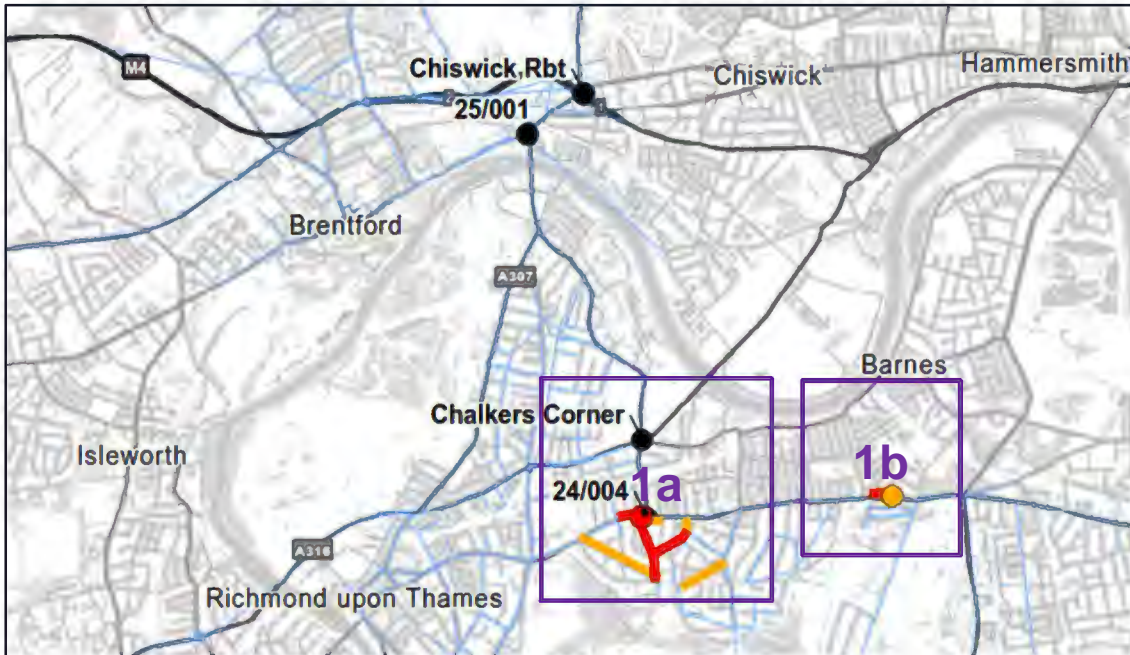


Figure 5-12: Area 1: Sub-area Definitions and ULEZ Impacts (AM Peak)

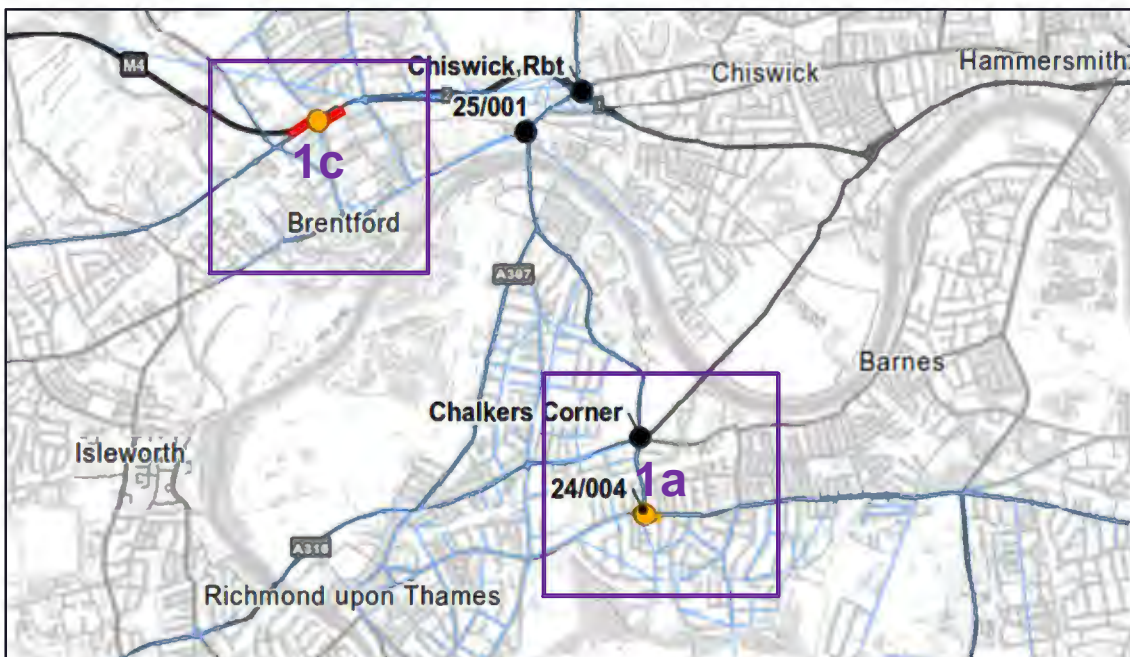
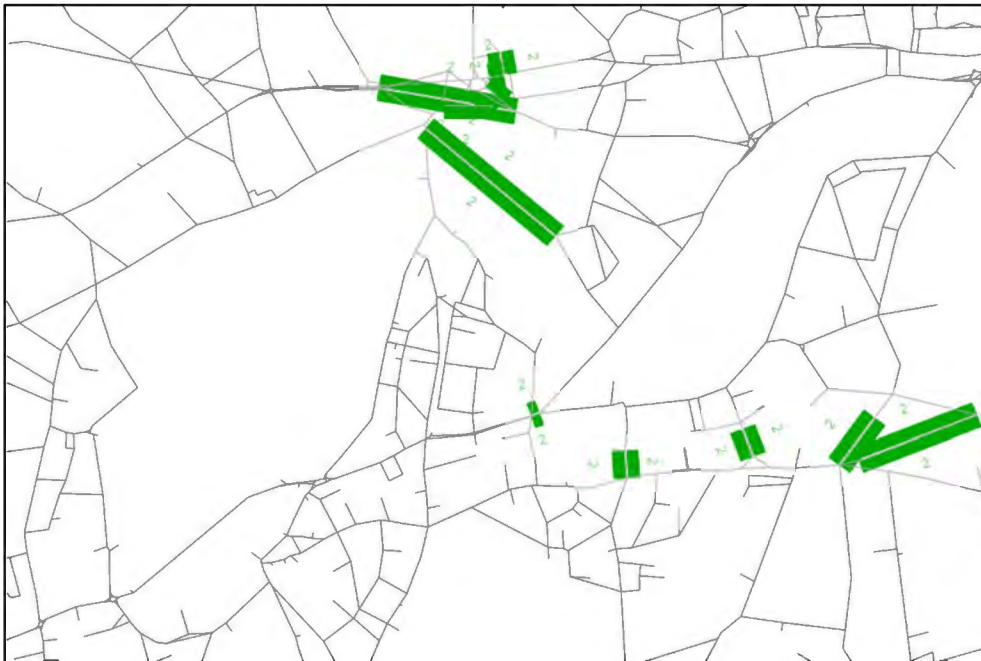


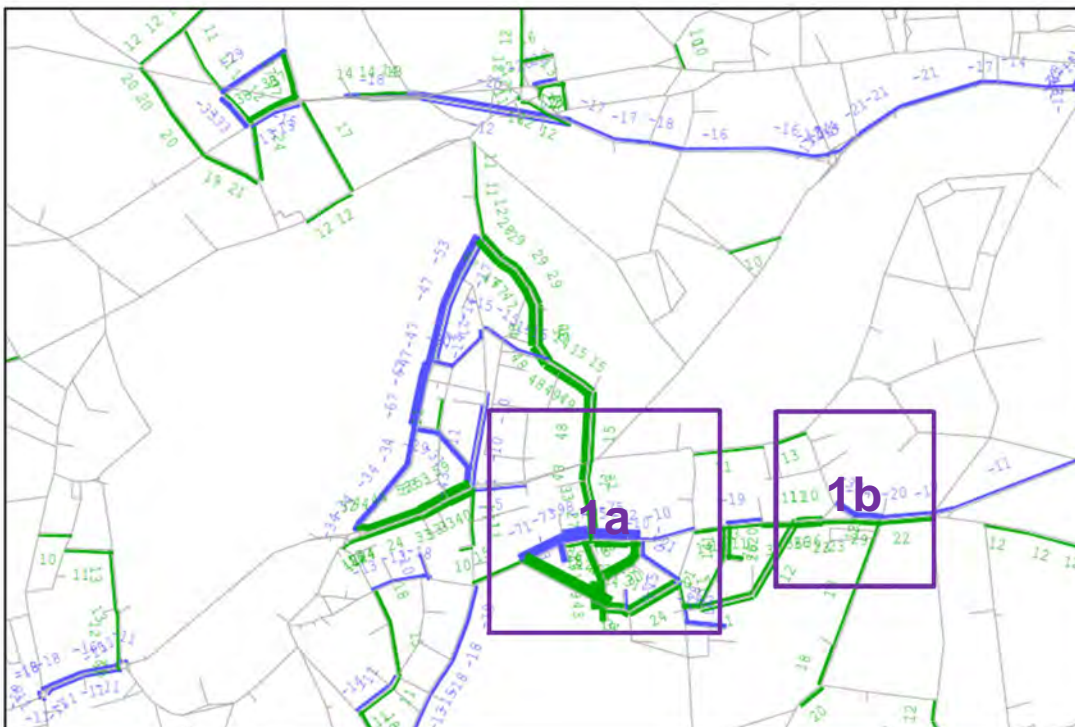
Figure 5-13: Area 1: Sub-area Definitions and ULEZ Impacts (PM Peak)

5.6.5. Figure 5-14 shows Area 1 and the location of the ULEZ boundary.



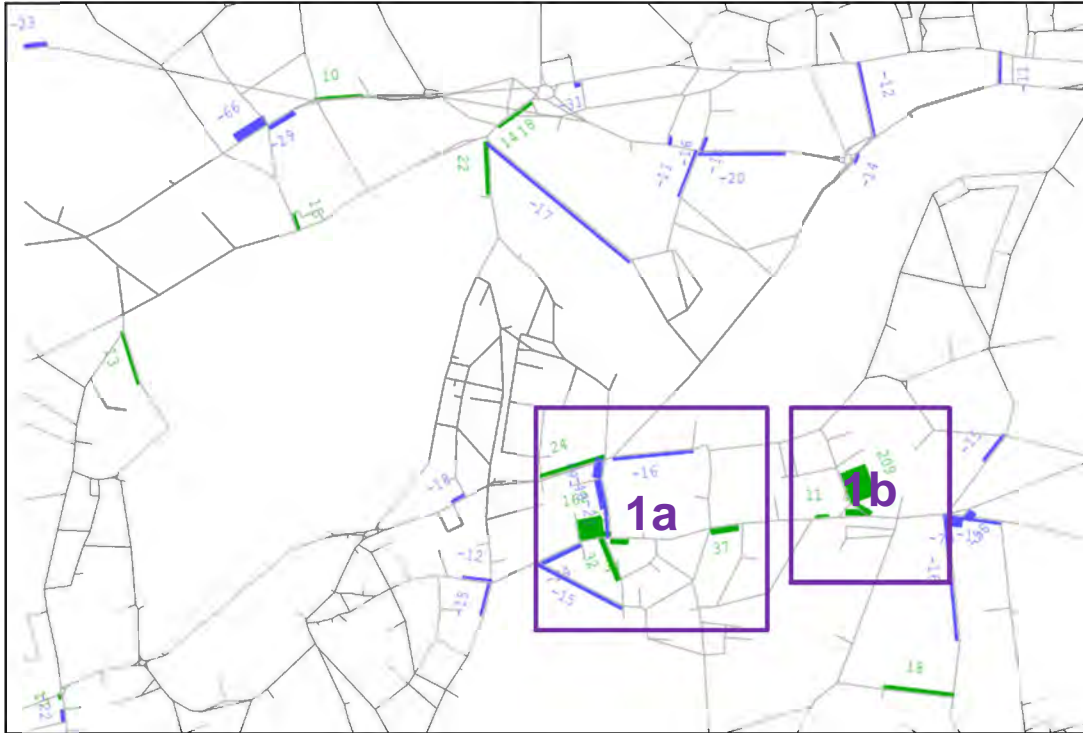
**Figure 5-14: Area 1 ULEZ Boundary**

5.6.6. Figure 5-15 to Figure 5-20 show comparisons of actual flow, link delay and link V/C in Area 1 between the DM and DS, blue bands show a reduction and green show an increase

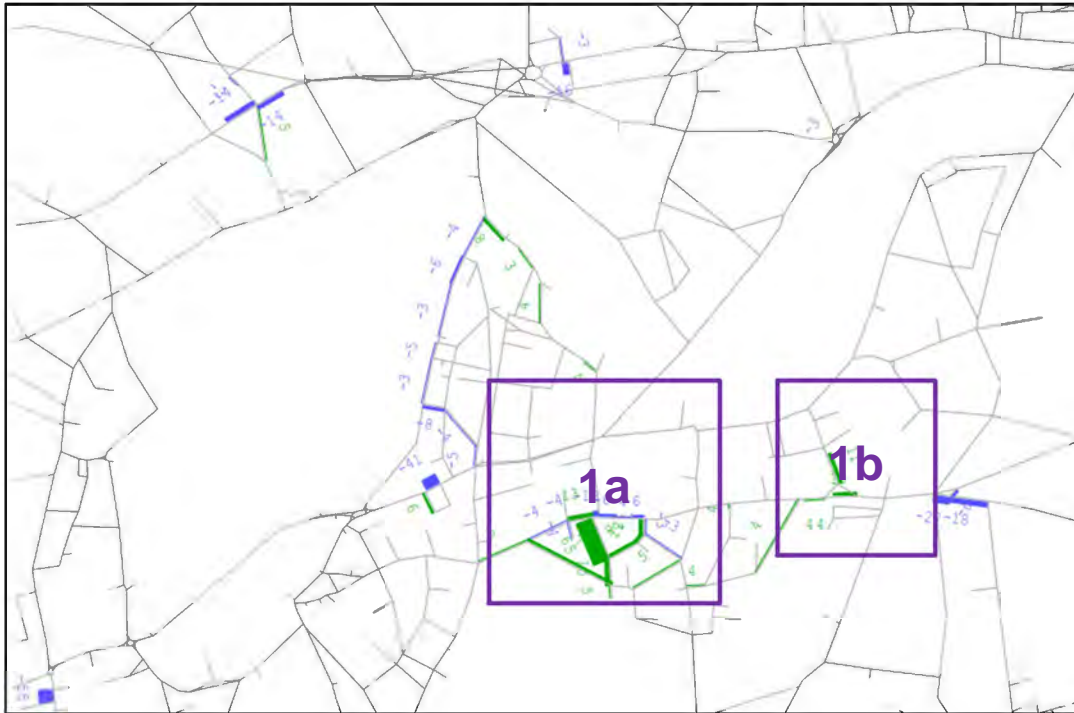


**Figure 5-15: Area 1: Actual Flow Difference (AM Peak)**

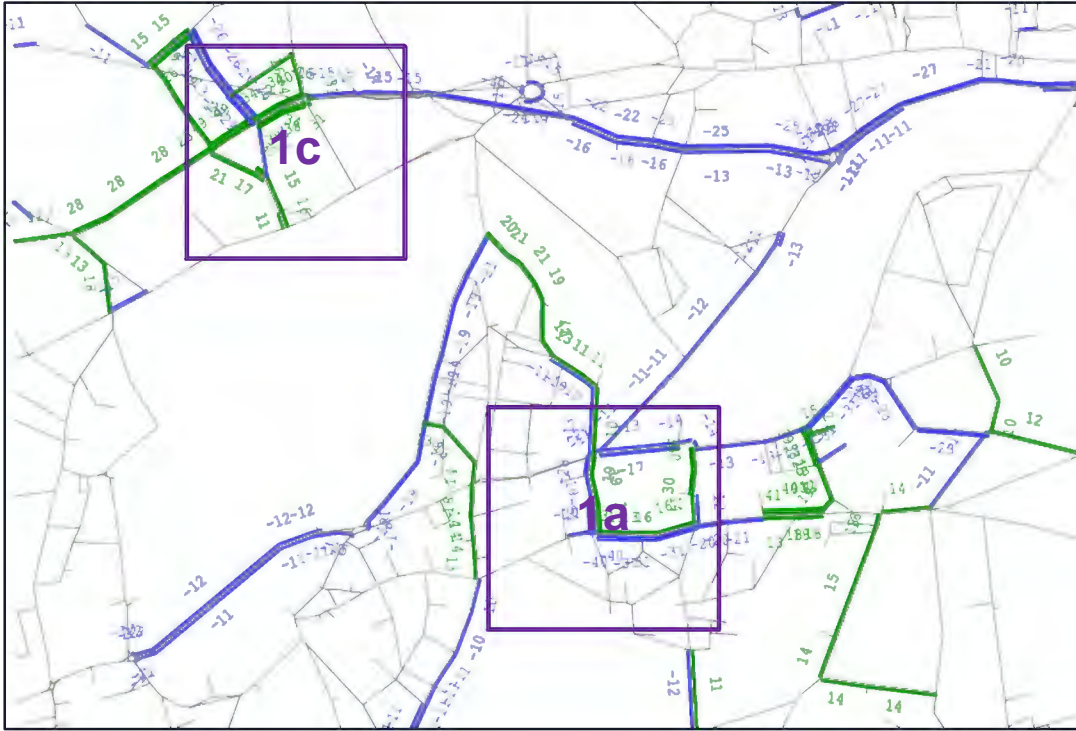




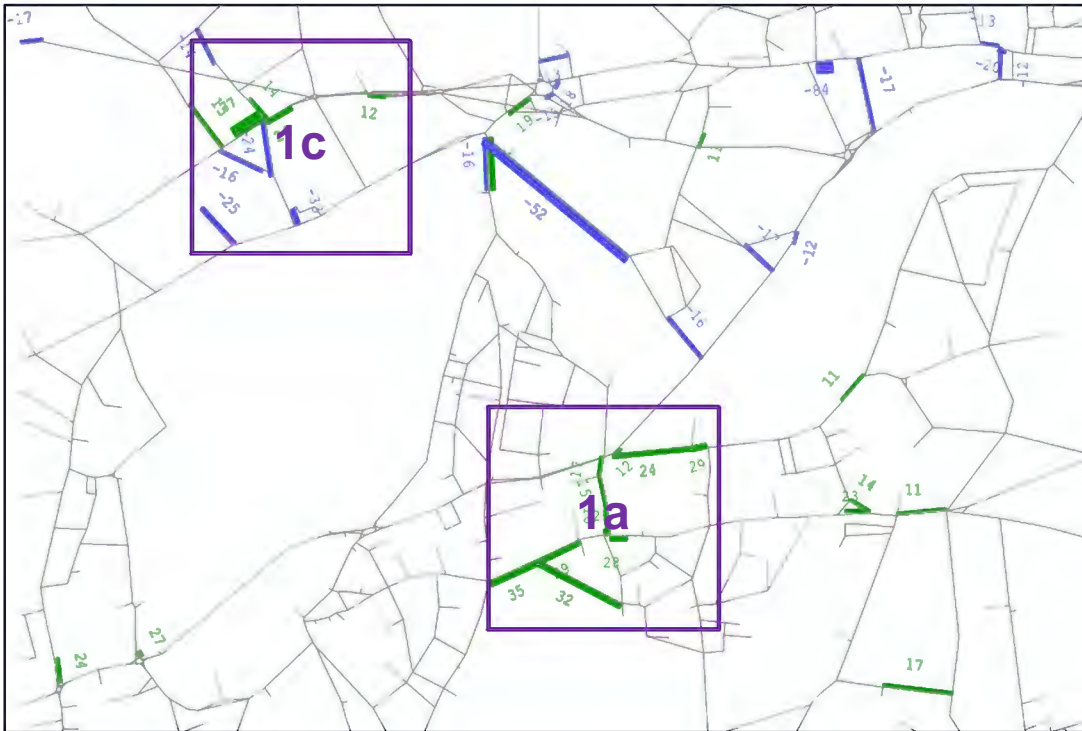
**Figure 5-16: Area 1: Link Delay Difference (AM Peak)**



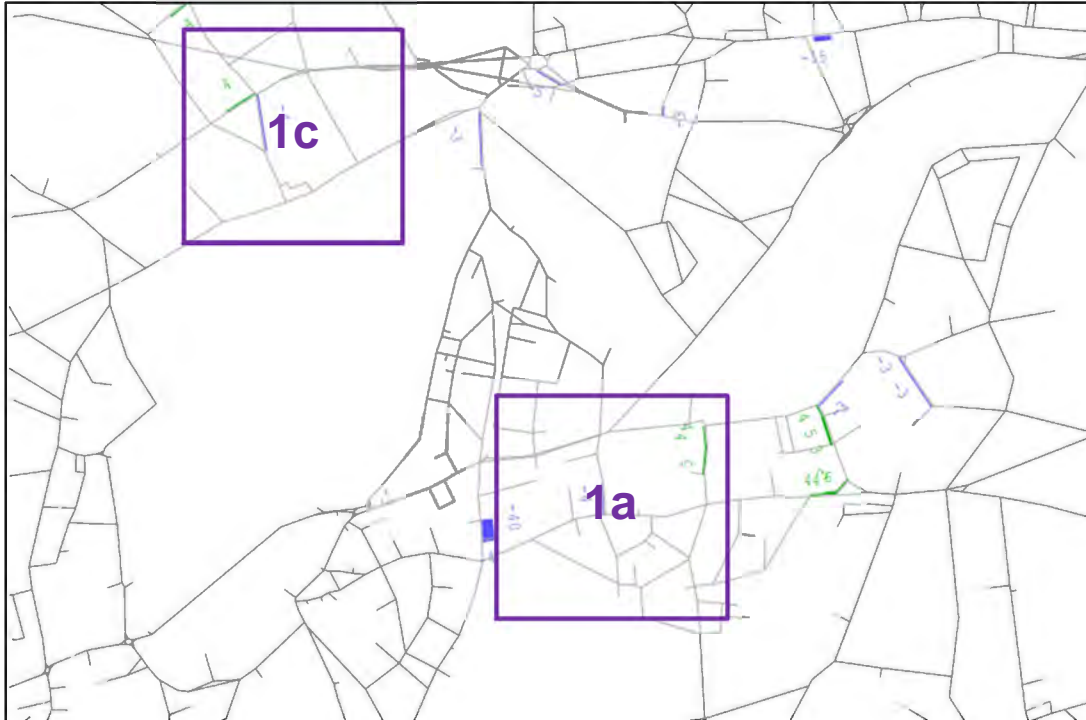
**Figure 5-17: Area 1: Link V/C Difference (AM Peak)**



**Figure 5-18: Area 1: Actual Flow Difference (PM Peak)**



**Figure 5-19: Area 1: Link Delay Difference (PM Peak)**

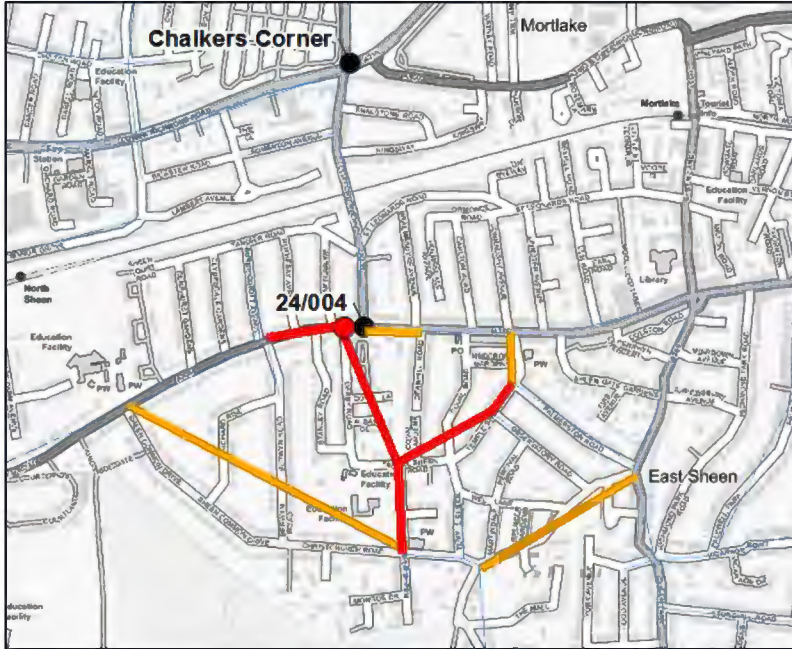


**Figure 5-20: Area 1: Link V/C Difference (PM Peak)**

5.6.7. The impacts within each of these sub-areas is now discussed in turn, starting with Area 1a.

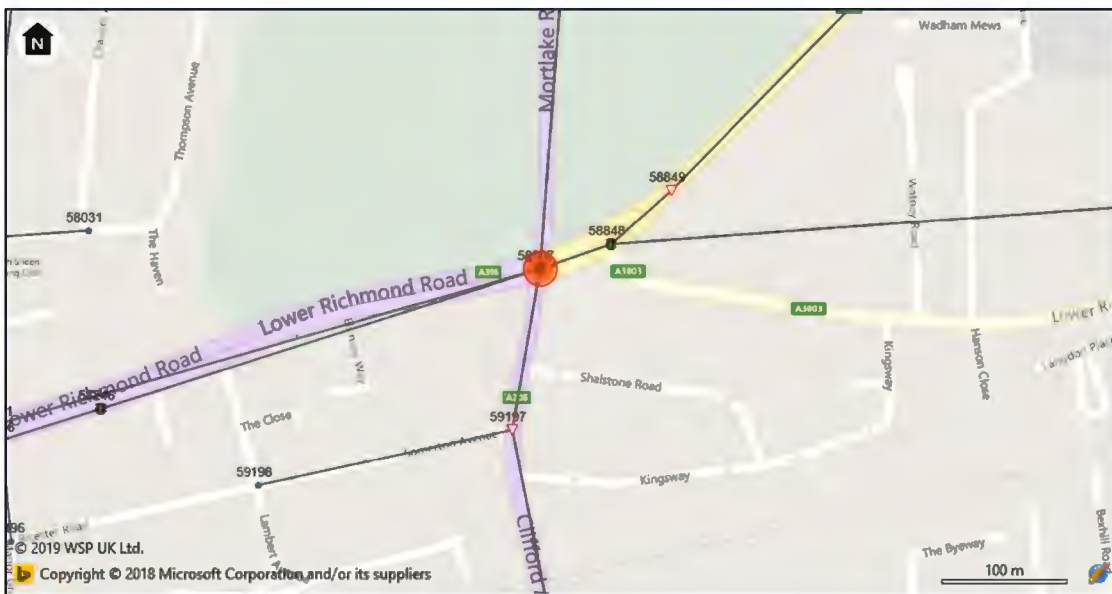
Area 1a) Chalkers Corner – AM Peak

5.6.8. As shown in Figure 5-21, the Moderate and Significant Adverse impacts in the AM peak in Area 1a are concentrated in an area just to the south of Chalkers Corner.



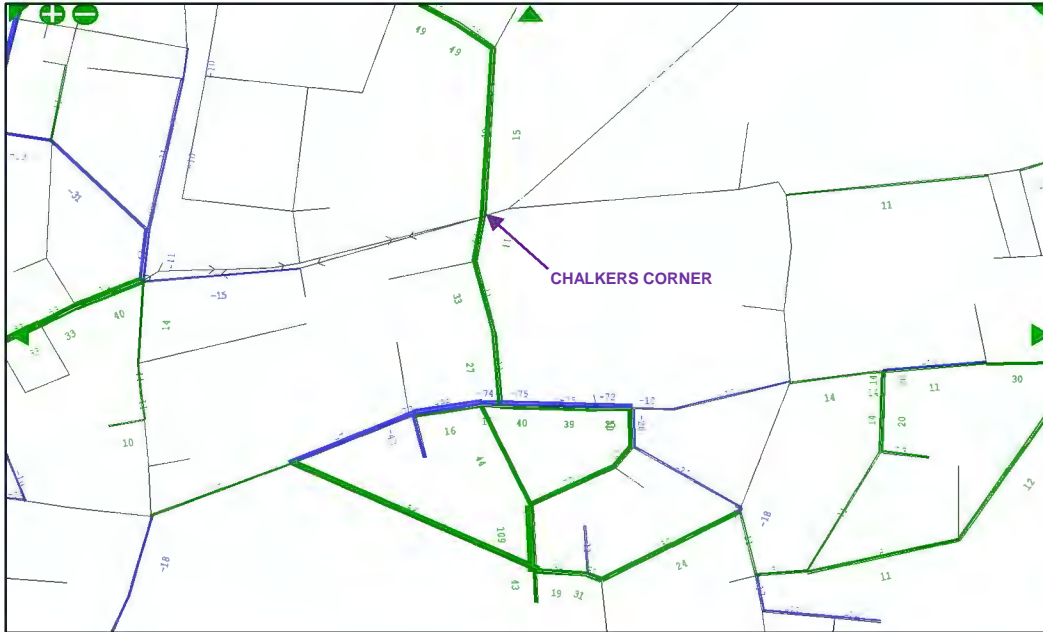
**Figure 5-21: Area 1a: ULEZ Impacts (AM Peak)**

5.6.9. At Chalkers Corner, located as shown in Figure 5-22, in the DS compared to the DM, there is additional traffic flow (up to +50 PCU/hr) on the A205 South Circular Road northbound (on the southern approach (A205 Clifford Avenue) to the A316 Lower Richmond Road junction) going straight-ahead (south-north) at the traffic signals in the AM peak.



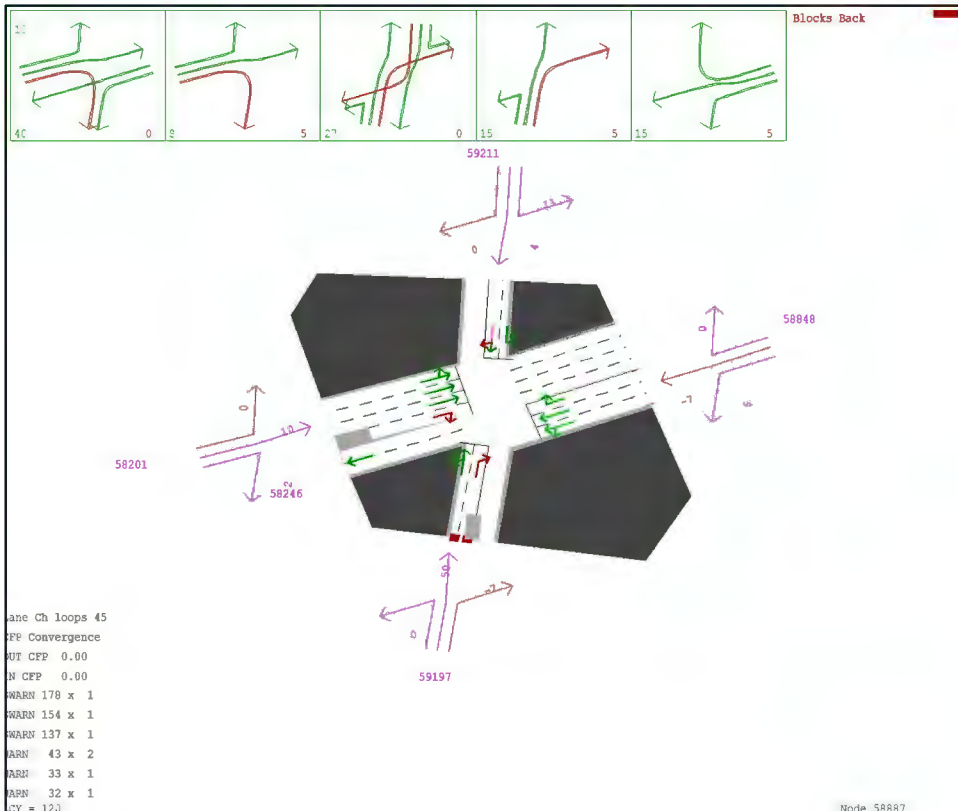
**Figure 5-22: Node 58887 Location (Chalkers Corner)**

5.6.10. This additional traffic flow is illustrated in Figure 5-23.



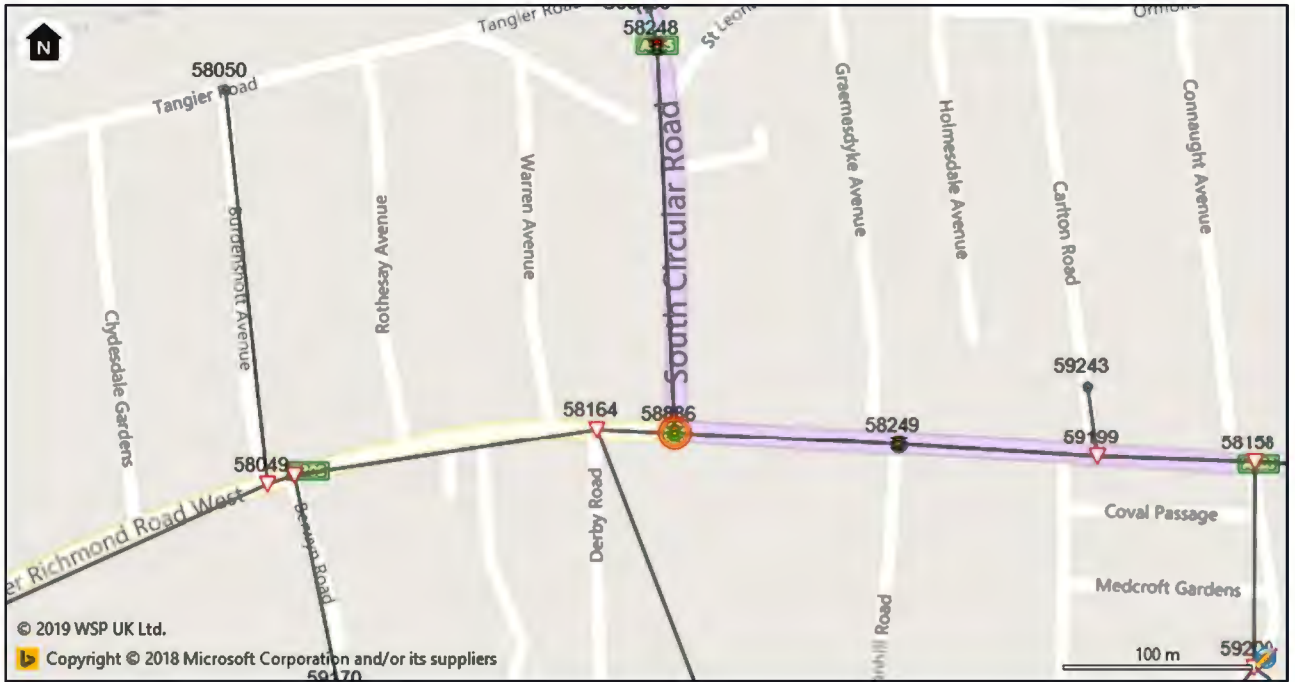
**Figure 5-23: AM Peak Actual Flow Difference DS vs DM at Chalkers Corner**

5.6.11. AM peak turning flow differences at Chalkers Corner between the DS and DM are shown in Figure 5-24, illustrating the additional +50PCU/hr on the A205 South Circular Road northbound and the consequential blocking back (queueing) to the south of the junction (northbound approach).

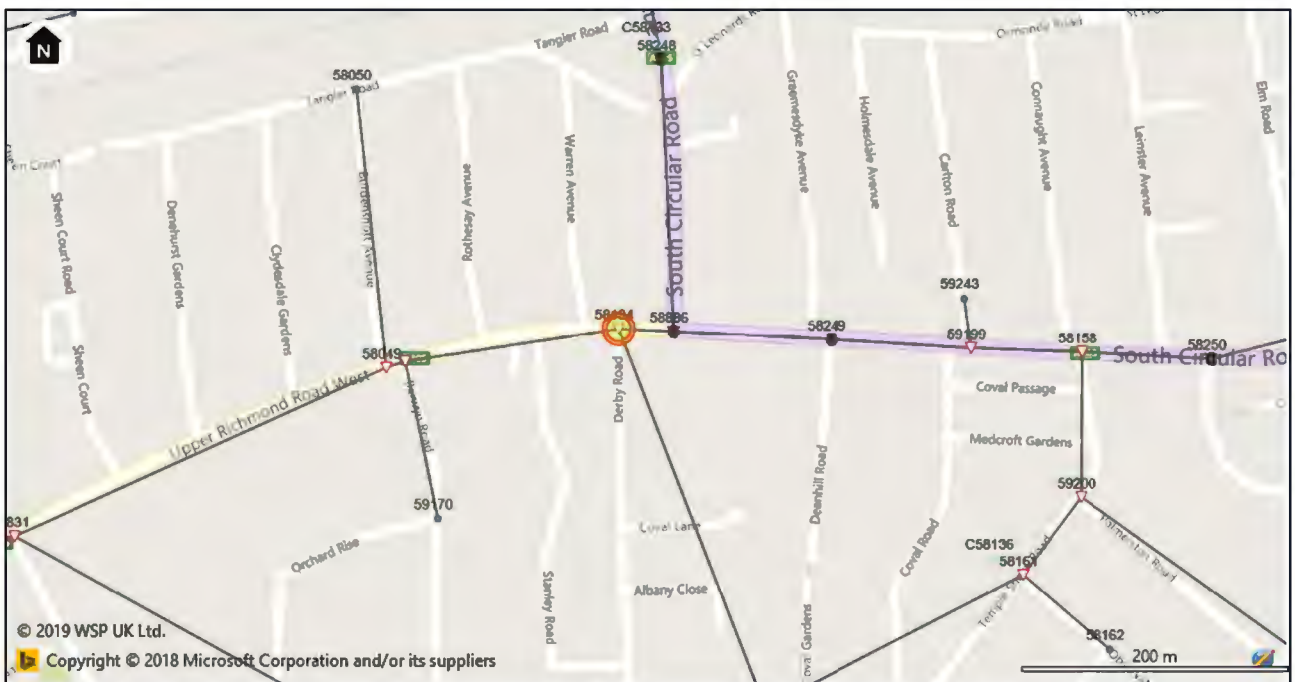


**Figure 5-24: AM Peak Turning Flow Differences DS vs DM at Chalkers Corner**

5.6.12. In the AM peak, this additional northbound traffic flow causes blocking back (queuing) on the A205 South Circular Road to extend further back from node 58886 (located as shown in Figure 5-25) to the A305 Upper Richmond Road West / Derby Road junction (located as shown in Figure 5-26).



**Figure 5-25: Node 58886 (A205 South Circular Road / A305 Upper Richmond Road West)**

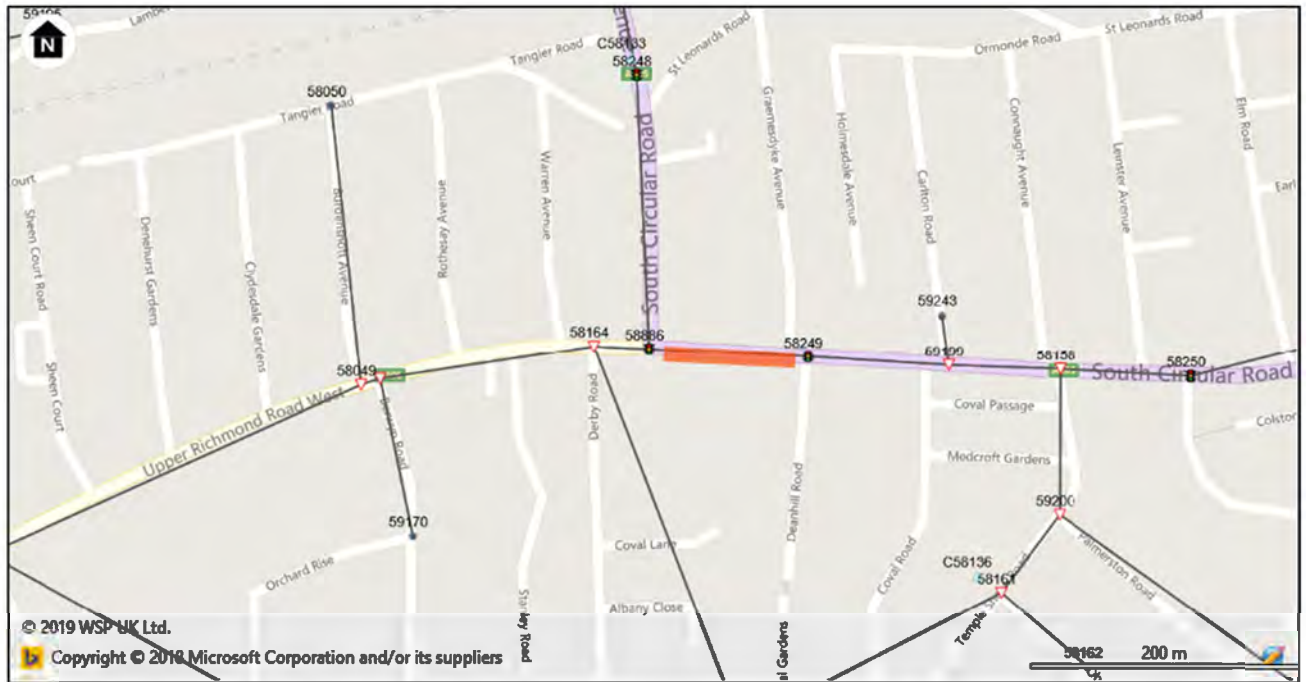


**Figure 5-26: Node 58164 (A305 Upper Richmond Road West / Derby Road)**

5.6.13. In the AM peak, node 58164 (A305 Upper Richmond Road West / Derby Road), located as shown in Figure 5-26, exhibits a Significant Adverse increase in total vehicle hours delay of +263% or +14 hours. This is due to blocking back (queueing) extending from the adjacent junction to the east

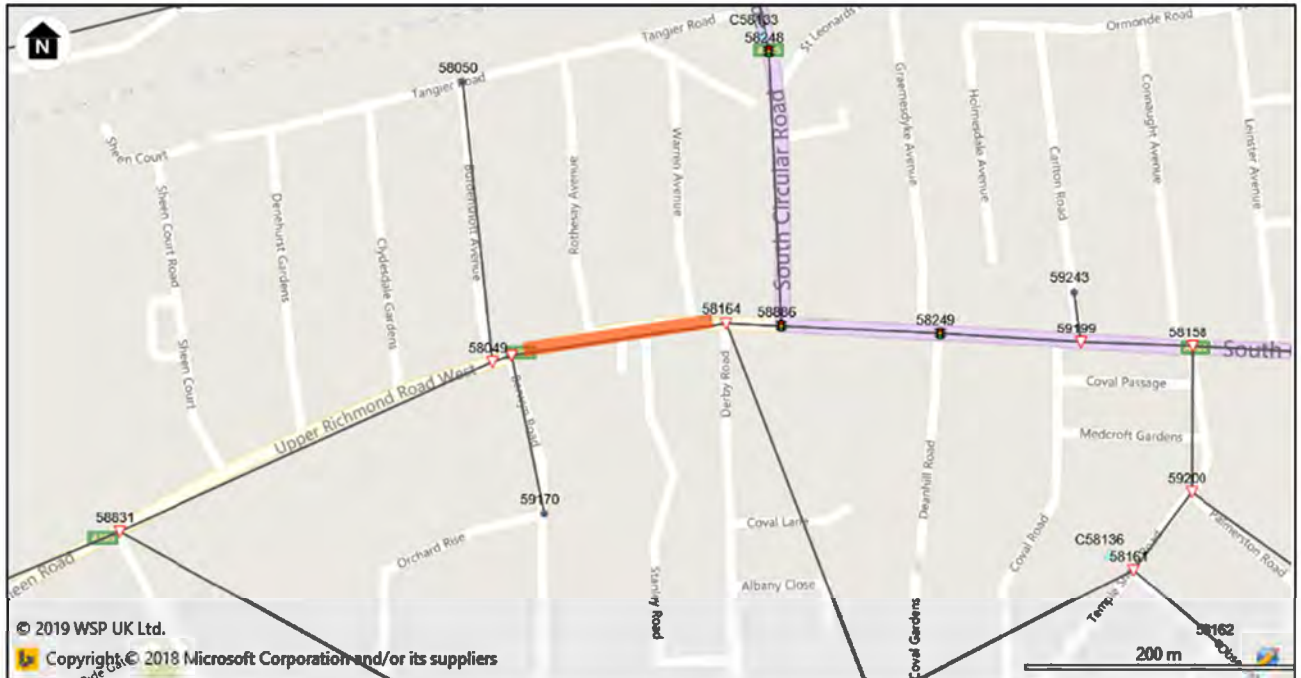
(A205 South Circular Road / A305 Upper Richmond Road West) and from the Chalkers Corner junction to the north (Figure 5-22).

- 5.6.14. Adjacent to these two junctions, link 58249-58886 (westbound approach to A205 South Circular Road / A305 Upper Richmond Road West), located as shown in Figure 5-27, exhibits a Moderate Adverse increase in total vehicle delay (+35% or +7 hours) due to an increase in actual flow of +40 PCU/hr (+7%) and an increase in delay (+34 seconds) in the AM peak.



**Figure 5-27: Link 58249-58886 (westbound approach to A205 South Circular Road / A305 Upper Richmond Road West)**

- 5.6.15. In the AM peak, link 59194-58164 (A305 Upper Richmond Road West eastbound) exhibits a Moderate Adverse impact in V/C (+13%) and a Significant Adverse impact in total vehicle delay (+269% or +13 hours). The link is located as shown in Figure 5-28. This is also due to the blocking back (queueing) extending down from Chalkers Corner to the north (Figure 5-22).



**Figure 5-28: Link 59194-58164 (A305 Upper Richmond Road West eastbound)**

- 5.6.16. Another adverse consequence of the additional traffic on the A205 South Circular Road, as well as delays and blocking back (queueing) from the A205 Clifford Avenue / A316 Lower Richmond Road junction, is that traffic heading eastbound along the A316 Upper Richmond Road to the A205 South Circular Road eastbound reassigns to other local roads in the area. In the AM peak up to 90 PCU/hr switches from the A205 South Circular Road, to local roads such as Sheen Lane, Palmerston Road, Temple Sheen Road, Derby Road and Sheen Common Drive, as illustrated in Figure 5-23.



5.6.17. Expanding on this issue, in the AM peak, link 58163-58164 (Derby Road northbound), located as shown in Figure 5-29, exhibits a Significant Adverse impact in V/C (+65%) and a Significant Adverse impact in actual flow (+339% or +44 PCU/hr) due to traffic reassignment in the local area.

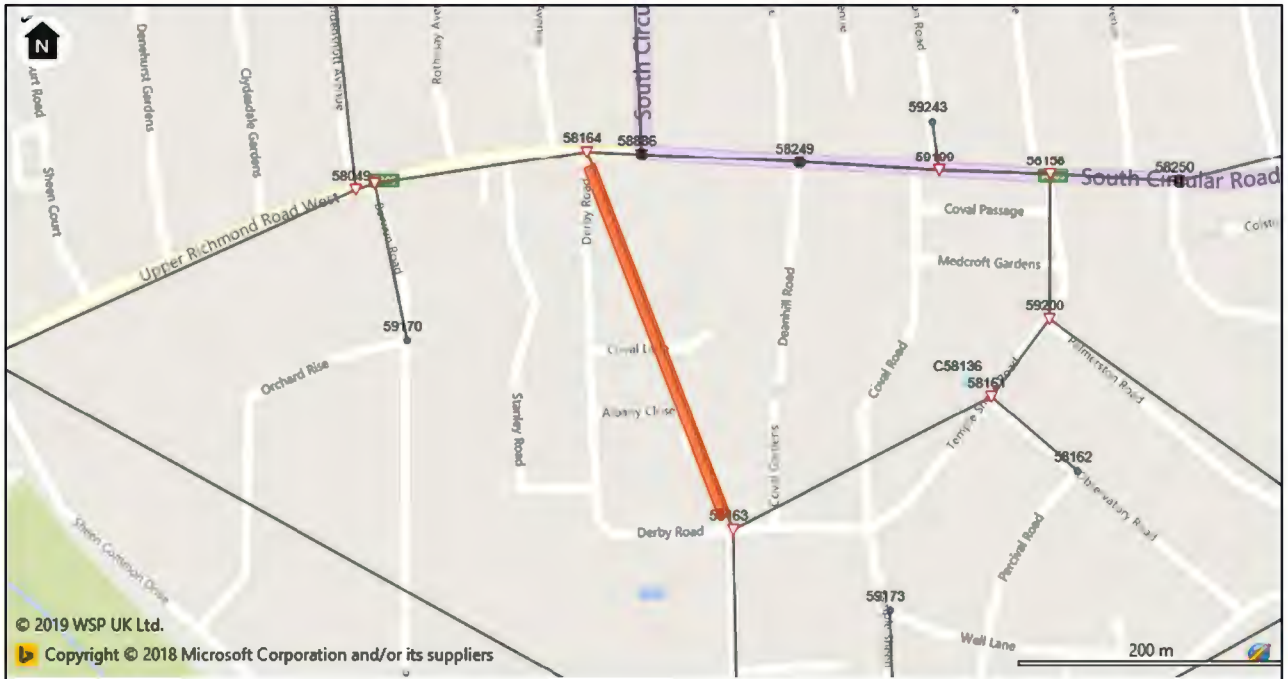


Figure 5-29: Link 58163-58164 (Derby Road northbound)

5.6.18. In the AM peak, link 58306-58163 (West Temple Sheen northbound), located as shown in Figure 5-30, exhibits a Significant Adverse increase in actual flow (+135% or +109 PCU/hr) and a Moderate Adverse increase in V/C (+15%) due to traffic reassignment in the local area.

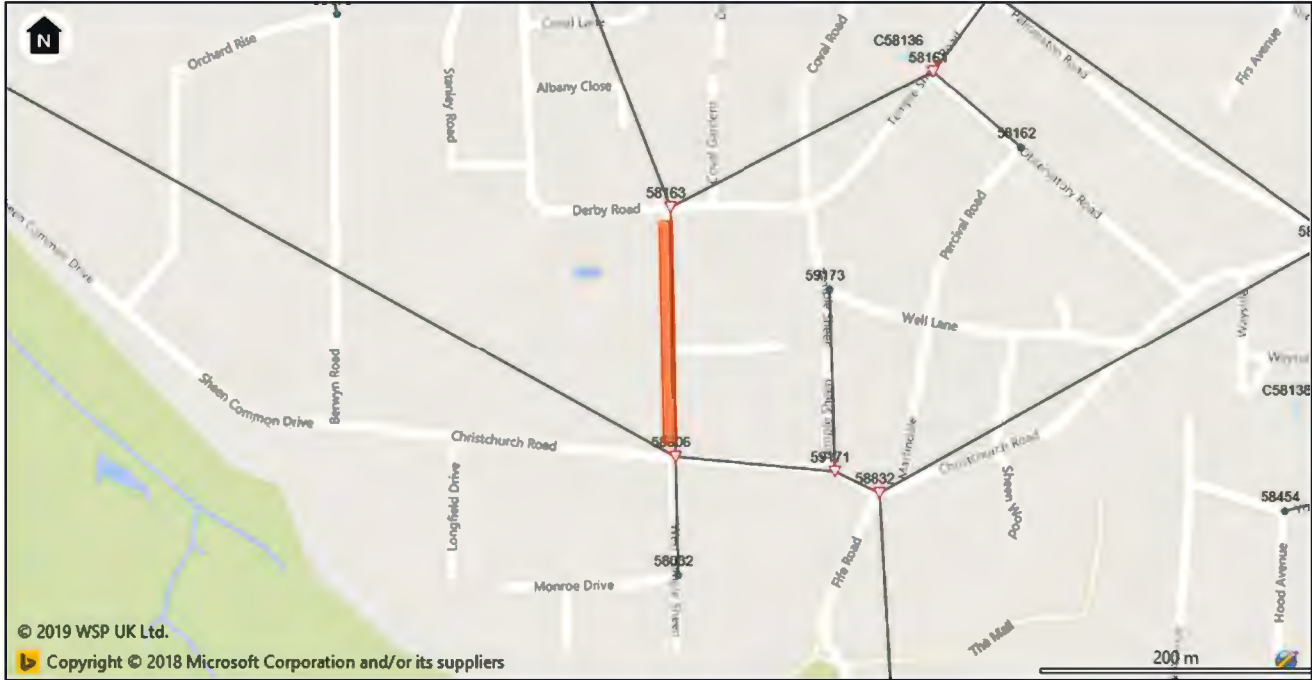
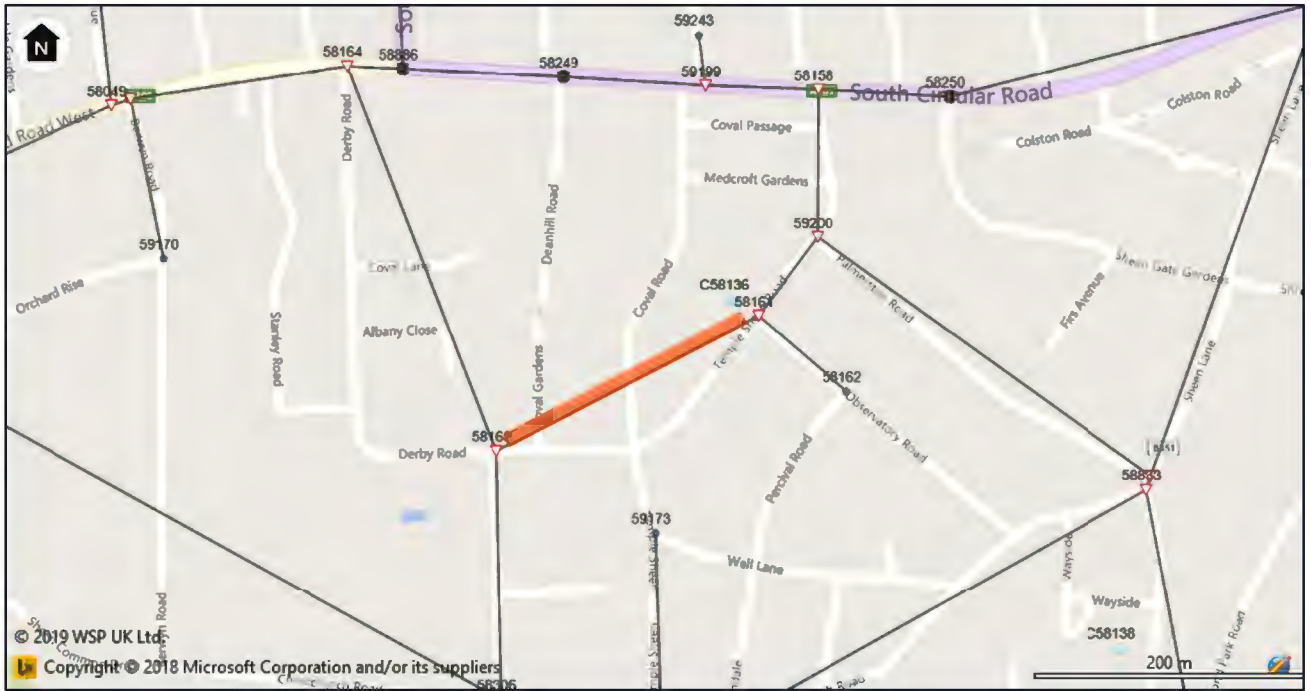


Figure 5-30: Link 58306-58163 (West Temple Sheen northbound)

5.6.19. In the AM peak, link 58163-58161 (Temple Sheen Road eastbound) exhibits a Significant Adverse increase in actual flow (+85% or +70 PCU/hr) due to traffic reassignment in the local area, see Figure 5-31.



**Figure 5-31: Link 58163-58161 (Temple Sheen Road eastbound)**

5.6.20. In the AM peak, link 58161-59200 (Temple Sheen northbound) exhibits a Significant Adverse increase in actual flow (+86%) and a Moderate Adverse increase in V/C (+11%) due to traffic reassignment in the local area. See Figure 5-32.



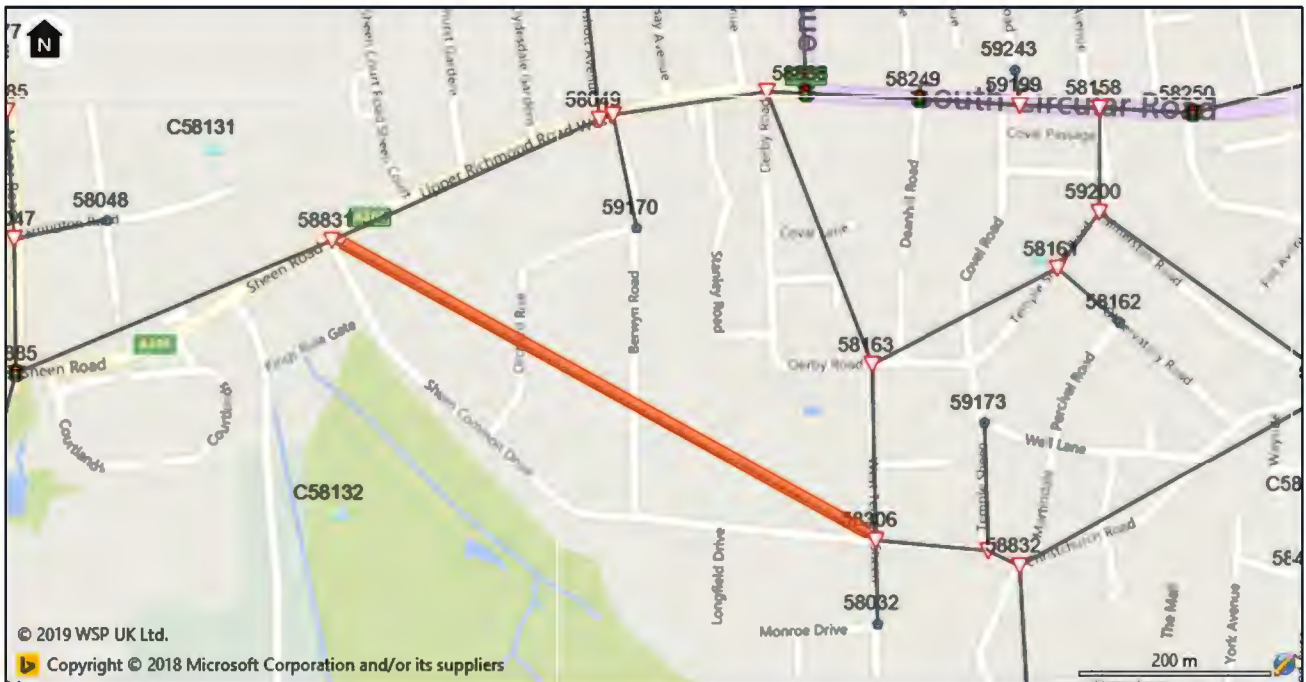
**Figure 5-32: Link 58161-59200 (Temple Sheen Road northbound)**

5.6.21. In the AM peak, there is a Moderate Adverse impact on V/C (+13%) and a Moderate Adverse impact on actual flow (+34% or +58 PCU/hr) due to traffic reassignment in the local area on link 59200-58158 (Temple Sheen Road northbound), located as shown in Figure 5-33.



**Figure 5-33: Link 59200-58158 (Temple Sheen Road northbound)**

5.6.22. In the AM peak, there is a Moderate Adverse impact on actual flow (+32% or +86 PCU/hr) on link 58831-58306 (Sheen Common Drive eastbound) due to traffic reassignment in the local area, located as shown in Figure 5-34.



**Figure 5-34: Link 58831-58306 (Sheen Common Drive eastbound)**

5.6.23. In the AM peak, an additional +24 PCU/hr (+44%) use Christchurch Road westbound (link 58833-58832). This is again due to local traffic reassignment away from the A205 South Circular Road in the local area and leads to a Moderate Adverse impact on actual flow on this link, located as shown in Figure 5-35.



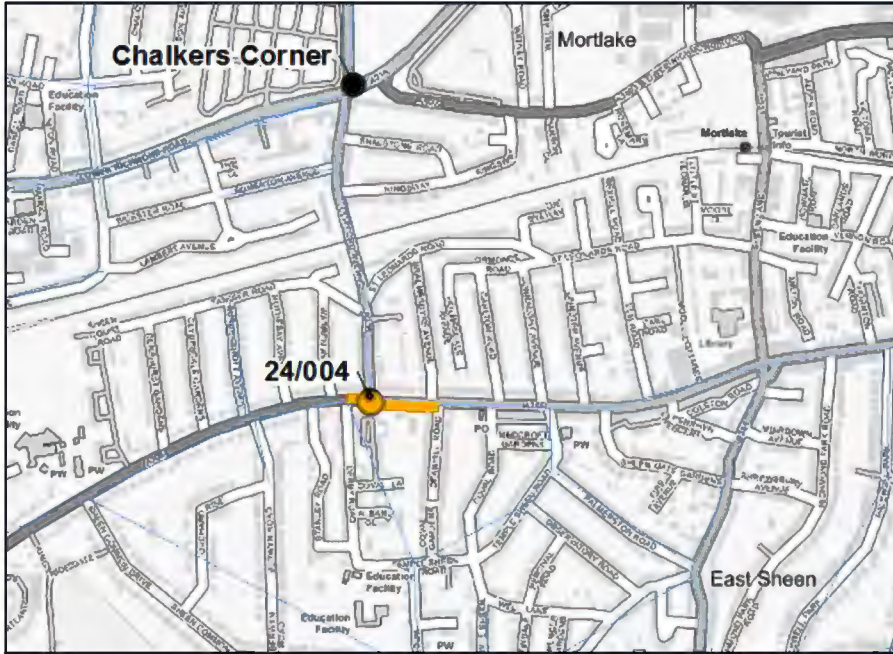
**Figure 5-35: Link 58833-58832 (Christchurch Road westbound)**

Area 1a AM Peak Summary

- 5.6.24. Overall the adverse impacts seen in the AM peak in Area 1a are all a result of the increase in vehicles travelling northbound on the south circular. This generates additional blocking back (queueing) within LoHAM which affects several junctions downstream and results in additional vehicles running on local roads. If mitigation was implemented at Chalkers Corner to mitigate against the impacts of the additional traffic the knock-on impacts would likely be resolved.
- 5.6.25. There are no model convergence issues in either of the AM peak models in Area 1.

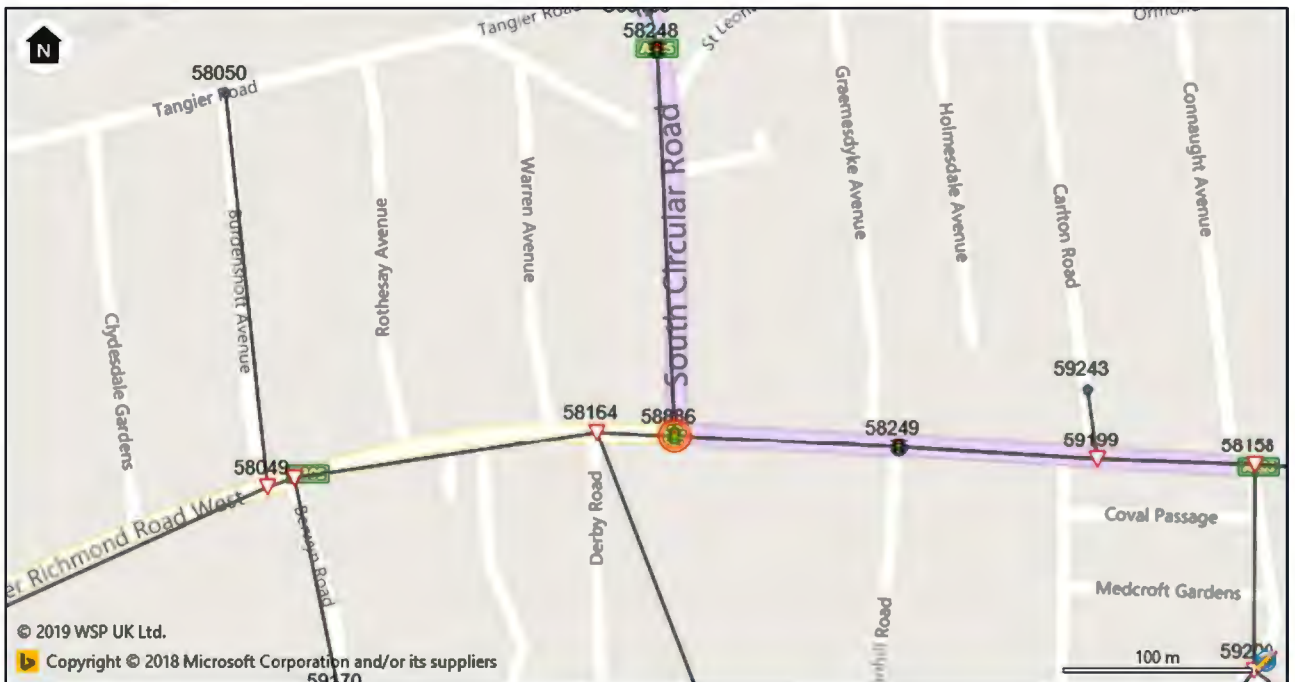
Area 1a) Chalkers Corner – PM Peak

5.6.26. As shown in Figure 5-36, the Moderate and Significant Adverse impacts in the PM peak in Area 1a are concentrated around the A205 South Circular Road / A305 Upper Richmond Road West junction.



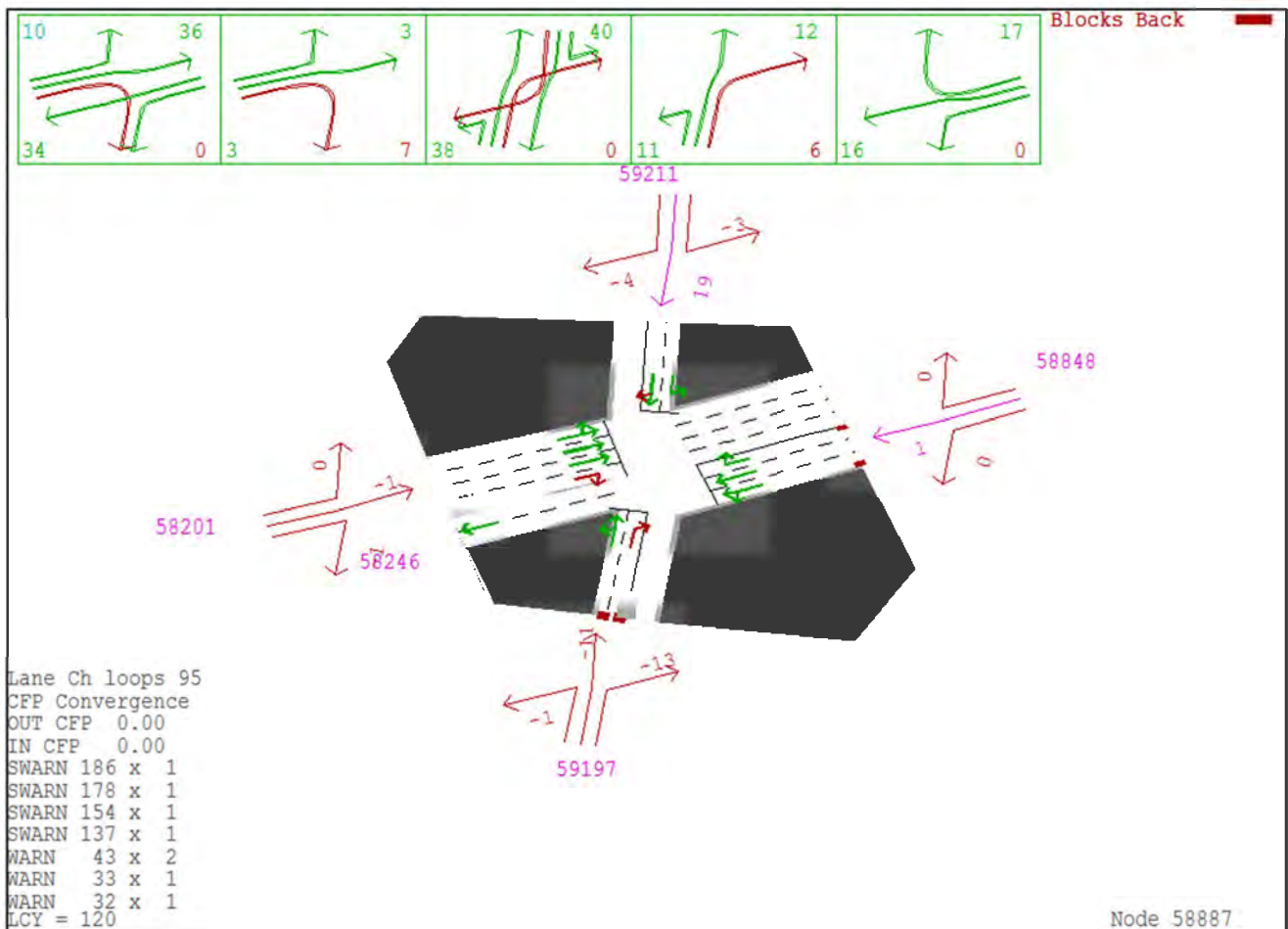
**Figure 5-36: Area 1a: ULEZ Impacts (PM Peak)**

5.6.27. In the PM peak, this junction, node 58886 (A205 South Circular Road / A305 Upper Richmond Road West), located as shown in Figure 5-37, exhibits a Moderate Adverse total vehicle delay impact (+33% or +8 hours).



**Figure 5-37: Node 58886 (A205 South Circular Road / A305 Upper Richmond Road West)**

- 5.6.28. The two links either side of the junction also exhibit Moderate Adverse impacts:
- Link 58164-58886 (eastbound approach to node 58886) suffers a Moderate Adverse total vehicle delay impact (+38% or +3 hours).
  - Link 58249-58886 (westbound approach to node 58886) suffers a Moderate Adverse total vehicle delay impact (+44% or +5 hours).
- 5.6.29. The adverse impacts at the A205 South Circular Road / A305 Upper Richmond Road West junction and on two of its approach links, are due to additional blocking back (queuing) extending down from Chalkers Corner to the north (Figure 5-22) which causes additional delays to northbound traffic on the A205 South Circular Road.
- 5.6.30. To illustrate why there is additional blocking back (queueing) and delays extending down from Chalkers Corner in the PM peak, Figure 5-38 illustrates the turning flow difference at Chalkers Corner. It shows an additional 19 PCU/hr heading southbound through the junction along the A205 South Circular Road, which can be attributed to the impacts of the ULEZ. As the north and southbound arms run in the same signal stage (the third stage) the increase in flow southbound increases the delays for vehicles from the south turning right (+17 seconds delay), increasing the blocking back and delays along the A205 South Circular Road.



**Figure 5-38: PM Peak Turning Flow Differences DS vs DM at Chalkers Corner**

- 5.6.31. There is also delay convergence issues at the Chalkers Corners junction (node 58886) in the PM peak DS model which will be contributing to instabilities in the LoHAM model at this location.

Area 1b) Priests Bridge – AM Peak

5.6.32. As shown in Figure 5-39, the Moderate and Significant Adverse impacts in the AM peak in Area 1b are concentrated on the A205 South Circular Road at its junction with Priests Bridge. As the following analysis shows, these impacts stem back from the junction to its east, namely A205 South Circular Road / Vine Road / Priory Lane.



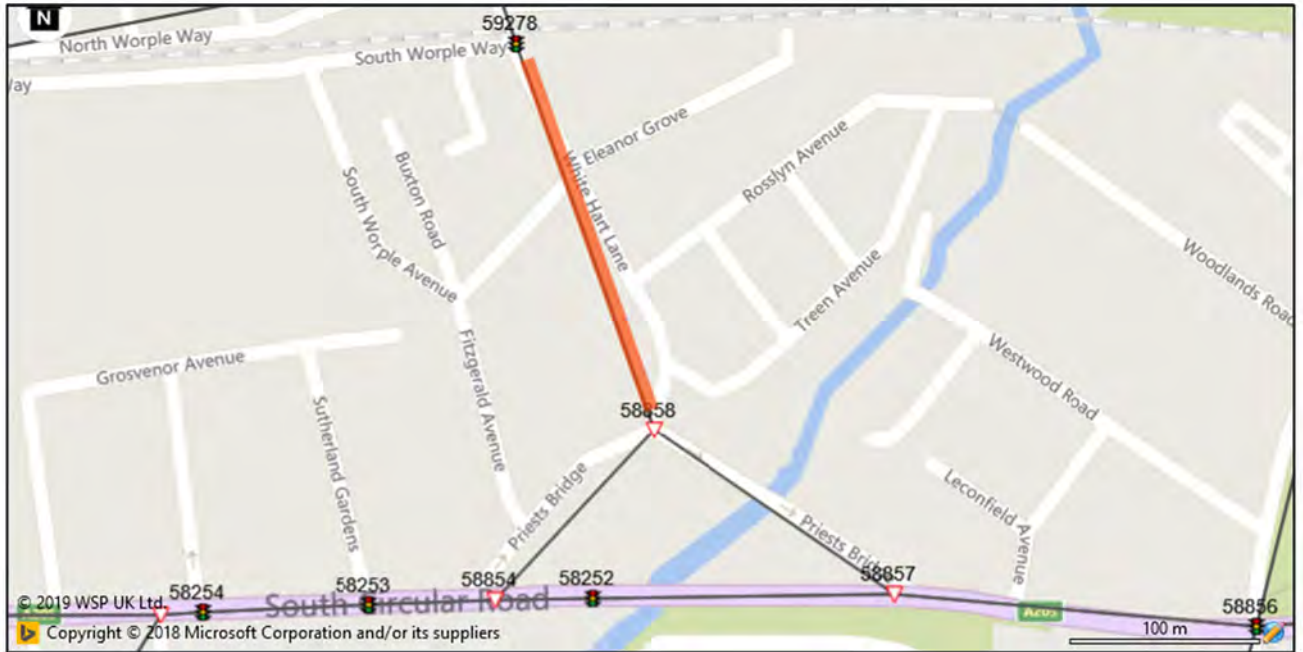
**Figure 5-39: Area 1b: ULEZ Impacts (AM Peak)**

5.6.33. In the AM peak link 58252-58857 (A205 South Circular Road eastbound at Priests Bridge), located as shown in Figure 5-40, exhibits a Significant Adverse impact on total vehicle delay (+220% or +10 hours) and a Moderate Adverse impact on V/C (+10%). The V/C rises from 90% in the DM to 100% in the DS. A Moderate Adverse impact on total vehicle hour's delay is also exhibited at the junction itself (node 58857) with the junction's total vehicle delay rising by +45% or +10 hours.



**Figure 5-40: Link 58252-58857 (A205 South Circular Road eastbound)**

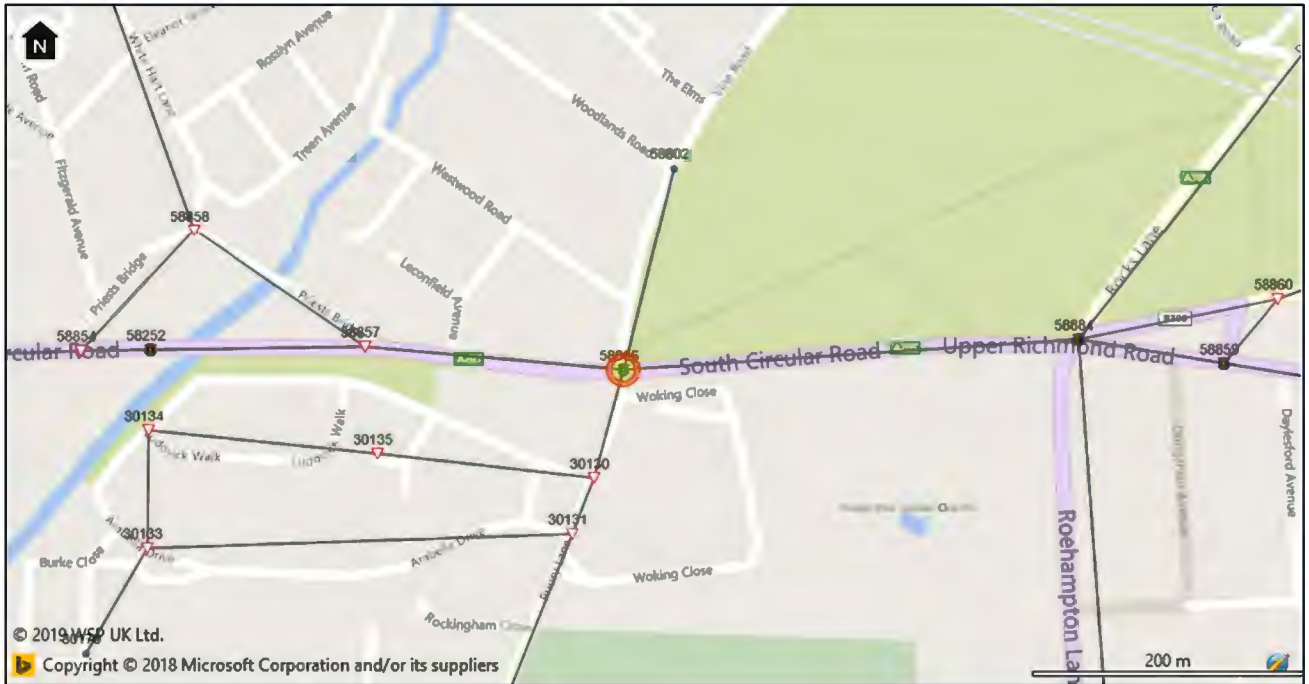
5.6.34. The Significant Adverse effects extend back to White Hart Lane (link 59278-58858), located as shown in Figure 5-41, where a delay increase of +209 seconds occurs due to the congestion on the A205 South Circular Road eastbound in the AM peak. (Note, that this junction is not within the study area, as it is on the inside of the A205 South Circular Road, but it is worth noting the impact.)



**Figure 5-41: Link 59278-58858 (White Hart Lane southbound)**



5.6.35. As mentioned previously, the congestion on the eastbound A205 South Circular Road in the AM peak stems from the A205 South Circular Road / Vine Road / Priory Lane junction (node 58856), located as shown in Figure 5-42. Here, an increase in actual traffic flow on the A205 South Circular Road westbound (+20 PCU/hr westbound) creates less opportunities for traffic to turn right onto Priory Lane southbound and results in queueing/delays on the A205 South Circular Road eastbound which extend back to Priests Bridge.



**Figure 5-42: Node 58856 (A205 South Circular Road / Vine Road / Priory Lane)**

- 5.6.36. Furthermore, due to the ULEZ extension, in the AM peak there is additional demand flow eastbound and westbound on the A205 South Circular Road (+11 PCU/hr eastbound) and (+14 PCU/hr westbound) which exacerbates the adverse effects.
- 5.6.37. As a result of the ULEZ extension, there is an increase in traffic demand at this junction which impacts the eastbound traffic traveling along the A205 South Circular Road.
- 5.6.38. There are no Moderate or Significant PM peak impacts in Area 1b to report.

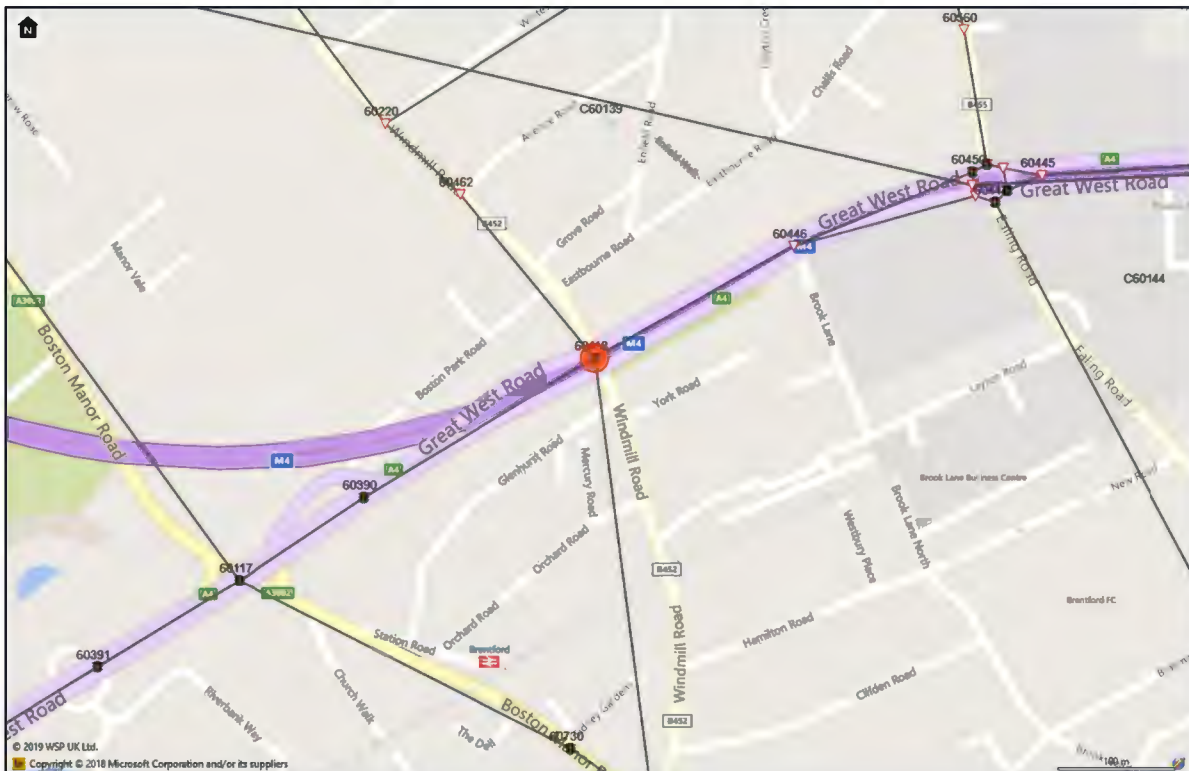
Area 1c) A4 corridor to Chiswick Roundabout – PM Peak

5.6.39. As shown in Figure 5-43, the Moderate and Significant Adverse impacts in the PM peak in Area 1c are concentrated around the A4 Great West Road / Windmill Road junction.



**Figure 5-43: Area 1c: ULEZ Impacts (PM Peak)**

5.6.40. In the PM peak, the junction of the A4 Great West Road / Windmill Road (node 60118), located as shown in Figure 5-44, exhibits a Moderate Adverse impact on total vehicle delay (+31% or +48 hours) between the DM and DS.

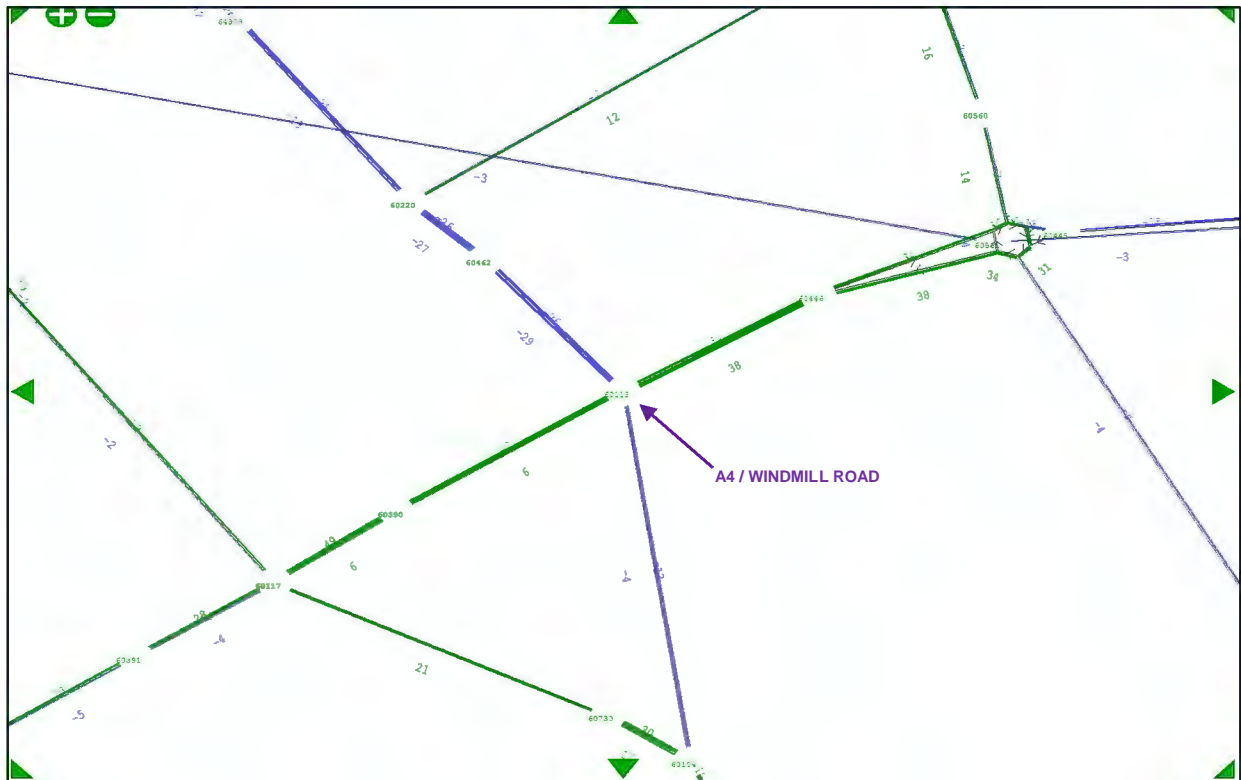


**Figure 5-44: Node 60118 (A4 Great West Road / Windmill Road)**

5.6.41. The two links on the A4 Great West Road either side of this junction also exhibit adverse impacts in the PM peak:

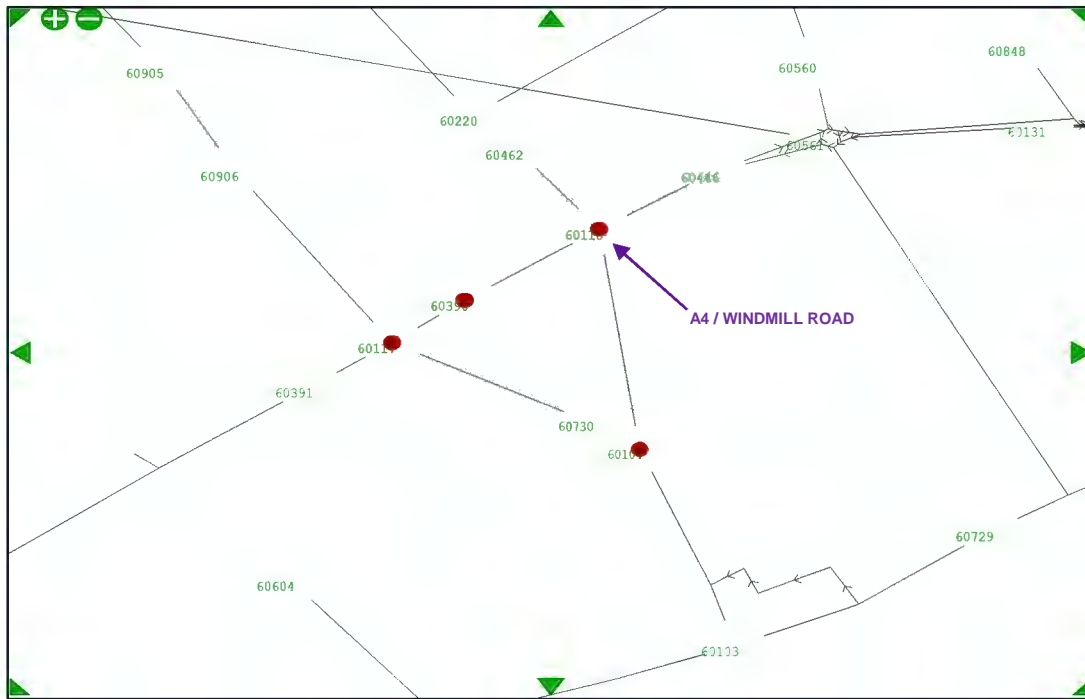
- Link 60446-60118 (A4 Great West Road westbound towards the Windmill Road junction) exhibits a Moderate Adverse impact on total vehicle delay (+52% or +14 hours).
- Link 60390-60118 (A4 Great West Road eastbound towards the Windmill Road junction) exhibits a Significant Adverse impact on total vehicle delay (+69% or +43 hours).

5.6.42. Figure 5-45 shows the additional traffic flow (and hence total vehicle delay) in the PM peak.



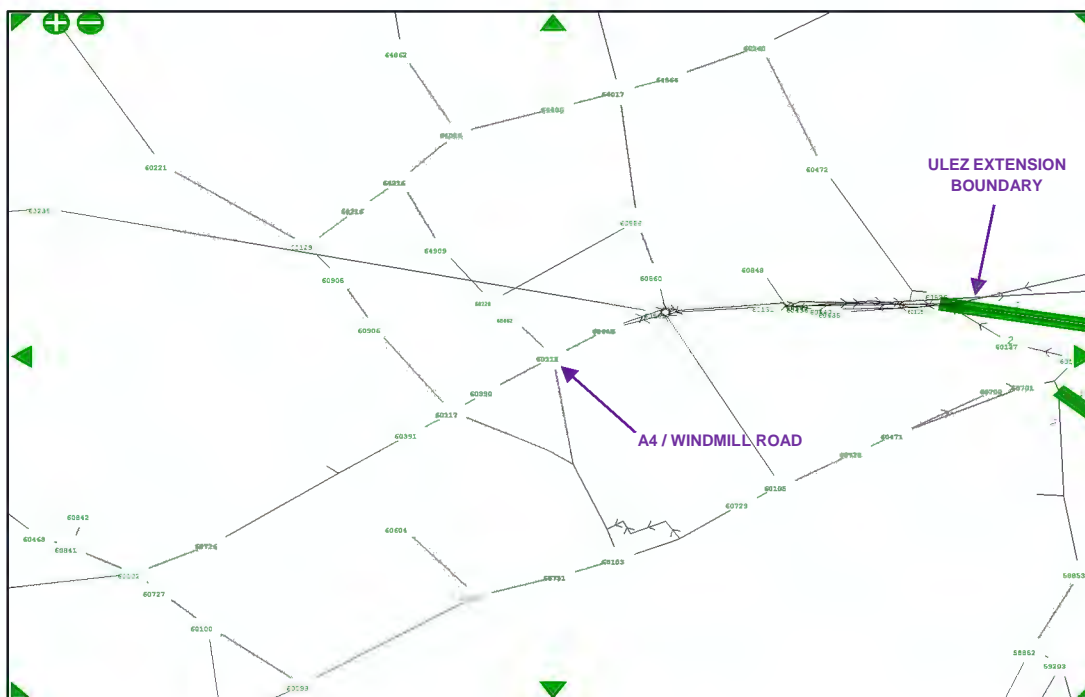
**Figure 5-45: PM Peak Actual Flow Difference DS vs DM at A4 / Windmill Road Junction**

5.6.43. Having investigated the issue, it is concluded that these impacts are attributable to flow convergence issues in the PM peak, as shown in Figure 5-46, and are not attributable to the impacts of the ULEZ extension.



**Figure 5-46: Flow Convergence Issues (PM peak)**

5.6.44. There are no other adverse impacts around the junction and it is 2km from the ULEZ extension boundary, as shown in Figure 5-47, indicating that this is not an impact that can be attributed directly to the effects of the ULEZ extension.



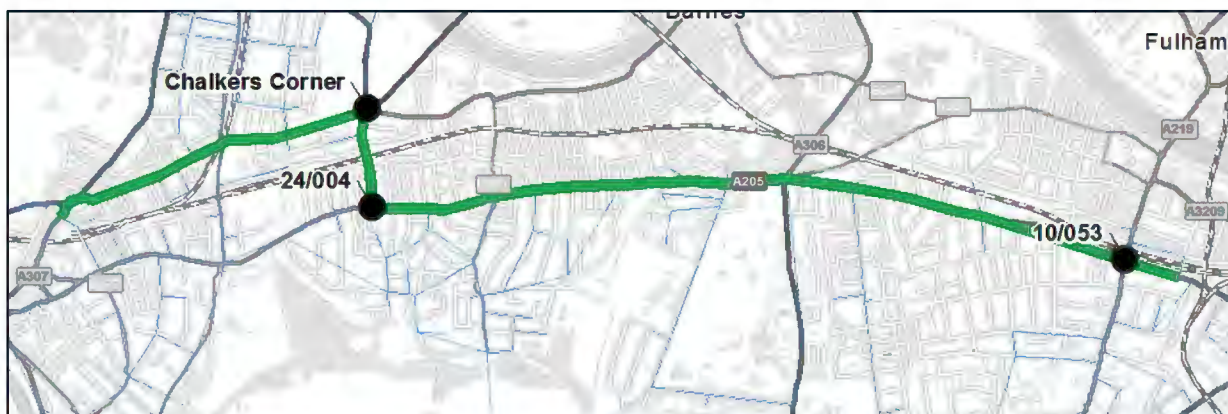
**Figure 5-47: ULEZ Extension Boundary Location**

### Area 1 Journey Times

5.6.45. Two routes have been analysed to show the impact of the ULEZ extension on journey times:

- R225: A316 Richmond to A205 Putney (eastbound)
- R226: A205 Putney to A316 Richmond (westbound)

5.6.46. As shown in Figure 5-48, both routes run along the A205 South Circular Road and the A316 between Putney and Richmond. They pass through several junctions discussed in the analysis.



**Figure 5-48: TfL Journey Time Routes R225 (Eastbound) and R226 (Westbound)**

5.6.47. Table 5-6 and Table 5-7 show the journey time changes along these routes in the AM and PM peaks, respectively.

**Table 5-6: Journey Times (AM Peak)**

Code	Route	Direction	Modelled Journey Time (s)			
			DM	DS	Diff. (DS vs DM)	% Diff. (DS vs DM)
R225	A316 Richmond to A205 Putney	Eastbound	1719	1774	55	3%
R226	A205 Putney to A316 Richmond	Westbound	3022	2920	-102	-3%

**Table 5-7: Journey Times (PM Peak)**

Code	Route	Direction	Modelled Journey Time (s)			
			DM	DS	Diff. (DS vs DM)	% Diff. (DS vs DM)
R225	A316 Richmond to A205 Putney	Eastbound	2006	1977	-29	-1%
R226	A205 Putney to A316 Richmond	Westbound	2323	2474	151	7%

5.6.48. In the AM peak, the journey time increases by +3% eastbound, primarily due to greater delays on the A205 South Circular Road at Priests Bridge in the eastbound. In contrast, journey times decrease by -3% westbound in the AM peak primarily due to both lower delays on the A205 South Circular Road approaching Chalkers Corner and fewer delays around the Priests Bridge area in the westbound direction.

- 5.6.49. In the PM peak, the journey time decreases by -1% eastbound, primarily due to lower delays on the A205 South Circular Road at Chalkers Corner. In contrast, the journey time increases by +7% westbound in the PM peak primarily due to greater delays on the A205 South Circular Road at Chalkers Corner.

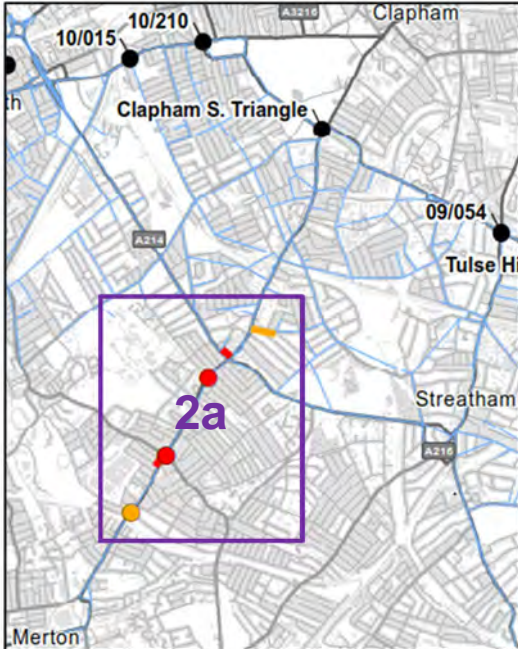
### **Area 1 Junctions for Mitigation**

- 5.6.50. Following the analysis we have undertaken on the impacts within Area 1, we are of the view that the following two junctions require mitigation.
- Chalkers Corner: A205 South Circular Road / A316 Lower Richmond Road / A316 Clifford Avenue
    - If mitigation alone at Chalkers Corner is not enough to mitigate the adverse impacts around the A205 South Circular Road / A305 Upper Richmond Road West junction (and on surrounding residential roads), then mitigation at the A205 South Circular Road / A305 Upper Richmond Road West junction could be beneficial too.
  - A205 South Circular Road / Vine Road / Priory Lane

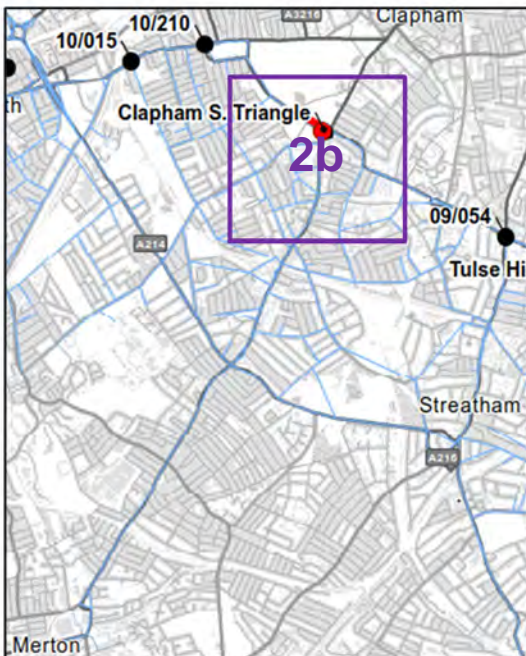
## A2. A24 CORRIDOR BETWEEN MERTON AND CLAPHAM (SOUTH LONDON)

5.6.51. As shown in Figure 5-49 and Figure 5-50, Area 2 has been subdivided into two sub-areas:

- 2a) A24 corridor near Tooting Bec and Tooting Broadway
- 2b) Clapham South Triangle



**Figure 5-49: Area 2: Sub-area Definitions and ULEZ Impacts (AM Peak)**



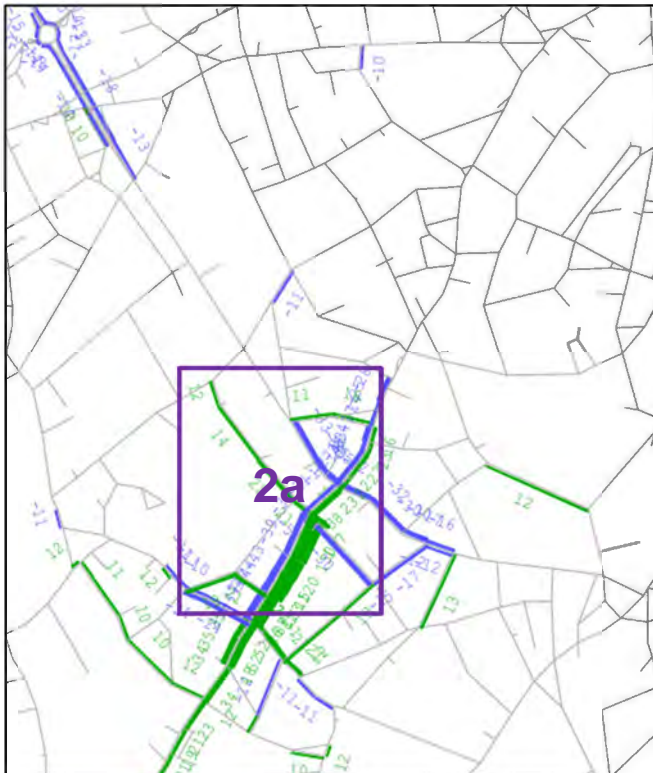
**Figure 5-50: Area 2: Sub-area Definitions and ULEZ Impacts (PM Peak)**

5.6.52. Figure 5-51 shows Area 2 and the location of the ULEZ boundary.



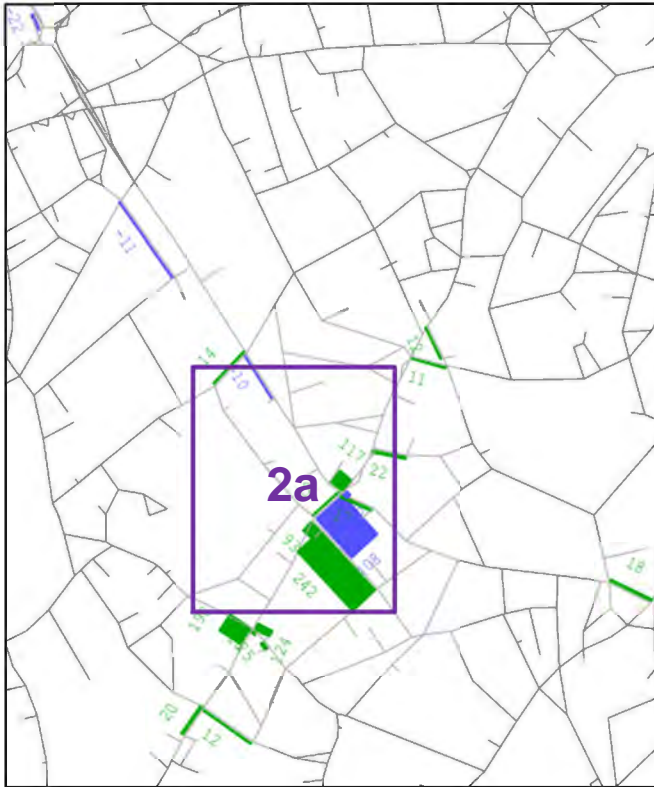
**Figure 5-51: Area 2 ULEZ Boundary**

5.6.53. Figure 5-52 to Figure 5-57 show comparisons of actual flow, link delay and link V/C in Area 2 between the DM and DS, blue bands show a reduction and green show an increase.

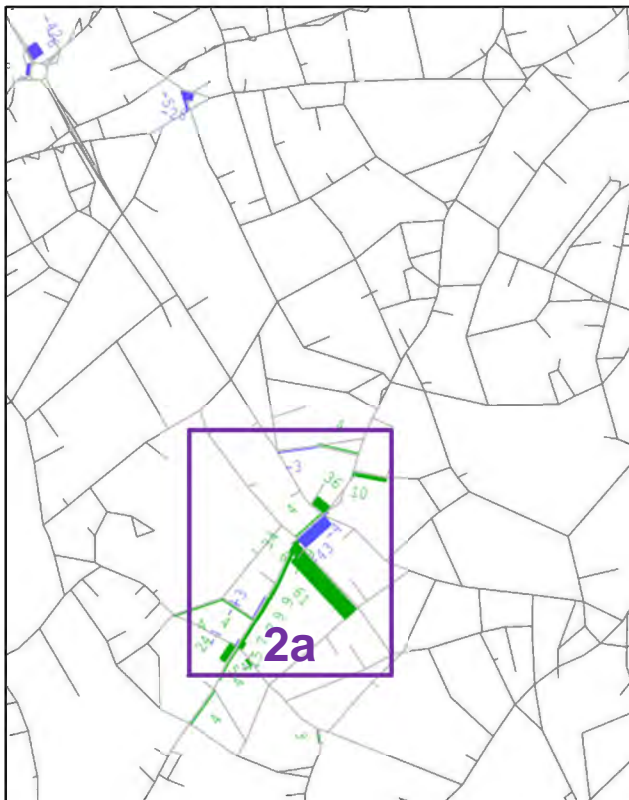


**Figure 5-52: Area 2: Actual Flow Difference (AM Peak)**

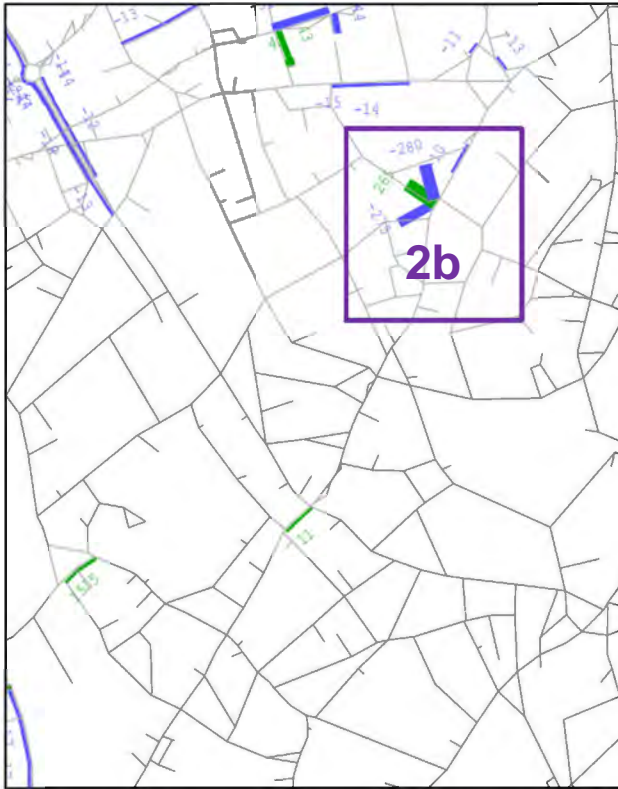




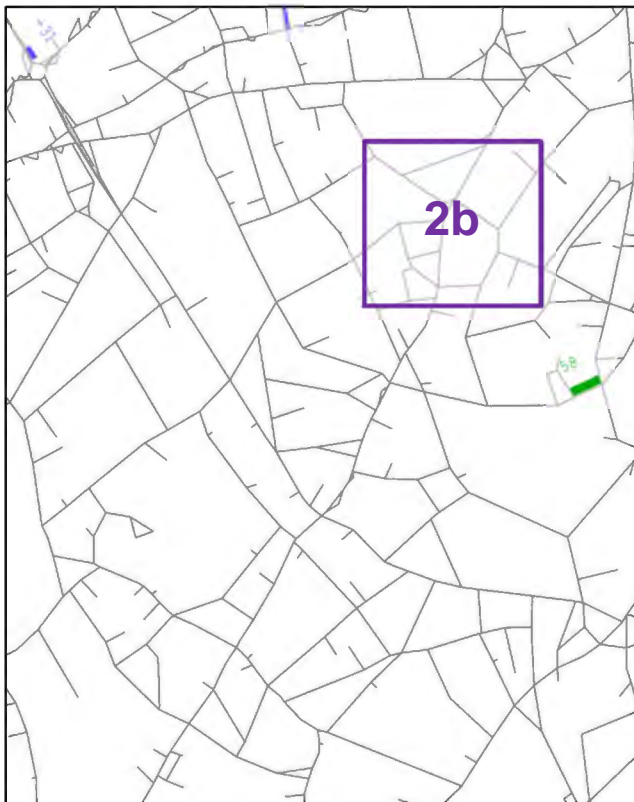
**Figure 5-53: Area 2: Link Delay Difference (AM Peak)**



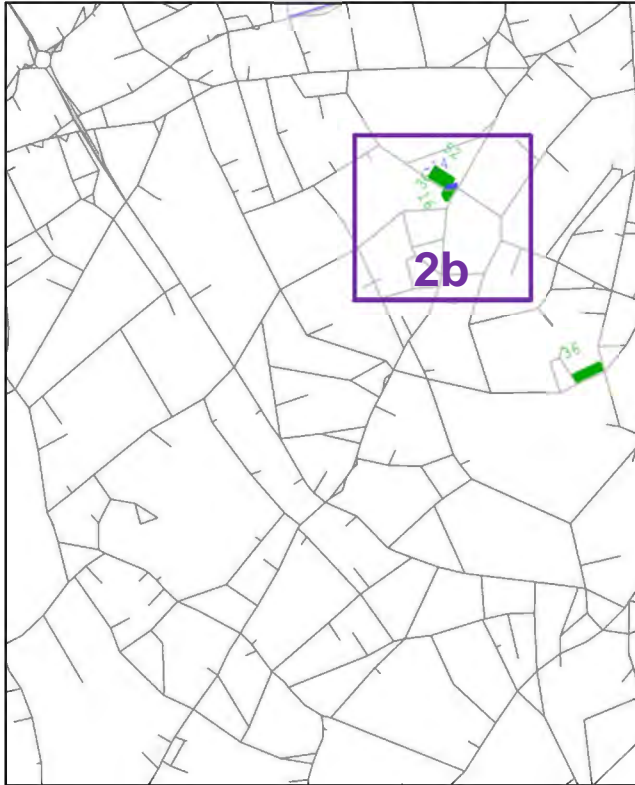
**Figure 5-54: Area 2: Link V/C Difference (AM Peak)**



**Figure 5-55: Area 2: Actual Flow Difference (PM Peak)**



**Figure 5-56: Area 2: Link Delay Difference (PM Peak)**



**Figure 5-57: Area 2: Link V/C Difference (PM Peak)**

5.6.54. The impacts within each of these sub-areas is now discussed in turn, starting with Area 2a.

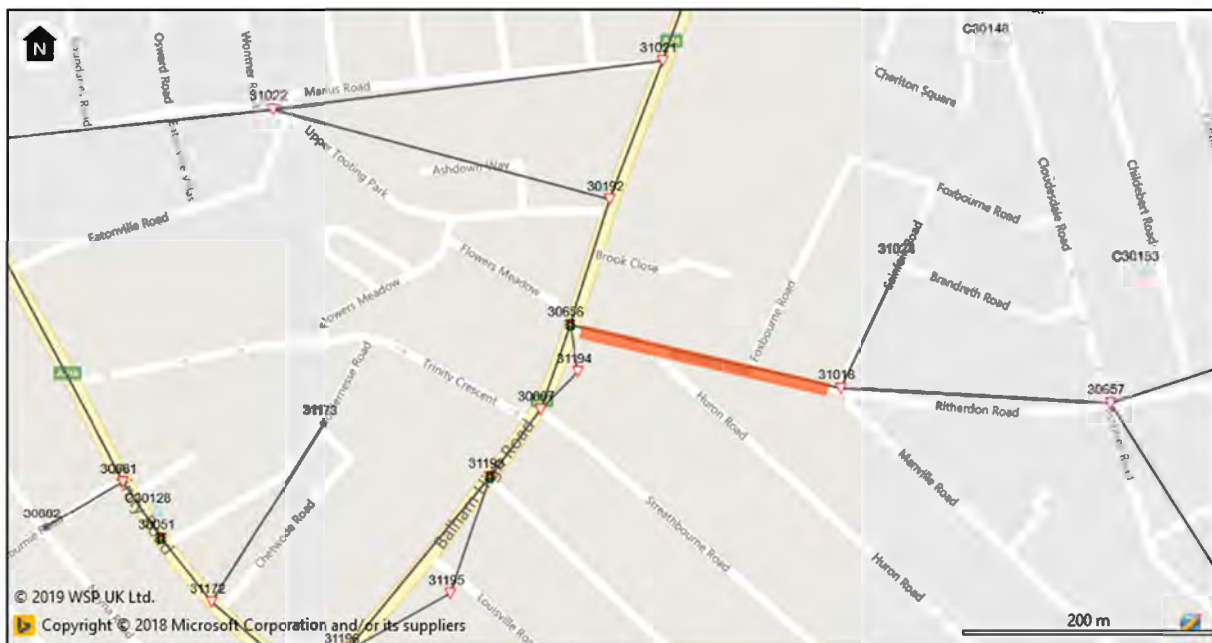
Area 2a) A24 corridor near Tooting Bec and Tooting Broadway – AM Peak

5.6.55. As shown in Figure 5-58, there are a series of links and nodes with Moderate and Significant Adverse impacts along the A24 corridor near Tooting Bec and Tooting Broadway London Underground stations in the AM peak.



**Figure 5-58: Area 2b: ULEZ Impacts (AM Peak)**

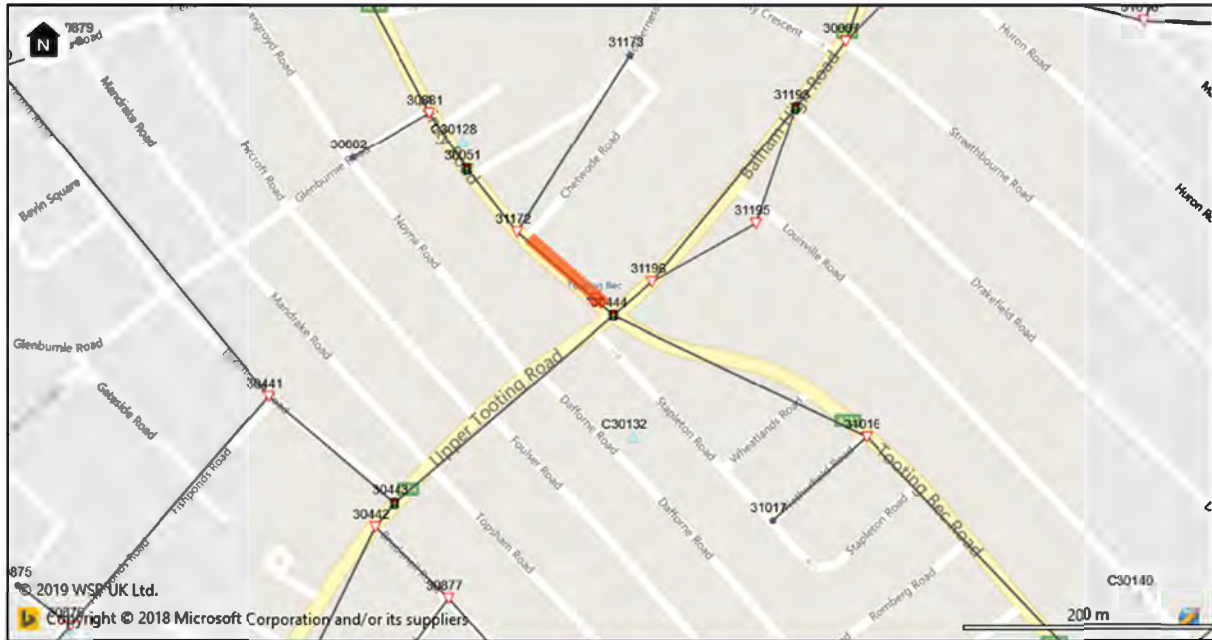
5.6.56. In the AM peak, link 31018-30656 (Ritherdon Road westbound), located as shown in Figure 5-59, exhibits a Moderate Adverse V/C impact (+10%) and a Moderate Adverse total vehicle delay impact (+33% or +2 hours).



**Figure 5-59: Link 31018-30656 (Ritherdon Road westbound)**

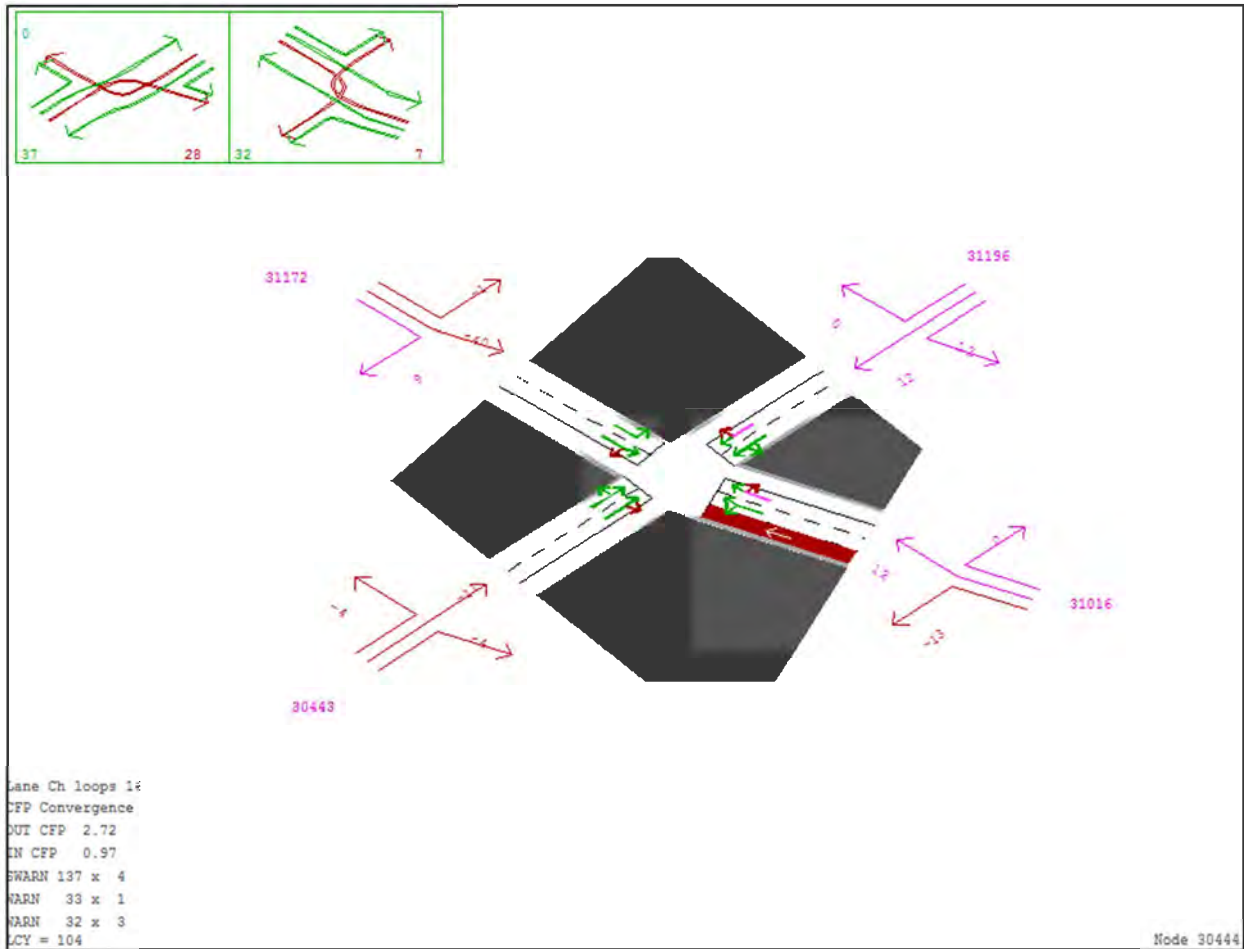
5.6.57. This is due to an increase of +7 PCU/hr on Ritherdon Road westbound (towards its junction with the A24).

5.6.58. In the AM peak, link 31172-30444 (A214 Trinity Road eastbound), located as shown in Figure 5-60, exhibits a Significant Adverse V/C impact (+36%) and a Significant Adverse total vehicle delay impact (+247% or +14 hours). The V/C of the link rises from 64% in the DM to 100% in the DS (+36%).



**Figure 5-60: Link 31172-30444 (A214 Trinity Road eastbound)**

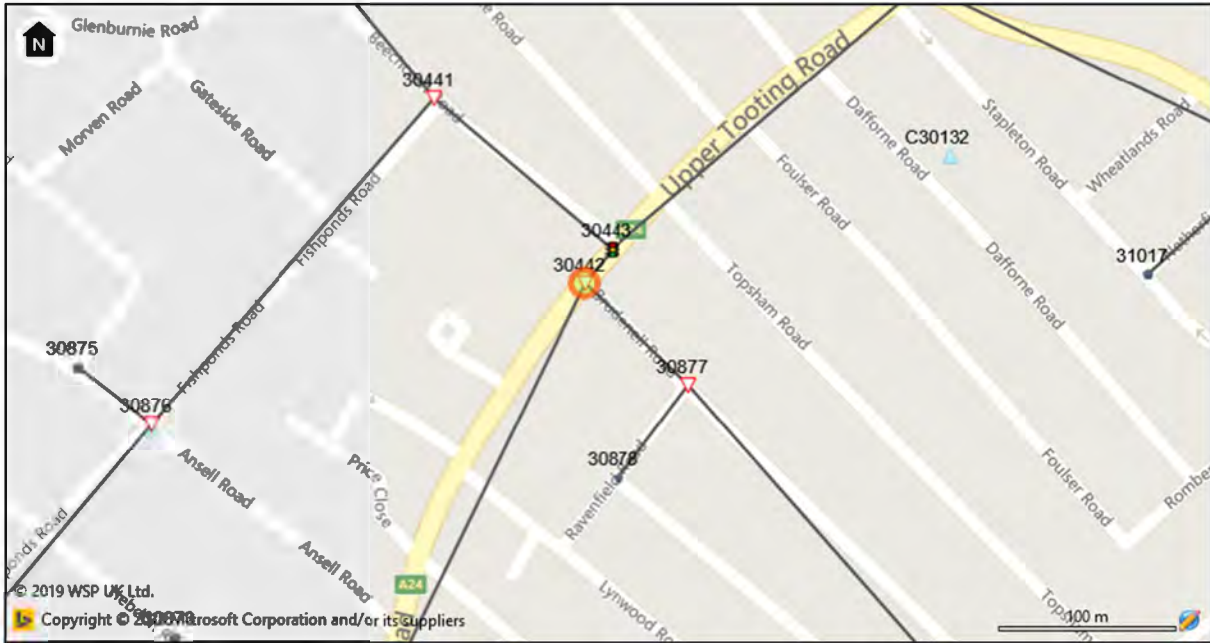
5.6.59. These Significant Adverse impacts are explained in the junction turning movement differences between the DM and DS for node 30444 (A24 / A214 Tooting Bec Road / A214 Trinity Road), as shown in Figure 5-61.



**Figure 5-61: AM Peak Junction Turning Flow Difference (DM vs DS) at A24 / A214 Tooting Bec Road / A214 Trinity Road (Node 30444)**

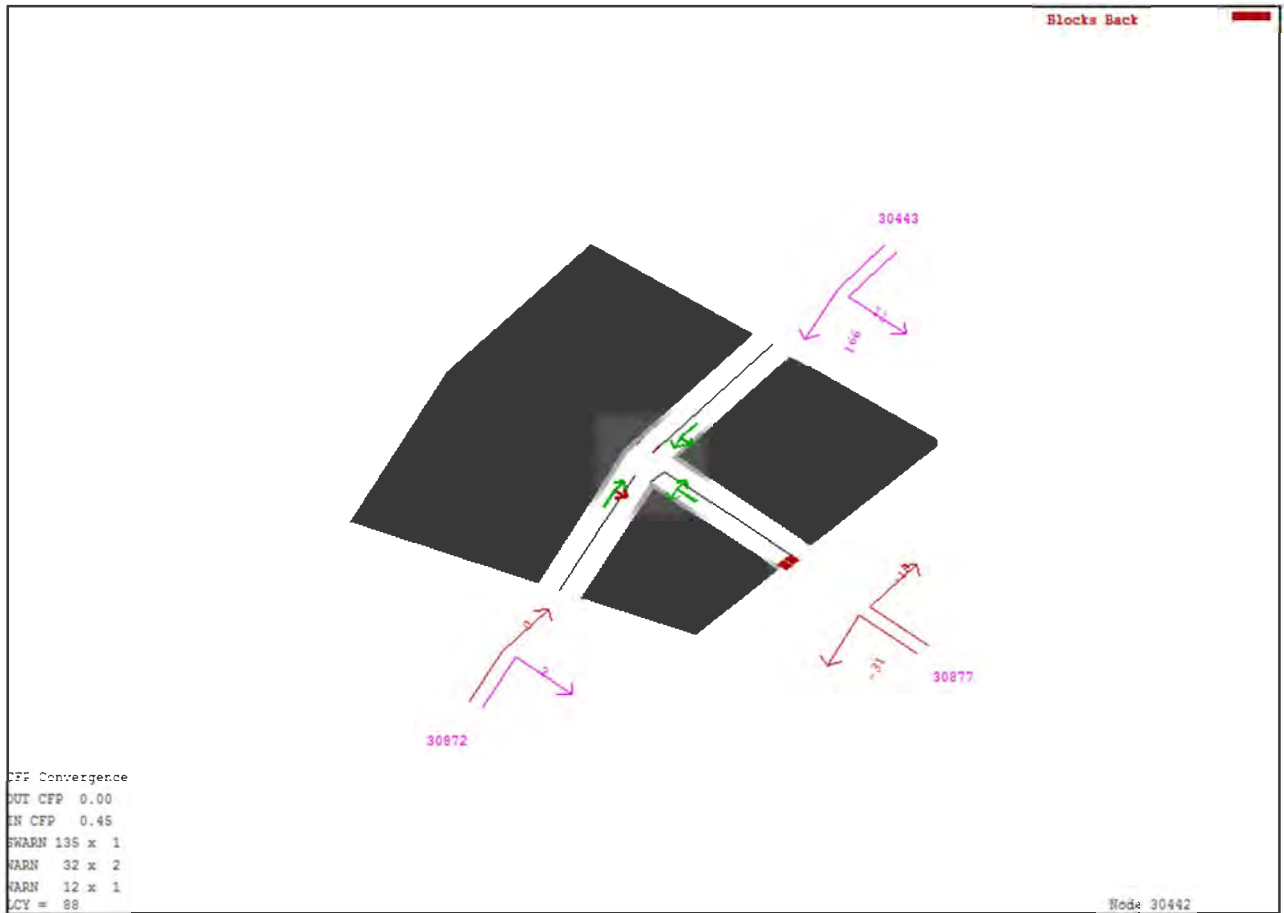
5.6.60. Due to the way the signal stages are configured (with both A214 arms sharing the same stage), an increase of +12 PCU/hr heading westbound across the junction delays traffic turning from A214 Trinity Road and causes Significant Adverse increases in total vehicle delay and V/C on this link.

5.6.61. In the AM peak, node 30442 (A24 / Brudenell Road), located as shown in Figure 5-62, exhibits a Moderate Adverse V/C impact (+2%).



**Figure 5-62: Node 30442 (A24 / Brudenell Road)**

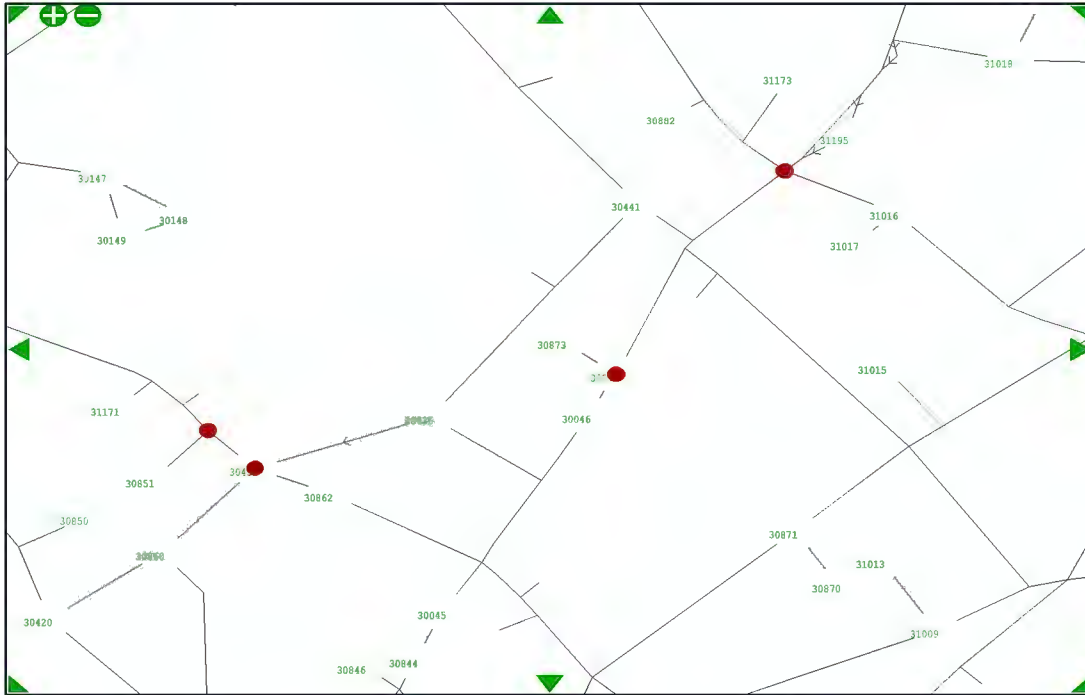
5.6.62. As shown in Figure 5-63, an increase in flow southbound on the A24 of +166 PCU/hr causes an increase in V/C on Brudenell Road (+6%) and consequently on the junction overall (+2%).



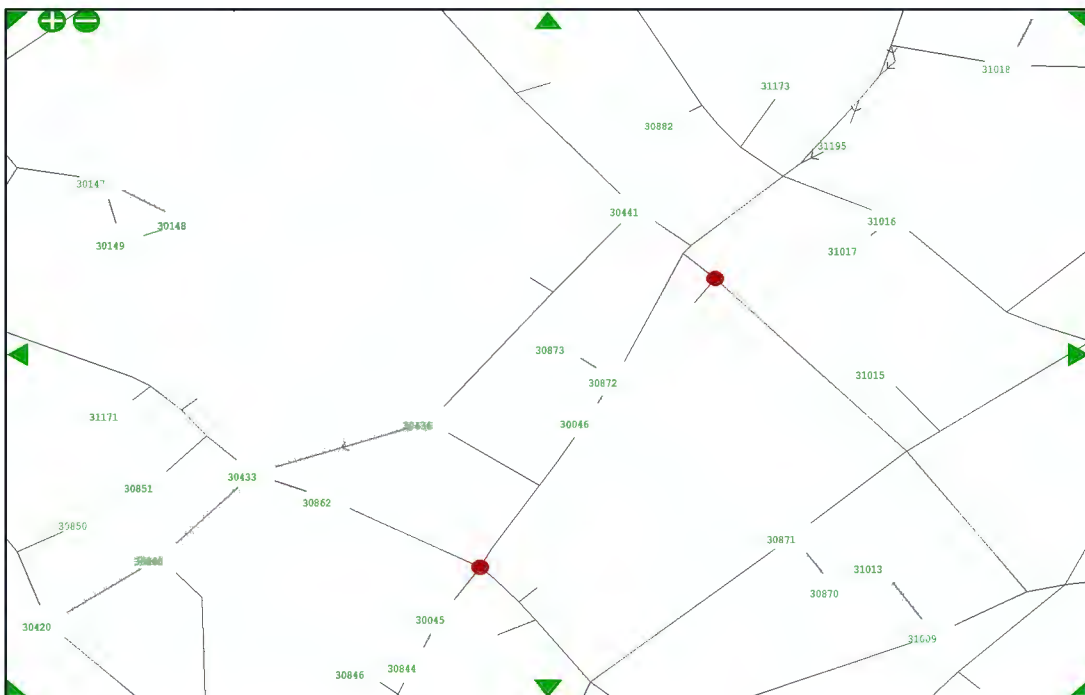
**Figure 5-63: AM Peak Junction Turning Flow Difference (DM vs DS) at A24 / Brudenell Road (Node 30442)**



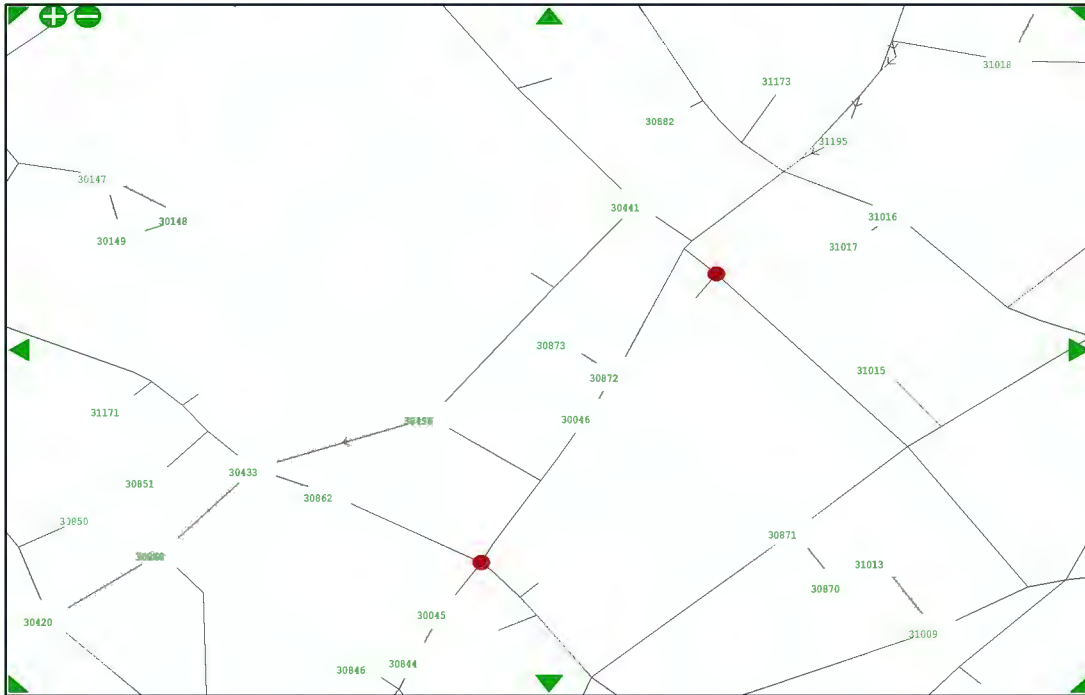
5.6.63. The increase in flow on the A24 is due to a decrease in queued flow on a stretch of the A24 between the junctions of A24 / Beechcroft Road and A24 / A217 Garratt Lane / A217 Mitcham Road. A decrease in queued flow results in an increase in actual flow of up to +130 PCU/hr southbound on the A24. These impacts are attributable to convergence issues in the AM peak DS model, as shown in Figure 5-64 to Figure 5-67.



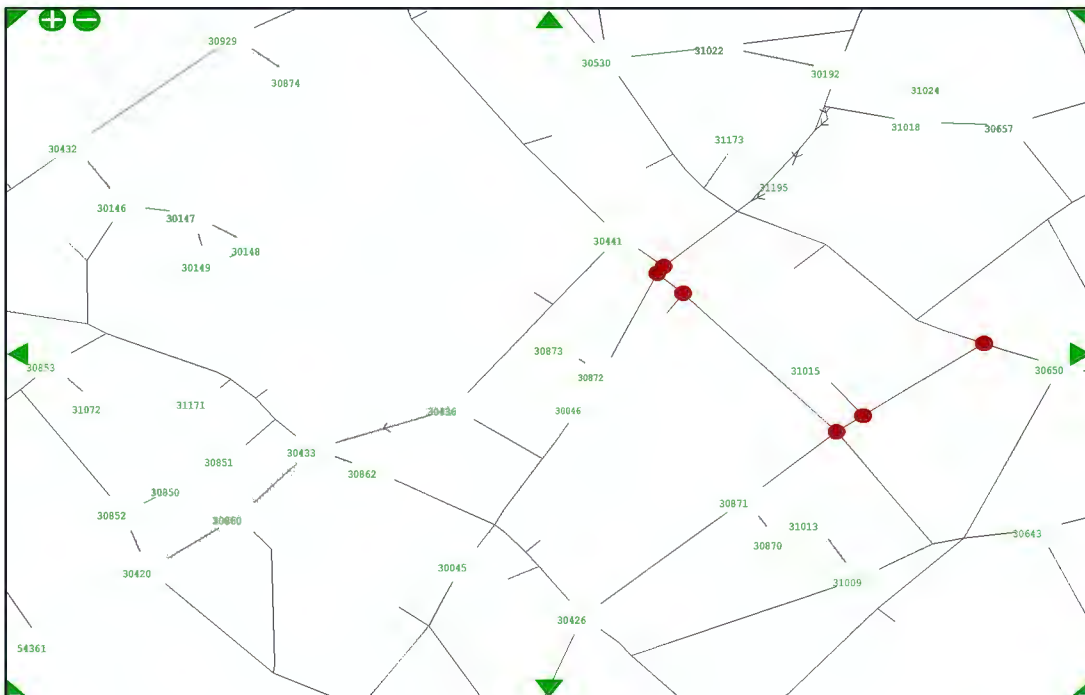
**Figure 5-64: Node Convergence Issues (AM peak)**



**Figure 5-65: Delay Convergence Issues (AM peak)**



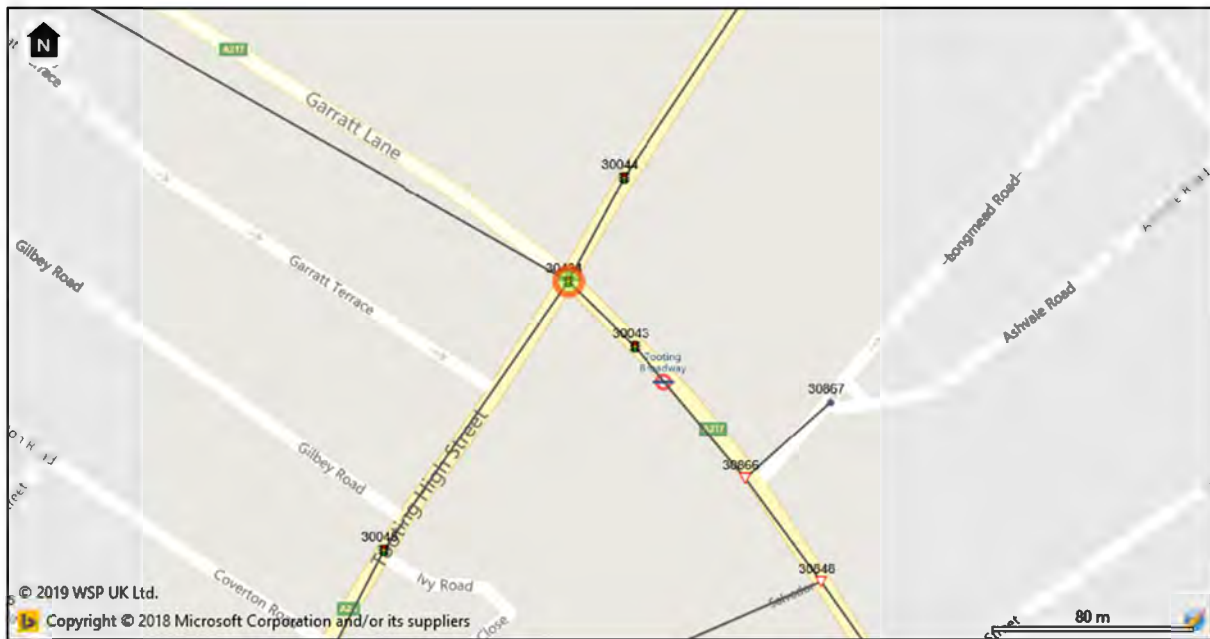
**Figure 5-66: Gap Convergence Issues (AM peak)**



**Figure 5-67: Flow Convergence Issues (AM peak)**

5.6.64. In the AM peak, node 30434 (A24 / Garratt Lane / Mitcham Road), located as shown in Figure 5-68, and both of its A24 approach links (30044-30434 and 30045-30434), exhibit Significant Adverse or Moderate Adverse impacts:

- At node 30434, there is a Moderate Adverse V/C impact with the V/C rising by +13% from 88% in the DS to 101% in the DS, and a Significant Adverse total vehicle delay impact (+89% or +85 hours).
- On link 30045-30434 (northbound A24 approach to node 30434), there is a Significant Adverse V/C impact (+24%) and a Significant Adverse total vehicle delay impact (+495% or +60 hours).
- On link 30044-30434 (southbound A24 approach to node 30434), there is a Moderate Adverse V/C impact (+15%) and a Significant Adverse total vehicle delay impact (+344% or +29 hours).



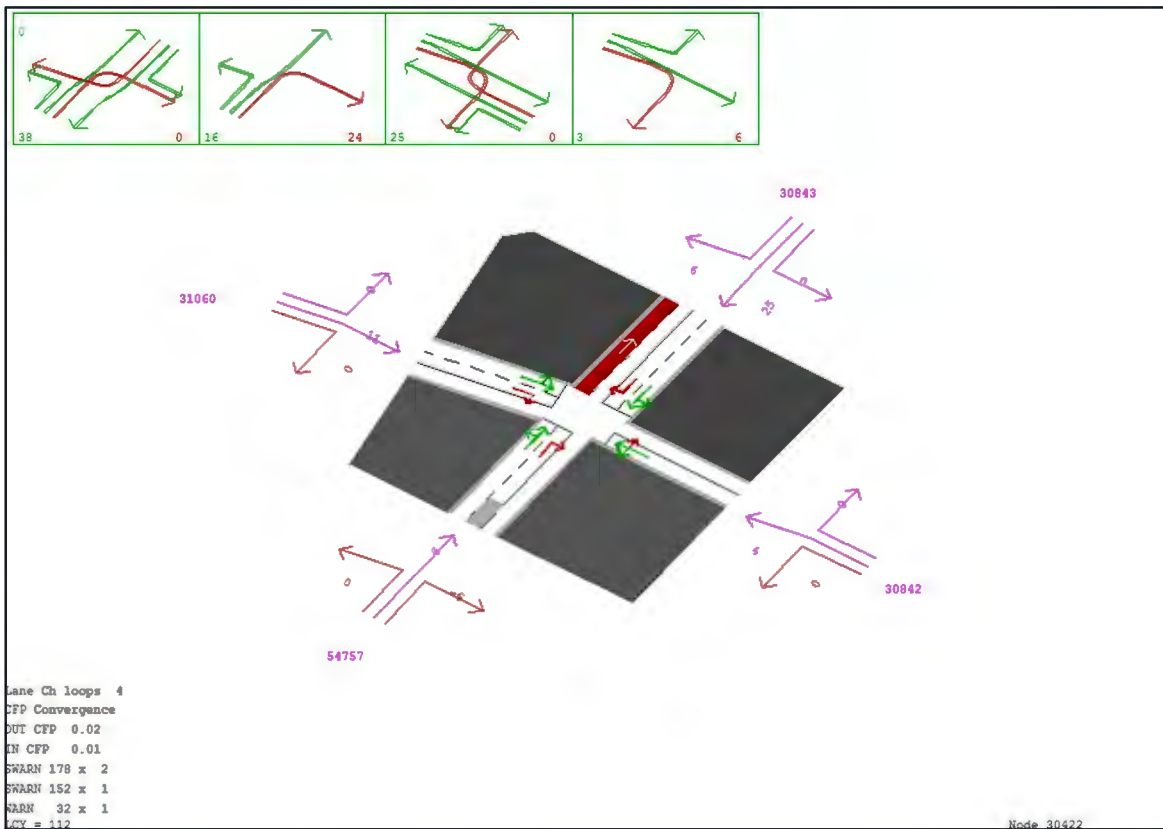
**Figure 5-68: Node 30434 (A24 / Garratt Lane / Mitcham Road)**

- 5.6.65. Although the adverse impacts are Significant or Moderate, convergence issues and a decrease in queued flow on a short stretch of the A24 between the junctions of A24 / Beechcroft Road and A24 / A217 Garratt Lane / A217 Mitcham Road causes a decrease in queued flow and results in an increase in actual flow of up to +130 PCU/hr southbound on the A24 in the AM peak. This raises the V/C and delay at the A24 / Garratt Lane / Mitcham Road junction, resulting in adverse impacts.
- 5.6.66. In the AM peak, node 30422 (A24 / Blackshaw Road / Longley Road), located as shown in Figure 5-69, exhibits a Moderate Adverse increase in V/C, rising from 90% to 92%, which although only a +2% increase, pushes the V/C into the next threshold (90%-100%).



**Figure 5-69: Node 30422 (A24 / Blackshaw Road / Longley Road)**

5.6.67. This is due to an actual flow increase of up to +34 PCU/hr on the junction's approaches, as shown in Figure 5-70, which raises the V/C to 92% in the DS. This is caused by the convergence issues previously discussed.



**Figure 5-70: AM Peak Junction Turning Flow Difference (DM vs DS) at A24 / Blackshaw Road / Longley Road (Node 30422)**

Area 2b) Clapham South Triangle – PM Peak

5.6.68. As shown in Figure 5-71 and Figure 5-72, there are several Significant Adverse impacts on the links/junctions around Clapham South Triangle.

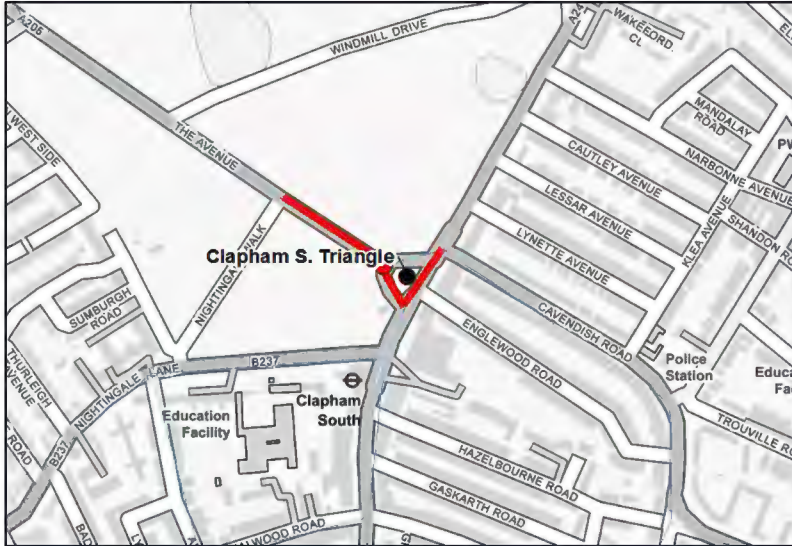


Figure 5-71: Area 2a: ULEZ Impacts (PM Peak)

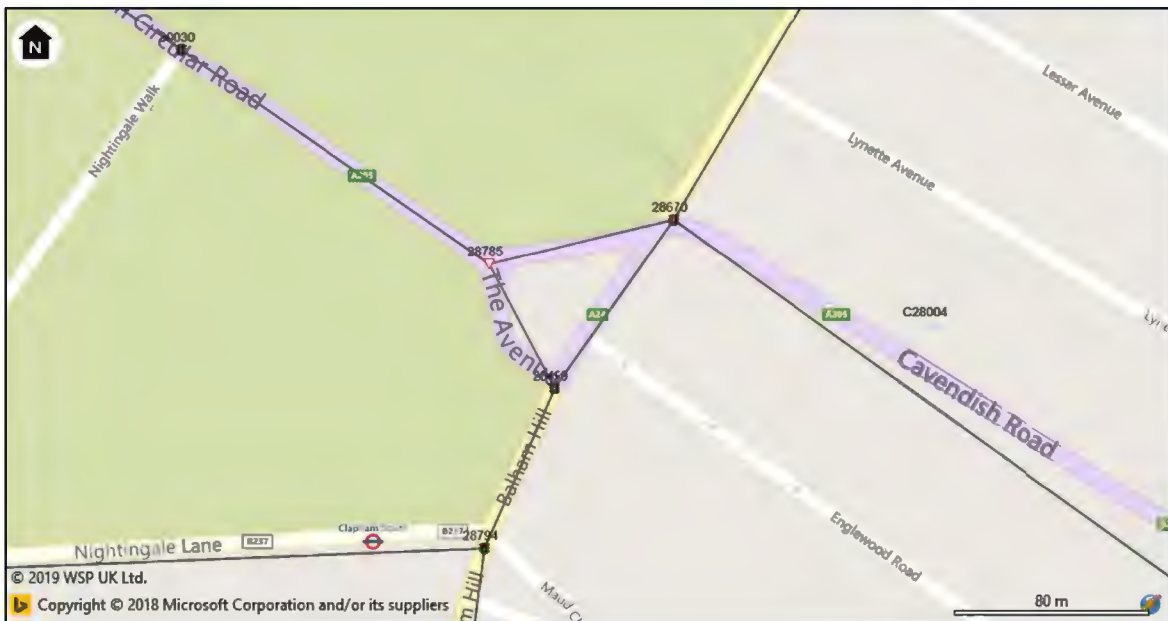
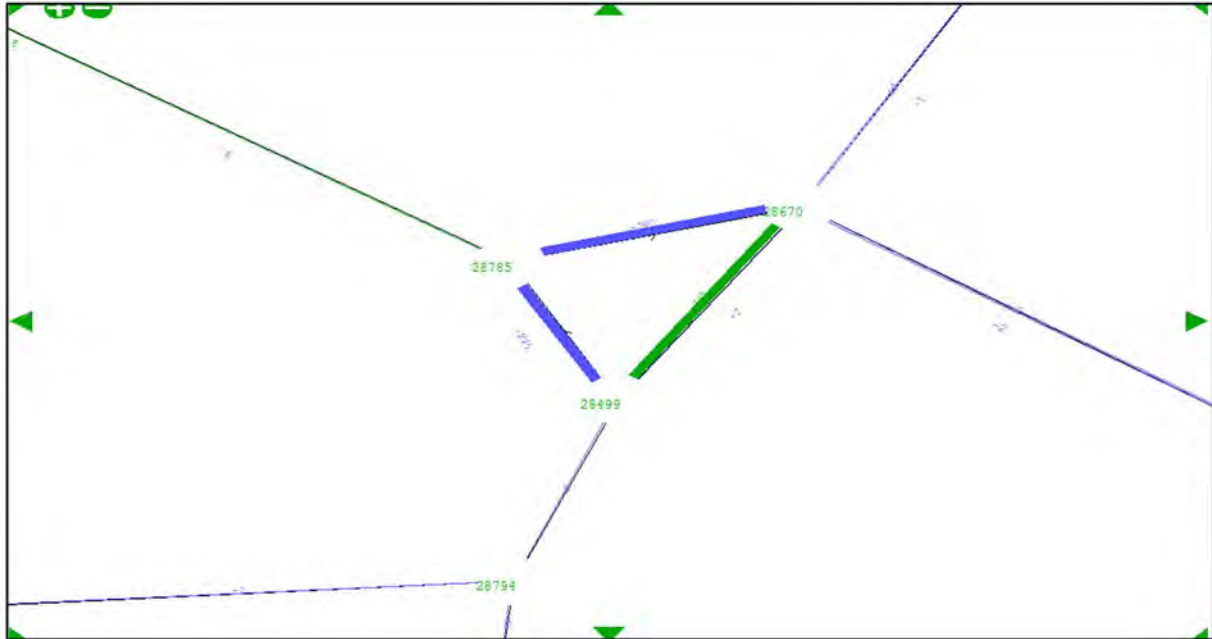


Figure 5-72: Model Nodes/Links at Clapham South Triangle

5.6.69. At Clapham South Triangle there is a Significant Adverse increase in V/C (+36%), actual flow (+157% or +265 PCU/hr) and total vehicle delay (+188% or +3 hours) on the A24 northbound mainline between Englewood Road and A205 Cavendish Road (link 28499-28670).

5.6.70. As shown in Figure 5-73, the actual flow changes here are isolated to Clapham South Triangle and do not extend outside of the Triangle. In the DS traffic switches to using the A24, rather than routing via node 28785 as it did in the DM. This creates Significant Adverse impacts on the A24.



**Figure 5-73: PM Peak Actual Flow Difference Between DM and DS**

- 5.6.71. The result of this traffic reassignment is additional blocking back or queueing (+69%) on link 28670-28785, which causes the V/C at node 28785 to rise by +42% and the total vehicle delay at node 28785 to rise by +44% or +2 hours (both Significant Adverse impacts).
- 5.6.72. The two-links approaching node 28785 also exhibit Significant Adverse impacts in V/C of +16% (link 28499-28785) and +52% link (30030-28785).
- 5.6.73. We do not think that mitigation here is warranted, since the impacts are local to Clapham South Triangle, provide a more logical routing in the DS.

**Area 2 Junctions for Mitigation**

- 5.6.74. Following the analysis we have undertaken on the impacts within Area 2, we are of the view that there are no junctions which require mitigation. The analysis we have undertaken demonstrates the impacts along the A24 corridor are attributable to convergence issues in the DS model.

### A3. A2 CORRIDOR TO ELTHAM AND LOCATIONS NEAR CATFORD, LEWISHAM (SOUTH EAST LONDON)

5.6.75. As shown in Figure 5-74 and Figure 5-75, Area 3 has been subdivided into three sub-areas:

- 3a) A205 near Woolwich
- 3b) A205 through the London Boroughs of Southwark and Lewisham
- 3c) A2 corridor near Eltham

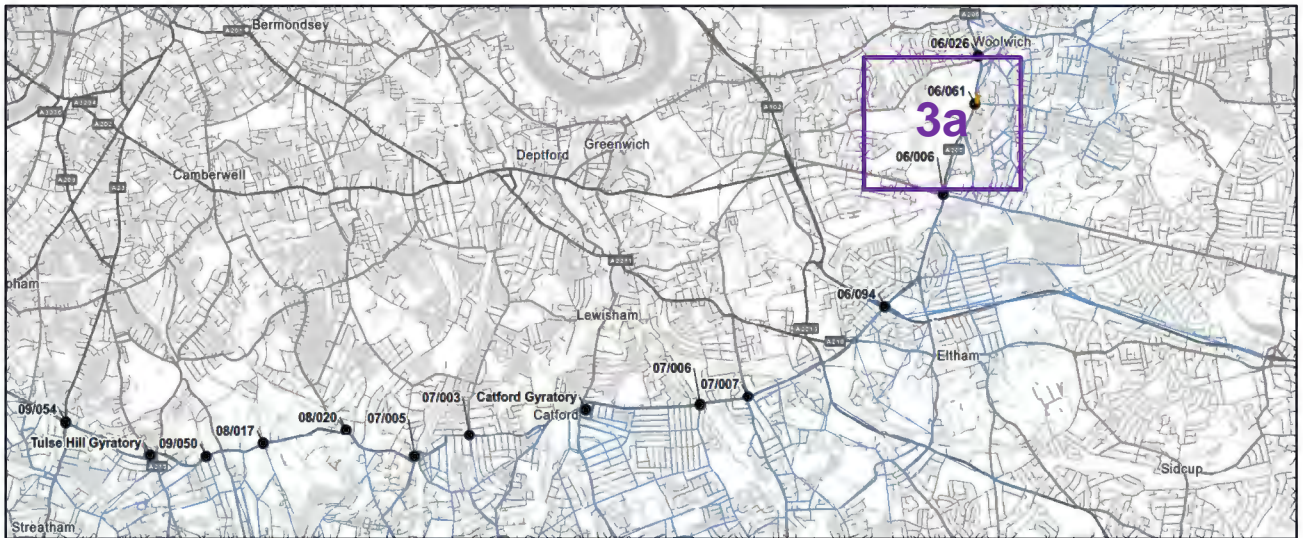


Figure 5-74: Area 3: Sub-area Definitions and ULEZ Impacts (AM Peak)

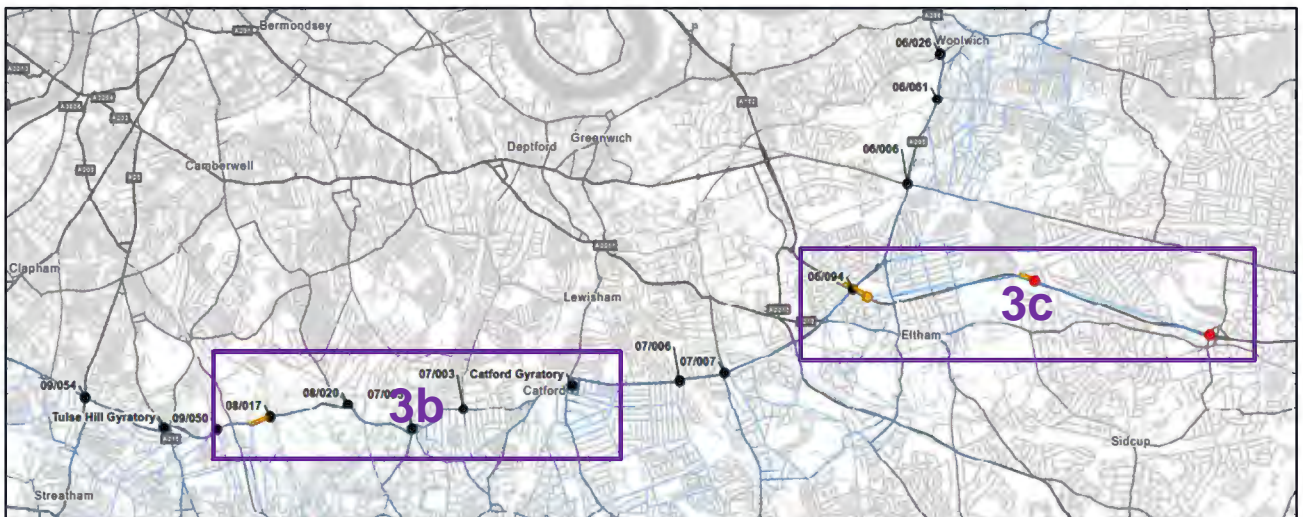


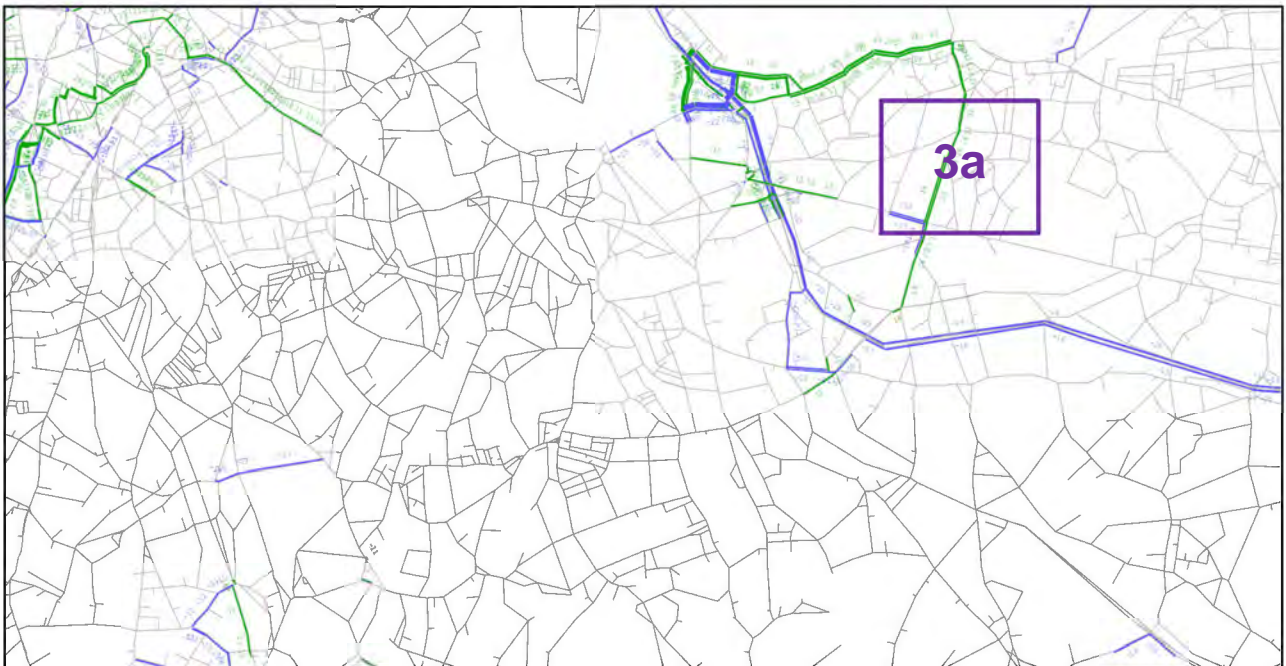
Figure 5-75: Area 3: Sub-area Definitions and ULEZ Impacts (PM Peak)

5.6.76. Figure 5-76 shows Area 3 and the location of the ULEZ boundary.



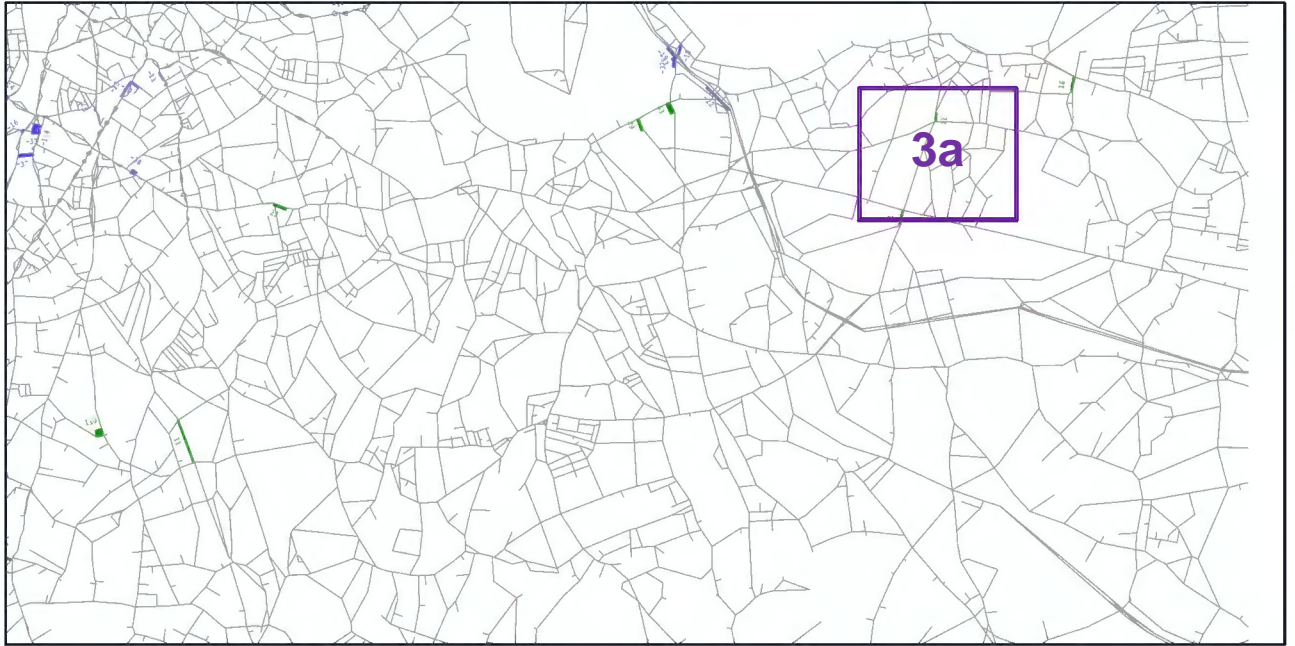
**Figure 5-76: Area 3 ULEZ Boundary**

5.6.77. Figure 5-77 to Figure 5-82 show comparisons of actual flow, link delay and link V/C in Area 3 between the DM and DS, blue bands show a reduction and green show an increase.



**Figure 5-77: Area 3: Actual Flow Difference (AM Peak)**

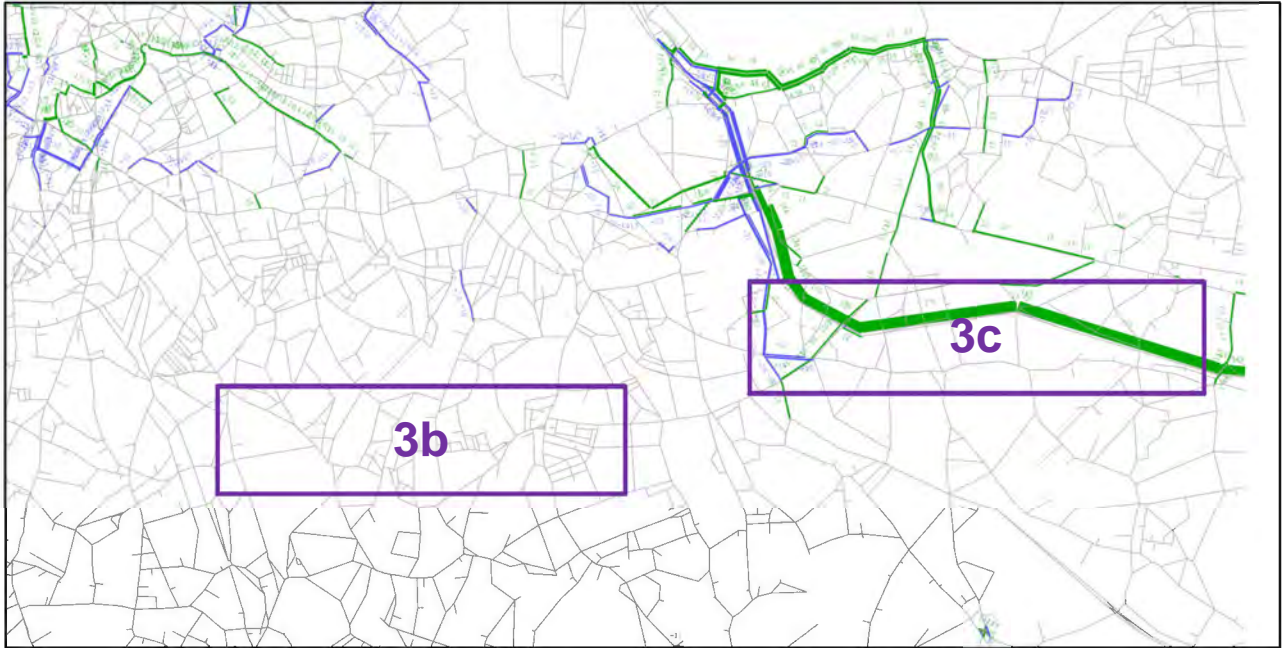




**Figure 5-78: Area 3: Link Delay Difference (AM Peak)**



**Figure 5-79: Area 3: Link V/C Difference (AM Peak)**



**Figure 5-80: Area 3: Actual Flow Difference (PM Peak)**



**Figure 5-81: Area 3: Link Delay Difference (PM Peak)**



**Figure 5-82: Area 3: Link V/C Difference (PM Peak)**

5.6.78. The impacts within each of these sub-areas is now discussed in turn, starting with Area 3a.

Area 3a) A205 near Woolwich – AM Peak

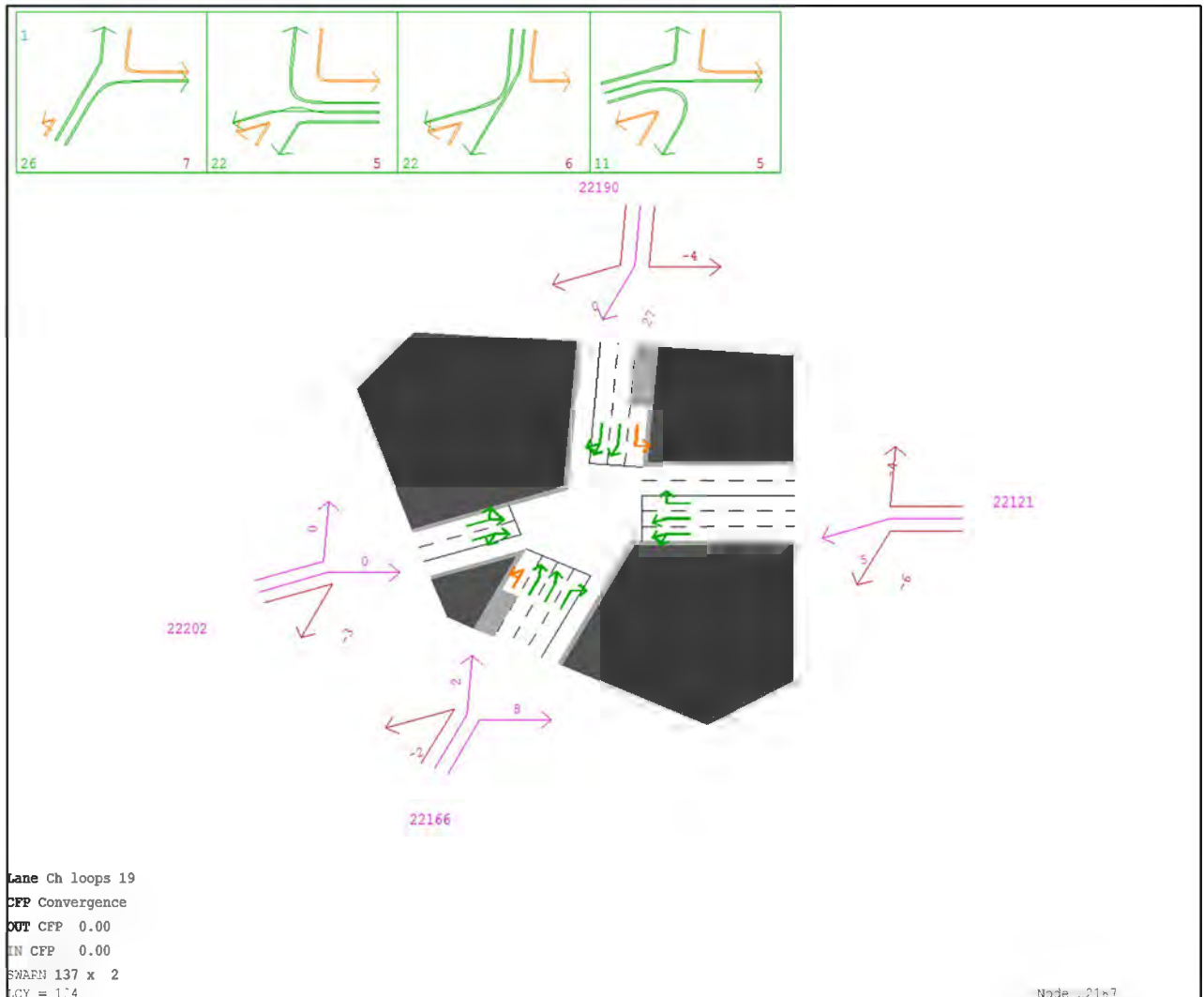
5.6.79. As shown in Figure 5-83, there is one Moderate Adverse impact on the A205 southbound approach to the junction of A205 South Circular Road / Ha-Ha Road / Nightingale Place (link 22190-22187).



**Figure 5-83: Area 3a: ULEZ Impacts (AM Peak)**

5.6.80. In the AM peak, there is a Moderate Adverse increase in V/C (+6%). This is due to an increase in actual flow on the A205 South Circular southbound of +22 PCU/hr on approach to the junction, as well as a delay increase of +11 seconds. This pushes up the link V/C from 86% in the DM to 92% in

the DS. AM peak turning flow differences between the DS and DM for the junction of A205 South Circular Road / Ha-Ha Road / Nightingale Place (node 22187) are shown in Figure 5-84.



**Figure 5-84: AM Peak Junction Turning Flow Difference (DS vs DM) at A205 South Circular Road / Ha-Ha Road / Nightingale Place (Node 22187)**

5.6.81. There are no convergence issues in the AM peak models at/around this junction and the increase in traffic flow on the south circular is likely to be a direct impact of the ULEZ.

Area 3b) A205 through the London Boroughs of Southwark and Lewisham – PM Peak

- 5.6.82. As shown in Figure 5-85, in the PM peak there is a Moderate Adverse impact on the A205 eastbound approach to the junction of A205 South Circular Road / College Road (link 26020-26064) and a Significant Adverse impact on the A205 northbound approach to the Catford Gyratory (link 24068-24071).



**Figure 5-85: Area 3b: ULEZ Impacts (PM Peak)**

- 5.6.83. The Moderate Adverse impact on the A205 eastbound approach to the junction of A205 South Circular Road / College Road (link 26020-26064) is related to a 5% rise in V/C between the DM and DS. The V/C rises from 88% in the DM to 92% in the DS. There is a +2 PCU/hr actual flow increase on the approach, which in turn reduces the capacity of the turns on this approach by up to -7PCU/hr and therefore, the V/C increases on this link by +5%. There are no convergence issues.

5.6.84. In the PM peak, there is a Significant Adverse impact on the A205 northbound approach to the Catford Gyratory (link 24068-24071), attributable to a +18% rise in V/C. The V/C is 24% in the DM and 41% in the DS. The exact location of this link within the Catford Gyratory is shown in Figure 5-86.



**Figure 5-86: Link 24068-24071 (A205 northbound approach to Catford Gyratory)**

5.6.85. An additional +1 PCU/hr on this link causes link 24071-24223 to reach capacity and blocking back to occur (queuing) to node 24071.

Area 3c) A2 corridor near Eltham – PM Peak

5.6.86. As shown in Figure 5-87, there are several Moderate Adverse and Significant Adverse impacts on the A2 corridor near Eltham and on a couple of links in the surrounding area.



**Figure 5-87: Area 3c: ULEZ Impacts (PM Peak)**

5.6.87. In the PM peak, there is a Moderate Adverse total vehicle delay impact at node 22074 (A2 eastbound on-slip at the junction of A205 South Circular Road / A2 Rochester Way Relief Road), located as shown in Figure 5-88. Here the total vehicle delay increases by +35% or +1 hours.



**Figure 5-88: Node 22074 (A2 eastbound on-slip at the junction of A205 South Circular Road / A2 Rochester Way Relief Road)**

5.6.88. There is also a Moderate Adverse total vehicle delay impact on the eastbound mainline A2 link approaching this node (link 22056-22074) where the total vehicle delay rises by +39% or +2 hours.

- 5.6.89. On this link, the delay between the DM and DS increases by +2 seconds, but because this delay increase is applied to an increased number of vehicles between the DM and DS (+162 PCU/hr), the total vehicle delay is +39% or +2 hours.
- 5.6.90. In the PM peak, there is a Significant Adverse total vehicle delay impact at node 22170 (A2 eastbound on-slip at the junction of A2 East Rochester Way / Wincrofts Drive), located as shown in Figure 5-89. Here the total vehicle delay increases by +78% or +4 hours.

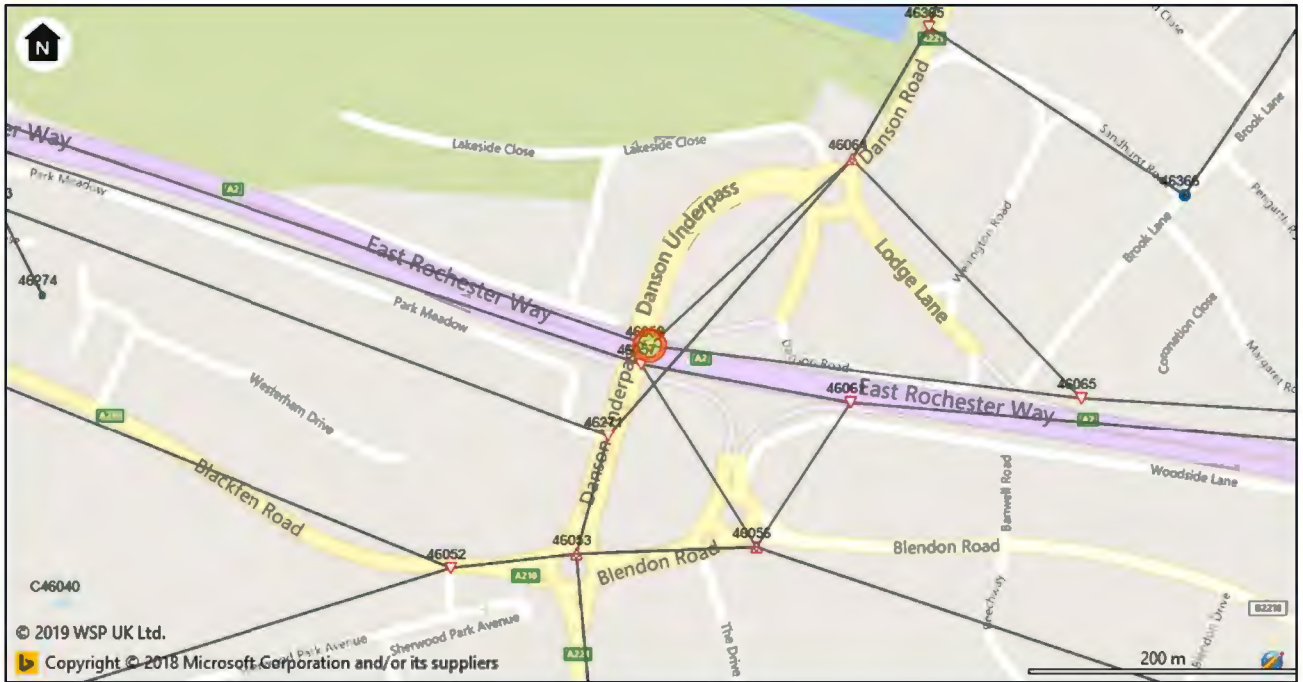


**Figure 5-89: Node 22170 (A2 eastbound on-slip at the junction of A2 East Rochester Way / Wincrofts Drive)**

- 5.6.91. There is also a Moderate Adverse total vehicle delay impact on the eastbound mainline A2 link approaching this node (link 22168-22170) where the total vehicle delay rises by +54% or +5 hours.
- 5.6.92. On this link, the delay between the DM and DS increases by +5 seconds, but because this delay increase is applied to an increased number of vehicles between the DM and DS (+165 PCU/hr), the total vehicle delay is +54% or +5 hours.



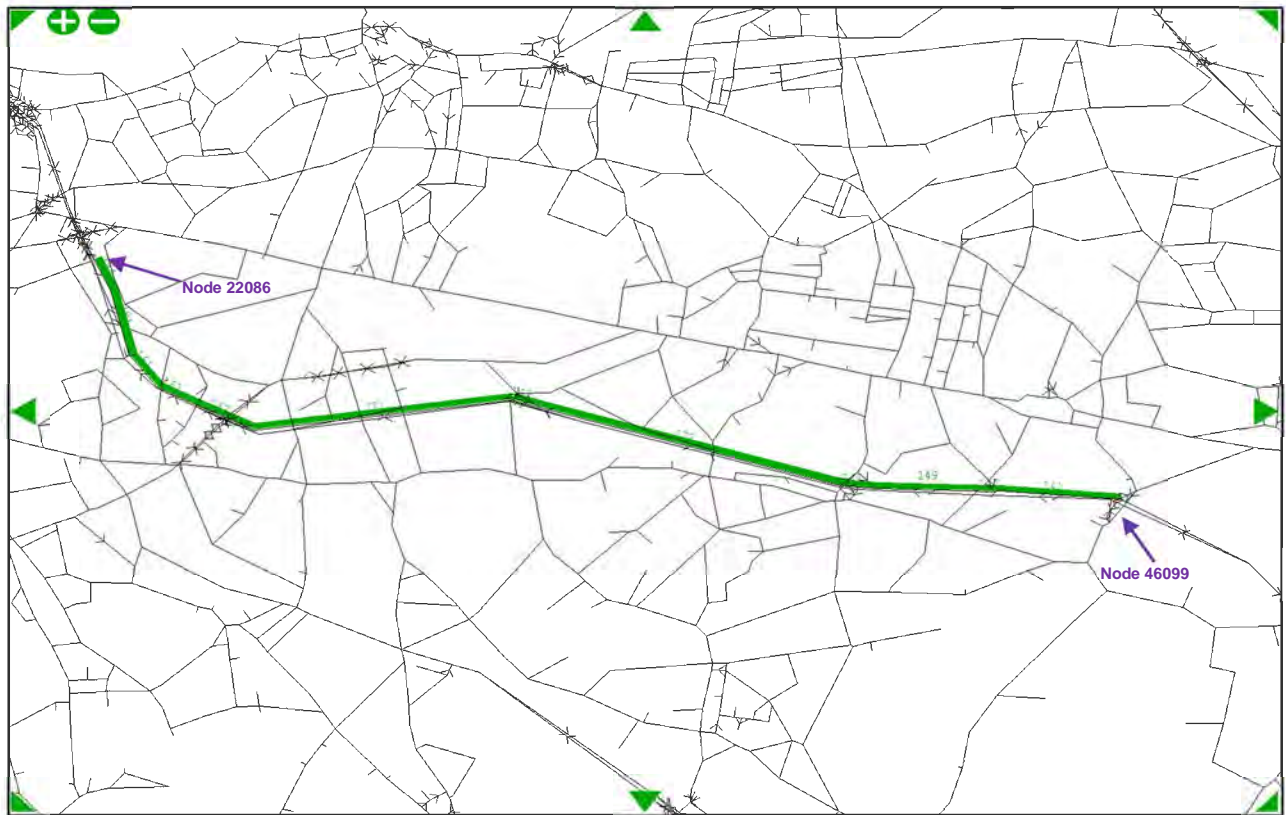
5.6.93. In the PM peak, there is a Significant Adverse total vehicle delay impact at node 46058 (A2 eastbound off-slip at the junction of A2 East Rochester Way / Danson Road), located as shown in Figure 5-90. Here the total vehicle delay increases by +131% or +12 hours.



**Figure 5-90: Node 46058 (A2 eastbound off-slip at the junction of A2 East Rochester Way / Danson Road)**

5.6.94. The eastbound approach link to this node exhibits a delay increase between the DM and DS of +17 seconds, but because this delay increase is applied to an increased number of vehicles between the DM and DS (+172 PCU/hr), the total vehicle delay is +131% or +12 hours.

5.6.95. The reason for the adverse impacts on the A2 is a localised reduction in queued flow leading to an increase in actual flow, as shown in Figure 5-91, between node 22086 (A2 eastbound on-slip / Shooters Hill Road) and node 46099 (A2 eastbound off-slip / Bourne Road).



**Figure 5-91: A2 Eastbound Actual Flow Difference Between DM and DS (Node 22086 – 46099)**

5.6.96. Having investigated this in detail; we believe a reduction in queued flow in the DS creates an increase in actual flow.

### **Area 3 Junctions for Mitigation**

5.6.97. Following the analysis we have undertaken on the impacts within Area 3 we are of the view that the following junctions require mitigation as a result of ULEZ:

- A205 South Circular Road / Ha-Ha Road / Nightingale Place where there is an increase in traffic flow on the south circular which generates increased delays.
- The impacts on the Catford Gyratory and A205 through the London Boroughs of Southwark and Lewisham are a result of very small increases in vehicles; we would welcome TfL's views as to whether these warrant investigations into mitigation.

#### A4. A40 CORRIDOR NEAR HANGER LANE GYRATORY AND WEMBLEY (WEST LONDON)

5.6.98. As shown in Figure 5-92 and Figure 5-93, there is one corridor within Area 4 with impacts:

- 4a) A40 corridor to Hanger Lane

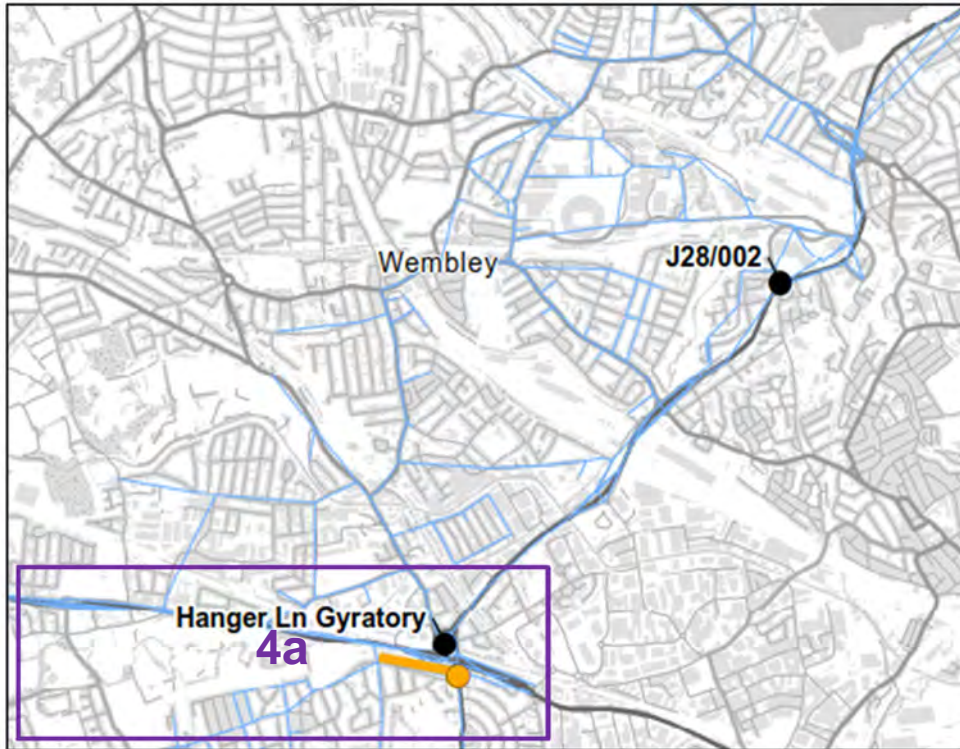
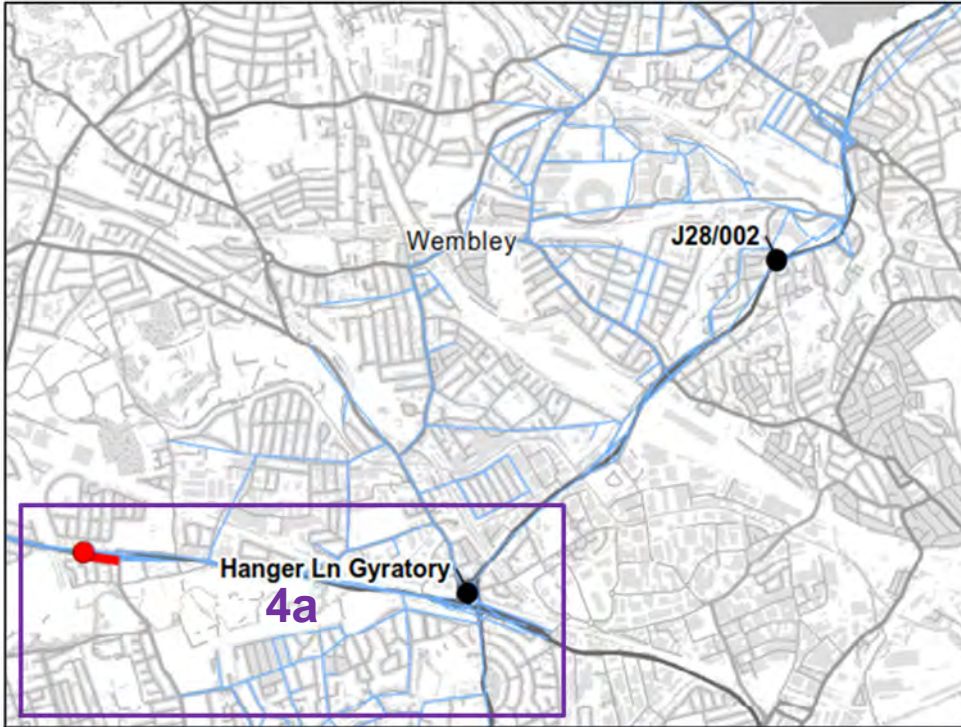


Figure 5-92: Area 4: Sub-area Definitions and ULEZ Impacts (AM Peak)



**Figure 5-93: Area 4: Sub-area Definitions and ULEZ Impacts (PM Peak)**

5.6.99. Figure 5-94 shows Area 4 and the location of the ULEZ boundary.



**Figure 5-94: Area 4 ULEZ Boundary**

5.6.100. Figure 5-95 to Figure 5-100 show comparisons of actual flow, link delay and link V/C in Area 4 between the DM and DS, blue bands show a reduction and green show an increase.

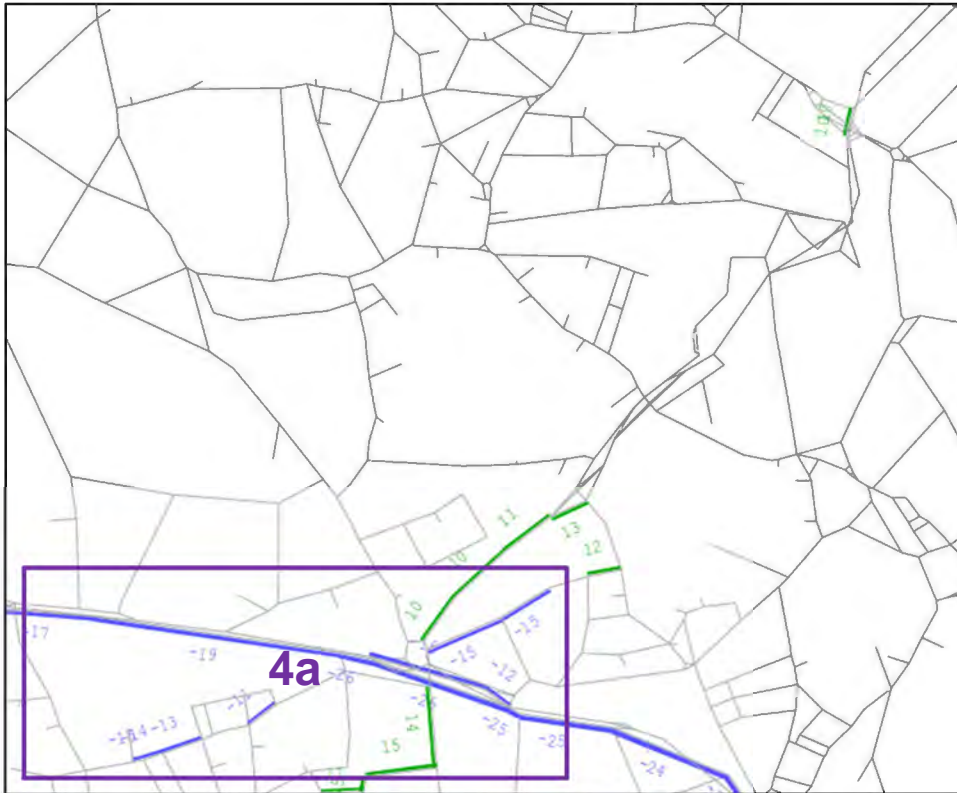


Figure 5-95: Area 4: Actual Flow Difference (AM Peak)

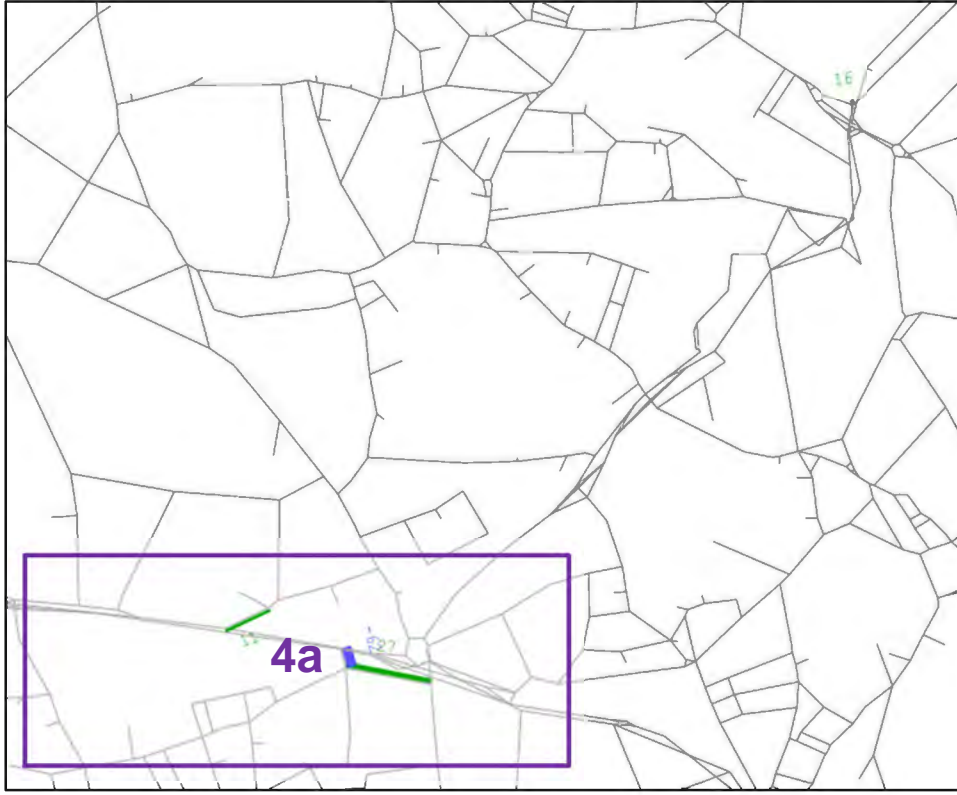
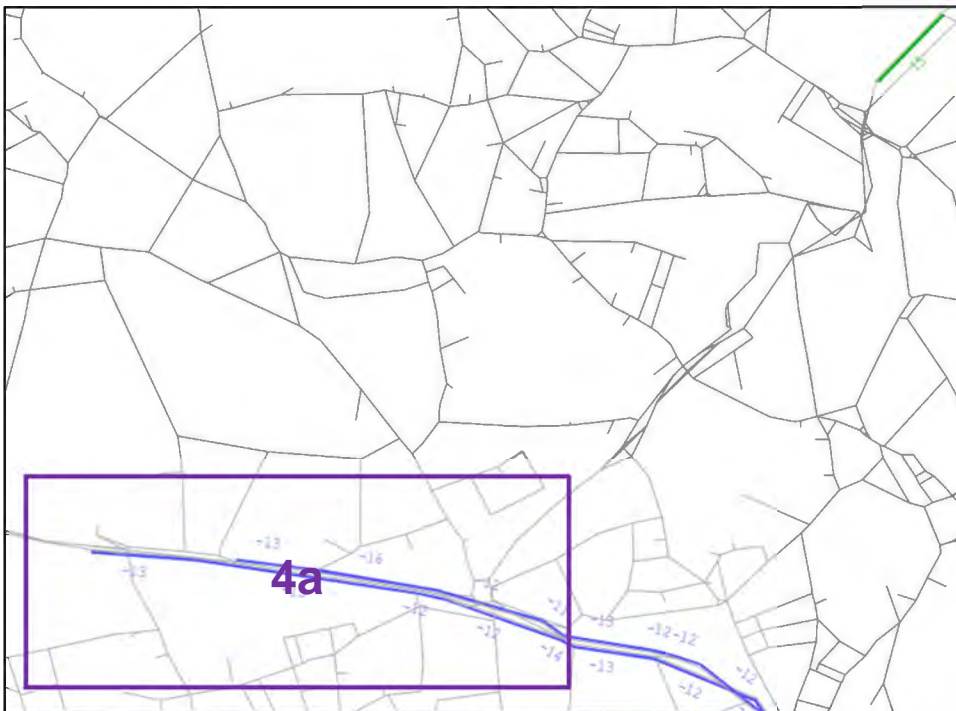


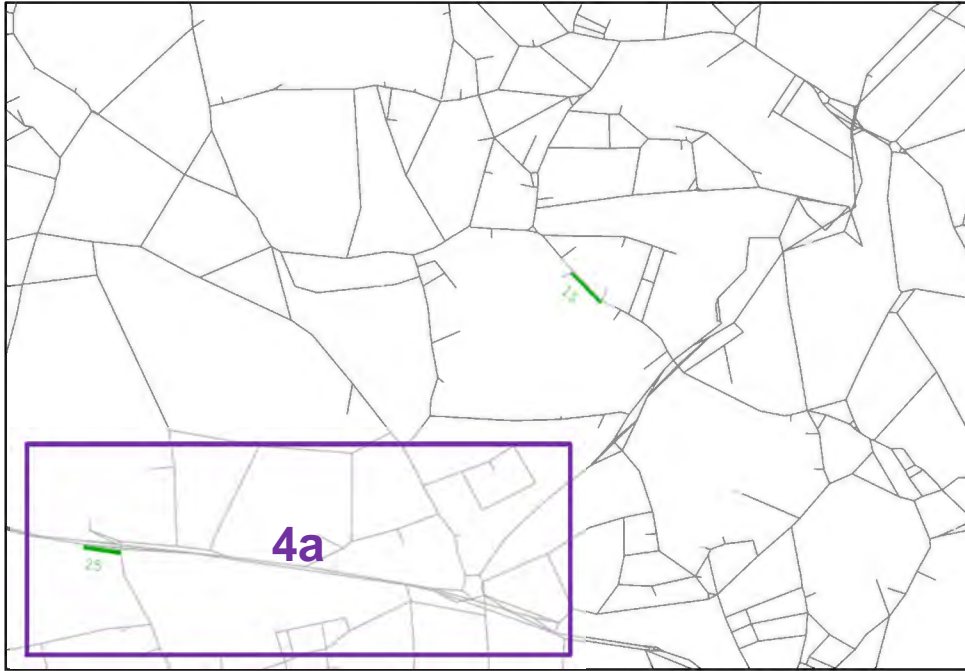
Figure 5-96: Area 4: Link Delay Difference (AM Peak)



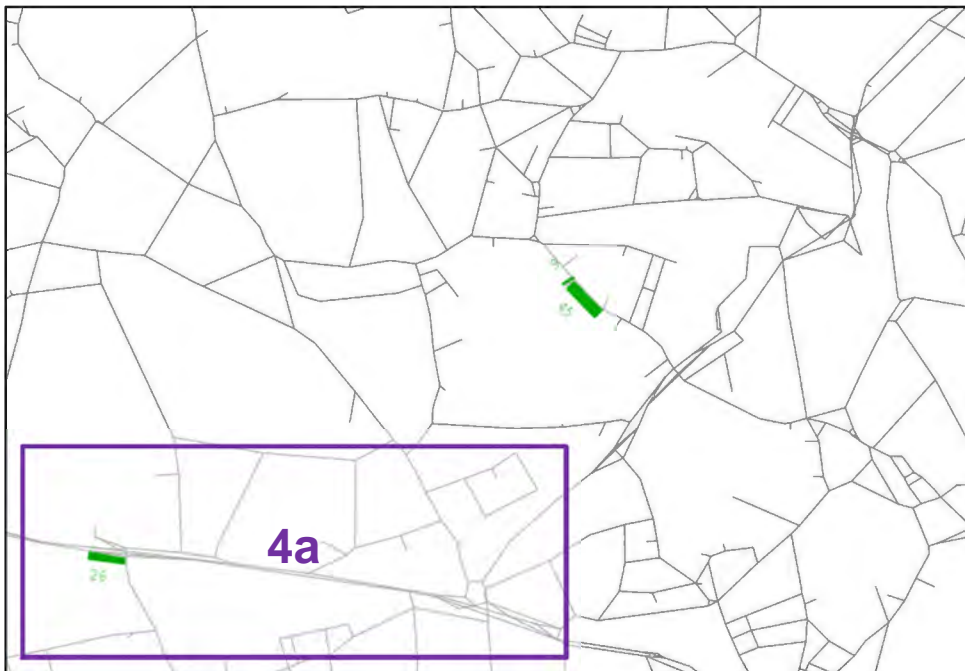
**Figure 5-97: Area 4: Link V/C Difference (AM Peak)**



**Figure 5-98: Area 4: Actual Flow Difference (PM Peak)**



**Figure 5-99: Area 4: Link Delay Difference (PM Peak)**

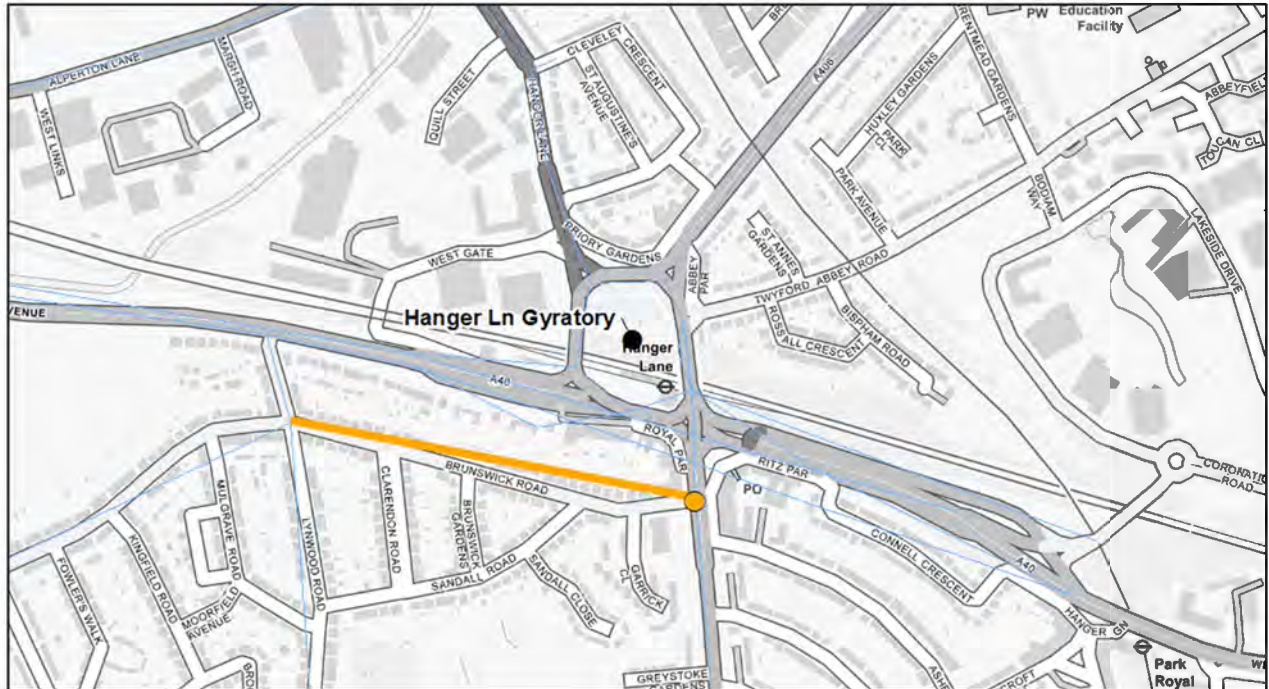


**Figure 5-100: Area 4: Link V/C Difference (PM Peak)**

5.6.101. The impacts within Area 4a are now discussed, beginning with the AM peak.

Area 4a) A40 corridor near Hanger Lane – AM Peak

5.6.102. As shown in Figure 5-101, there is a Moderate Adverse impact at the junction of A406 North Circular Road / Brunswick Road (node 64133) and on the junction's eastbound approach (Brunswick Road).



**Figure 5-101: Area 4a: ULEZ Impacts (AM Peak)**

5.6.103. The junction of A406 North Circular Road / Brunswick Road (node 64133) exhibits a Moderate Adverse total vehicle delay impact (+34% or +3 hours) and Brunswick Road eastbound to this junction (link 64020-64133) exhibits a Moderate Adverse total vehicle delay impact (+30% or +3 hours).

5.6.104. Both adverse impacts occur due a slight increase in blocking back (queuing) from the Hanger Lane Gyratory (node 64156), located as shown in Figure 5-102. This blocking back is caused by an increase in traffic travelling northbound along the north circular, approx. 14 vehicles. On the northbound approach to this junction, the blocking back factor (queuing) increases by +2% and delay increases by +3 seconds. This causes a +27 second delay to vehicles turning left out of Brunswick Road onto the A406 North Circular Road, although the A406 North Circular Road itself does not experience a Moderate or Significant adverse impact.

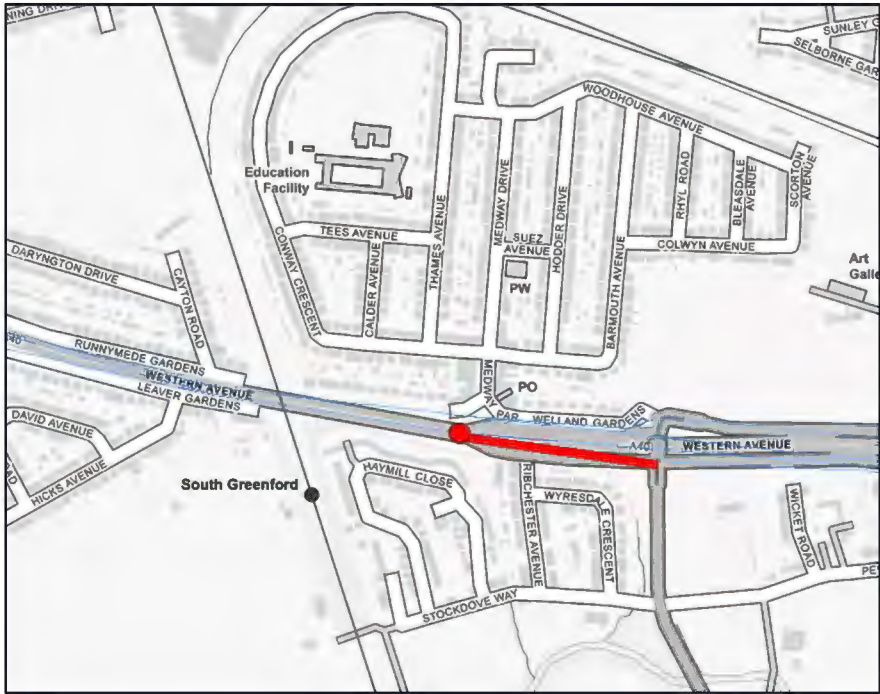




**Figure 5-102: Node 64156 (Hanger Lane Gyratory)**

Area 4a) A40 corridor near Hanger Lane – PM Peak

5.6.105. As shown in Figure 5-103, there are two links with Moderate or Significant Adverse impacts in the PM peak and a node with a Significant Adverse impact on the A40 near South Greenford station.

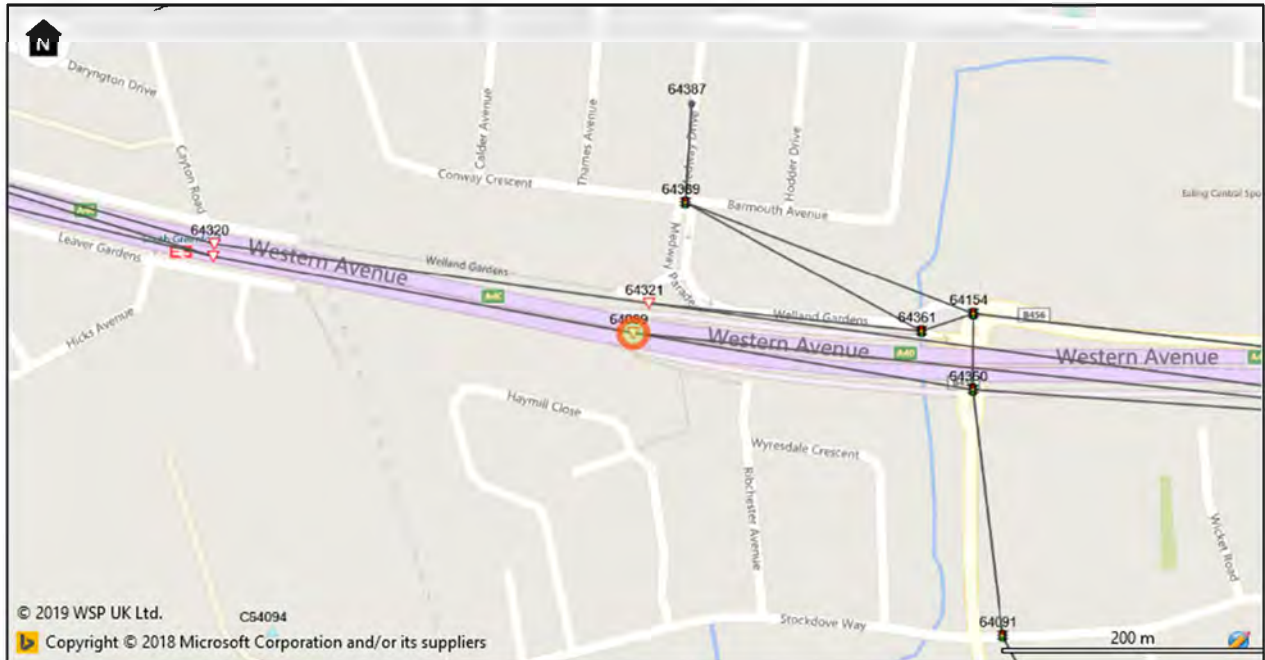


**Figure 5-103: Area 4a: ULEZ Impacts (PM Peak)**

5.6.106. There is a Significant Adverse impact at the junction of the A40 westbound on-slip with Argyle Road (node 64089) and this Significant Adverse impact stretches onto the westbound on-slip itself (link

64360-64089). At node 64089, total vehicle delay increases by +100% or +6 hours. On link 64360-64089 the V/C rises from 74% to 100% (+26%) and total vehicle delay increases by +288% or +6 hours.

5.6.107. Node 64089 is located as shown in Figure 5-104.



**Figure 5-104: Node 64089 (A40 westbound on-slip with Argyle Road)**

5.6.108. Combined with the gap and capacity convergence issues that are exhibited at this node in the PM peak DS, an increase of +8 PCU/hr between the DM and DS on the slip-road causes these adverse impacts.

#### **Area 4 Junctions for Mitigation**

5.6.109. Following the analysis we have undertaken on the impacts within Area 4, we think that Hanger Lane Gyratory around the A406 North Circular Road / Brunswick Road (node 64133) junction in the AM peak could benefit from mitigation.

## A5. A1 CORRIDOR TO BRENT CROSS AND STAPLES CORNER (NORTH LONDON)

5.6.110. As shown in Figure 5-105 and Figure 5-106, Area 5 has been subdivided into two sub-areas:

- 5a) Staples Corner (Tilling Way)
- 5b) A1 Corridor

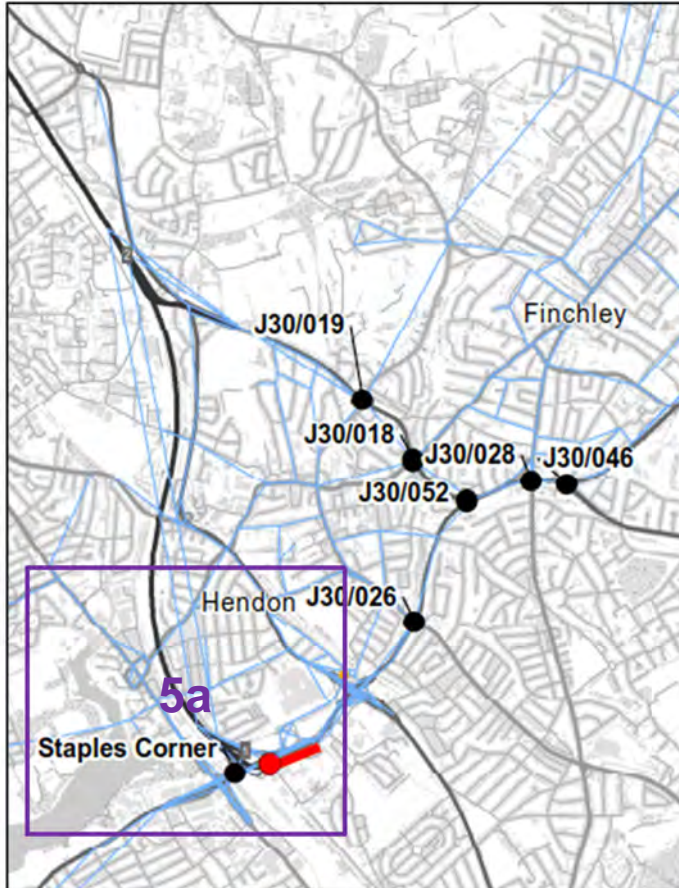
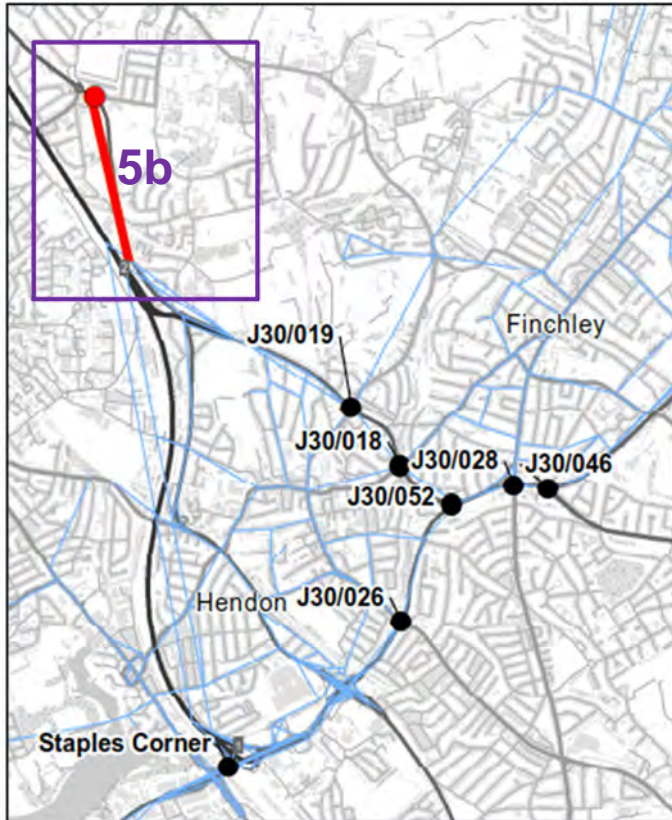


Figure 5-105: Area 5: Sub-area Definitions and ULEZ Impacts (AM Peak)



**Figure 5-106: Area 5: Sub-area Definitions and ULEZ Impacts (PM Peak)**

5.6.111. Figure 5-107 shows Area 5 and the location of the ULEZ boundary.

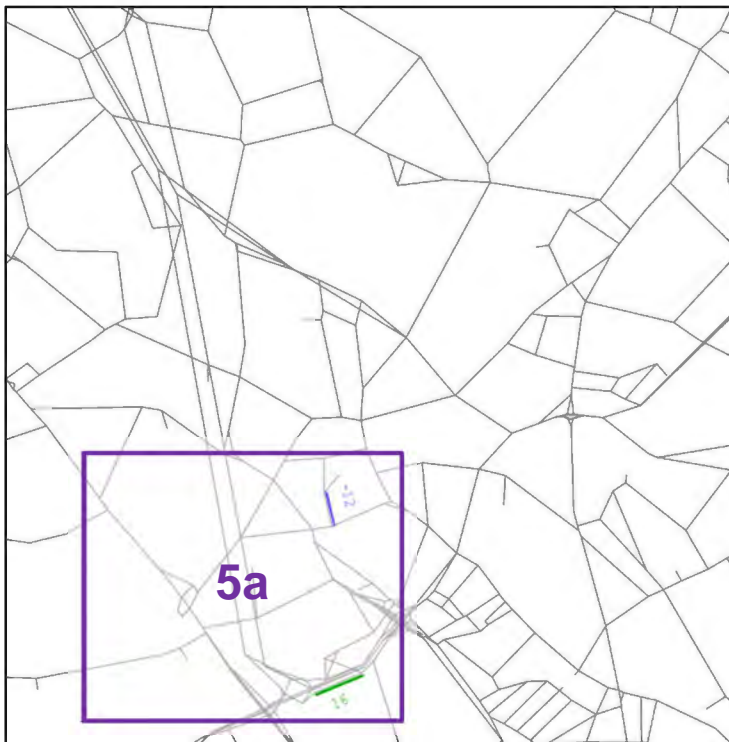


**Figure 5-107: Area 5 ULEZ Boundary**

5.6.112. Figure 5-108 to Figure 5-113 show comparisons of actual flow, link delay and link V/C in Area 5 between the DM and DS, blue bands show a reduction and green show an increase.



**Figure 5-108: Area 5: Actual Flow Difference (AM Peak)**



**Figure 5-109: Area 5: Link Delay Difference (AM Peak)**

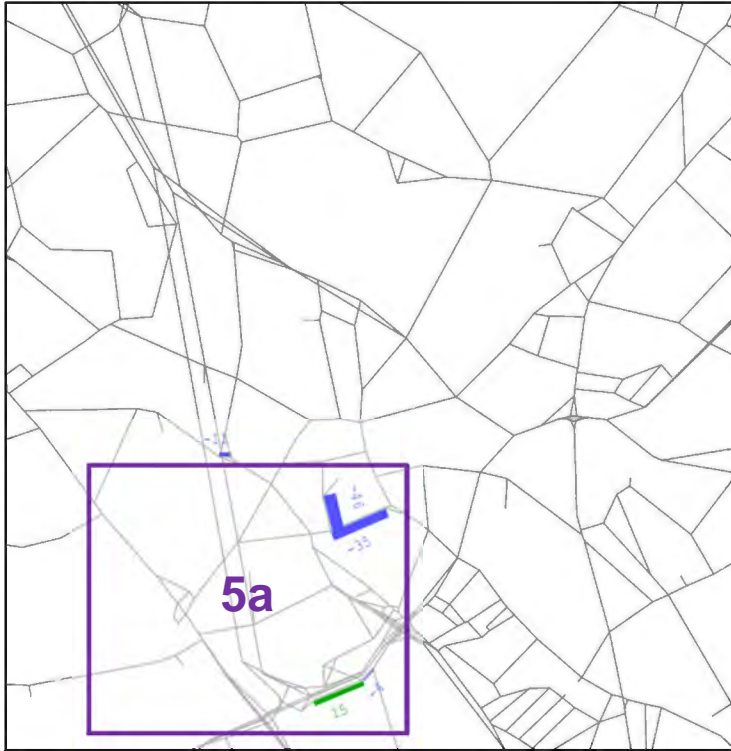


Figure 5-110: Area 5: Link V/C Difference (AM Peak)

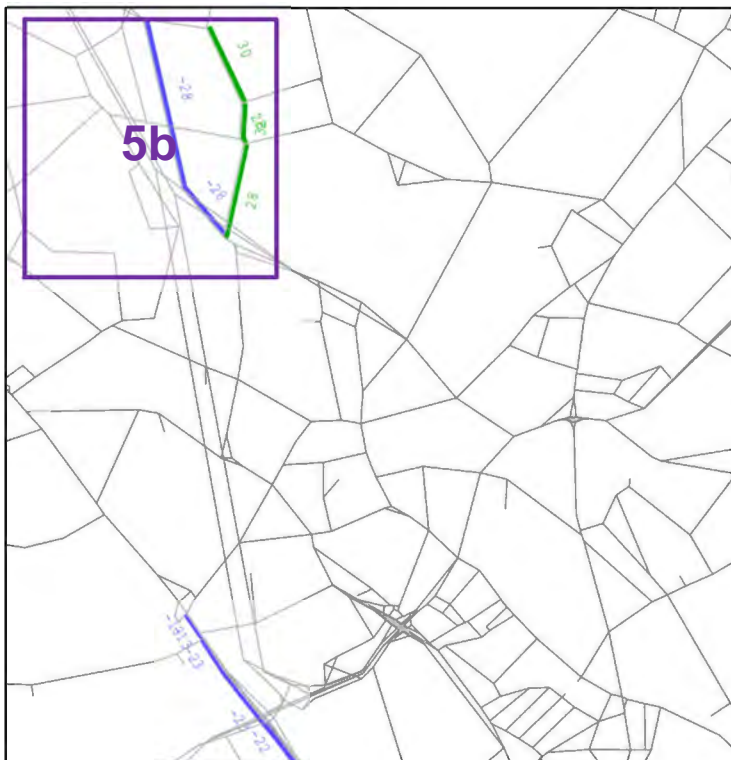
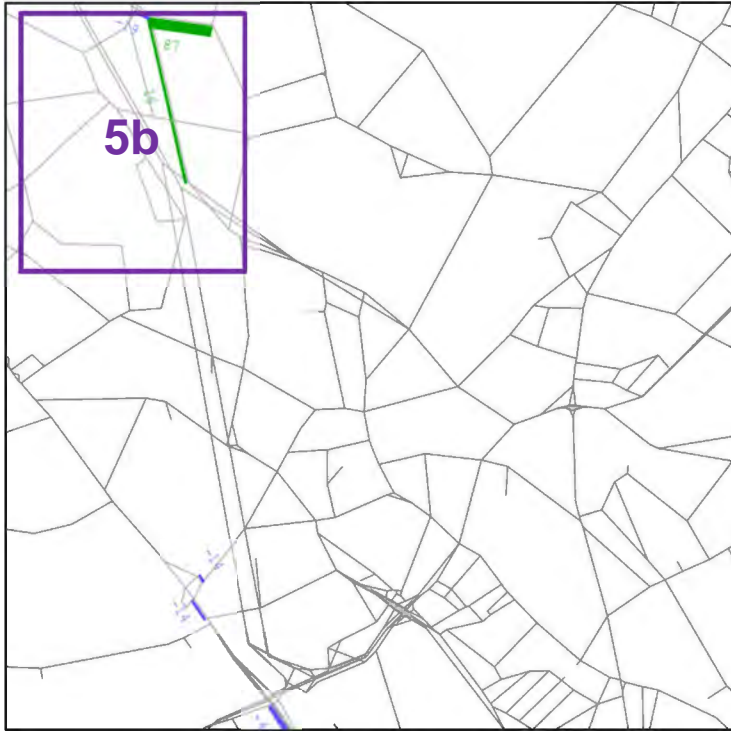
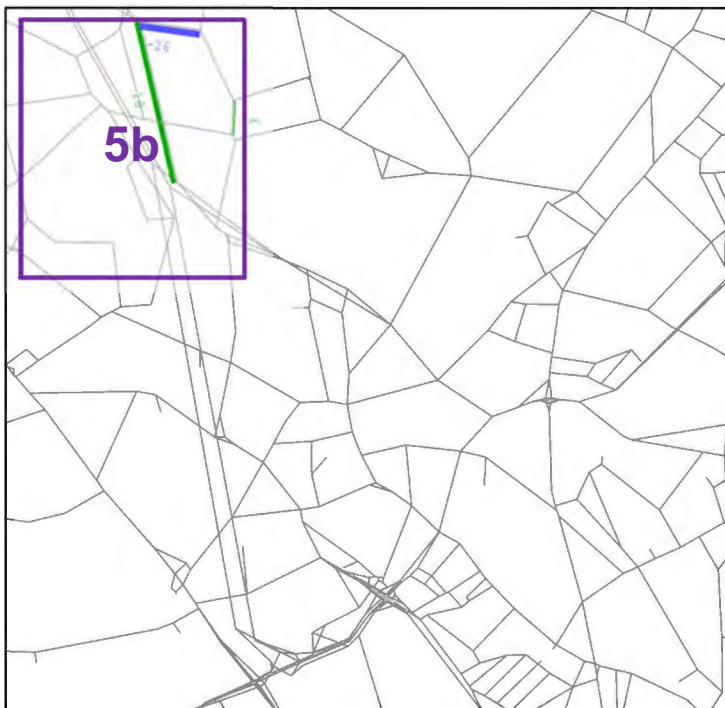


Figure 5-111: Area 5: Actual Flow Difference (PM Peak)



**Figure 5-112: Area 5: Link Delay Difference (PM Peak)**

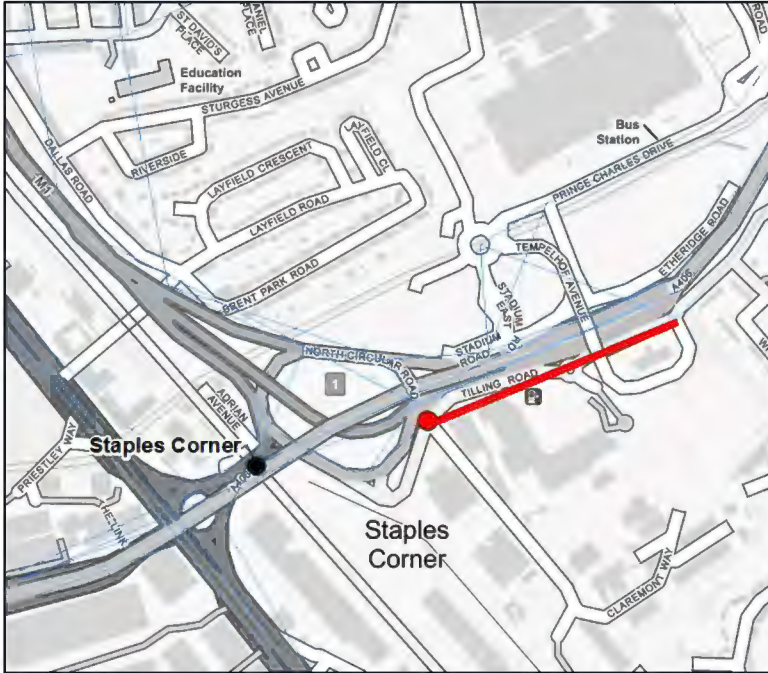


**Figure 5-113: Area 5: Link V/C Difference (PM Peak)**

5.6.113. The impacts within each of these sub-areas is now discussed in turn, starting with Area 5a.

Area 5a) Staples Corner (Tilling Way) – AM Peak

5.6.114. As shown in Figure 5-114, there are several Significant or Moderate Adverse impacts on the links/junctions around Staples Corner.



**Figure 5-114: Area 5a: ULEZ Impacts (AM Peak)**

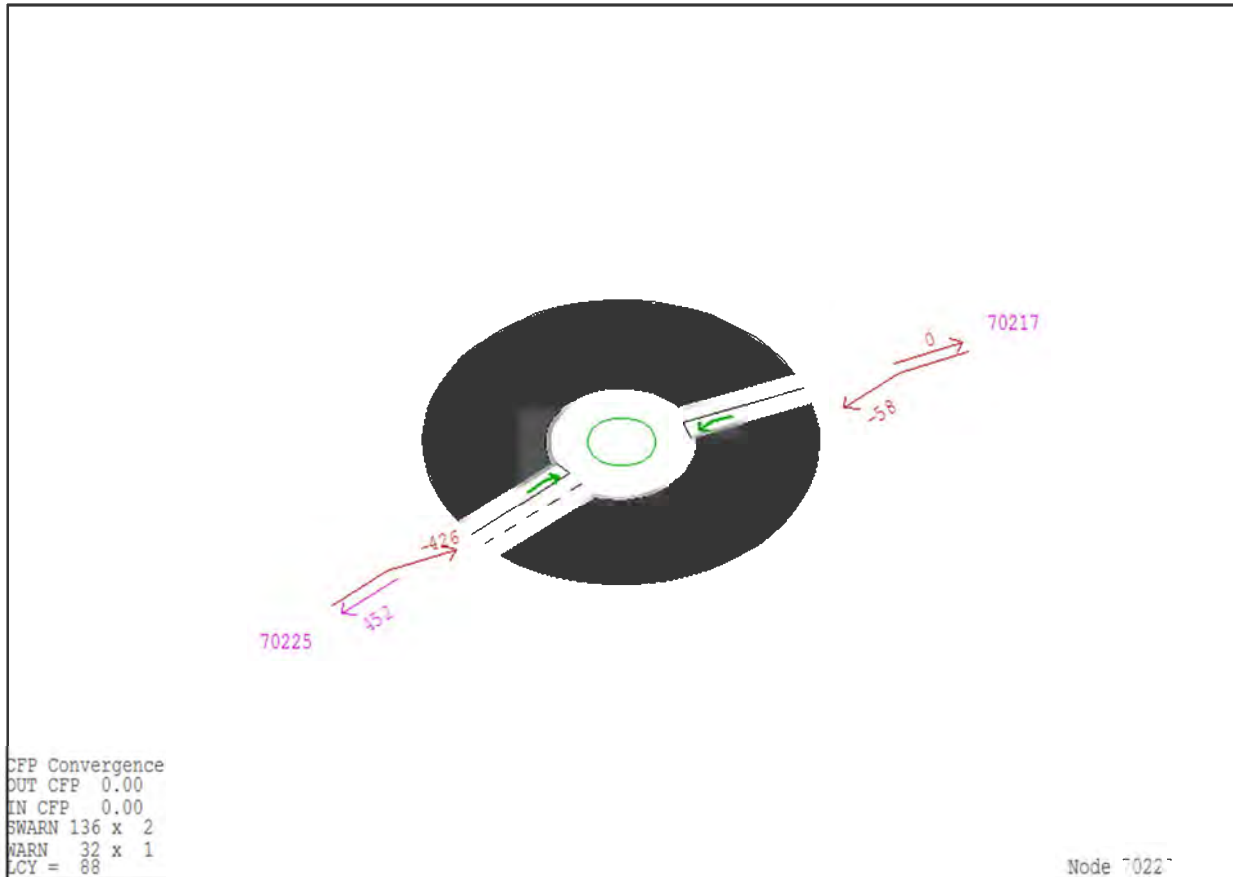
5.6.115. In the AM peak, there is a Significant Adverse total vehicle delay impact (+87% or +4 hours) at node 70227 (Tilling Road / Brent Terrace), located as shown in Figure 5-115. There is also a Significant Adverse V/C impact (+15%) and a Moderate Adverse total vehicle delay impact (+51% or +3 hours) on the westbound link approaching the junction (Tilling Road westbound).



**Figure 5-115: Node 70227 (Tilling Road / Brent Terrace) and Link 70217-70227 (Tilling Road westbound)**



5.6.116. Since node 70227 is a “dummy” node (a roundabout with only two-arms) to understand why the adverse effects occur at the node and on its westbound approach link, it is necessary to look at the turning flow differences. As shown in Figure 5-116, in the DS compared to the DM, +452 PCU/hr u-turn at node 70227.



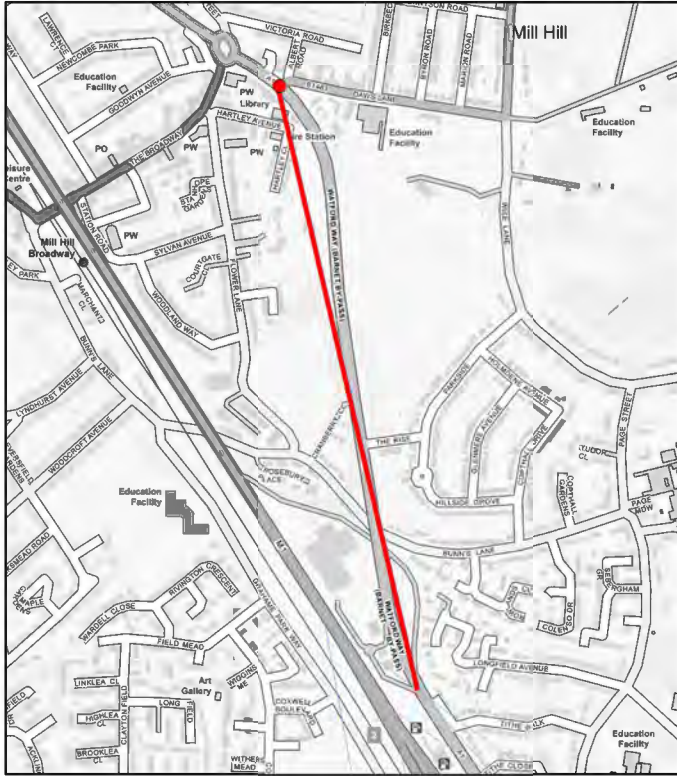
**Figure 5-116: AM Peak Turning Flow Difference at Node 70227 (Tilling Road / Brent Terrace) Between DM and DS**

5.6.117. Zone 70144 and Zone 70045 load directly onto node 70227. Since SATURN’s assignment routine forces +452 PCU/hr loading onto node 70227 from Zone 70144 and Zone 70045 to make a u-turn in the DS, the total vehicle delay and V/C of the junction is increased and results in the adverse impacts identified at the junction and on its approach link (Tilling Way westbound).

5.6.118. Since this effect is due to a change in SATURN’s assignment routine, these effects are not attributable to the ULEZ extension. Therefore, we do not recommend any form of mitigation at the junction or on Tilling Way and due to the extremely localised impact. No adverse effects are exhibited beyond this node and its approach links.

Area 5b) A1 Corridor – PM Peak

5.6.119. As shown in Figure 5-117, there are a couple of Significant Adverse impacts on a link and a junction on the A1 corridor around B1461 Daws Lane.



**Figure 5-117: Area 5b: ULEZ Impacts (PM Peak)**

5.6.120. In the PM peak, node 70125 (A1 / B1461 Daws Lane), located as shown in Figure 5-118, exhibits a Significant Adverse total vehicle delay impact (+190% or +10 hours) and link 70095-70125 (A1 northbound to B1461 Daws Lane) exhibits a Significant Adverse V/C impact (+18%) together with a Significant Adverse total vehicle delay impact (+152% or +11 hours).



**Figure 5-118: Node 70125 (A1 / B1461 Daws Lane) and Link 70095-70125 (A1 northbound to B1461 Daws Lane)**

5.6.121. The adverse impacts are due to increase blocking back (queuing) from node 70359 at the A1 / A5100 The Broadway signalled roundabout, as shown in Figure 5-119. These impacts are not easily attributable to the ULEZ extension and are isolated to the local area.



**Figure 5-119: Node 70359 (A1 / A5100 The Broadway)**

### Area 5 Junctions for Mitigation

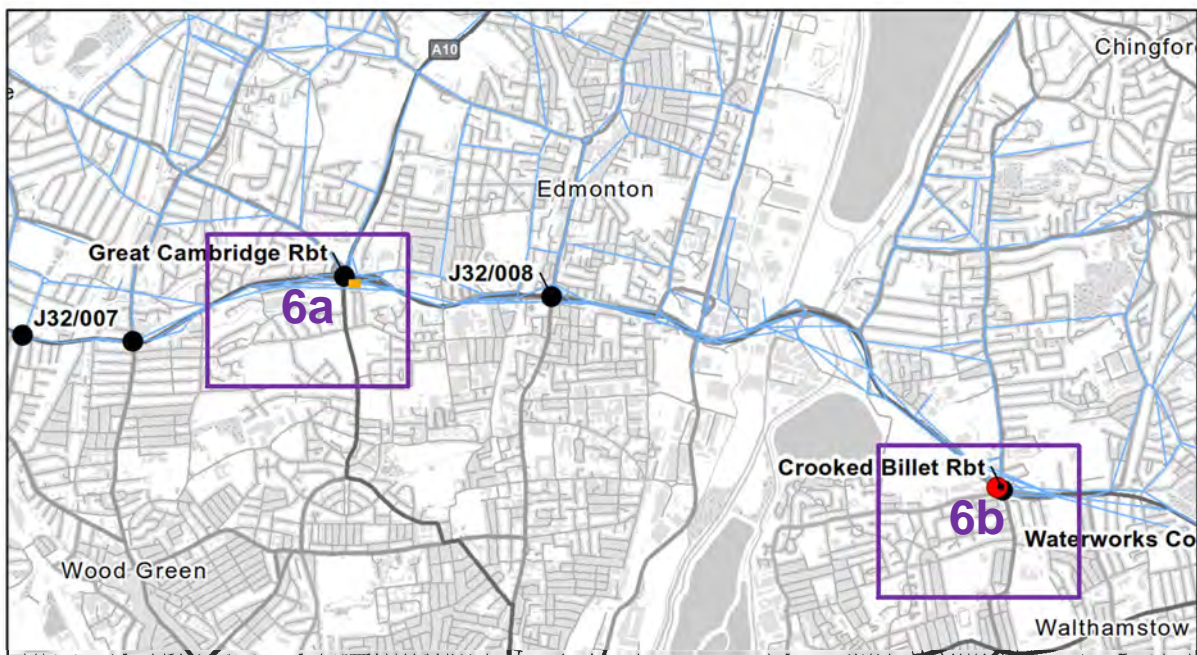
5.6.122. Following the analysis we have undertaken on the impacts within Area 5, we are of the view that there are no junctions which require mitigation to alleviate the impacts of the ULEZ extension.

### **A6. CROOKED BILLET ROUNDABOUT AND GREAT CAMBRIDGE ROUNDABOUT (NORTH EAST LONDON)**

5.6.123. As shown in Figure 5-120, there are two areas within Area 6 with impacts in the PM peak:

- 6a) Great Cambridge Roundabout
- 6b) Crooked Billet Roundabout

5.6.124. There are no Area 6 impacts in the AM peak.



**Figure 5-120: Area 6: Sub-area Definitions and ULEZ Impacts (PM Peak)**

5.6.125. Figure 5-127 shows Area 6 and the location of the ULEZ boundary.



**Figure 5-121: Area 6 ULEZ Boundary**

5.6.126. Figure 5-122 to Figure 5-124 show comparisons of actual flow, link delay and link V/C in Area 6 between the DM and DS, blue bands show a reduction and green show an increase.



**Figure 5-122: Area 6: Actual Flow Difference (PM Peak)**



**Figure 5-123: Area 6: Link Delay Difference (PM Peak)**



**Figure 5-124: Area 6: Link V/C Difference (PM Peak)**

5.6.127. The impacts within Area 6 are now discussed, beginning with Area 6a.

Area 6a) Great Cambridge Roundabout – PM Peak

5.6.128. As shown in Figure 5-125, there is a Moderate Adverse impact on the westbound approach to the Great Cambridge Roundabout from the A406 North Circular Road (link 74221-74263).

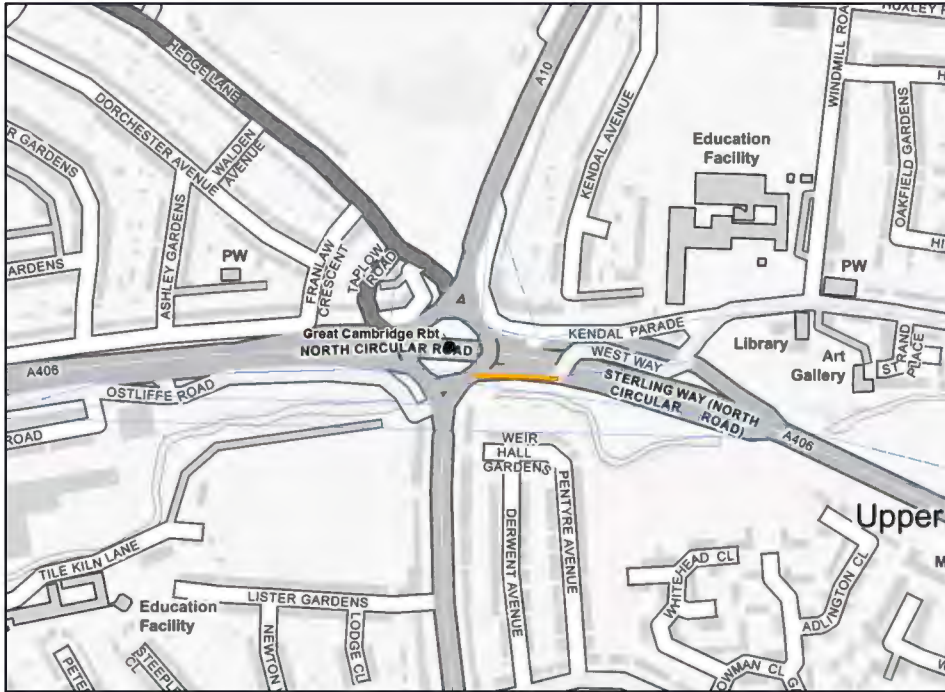


Figure 5-125: Area 6a: ULEZ Impacts (PM Peak)

5.6.129. This link is located as shown in Figure 5-126. Here, there is a +12% increase in V/C. The V/C in the DM is 68% and the V/C in the DS is 80%.

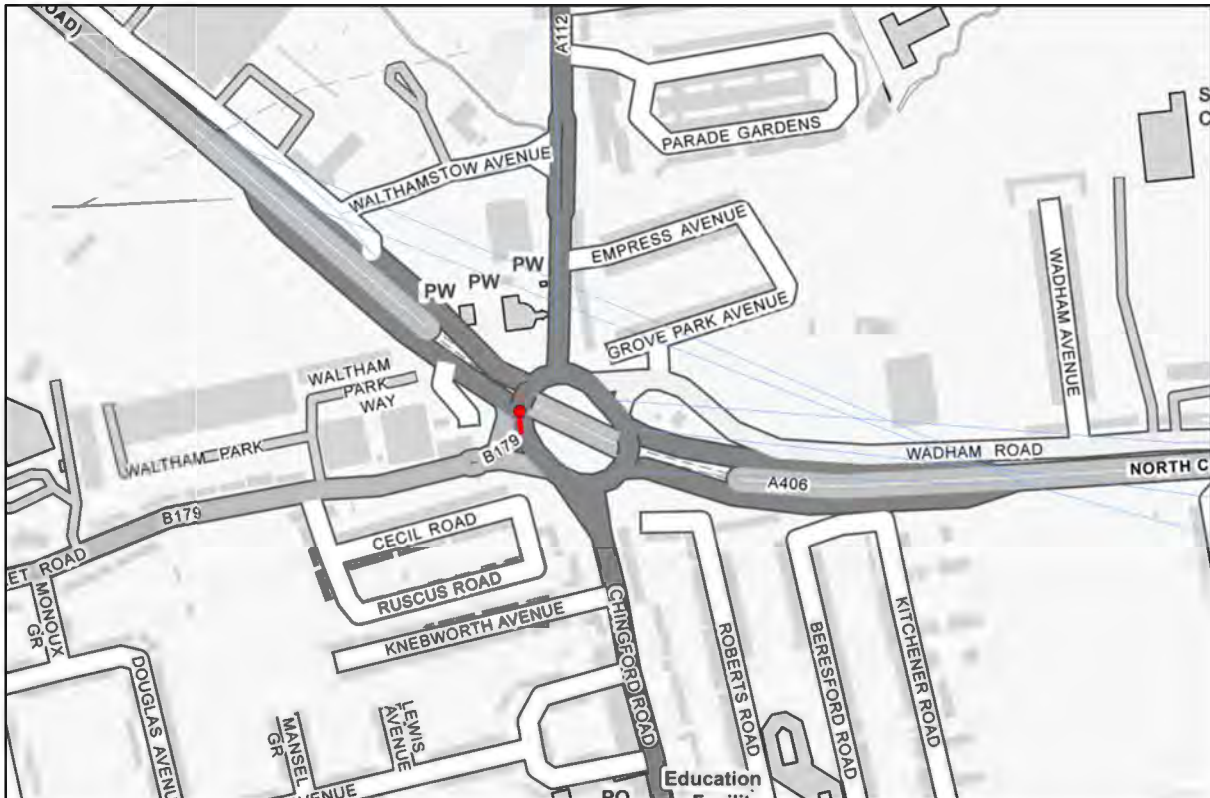


Figure 5-126: Link 74221-74263 (westbound approach to Great Cambridge Roundabout)

5.6.130. There is a +4 PCU/hr increase in actual flow on this link. This, combined with the increased blocking back (queuing) from node 74264 on the Great Cambridge Roundabout (+19%), leads to the Moderate Adverse impacts in V/C on the westbound approach link to the roundabout.

Area 6b) Crooked Billet Roundabout – PM Peak

5.6.131. As shown in Figure 5-127, there are Significant Adverse impacts in the PM peak on the Crooked Billet Roundabout at a node and on its northbound approach link.



**Figure 5-127: Area 6b: ULEZ Impacts (PM Peak)**

5.6.132. The link is located as shown in Figure 5-128. Here, the V/C of the node and the link increases from 33% in the DM to 70% in the DS (+37%).





**Figure 5-128: Link 36308-36309 (Crooked Billet Roundabout)**

5.6.133. There is no increase in actual flow on this link, but the link to the north of this on the Crooked Billet Roundabout (link 36309-36202) exhibits an actual flow increase of +1 PCU/hr and blocking back (queuing) increases by +68%. However, the capacity of the link and the junction does not change, which means the adverse impacts are due to the V/C of link 36302-36309 in the DM being very close to capacity (96%) and the additional +1 PCU/hr pushes the junction over capacity and results in blocking back (queuing).

**Area 6 Junctions for Mitigation**

5.6.134. Following the analysis we have undertaken on the impacts within Area 6, the impacts on the Great Cambridge roundabout and the Crooked Billet roundabout are a result of a very small increases in vehicles, we would welcome TfL’s views as to whether these warrant investigations into mitigation.

## 6 MITIGATION ASSESSMENT

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### 6.1 INTRODUCTION

- 6.1.1. Following identification and approval of the list of junctions to mitigate, TfL Engineering supplied WSP with the latest signal timing data to implement into the DM and DS models, at the following junctions/areas where adverse impacts were exhibited in the initial impact assessment:
- A205 / Haha Road / Nightingale Place
  - A205 / Vine Road / Priory Lane
  - Chalkers Corner
- 6.1.2. This chapter details the updates made to the signal timings at each of the above junctions and the resulting ULEZ extension impacts by comparing the updated DM and DS models. The same thresholds as previously outlined have been used to ensure that the proposed mitigations are effective and that together they do not generate any wider/secondary impacts at neighbouring/adjacent junctions.
- 6.1.3. Initially, in this chapter the technical details of the signal timing updates made are outlined and then details on the new impact threshold assessment (with mitigation).

## 6.2 SIGNAL TIMING UPDATES

### MITIGATION OF: A205 / HA-HA ROAD / NIGHTINGALE PLACE

6.2.1. The A205 / Ha- Ha Road / Nightingale Place junction is represented by node 22187. Table 6-1 shows the signal timings for the A205 / Ha-Ha Road junction in each peak, both before and after mitigation. (Note that in Table 6-1, the green time is shown in green font, and the intergreen time is shown in red font.)

**Table 6-1: Signal Timings at A205 / Ha-Ha Rd / Nightingale Place junction.**

Stage	Original Signal Timings (secs)		Updated Signal Timings (secs)		Phasing Updates	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	26 7	22 5	22 17	9 17	Remove left turn from A205 Southbound (Node 22190).	Remove left turn from A205 Southbound (Node 22190).
2	22 5	16 5	12 8	9 8	Remove left turn from A205 Southbound (Node 22190). Remove left turn from A205 Northbound (Node 22166).	Remove left turn from A205 Southbound (Node 22190). Remove left turn from A205 Northbound (Node 22166).
3	22 6	29 5	11 15	22 15	Remove left turn from A205 Northbound (Node 22166).	Remove left turn from A205 Northbound (Node 22166).
4	11 5	17 5	4 15	9 15	Remove left turn from A205 Southbound (Node 22190). Remove left turn from A205 Northbound (Node 22166).	Remove left turn from A205 Southbound (Node 22190). Remove left turn from A205 Northbound (Node 22166).

## MITIGATION OF: A205 / VINE ROAD / PRIORY LANE

6.2.2. The A205 / Vine Road / Priory Lane junction is represented by node 58856. Table 6-2 shows the signal timings for the A205 / Vine Road junction in each peak.

**Table 6-2: Signal Timings at A205 / Vine Rd / Priory Lane Junction**

Stage	Original Signal Timings (secs)		Updated Signal Timings (secs)		Phasing Updates	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	51 0	41 0	39 9	37 9	No changes	No changes
2	12 14	4 28	4 6	9 6	No changes	No changes
3	22 5	23 8	21 33	18 33	No changes	No changes

## MITIGATION OF: CHALKERS CORNER

6.2.3. Chalkers Corner is represented by two nodes, namely 58887 and 58848. Table 6-3 and Table 6-4 show the signal timings for the two junctions which constitute Chalkers Corner in both the AM and the PM peak, before and after mitigation measures.

**Table 6-3: Signal Timings at A205 / A316 Lower Richmond Rd Junction**

Stage	Original Signal Timings (secs)		Updated Signal Timings (secs)		Phasing Updates	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	40 0	34 0	28 7	26 7	No changes	No changes
2	8 5	3 7	4 9	4 9	No changes	No changes
3	27 0	38 0	22 11	25 11	No changes	No changes
4	15 5	11 6	7 8	8 8	No changes	No changes
5	15 5	16 0	12 12	10 12	No changes	No changes

**Table 6-4: Signal Timings at A316 / A3003 junction**

Stage	Original Signal Timings (secs)		Updated Signal Timings (secs)		Phasing Updates	
	AM Peak	PM Peak	AM Peak	PM Peak	AM Peak	PM Peak
1	3 0	3 0	-	-	Stage removed.	Stage removed.
2	33 5	40 5	35 5	37 5	No changes.	No changes.
3	11 0	10 0	14 9	14 9	No changes.	No changes.
4	31 0	31 0	22 13	25 13	No changes.	No changes.
5	3 5	2 5	-	-	Stage removed.	Stage removed.
6	5 0	5 0	-	-	Stage removed.	Stage removed.
7	19 5	14 5	14 8	9 8	Remove straight ahead option from A3003 Lower Richmond St (Node 59271).	Remove straight ahead option from A3003 Lower Richmond St (Node 59271).

## 6.3 IMPACT THRESHOLD ASSESSMENT

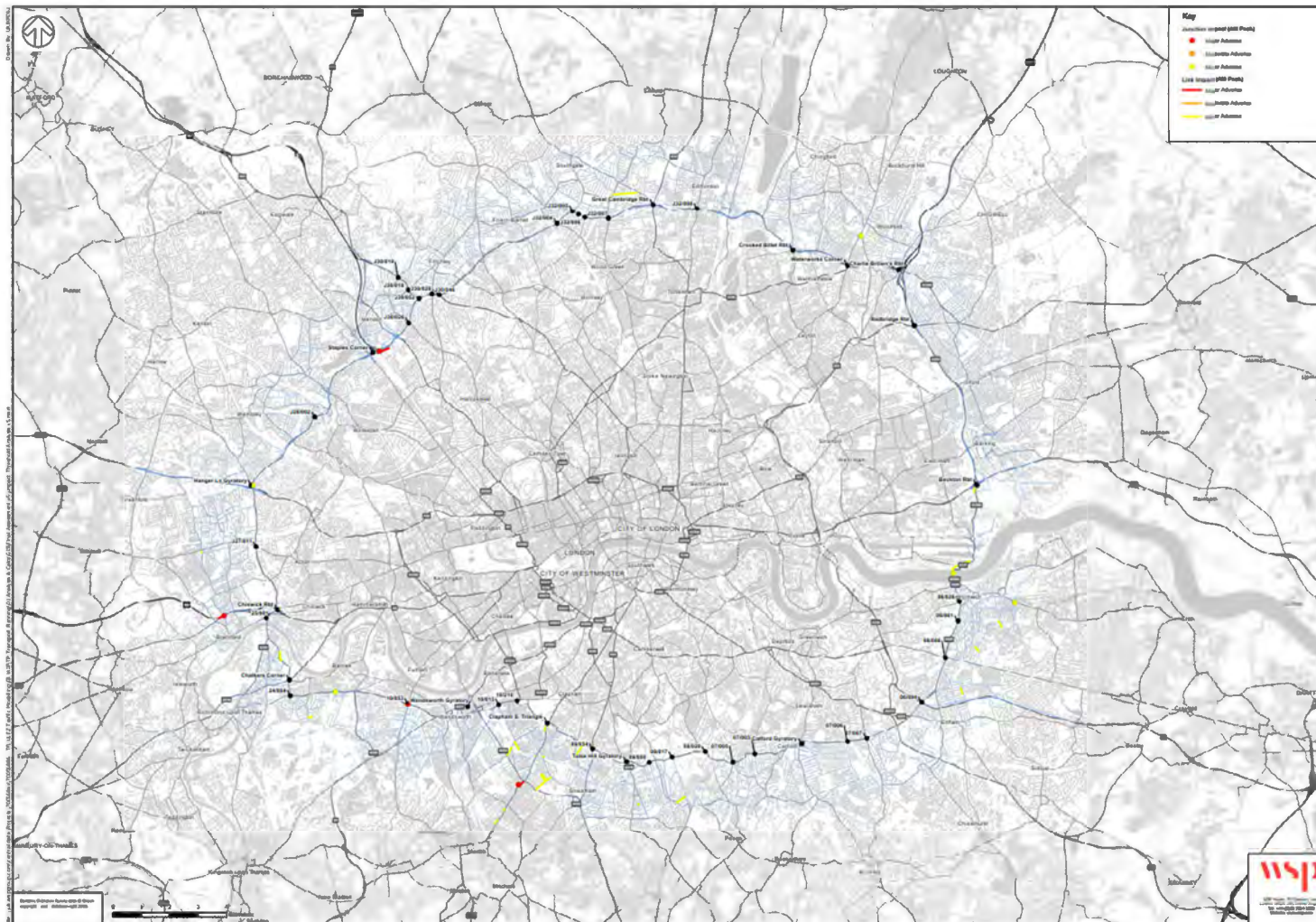
### HIGH-LEVEL OVERVIEW

- 6.3.1. This section provides a high-level overview of the impacts of the mitigation measures on the model in the AM and the PM peaks. Figure 6-1 and Figure 6-4 depict the locations of the adversely affected links and junctions, while Figure 6-2 and Figure 6-5 display the beneficially affected links and junctions in both the AM and PM peaks, respectively.
- 6.3.2. Table 6-5 shows the number of adversely affected links and junctions in the AM and PM peak which have been classified as moderate or significant. For reference, the same data is given from the original assessment, before mitigation.

**Table 6-5: Number of Adversely Affected Links and Junctions**

	Number of adversely affected links		Number of adversely affected junctions	
	AM Peak	PM Peak	AM Peak	PM Peak
Before signal updates	44	31	9	14
After signal updates	22	29	7	8

- 6.3.3. The locations of the moderate and significant adversely affected links and junctions are shown in Figure 6-3 and Figure 6-6.
- 6.3.4.



**Figure 6-1: AM Peak Adverse Impact**

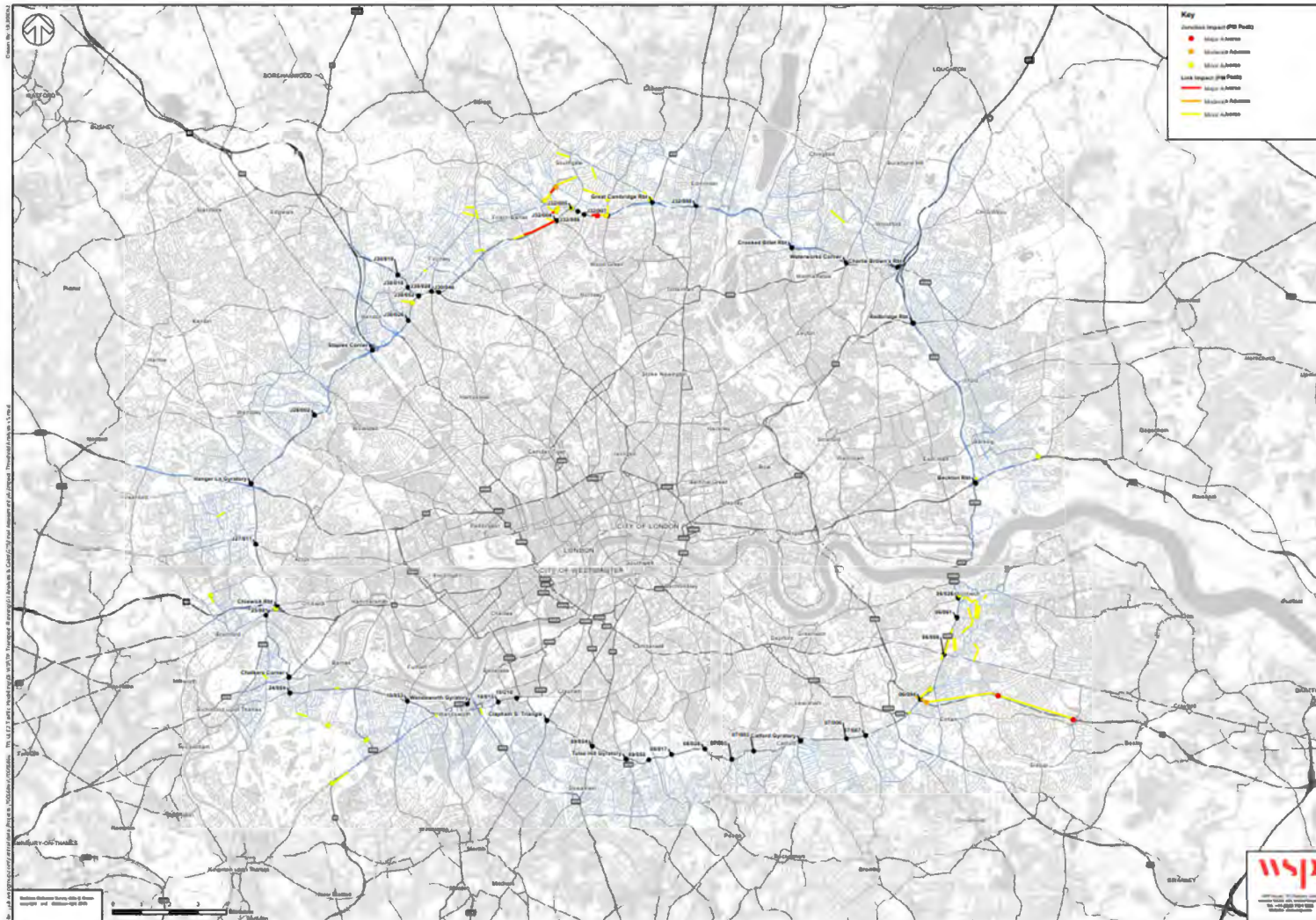


**Figure 6-2: AM Peak Beneficial Impact**



**Figure 6-3: AM Peak Significant and Moderate Adverse Impact**





**Figure 6-4: PM Peak Adverse Impact**



**Figure 6-5: PM Peak Beneficial Impact**



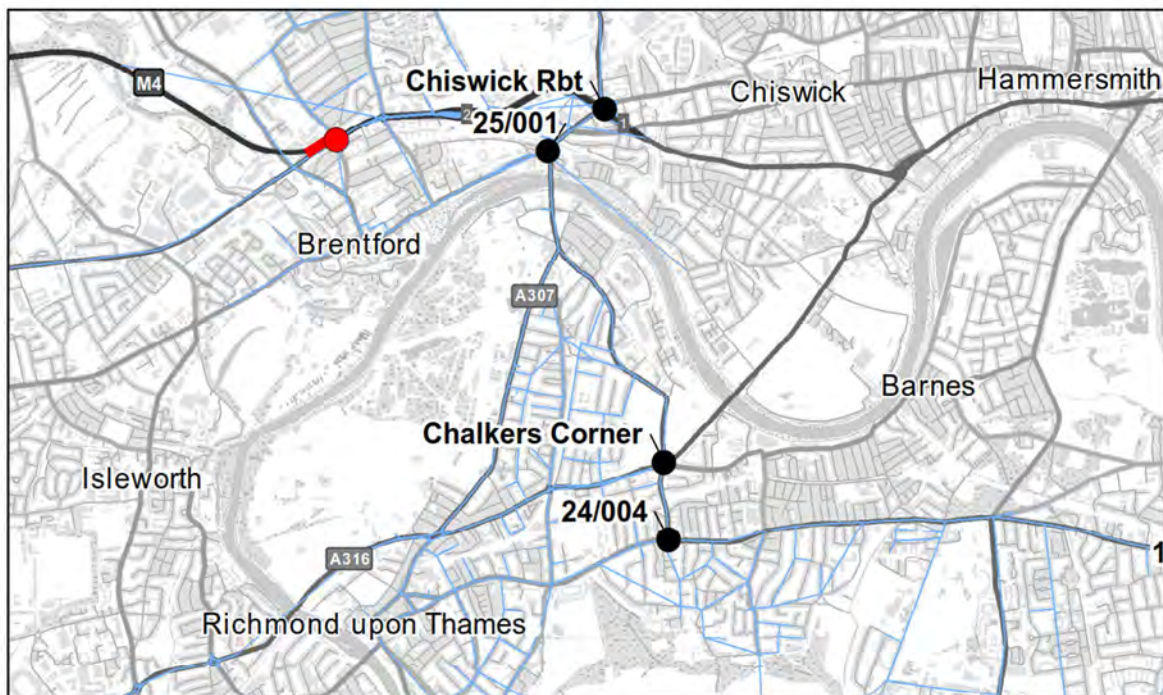
**Figure 6-6: PM Peak Significant and Moderate Adverse Impact**

## DETAILED HIGHWAY IMPACT ASSESSMENT

- 6.3.5. This section will discuss the adverse impacts of the mitigation measures in detail.
- 6.3.6. As discussed in Section 5.6, the high-level area of impact assessment was grouped into six areas, namely:
- Area 1 - Chalkers Corner and A4 corridor to Chiswick Roundabout (South West London)
  - Area 2 - A24 corridor between Merton and Clapham (South London)
  - Area 3 - A2 corridor to Eltham and locations near Catford, Lewisham (South East London)
  - Area 4 - A40 corridor to Hanger Lane Gyratory and Wembley (West London)
  - Area 5 - A1 corridor to Brent Cross and Staples Corner (North London)
  - Area 6 - Crooked Billet Roundabout and Great Cambridge Roundabout (North East London)
- 6.3.7. The impact of implementing the signal updates as mitigation will now be discussed for each of these areas in turn.

### AREA 1 – CHALKERS CORNER AND A4 CORRIDOR TO CHISWICK ROUNDABOUT

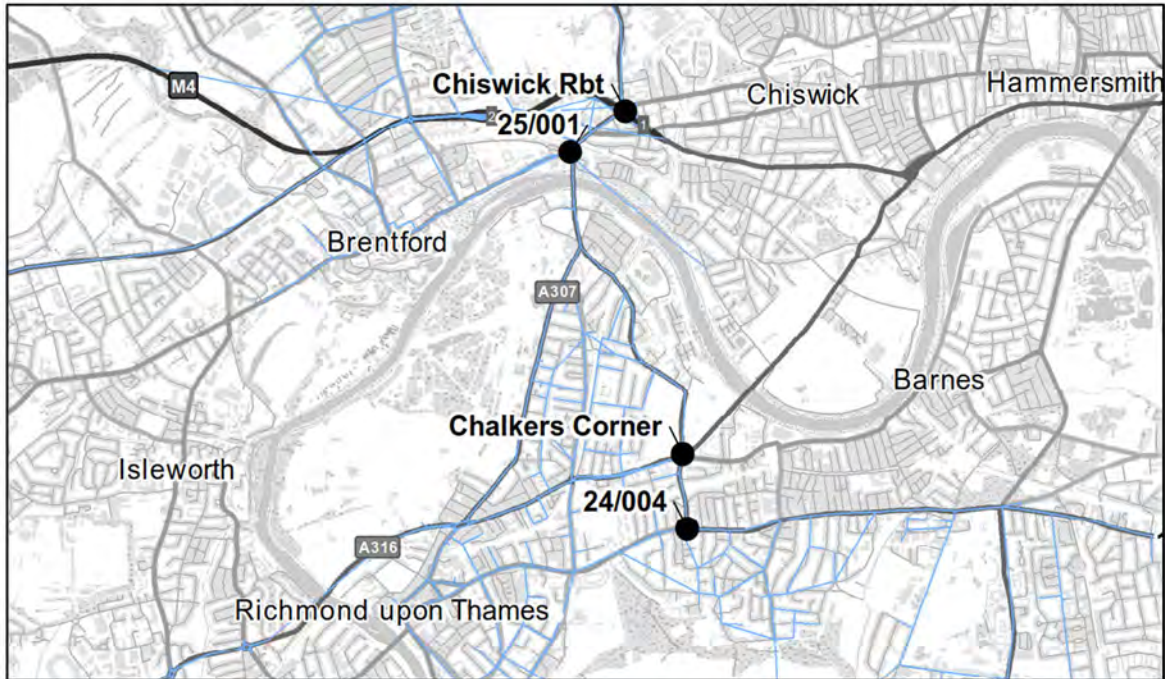
- 6.3.8. Figure 6-7 shows the links and junctions in Area 1 which have a moderate or significant adverse impact in the AM peak after the mitigation measures have been implemented. There are significant adverse link and junction impacts in the AM peak, namely on:
- A4 Great West Road corridor west of Chiswick Roundabout



**Figure 6-7: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 1**

- 6.3.9. This shows that all issues that were being generated at Chalkers corner in Figure 5-21 have been resolved as a result of implementing more accurate signal timing data into the model.

6.3.10. As shown in Figure 6-8, there are no adverse impacts in Area 1 in the PM peak after the mitigation measures have been implemented.



**Figure 6-8: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 1**

6.3.11. This shows that all issues that were being generated at Chalkers corner in Figure 5-36 have been resolved as a result of implementing more accurate signal timing data into the model.

6.3.12. Each adverse impact in Area 1 will now be discussed in more detail.

**A4 Great West Road west of Chiswick roundabout**

6.3.13. Figure 6-9 shows the adverse link and junction impact on the A4 Great West Road west of the Chiswick Roundabout in the AM peak.



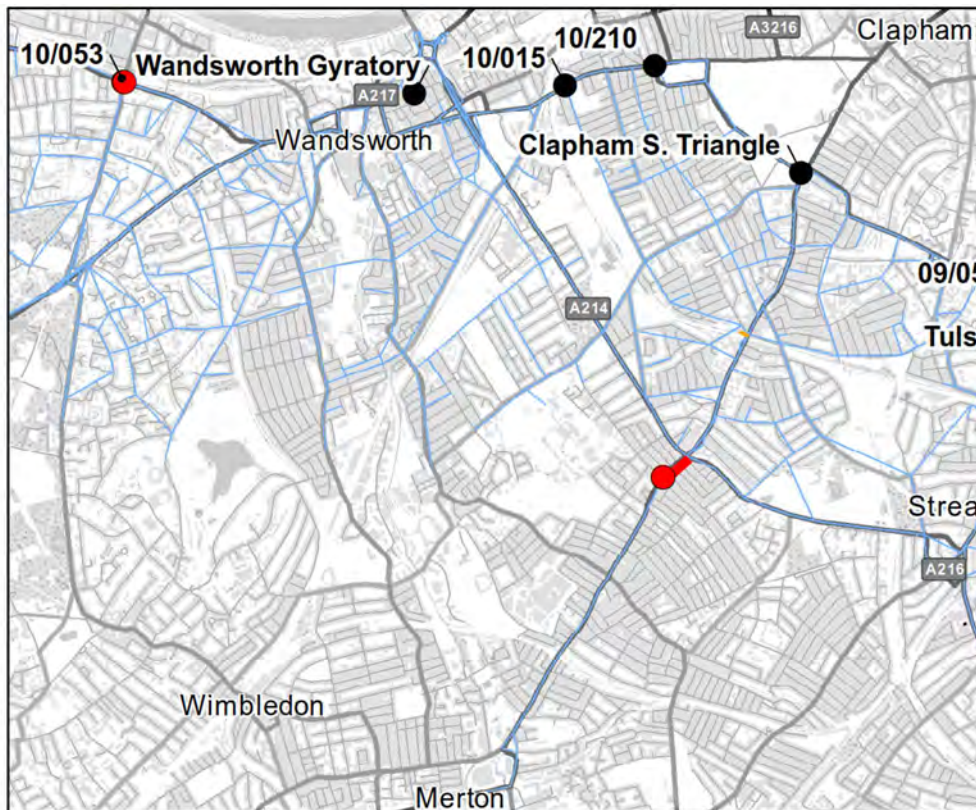
**Figure 6-9: AM Peak Adverse Impacts on A4 Great West Road**

6.3.14. After investigation, it was concluded that these significant adverse impacts can be attributed to gap and flow convergence issues in the model around this junction, and so are therefore not attributable to the ULEZ expansion. These convergence issues were also found in this area in the models without mitigation in the PM peak, but now they are occurring in the AM peak.

## AREA 2 – A24 CORRIDOR BETWEEN MERTON AND CLAPHAM (SOUTH LONDON)

6.3.15. Figure 6-10 shows the links and junctions in Area 2 which have a moderate or significant adverse impact in the AM peak after the mitigation measures have been implemented. There are two areas exhibiting significant adverse impacts in the AM peak:

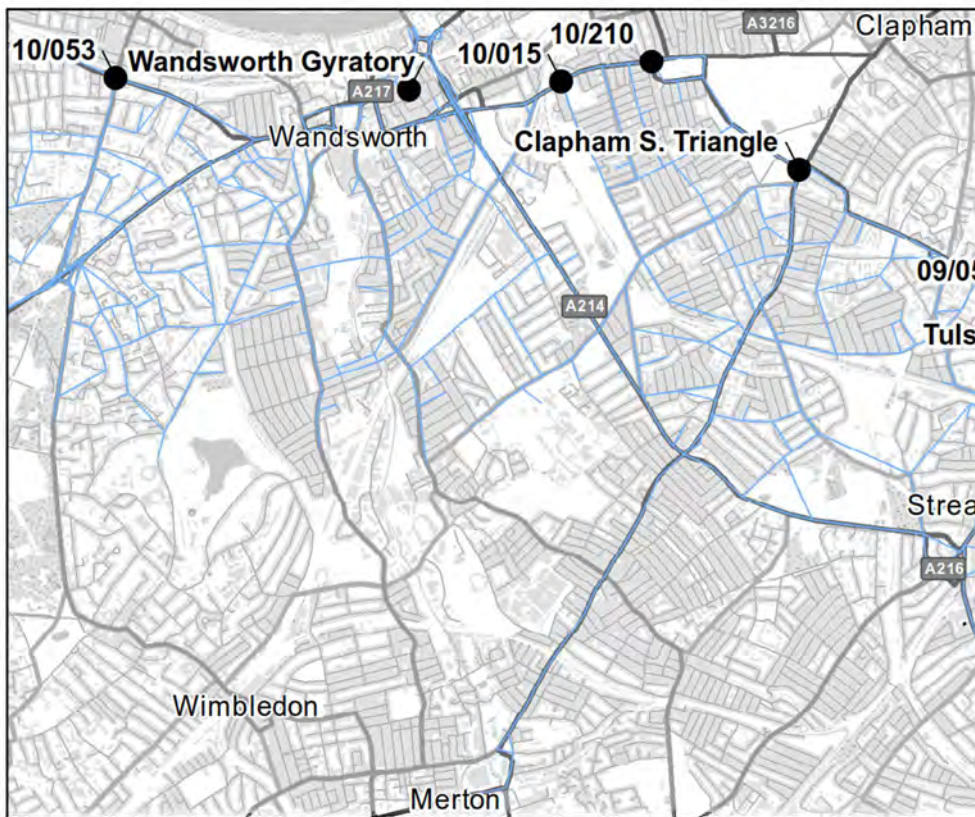
- A205 Upper Richmond Road / A219 / Putney High Street junction
- A24 Upper Tooting Road around Tooting Bec London Underground station



**Figure 6-10: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 2**

6.3.16. These are both affected areas which have occurred as a result of the implementation of the mitigation.

6.3.17. Figure 6-11 shows no adverse impacts in Area 2 in the PM peak after the mitigation measures were implemented.



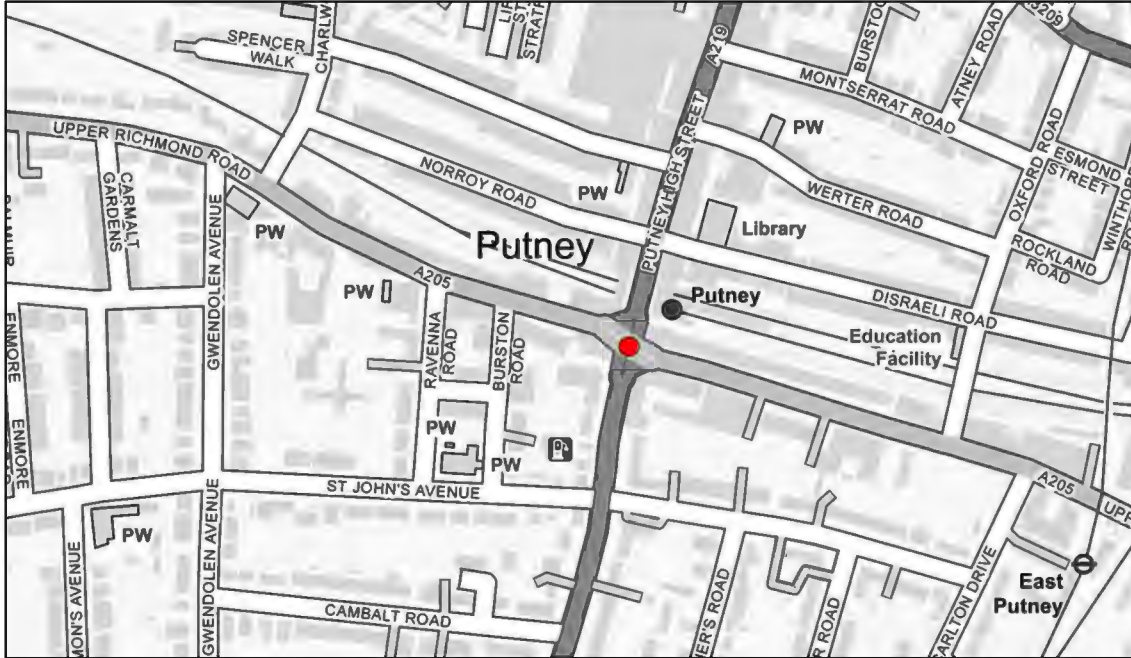
**Figure 6-11: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 2**

6.3.18. Each adverse impact in Area 2 will now be discussed in turn.



**A205 Upper Richmond Road / A219 / Putney High Street junction**

6.3.19. Figure 6-12 shows the significant adverse junction impact on the A205 / A219 / Putney High Street junction in the AM peak.

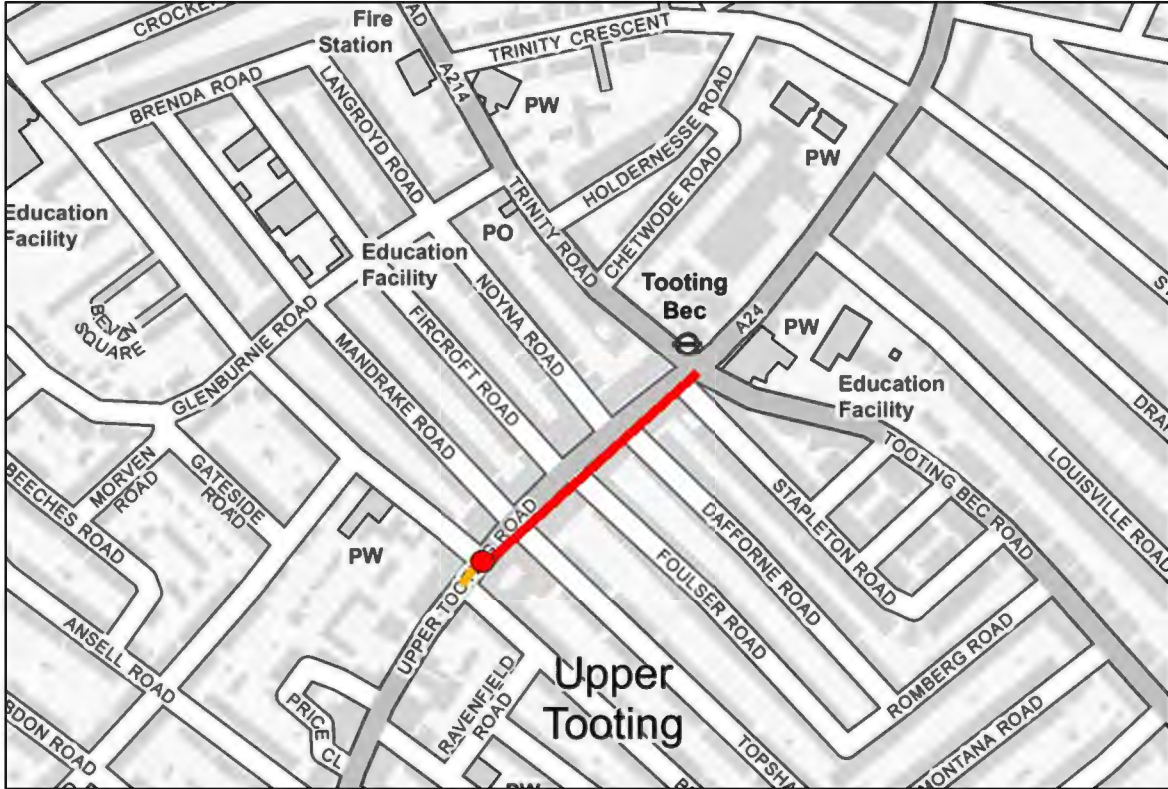


**Figure 6-12: AM Peak Adverse Impacts on A205 / A219 / Putney High Street junction**

6.3.20. After investigation this significant adverse impact was concluded to be due to delay, gap, capacity and node convergence issues at and around this junction (node 30496) in the model in the AM peak, and so is not attributable to the ULEZ expansion.

**A24 Upper Tooting Road around Tooting Bec London Underground Station**

Figure 6-13 shows the moderate and significant adverse impacts along the A24 corridor around Tooting Bec London Underground station in the AM peak.

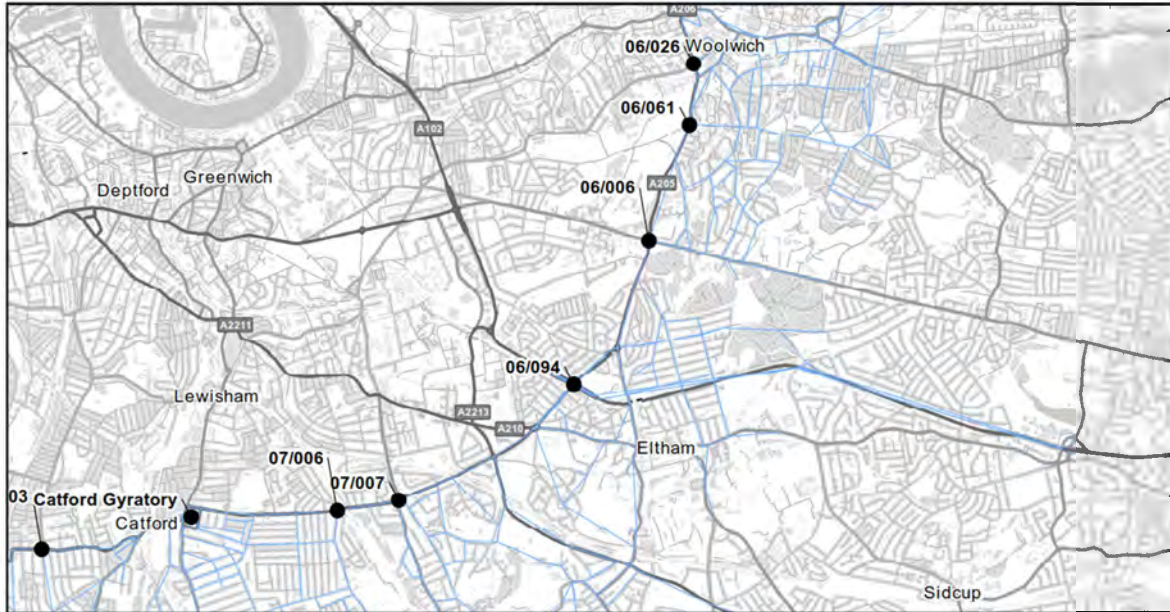


**Figure 6-13: AM Peak Adverse Impacts on A24 at Tooting Bec London Underground Station**

6.3.21. Although these particular adverse impacts along the A24 corridor have appeared after the mitigation measures were implemented, the corridor was highlighted in Section 5.6 as having extensive adverse impacts in the AM peak around Tooting Bec London Underground station. The impacts were found to be a result of node, delay, gap, and capacity convergence issues in this area of the model. The extent of the adverse impacts has since decreased as a result of implementing the signal updates, and in any case are not attributable to the ULEZ extension.

**AREA 3 – A2 CORRIDOR TO ELTHAM AND LOCATIONS NEAR CATFORD, LEWISHAM (SOUTH EAST LONDON)**

6.3.22. As shown in Figure 6-14, there are no adverse impacts in the AM peak in Area 3 after implementation of mitigation measures.



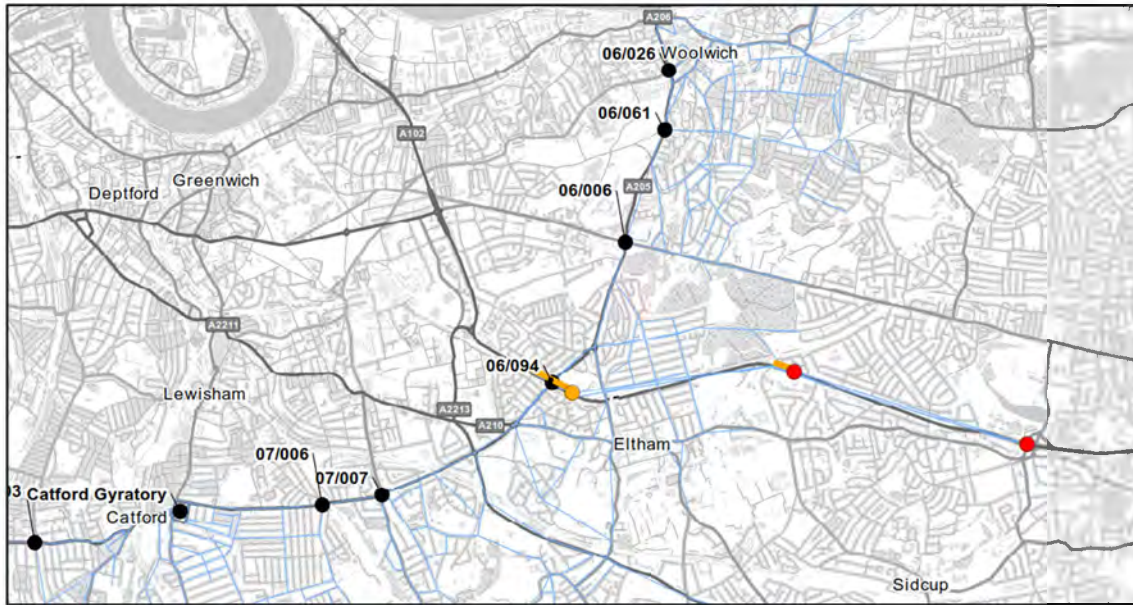
**Figure 6-14: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 3**

6.3.23. Figure 6-14 shows no adverse impacts in Area 3 in the AM peak after the mitigation measures were implemented.

6.3.24. Figure 6-15 shows adverse impacts in Area 3 in the PM peak in the following locations:

- A2 / A205 Westhorne Avenue junction
- A2 East Rochester Way / Riefield Road junction
- A2 East Rochester Way around the Danson Underpass

6.3.25. These adverse impacts remain from before mitigation measures were applied. In Section 5.6 of this report, these impacts were concluded to be due to a reduction in queued flow in the DS model creating an increase in actual flow, and they are therefore not attributable to the ULEZ expansion.



**Figure 6-15: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 3**

## AREA 4 – A40 CORRIDOR TO HANGER LANE GYRATORY AND WEMBLEY (WEST LONDON)

- 6.3.26. There are no adverse impacts in Area 4 after mitigation measures have been implemented, in the AM or the PM peak, as shown in Figure 6-16 and Figure 6-17.

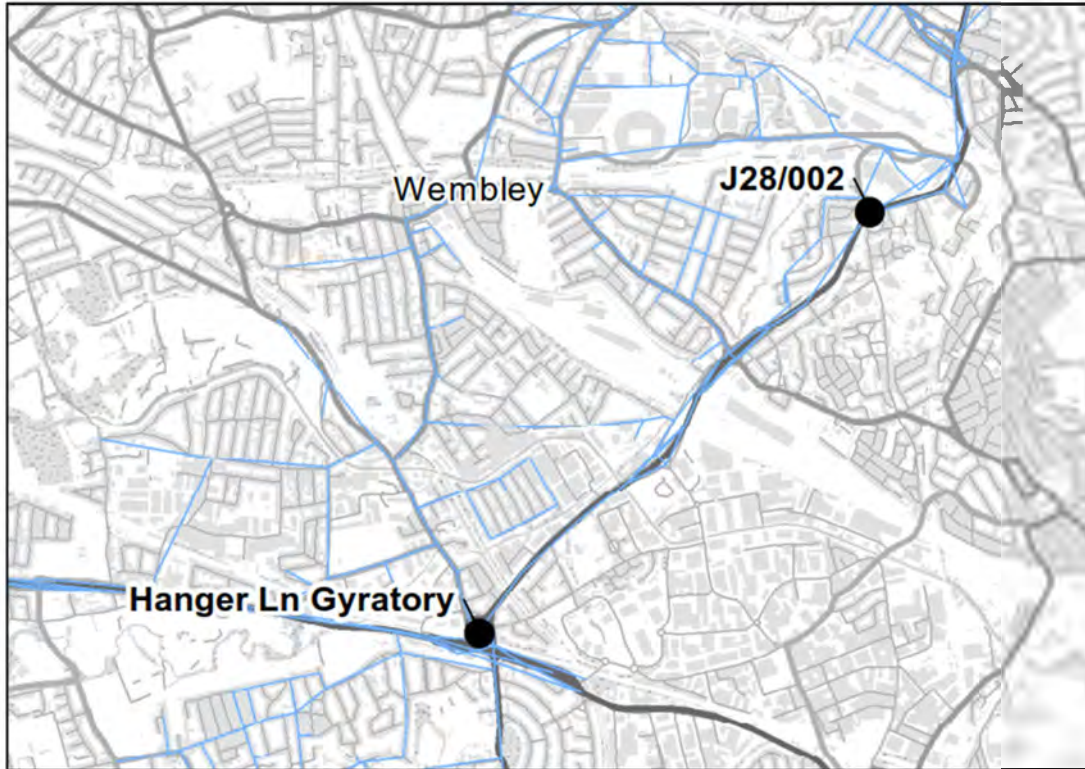
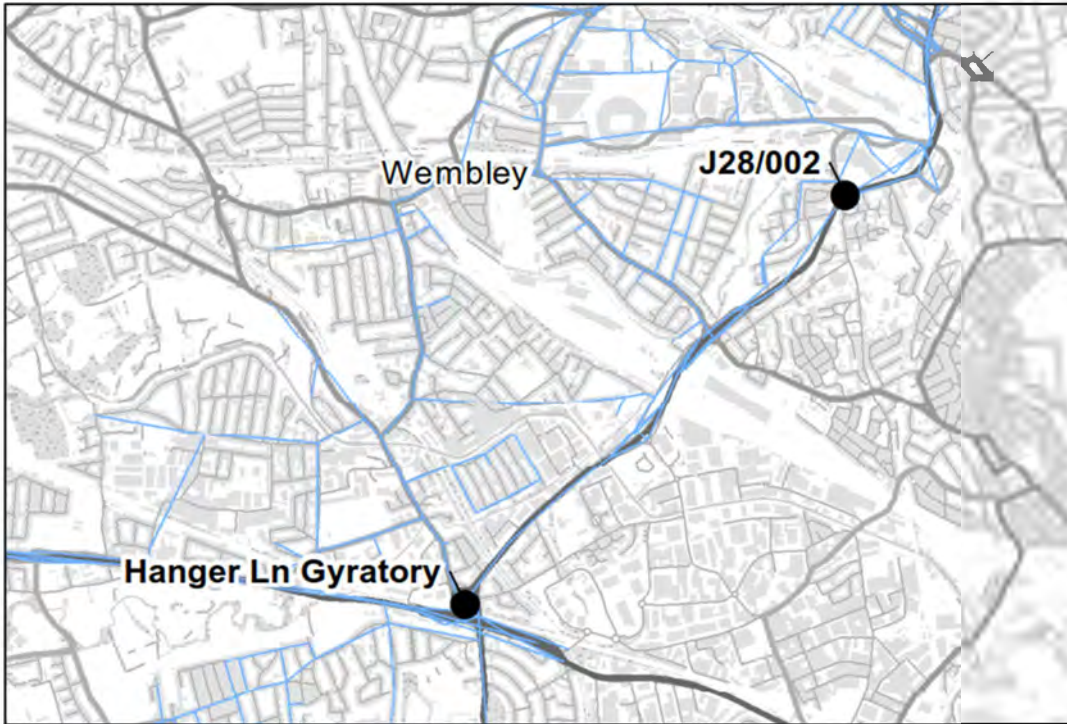


Figure 6-16: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 4



**Figure 6-17: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 4**

## AREA 5 – A1 CORRIDOR TO BRENT CROSS AND STAPLES CORNER (NORTH LONDON)

6.3.27. Figure 6-18 shows the adverse impacts in Area 5 in the AM peak after mitigation measures were implemented. There are significant adverse junction and link impacts in the following areas in the AM peak:

- Tilling Way at Staples Corner

6.3.28. These adverse impacts remain from before mitigation measures were applied, and were concluded in Section 5.6 to be attributable to LoHAM assignment routine, and not the ULEZ extension.

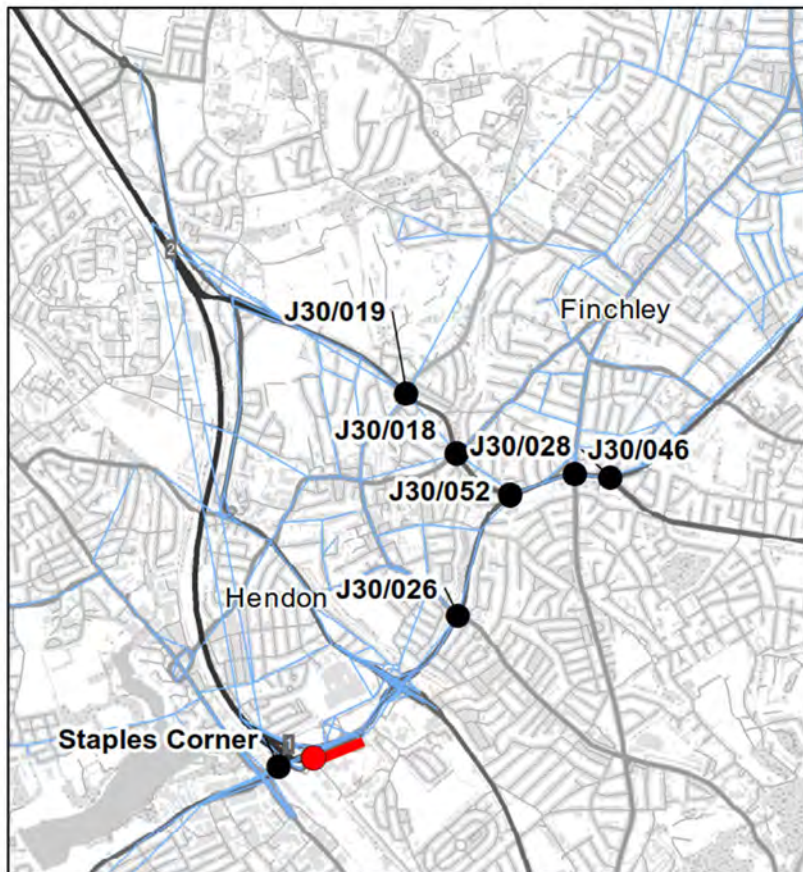
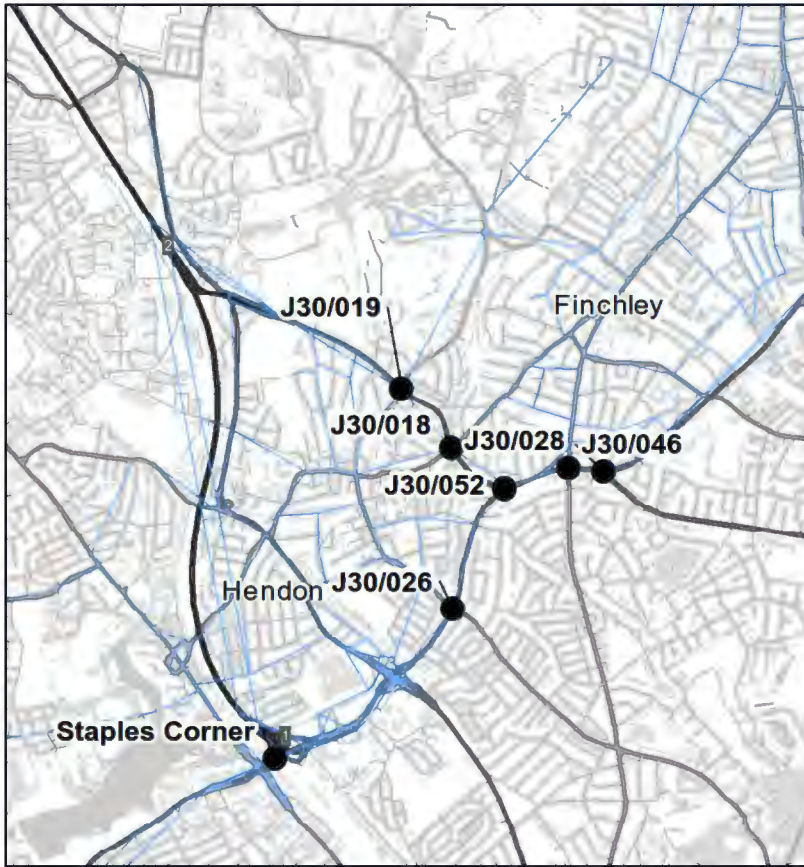


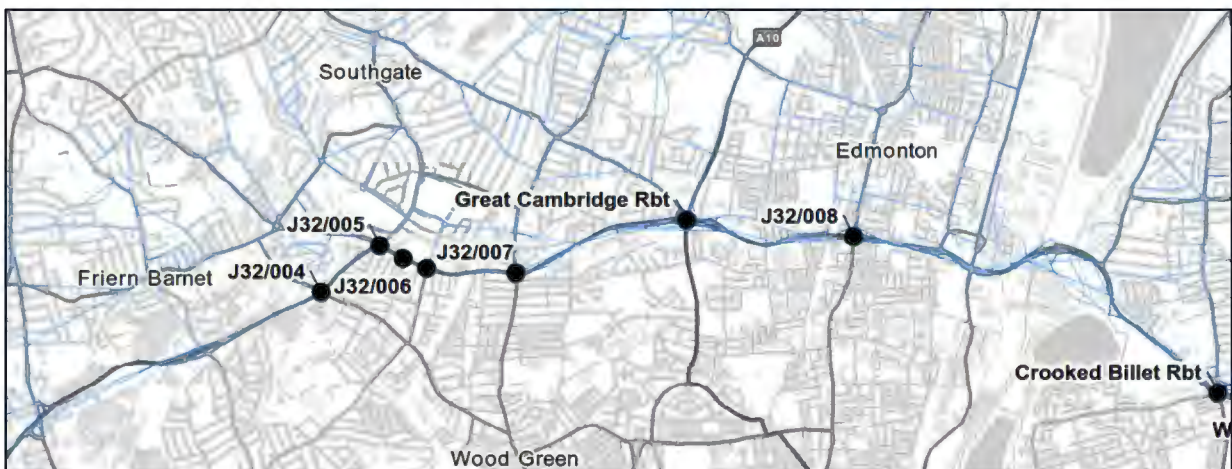
Figure 6-18: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 5

6.3.29. As shown in Figure 6-19, there are no adverse impacts in the PM peak in Area 5.



**Figure 6-19: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 5**  
**AREA 6 – CROOKED BILLET ROUNDABOUT AND GREAT CAMBRIDGE ROUNDABOUT (NORTH EAST LONDON)**

6.3.30. There are no adverse impacts in Area 6 in the AM peak after mitigation measures were implemented, as shown in Figure 6-20.

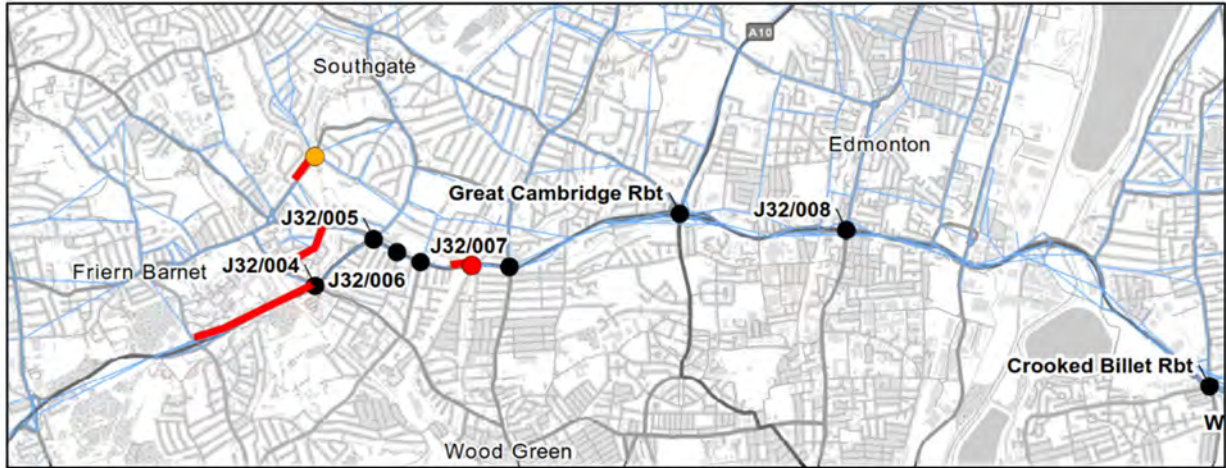


**Figure 6-20: AM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 6**



6.3.31. Figure 6-21 shows the adverse impacts in Area 6 in the PM peak after the implementation of mitigation measures. The following locations exhibit moderate or significant adverse impacts:

- A1003 Waterfall Road around the A1003 / Morton Way / Hampden Way roundabout
- Palmers Road, Upper Park Road and Inverforth Road
- A406 Pinkham Way (North Circular Road)
- A406 Bowes Road (North Circular Road)



**Figure 6-21: PM Peak Moderate or Significant Adverse Impacts after Mitigation in Area 6**

6.3.32. Each adverse impact in Area 6 will now be discussed in turn.

**A1003 Waterfall Road around the A1003 / Morton Way / Hampden Way roundabout**

6.3.33. Figure 6-22 shows the moderate and significant adverse impacts around the A1003 / Morton Way / Hampden Way roundabout in the PM peak.

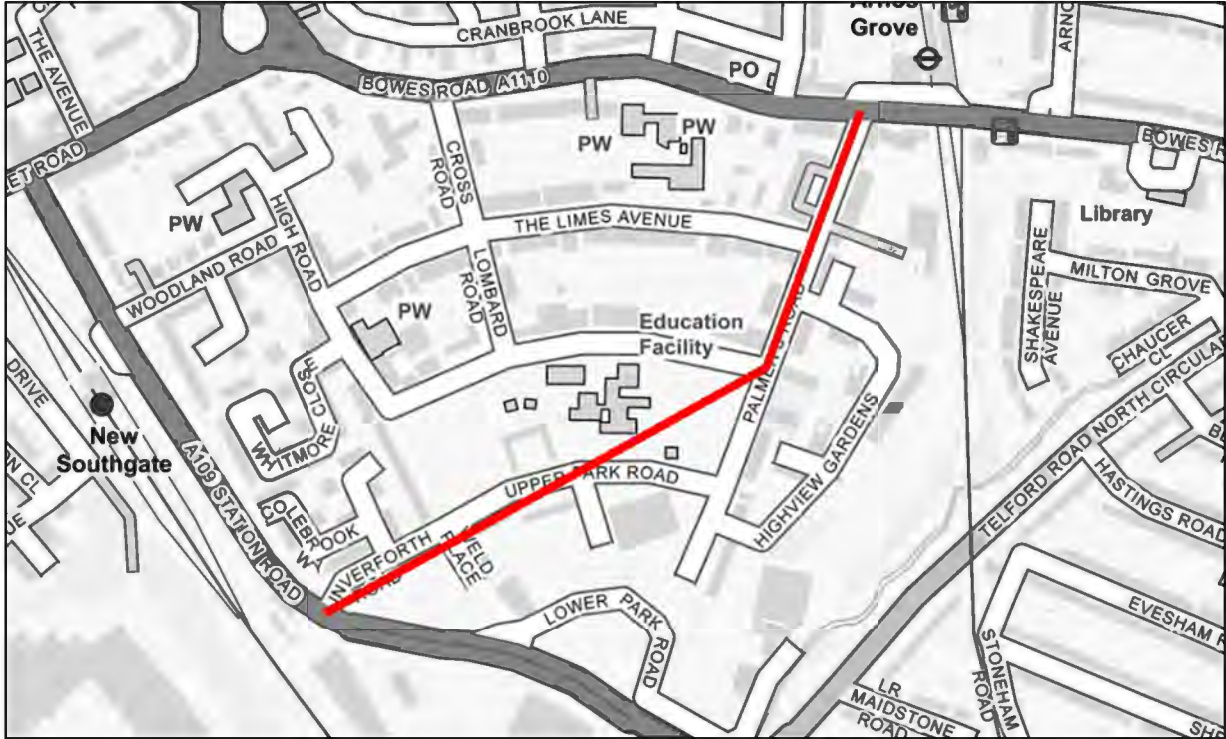


**Figure 6-22: PM Peak Adverse Impacts around the A1003 / Morton Way / Hampden Way roundabout**

6.3.34. Although these adverse impacts have appeared after implementation of the mitigation measures, investigation concluded that these were a result of capacity convergence issues at node 74017 in the model, and are not attributable to the ULEZ expansion.

**Palmers Road, Upper Park Road and Inverforth Road**

6.3.35. The significant adverse link impacts along Inverforth Road, Upper Park Road, and Palmers Road in the PM peak are displayed in Figure 6-23.



**Figure 6-23: PM Peak Adverse Impacts on Palmers Road, Upper Park Road and Inverforth Road**

6.3.36. These adverse impacts appeared after the mitigation measures were applied, but investigations have concluded that they are a result of capacity convergence issues at node 74017, and are therefore not attributable to the ULEZ expansion.

**A406 Pinkham Way (North Circular Road)**

6.3.37. Figure 6-24 shows the significant adverse link impact on the A406 Pinkham Way in the PM peak.



**Figure 6-24: PM Peak Adverse Impacts on the A406 Pinkham Way**

6.3.38. Again, although these are adverse impacts which have been introduced since implementing the mitigation measures, they are found to be due to capacity convergence issues in the model in the PM peak around this area. The adverse impacts are therefore not a result of the ULEZ expansion.

## A406 Boves Road (North Circular Road)

6.3.39. Figure 6-25 shows the significant adverse junction and link impact along the A406 Boves Road in the PM peak.



**Figure 6-25: PM Peak Adverse Impacts on the A406 Boves Road**

6.3.40. Similarly to above, these adverse impacts were introduced after the mitigation measures were applied, but they are concluded to be a result of capacity convergence issues in this area in the model in the PM peak, and not a result of the ULEZ expansion.

## 6.4 SUMMARY

6.4.1. To conclude, mitigation measures were implemented into LoHAM in the form of signal updates in both the AM and PM peaks at the following junctions:

- A205 / Haha Road / Nightingale Place
- A205 / Vine Road / Priory Lane
- Chalkers Corner

6.4.2. The impacts of these updates were then assessed. Adverse impacts were found in the following areas:

### ■ AM Peak

- Area 1
  - A4 Great West Road west of Chiswick roundabout
- Area 2
  - A205 Upper Richmond Road / A219 / Putney High Street
  - A24 Upper Tooting Road around Tooting Bec London Underground Station

- Area 5
  - Tilling Way at Staples Corner

- **PM Peak**

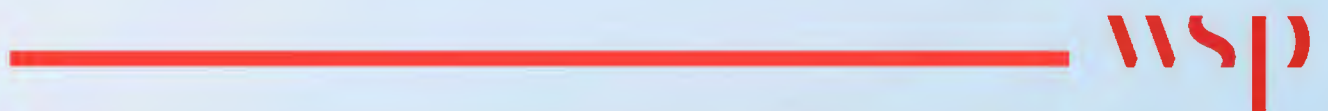
- Area 3
  - A2 / A205 Westthorne Avenue junction
  - A2 East Rochester Way / Riefield Road junction
  - A2 East Rochester Way around the Danson Underpass
- Area 6
  - A1003 Waterfall Road around the A1003 / Morton Way / Hampden Way roundabout
  - Palmers Road, Upper Park Road and Inverforth Road
  - A406 Pinkham Way (North Circular Road)
  - A406 Bowes Road (North Circular Road)

6.4.3. The impacts in Areas 3 and 5 remained from before mitigation measures were implemented, and were found not to be attributable to the ULEZ extension.

6.4.4. The adverse impacts in Areas 1, 2 and 6 were introduced after the signals were updated. These adverse impacts were investigated and were all found to be due to convergence issues in the model, and therefore are not attributable to the ULEZ expansion.

# Appendix A

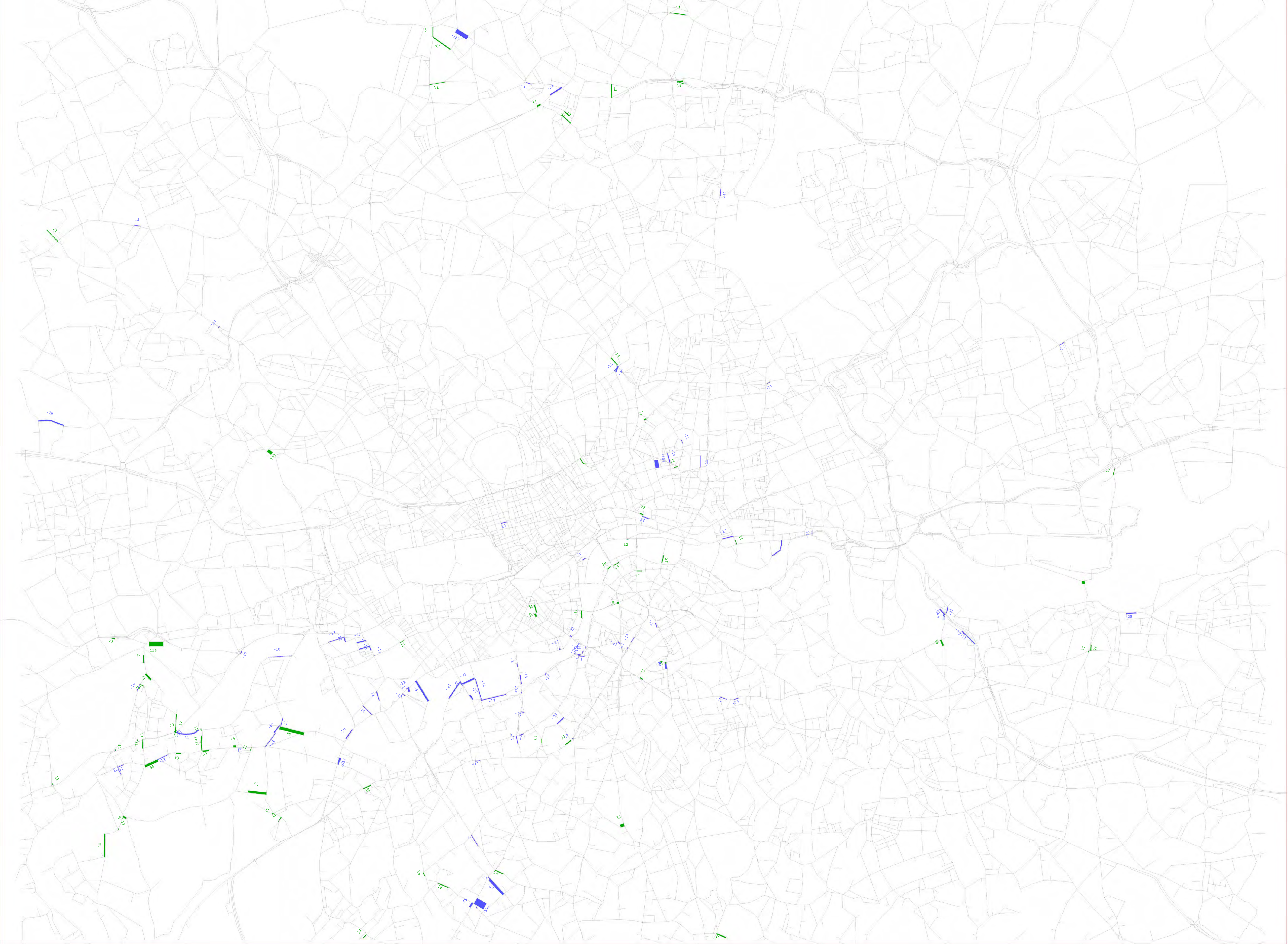
TASK A DIFFERENC PLOTS















SATURN  
Atkins Ltd /  
DVV / ITS  
503W\_PM\_CC22  
151U\_T10\_UFS  
CC2215CU\_T10  
Scale 41388  
Link Annot:  
+ Actual flo  
- Actual flo  
Differ: 1-2  
Bandwidths =  
50./mm

23- 6-19  
WSP MANAGEME



SATURN  
Atkins Ltd /  
DVV / ITS  
503W\_PM\_CC22  
151U\_T10.UFS  
CC2215CU\_T10  
Scale 41388  
Link Annot:  
+ Demand flo  
- Demand flo  
Differ: 1-2  
Bandwidths =  
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23- 6-19  
WSP MANAGEME



SATURN  
Atkins Ltd /  
DVV / ITS  
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CC2215CU\_T10  
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Differ: 1-2  
Bandwidths =  
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23- 6-19  
WSP MANAGEME

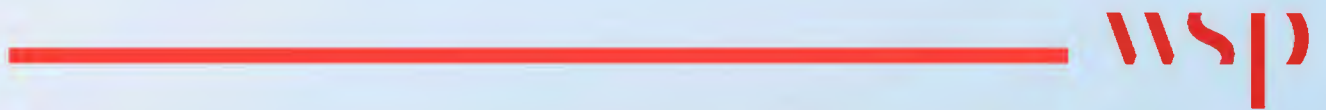


SATURN  
Atkins Ltd /  
DVV / ITS  
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+ VoverC  
- VoverC  
Differ: 1-2  
Bandwidths =  
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23- 6-19  
WSP MANAGEMEN

# Appendix B

TASK B CODING DIFFERENCE PLOTS





Drawn By: UKJUC000  
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Contains Ordnance Survey data © Crown copyright and database right 2019.

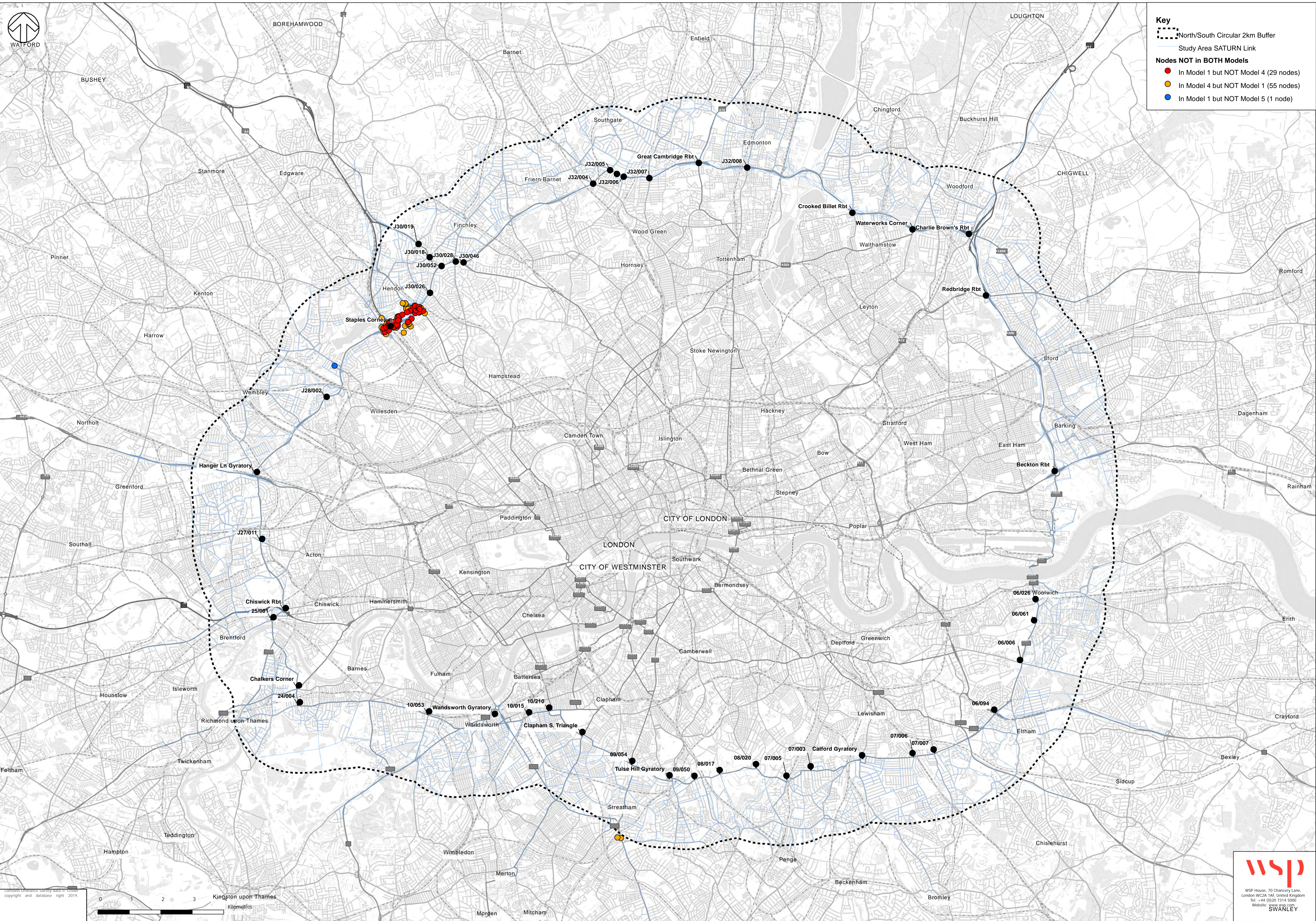


**Key**

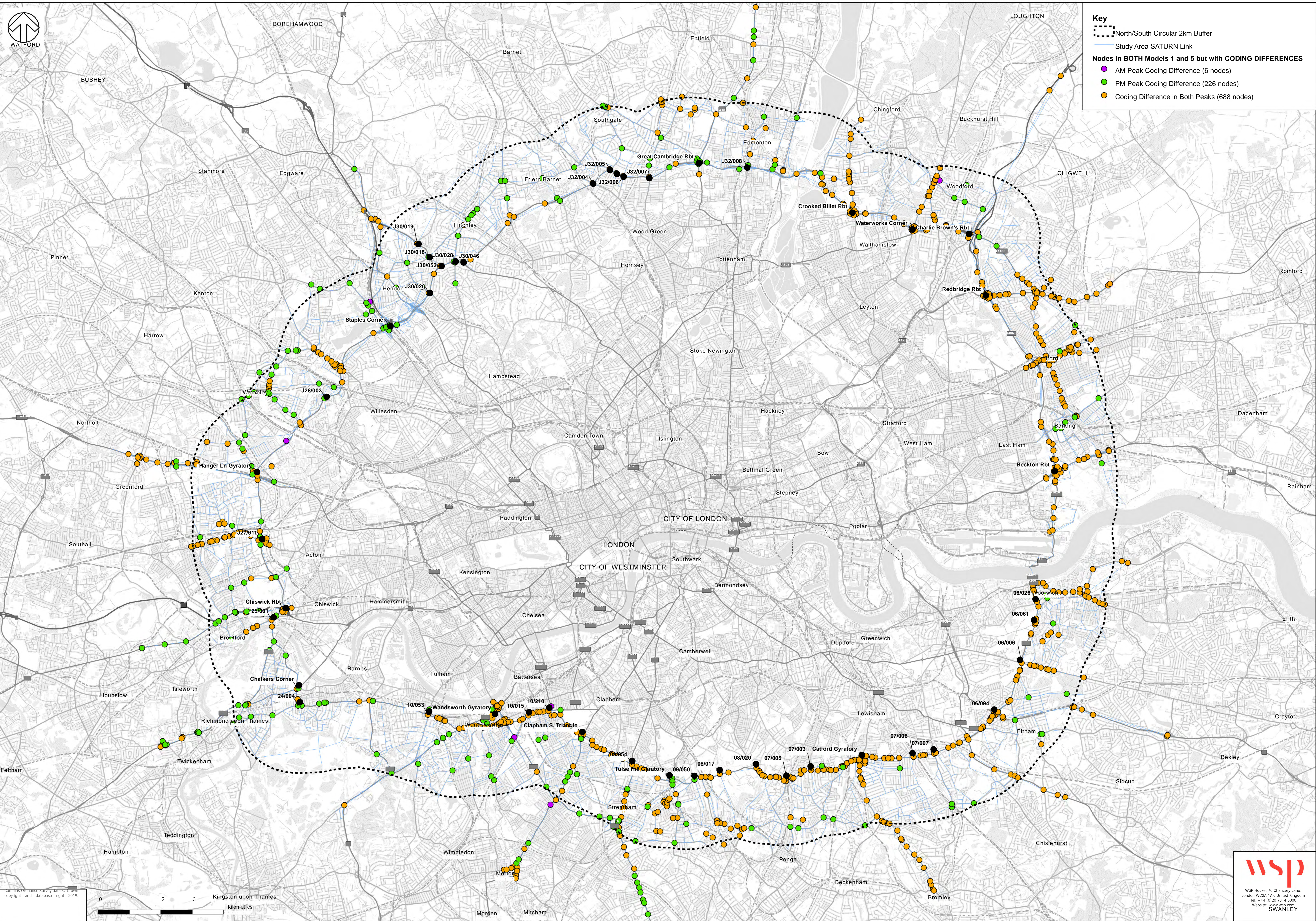
- North/South Circular 2km Buffer
- Study Area SATURN Link

**Nodes NOT in BOTH Models**

- In Model 1 but NOT Model 4 (29 nodes)
- In Model 4 but NOT Model 1 (55 nodes)
- In Model 1 but NOT Model 5 (1 node)



Drawn By: UKJUC000  
File: \\uk-j:\program\environmental\_data\projects\13\1317\1317\_Traffic\_Modelling\1317\_1317\_Traffic\_Modelling\1317\_1317\_Traffic\_Modelling.mxd  
Contains Ordnance Survey data © Crown copyright and database right 2019.



**Key**

- North/South Circular 2km Buffer
- Study Area SATURN Link

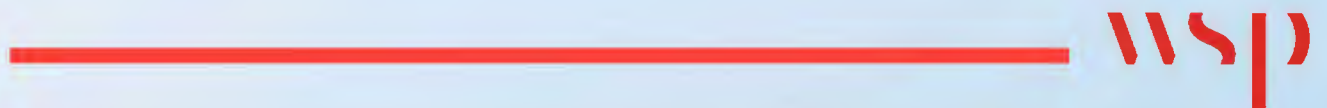
**Nodes in BOTH Models 1 and 5 but with CODING DIFFERENCES**

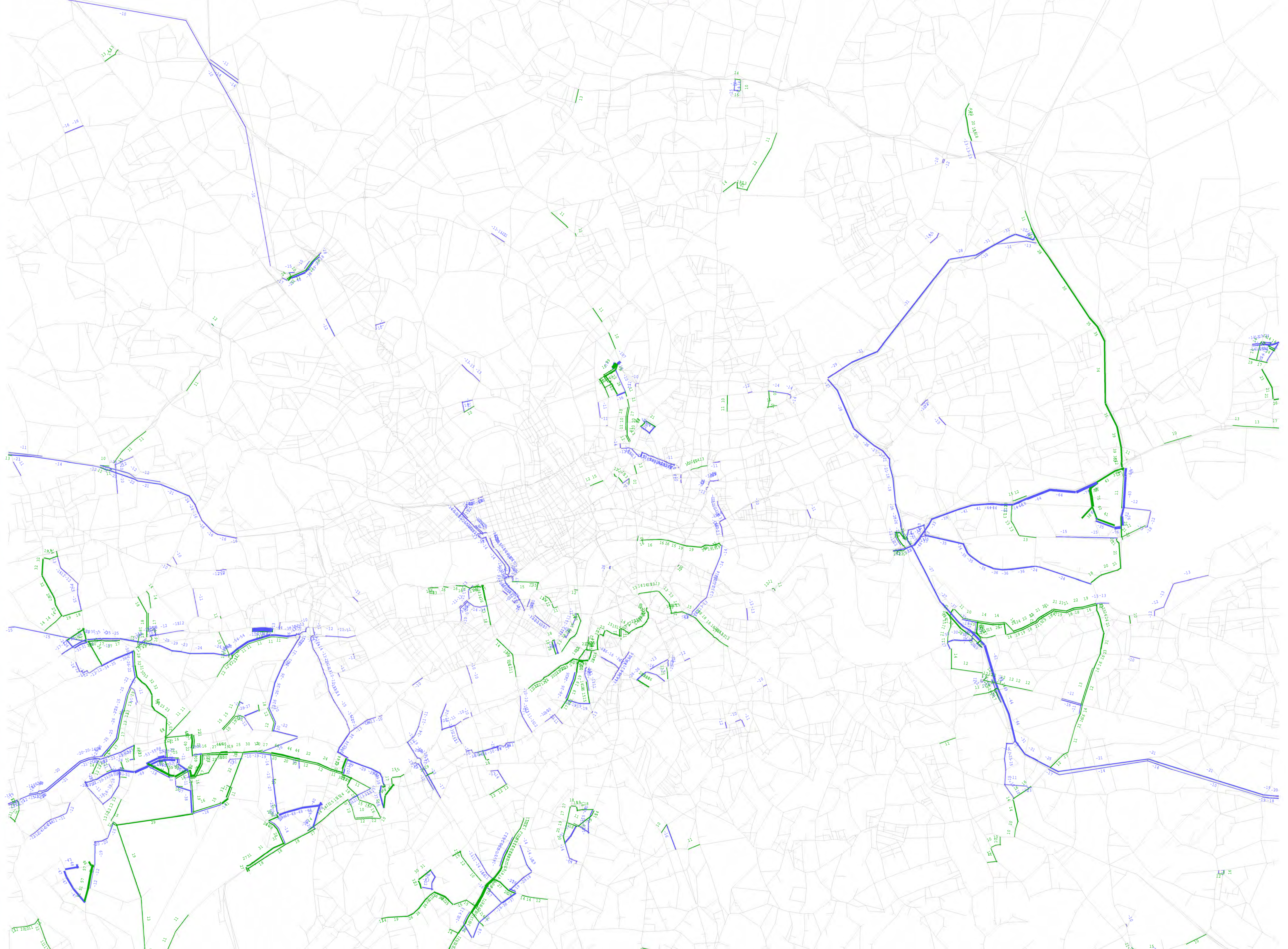
- AM Peak Coding Difference (6 nodes)
- PM Peak Coding Difference (226 nodes)
- Coding Difference in Both Peaks (688 nodes)

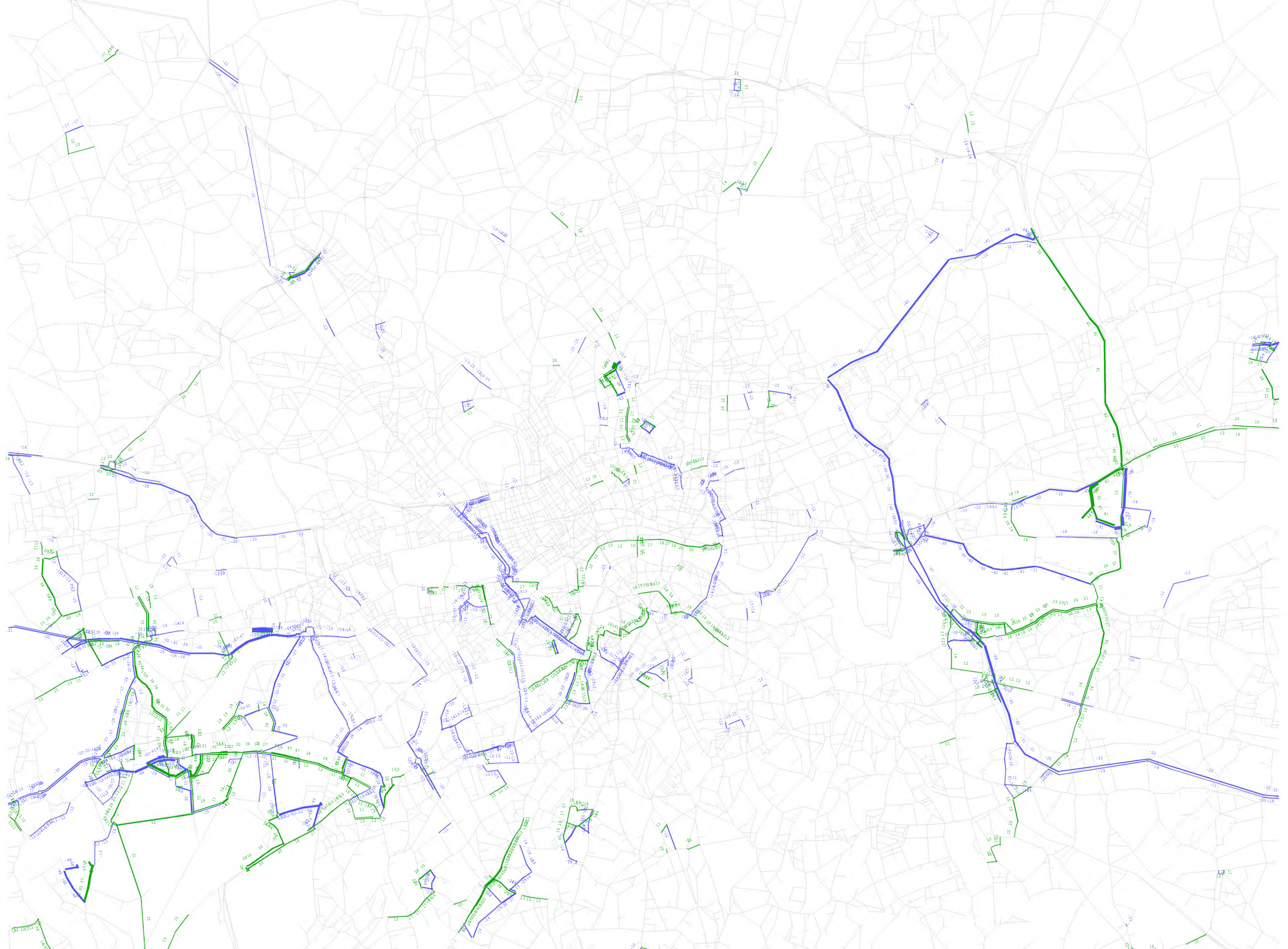


# Appendix C

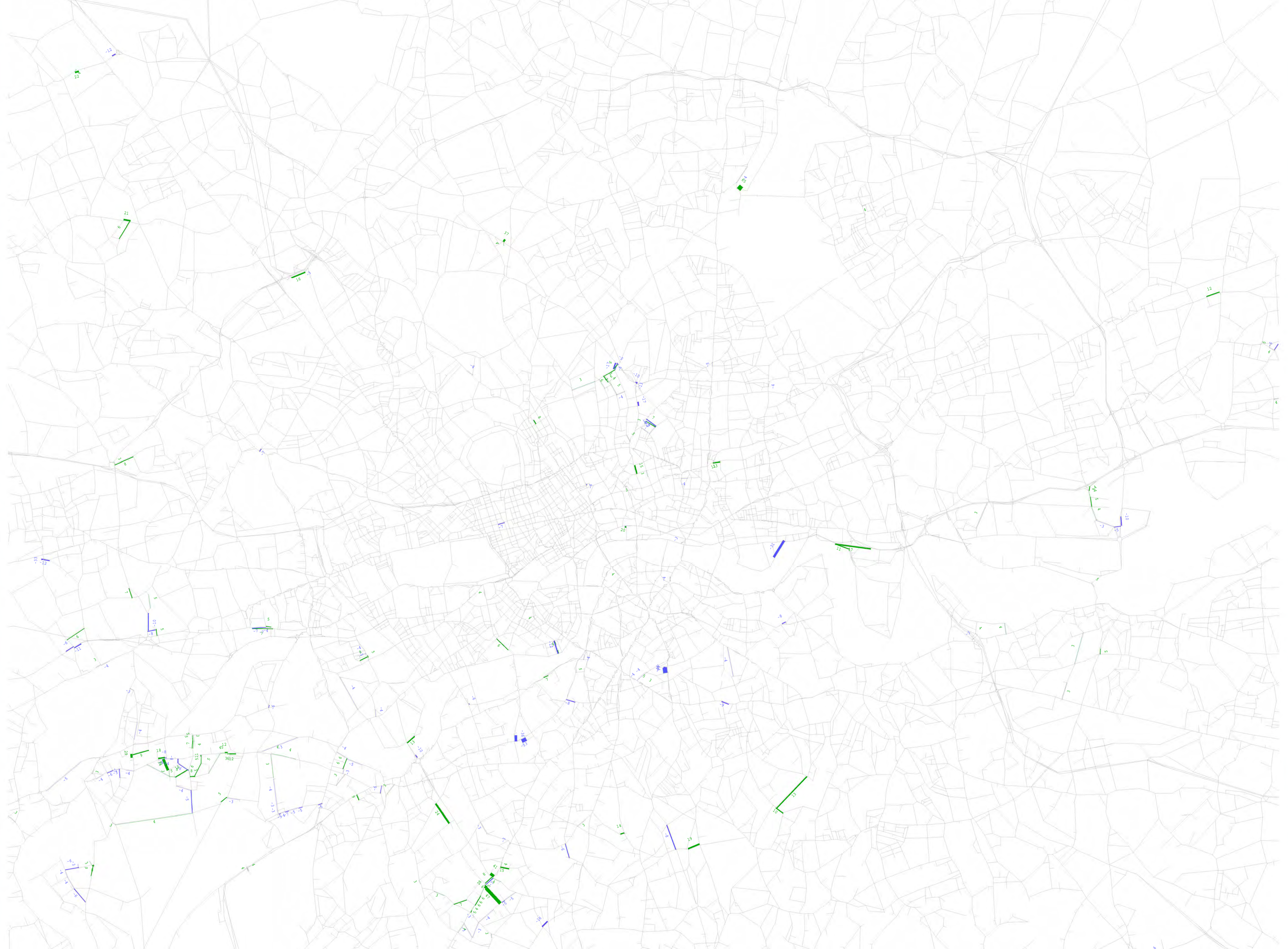
TASK B DIFFERENCE PLOTS



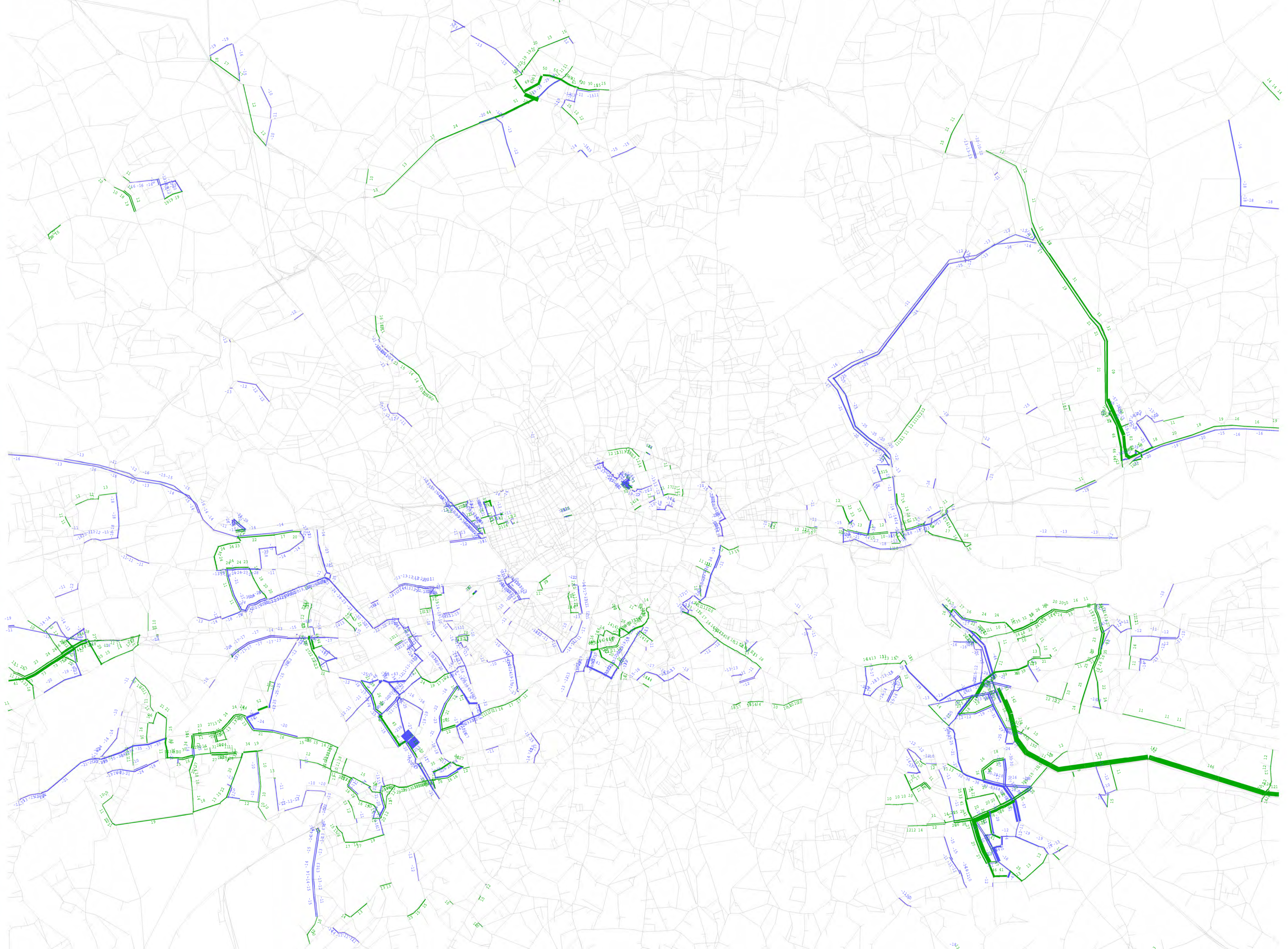


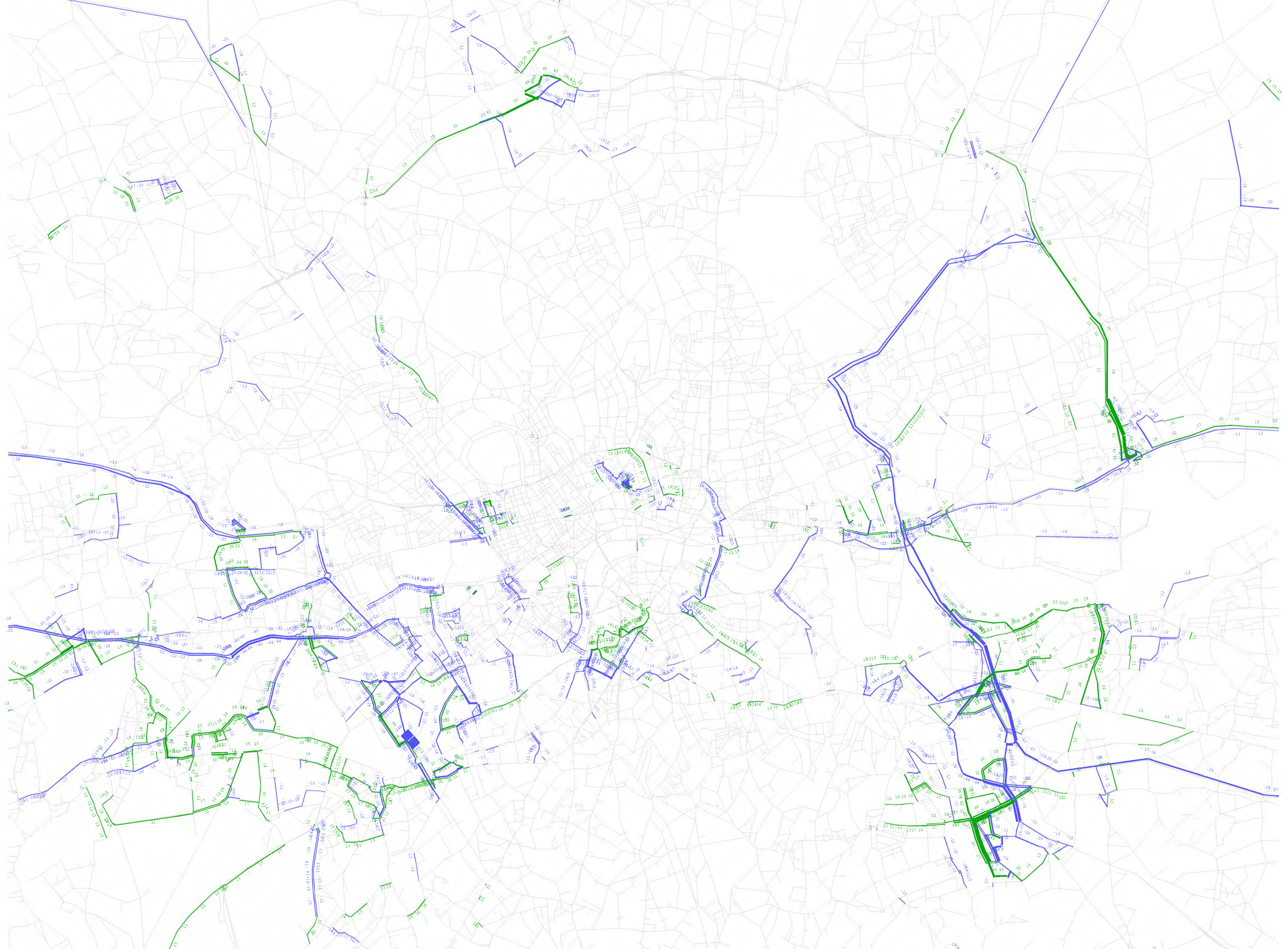










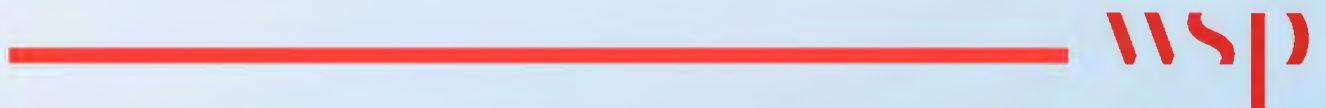


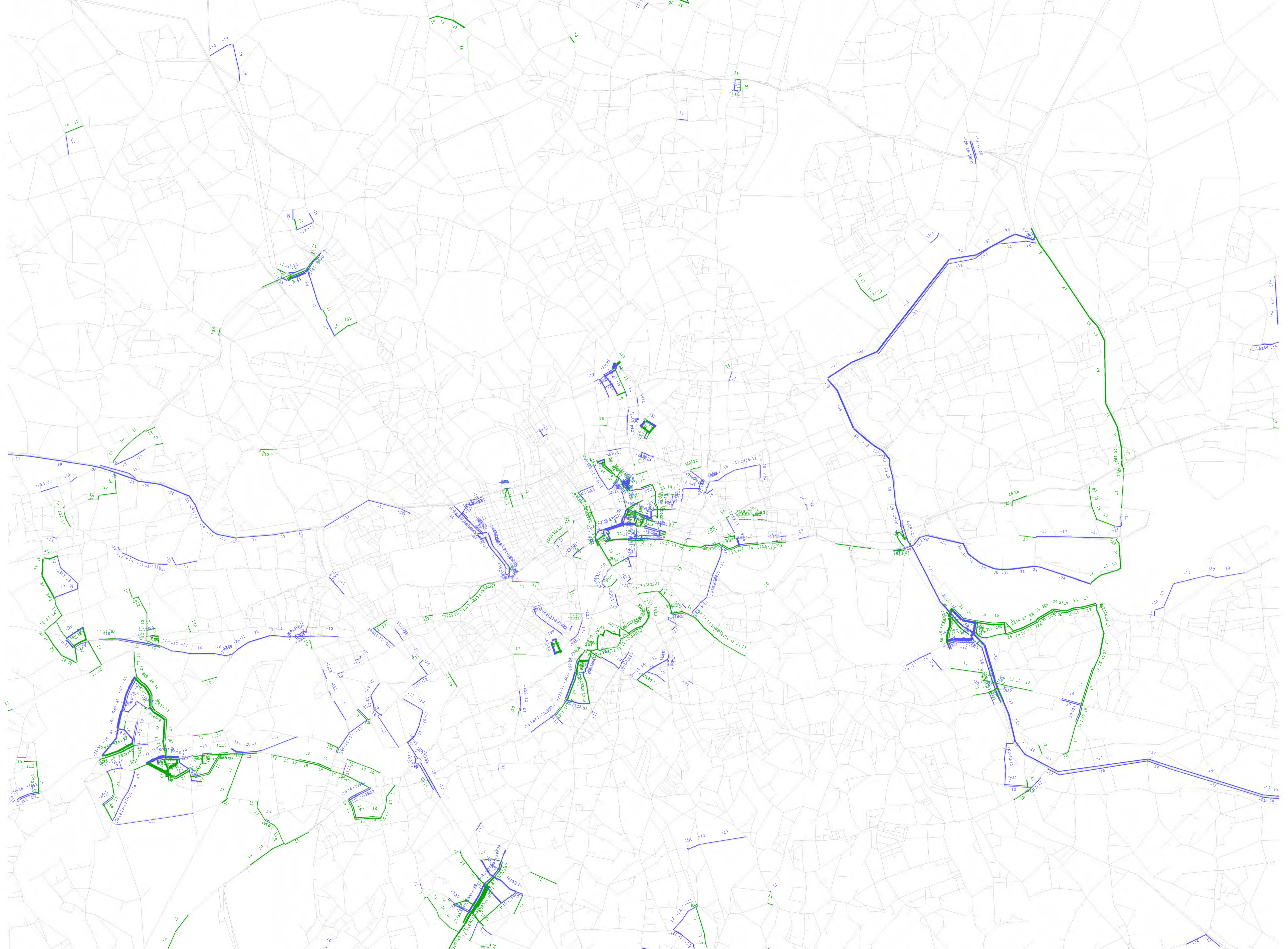


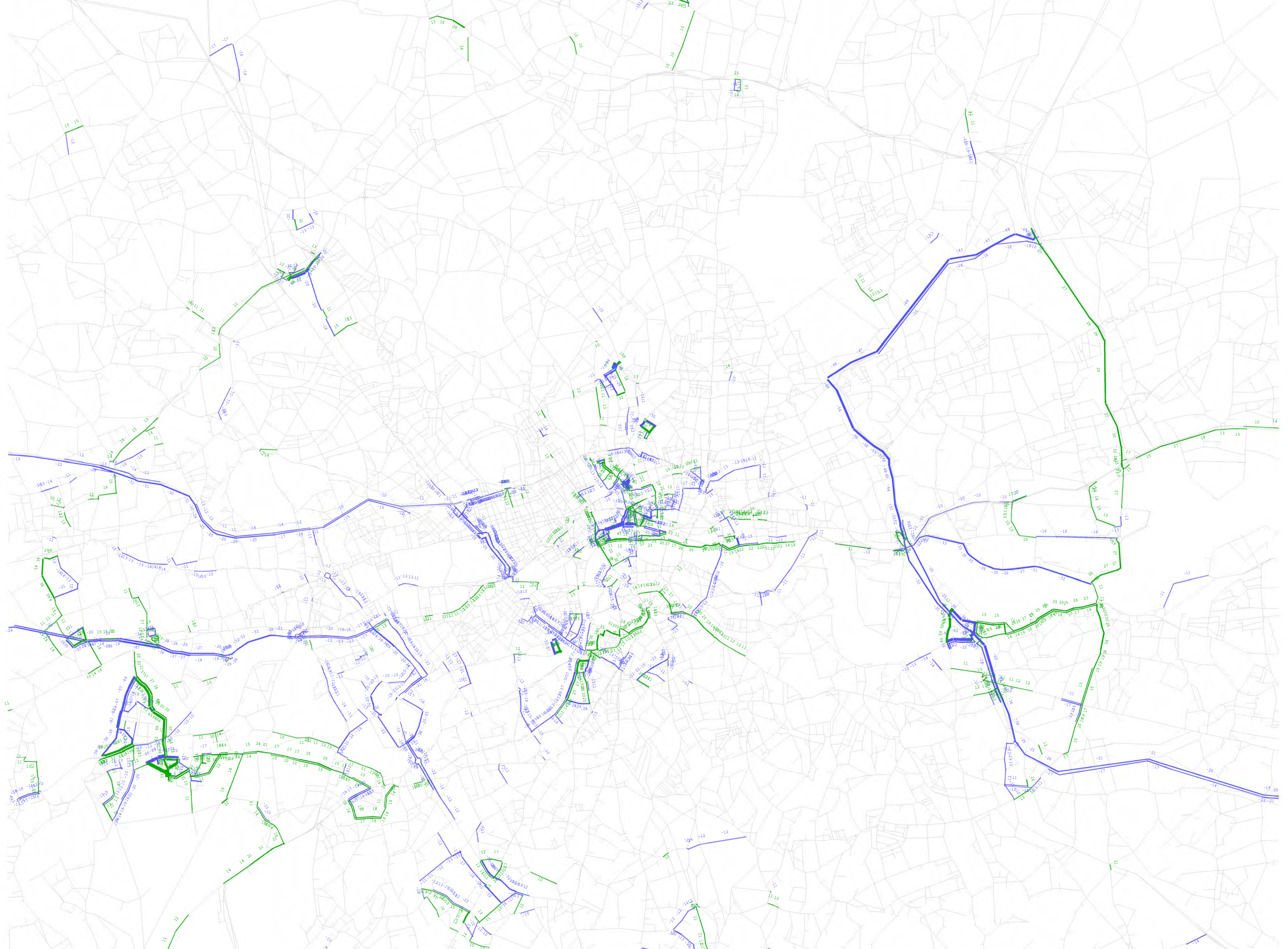


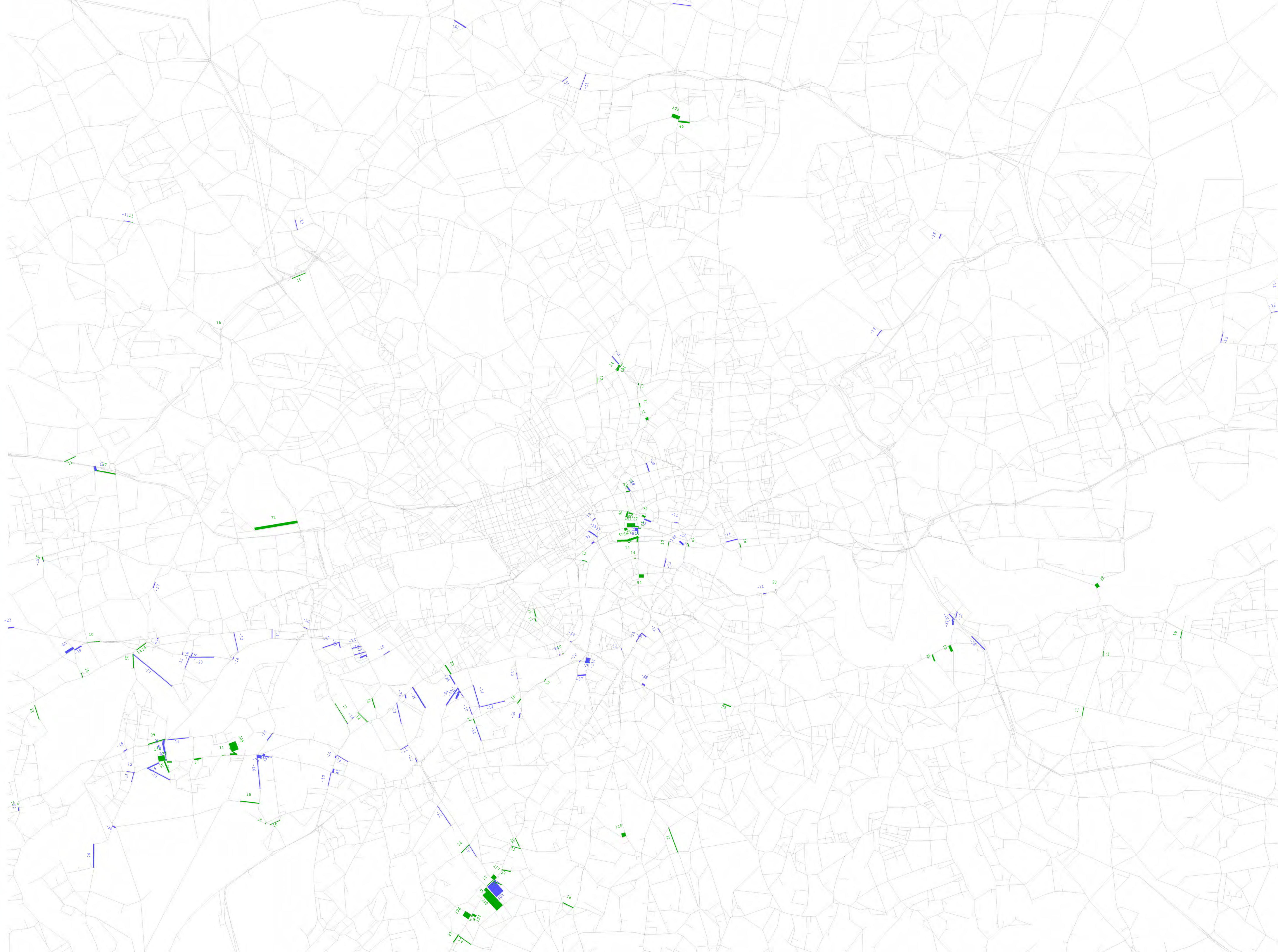
# Appendix D

TASK C DIFFERENCE PLOTS

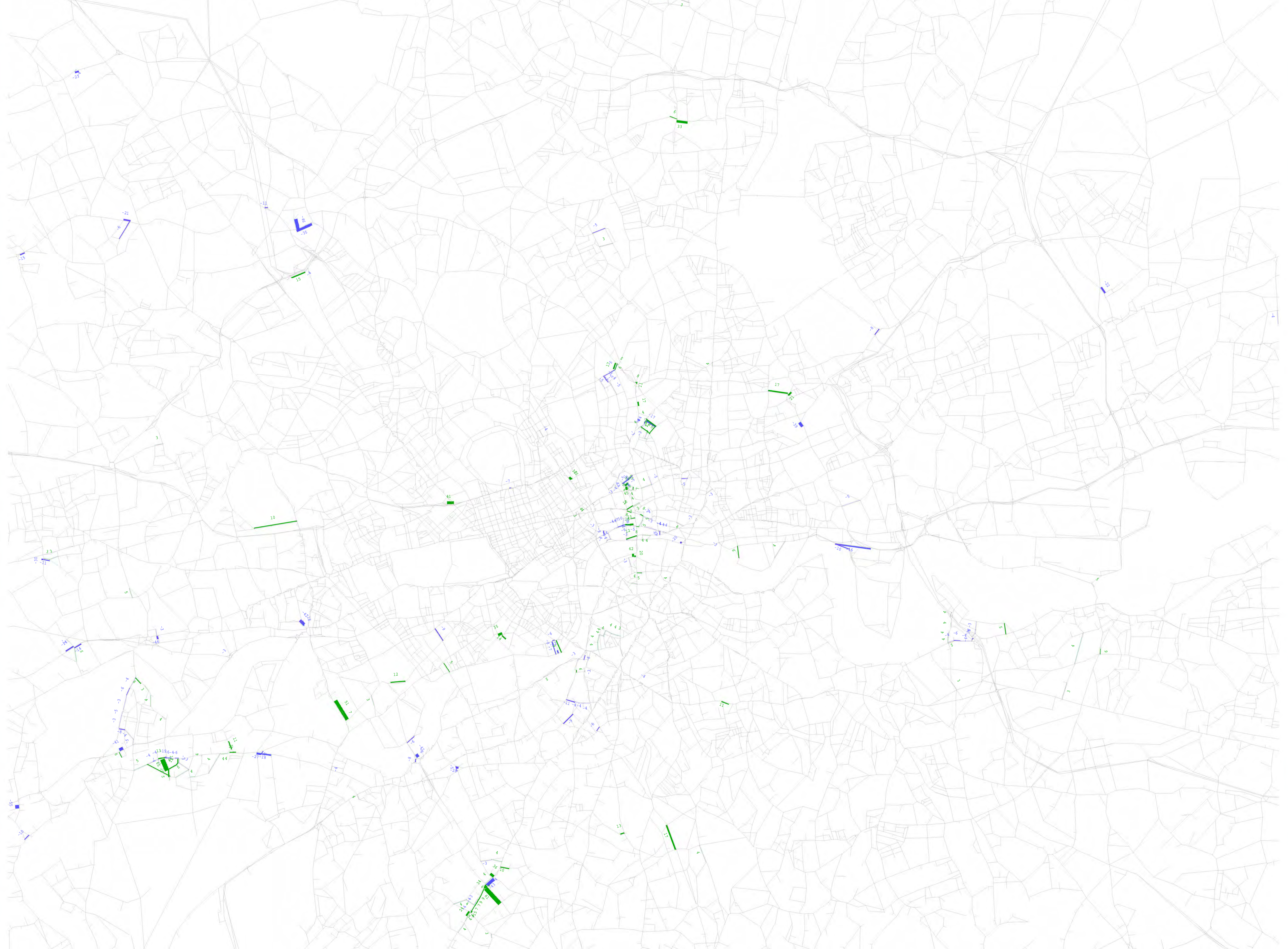


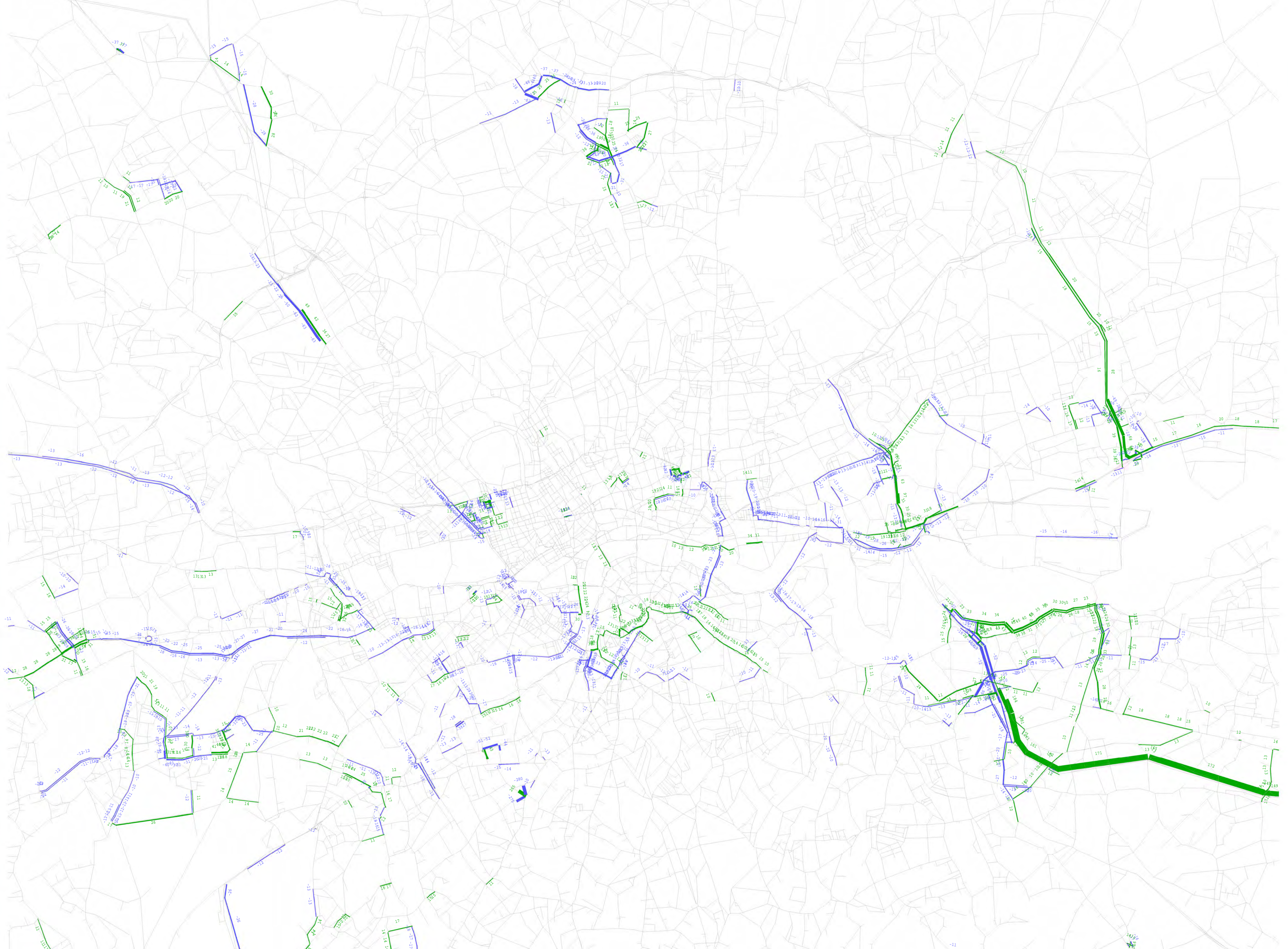


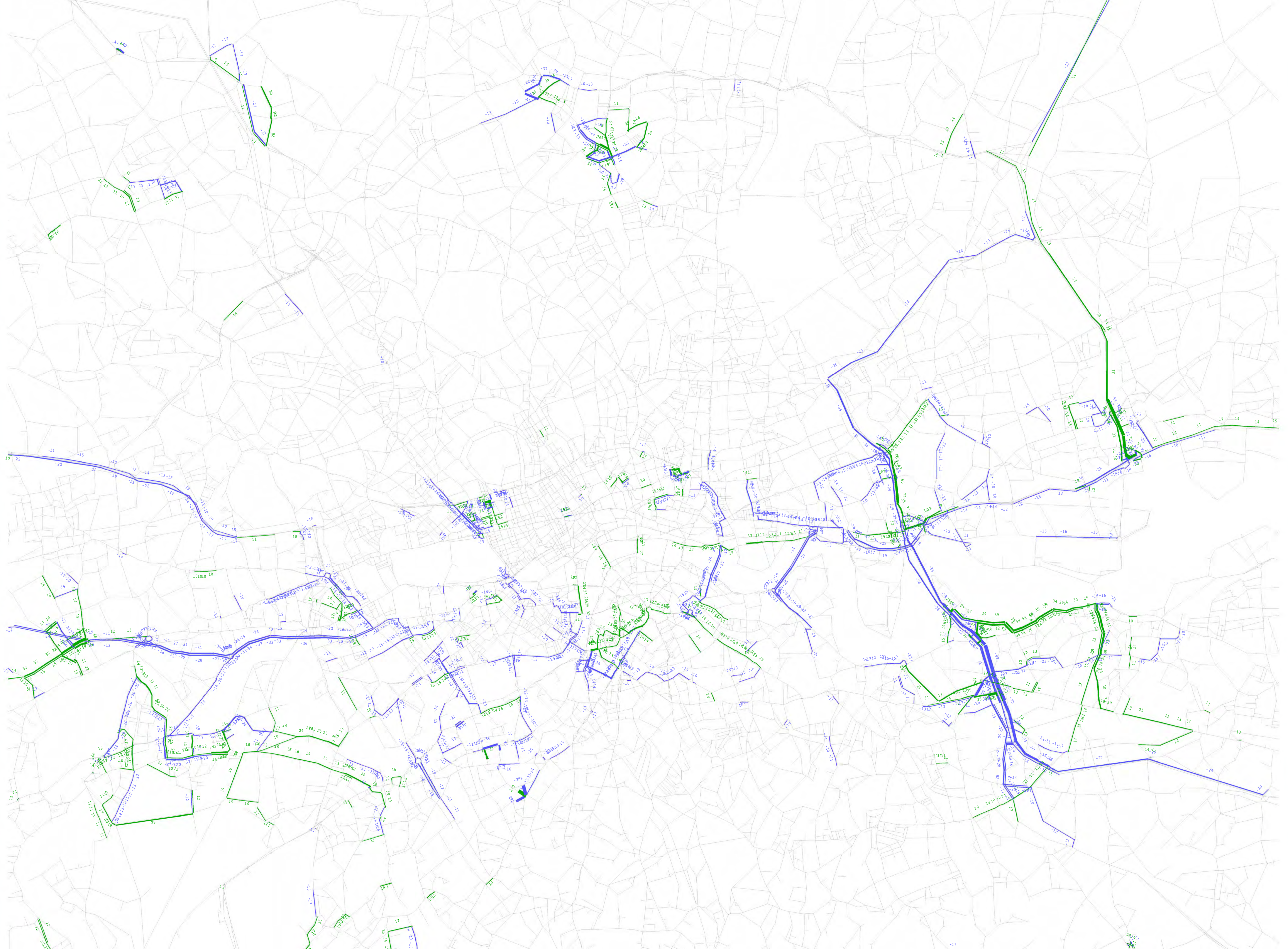


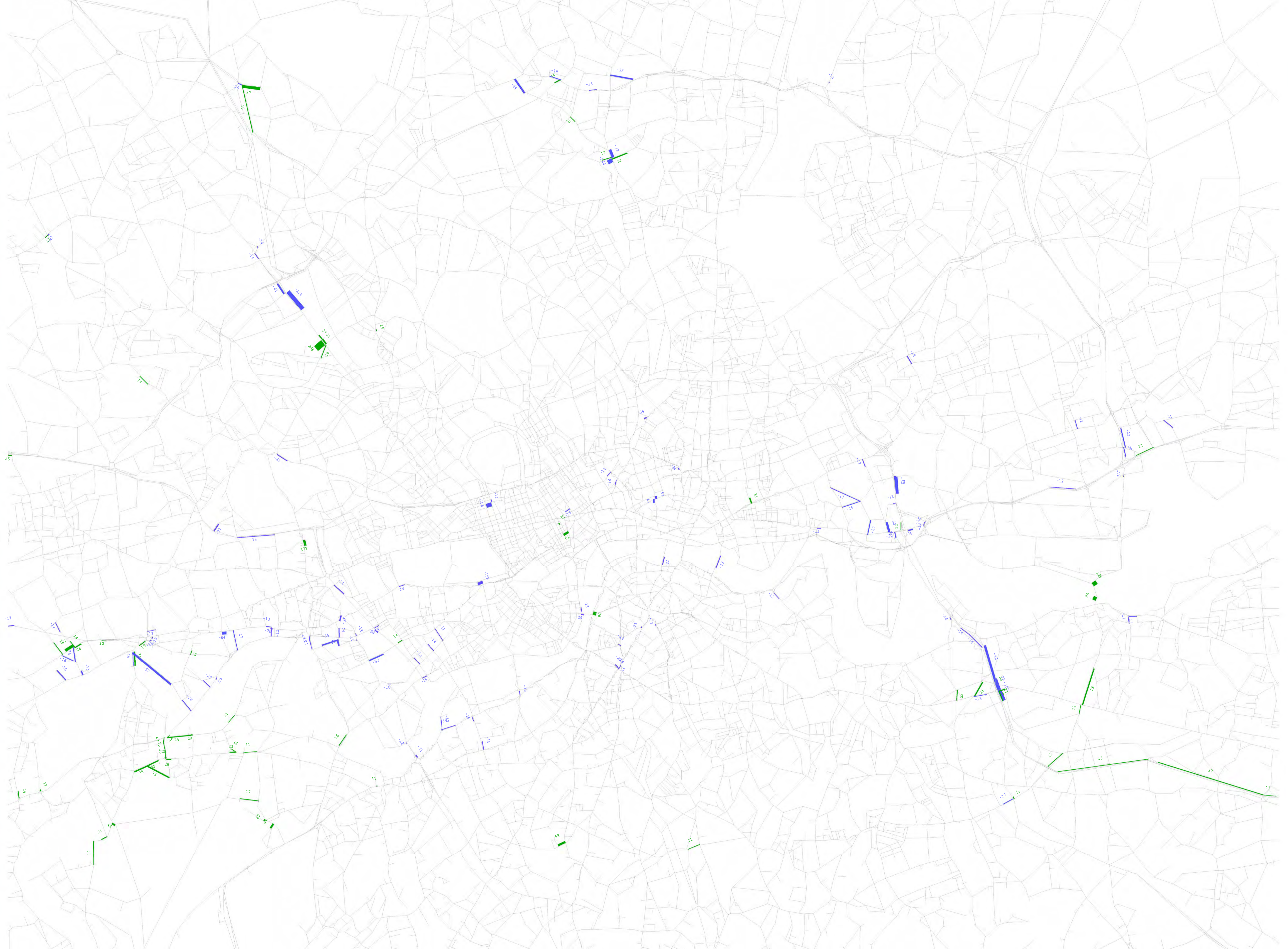








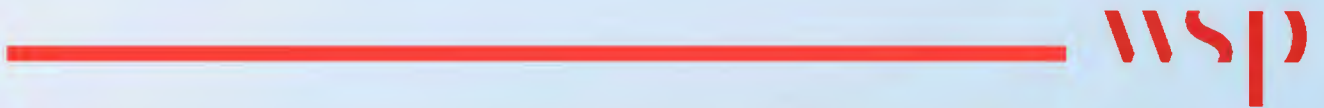






# Appendix E

SATURN VERSIONS



## SATURN VERSION

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### INTRODUCTION

A beta version of SATURN was available for use by WSP, namely version 11.5.04H+. The impact of assigning the models in this version is assessed and reported in this appendix by comparing the DM and DS models.

### IMPACT THRESHOLD ASSESSMENT

Figure 1 to Figure 16 show Actual Flow Difference, Demand Flow Difference, Delay Difference and V/C Difference for the following scenarios, respectively:

- 11.5.04H+ DM vs 11.5.03Y DM – AM Peak
- 11.5.04H+ DM vs 11.5.03Y DM – PM Peak
- 11.5.04H+ DS vs 11.5.03Y DS – AM Peak
- 11.5.04H+ DS vs 11.5.03Y DS – PM Peak

Figure 17 and Figure 18 show the moderate and significant adverse impacts after assignment in SATURN version 11.5.04H+ in the AM and PM peak respectively. The same information is displayed in Table 1 and Table 2.

There are no new adverse impacts in the AM peak, and there is one new significant adverse impact in the PM peak in the following area:

- A406 / A109 junction at New Southgate

Investigations show that these adverse link and junction impacts in the PM peak are a result of delay and gap convergence issues in this area of the model (node 74230), as well as extensive capacity and flow convergence issues. These impacts are therefore not attributable to ULEZ.

It is therefore concluded that assigning the models in version 11.5.04H+ does not have a significant adverse impact on the results of the impact of ULEZ.

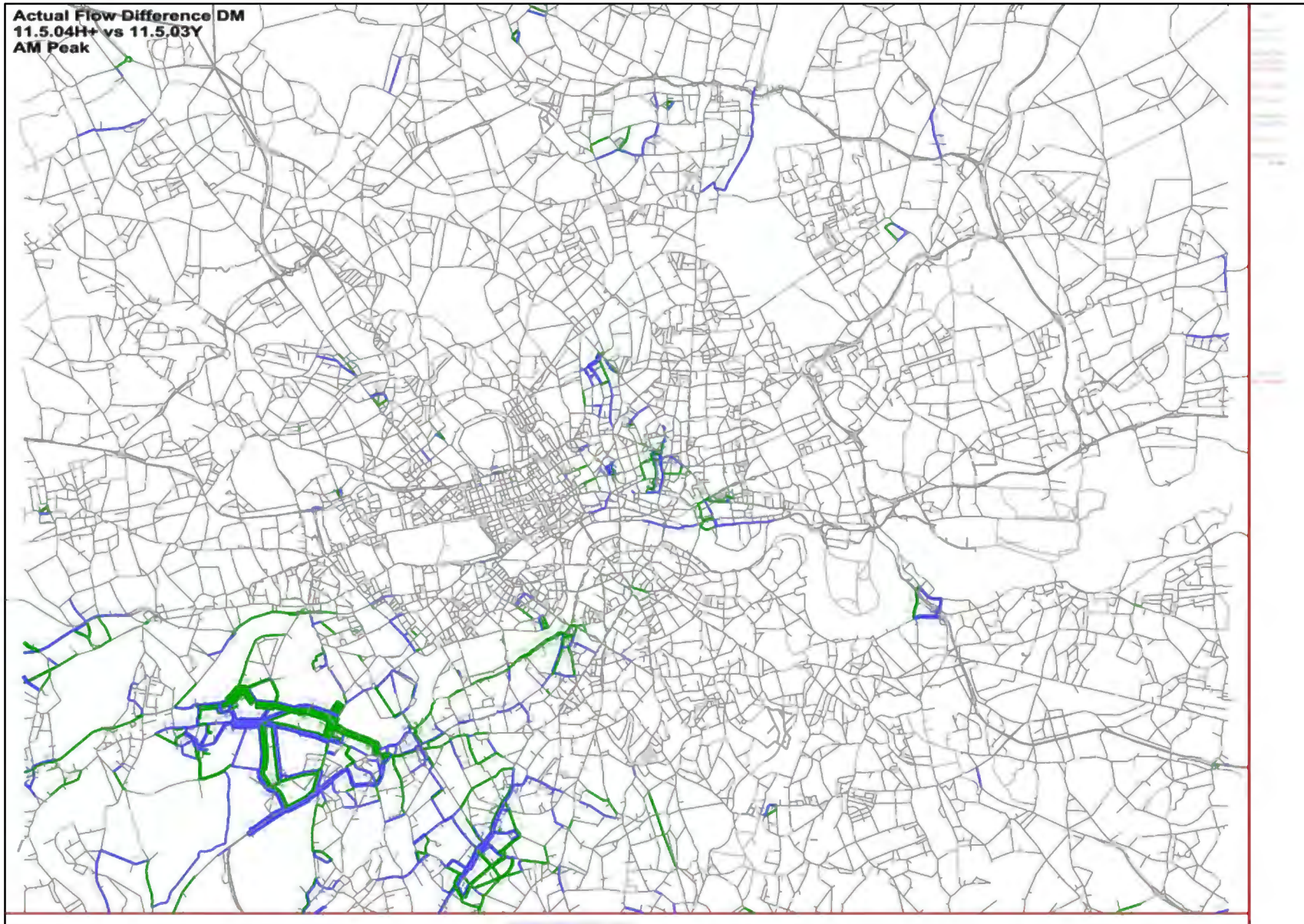


Figure 1: Actual Flow Difference DM – AM Peak



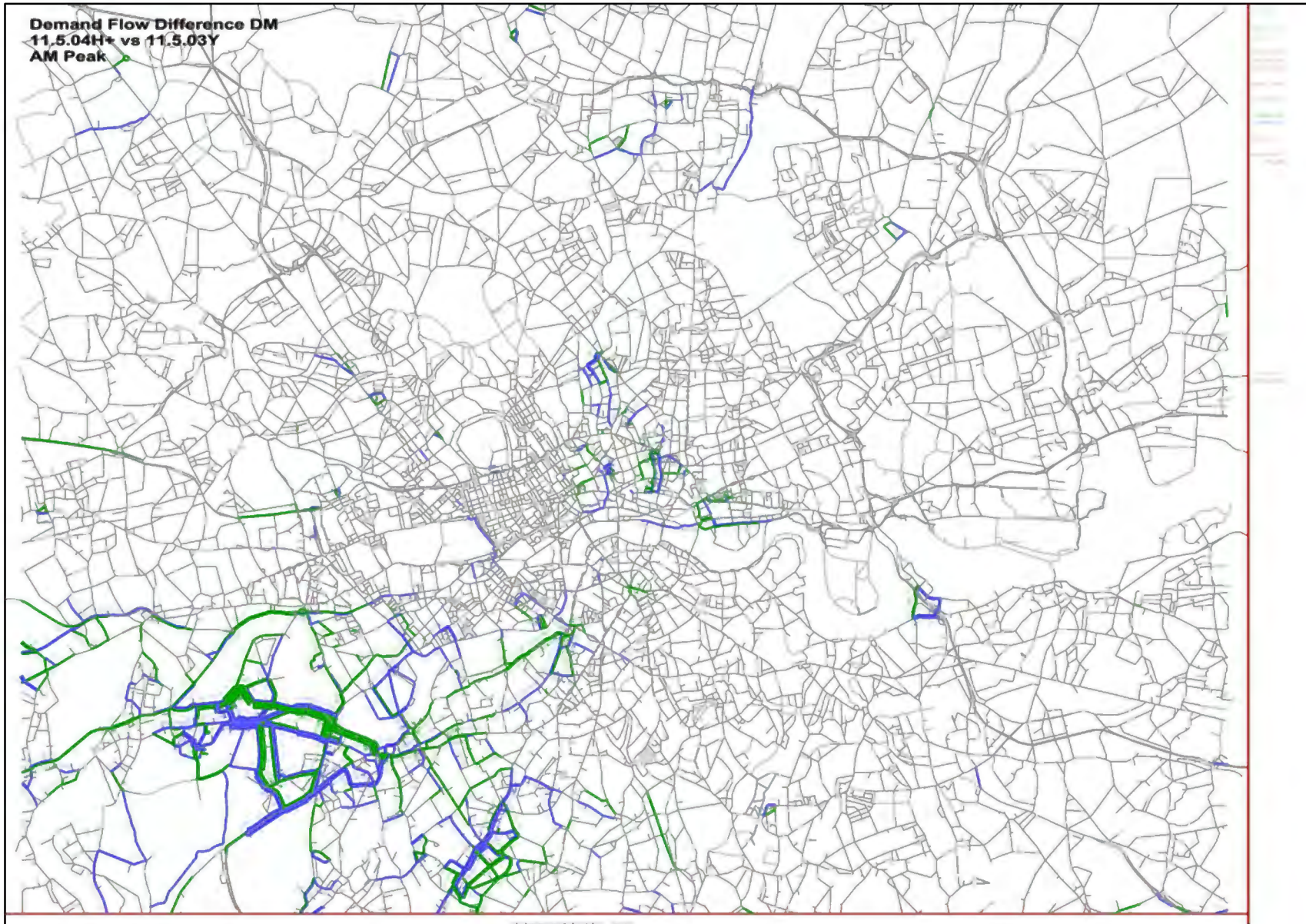


Figure 2: Demand Flow Difference DM – AM Peak

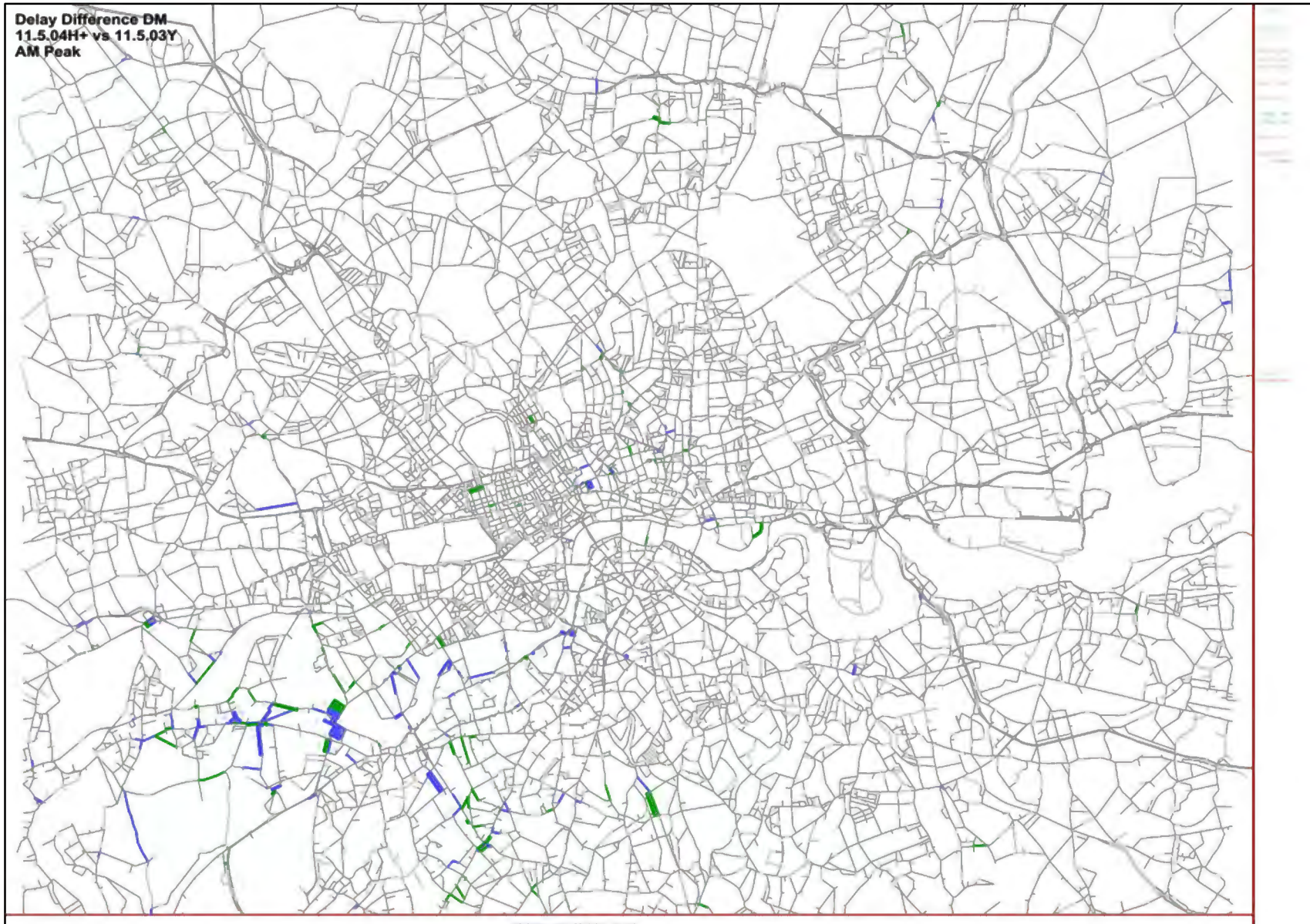


Figure 3: Delay Difference DM – AM Peak

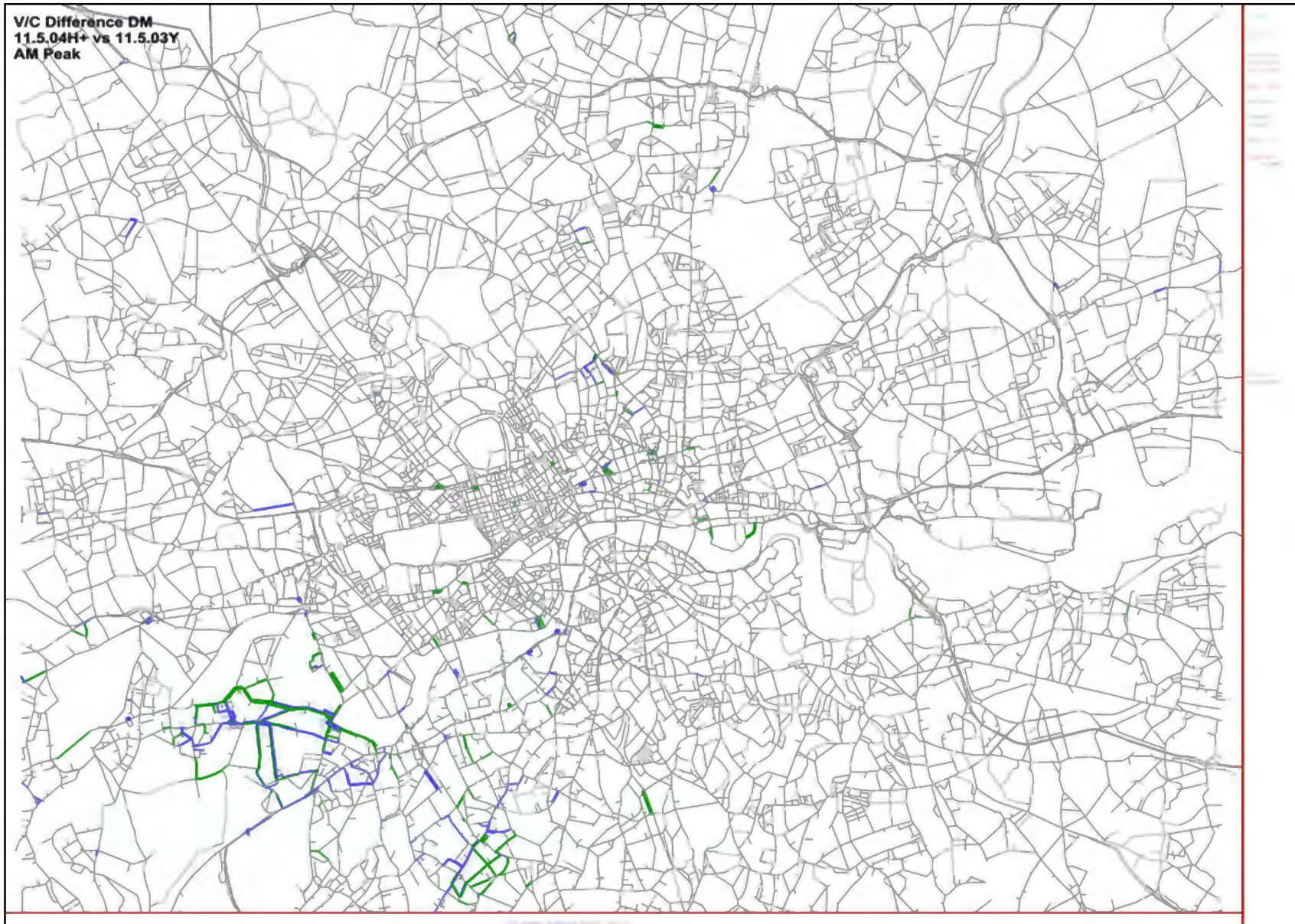


Figure 4: V/C Difference DM – AM Peak

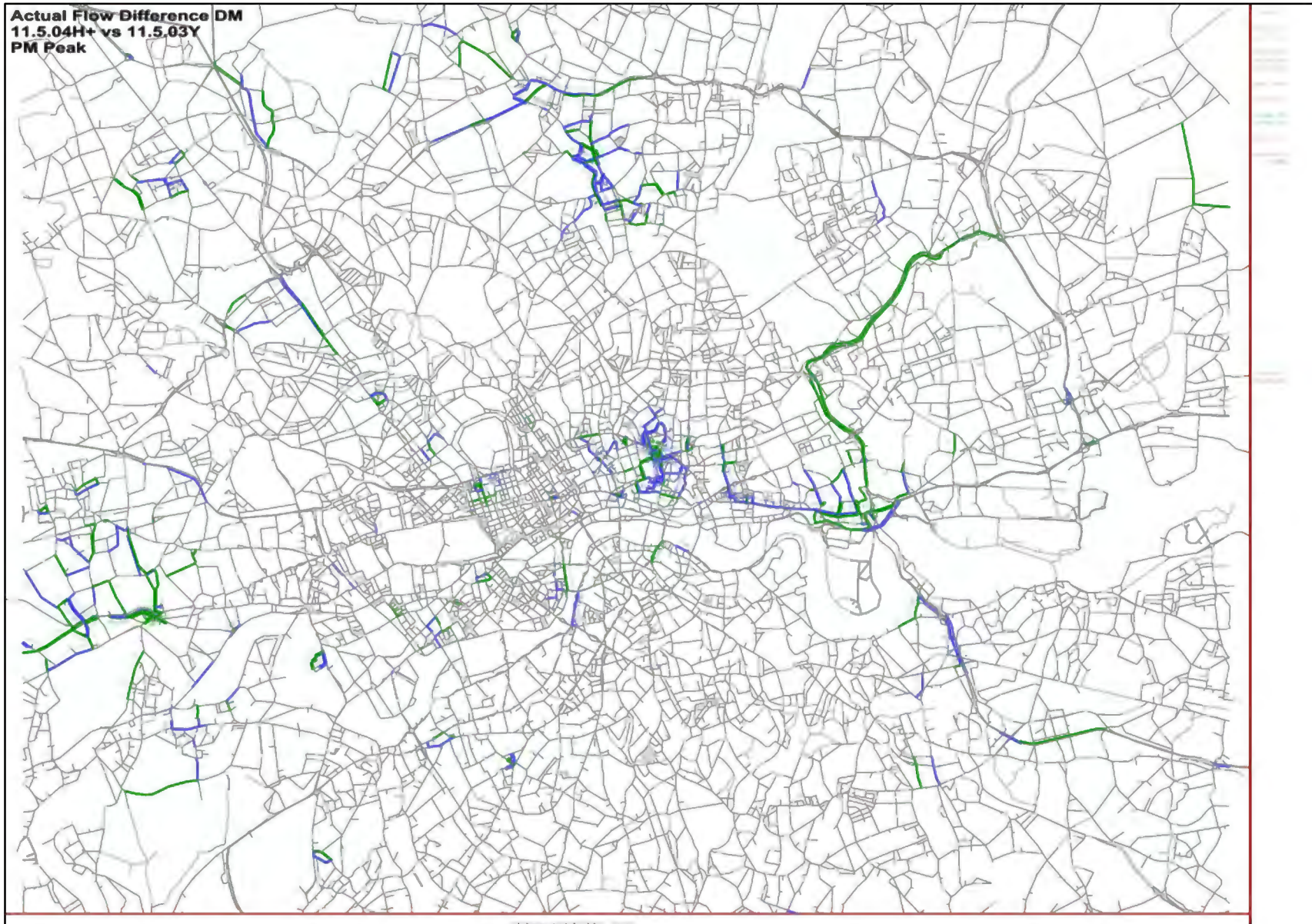


Figure 5: Actual Flow Difference DM – PM Peak

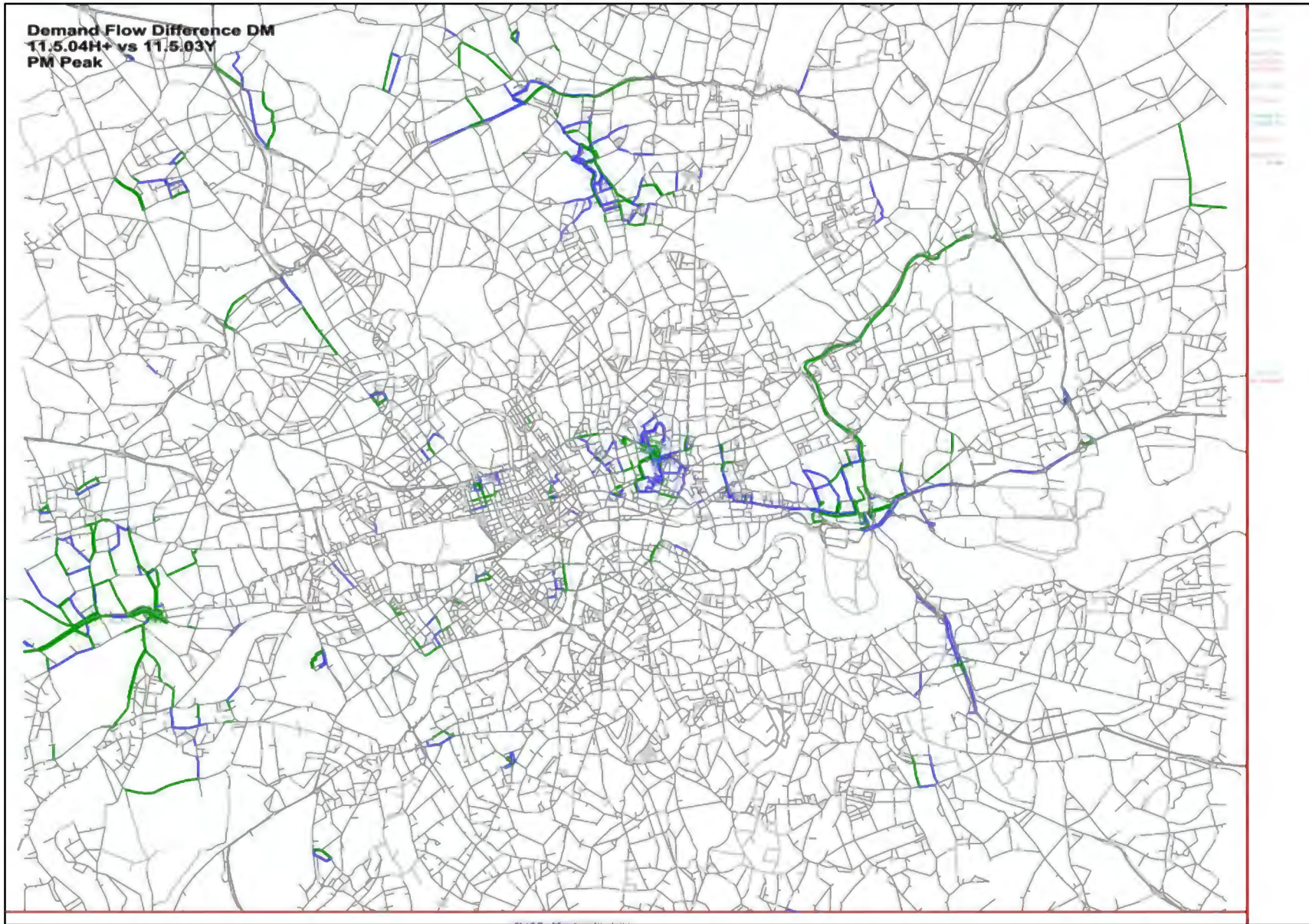


Figure 6: Demand Flow Difference DM – PM Peak

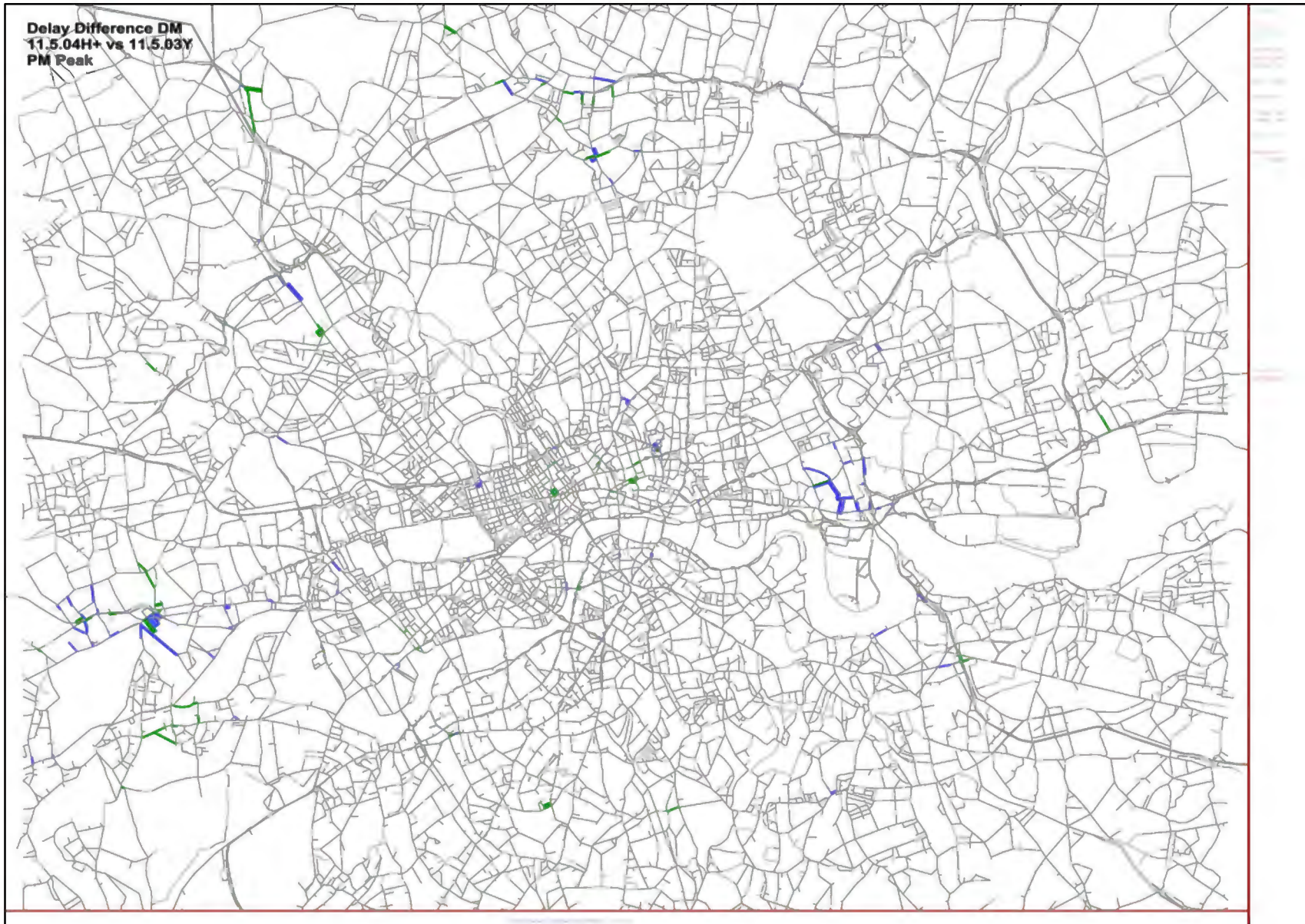


Figure 7: Delay Difference DM – PM Peak

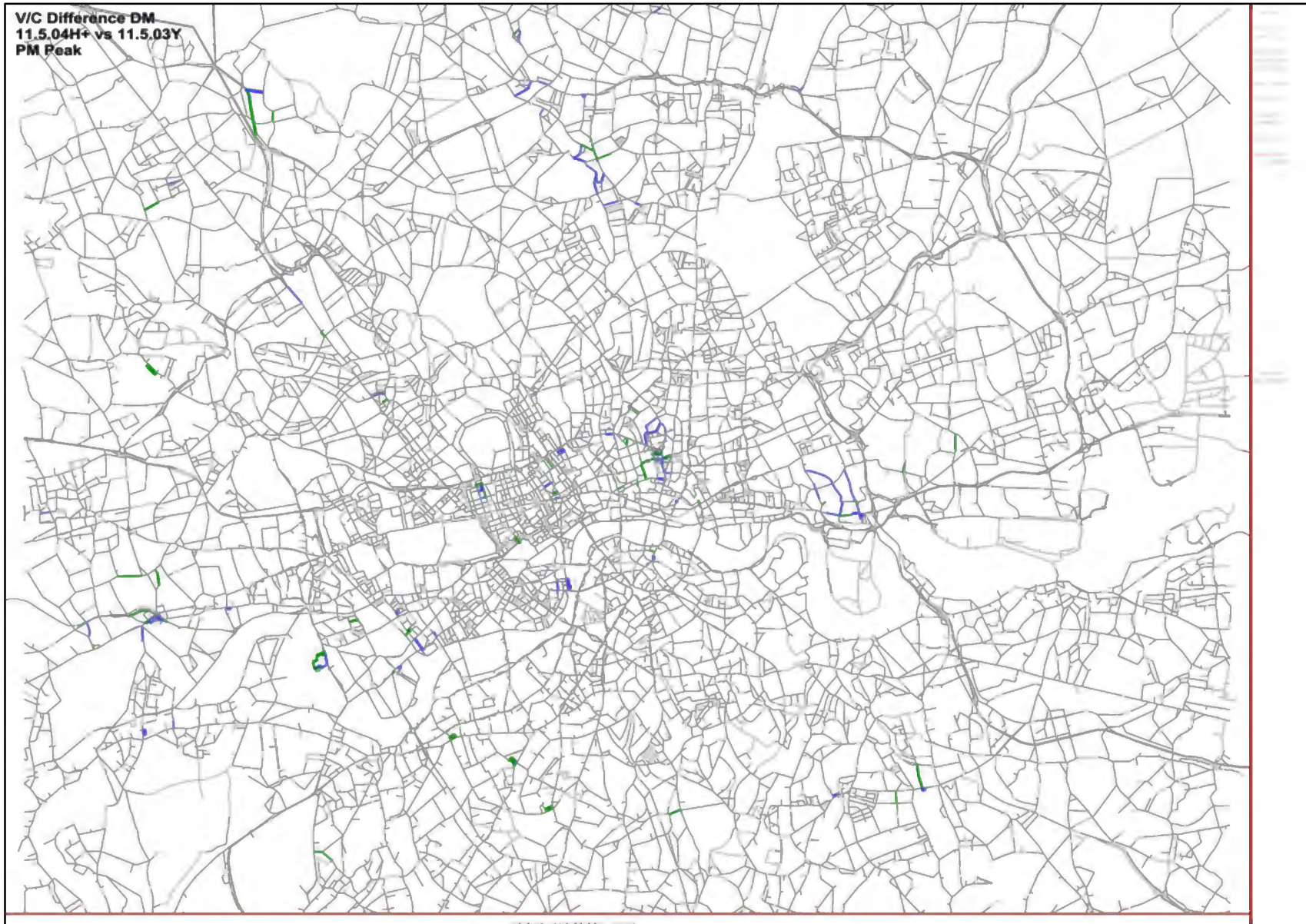


Figure 8: V/C Difference DM – PM Peak

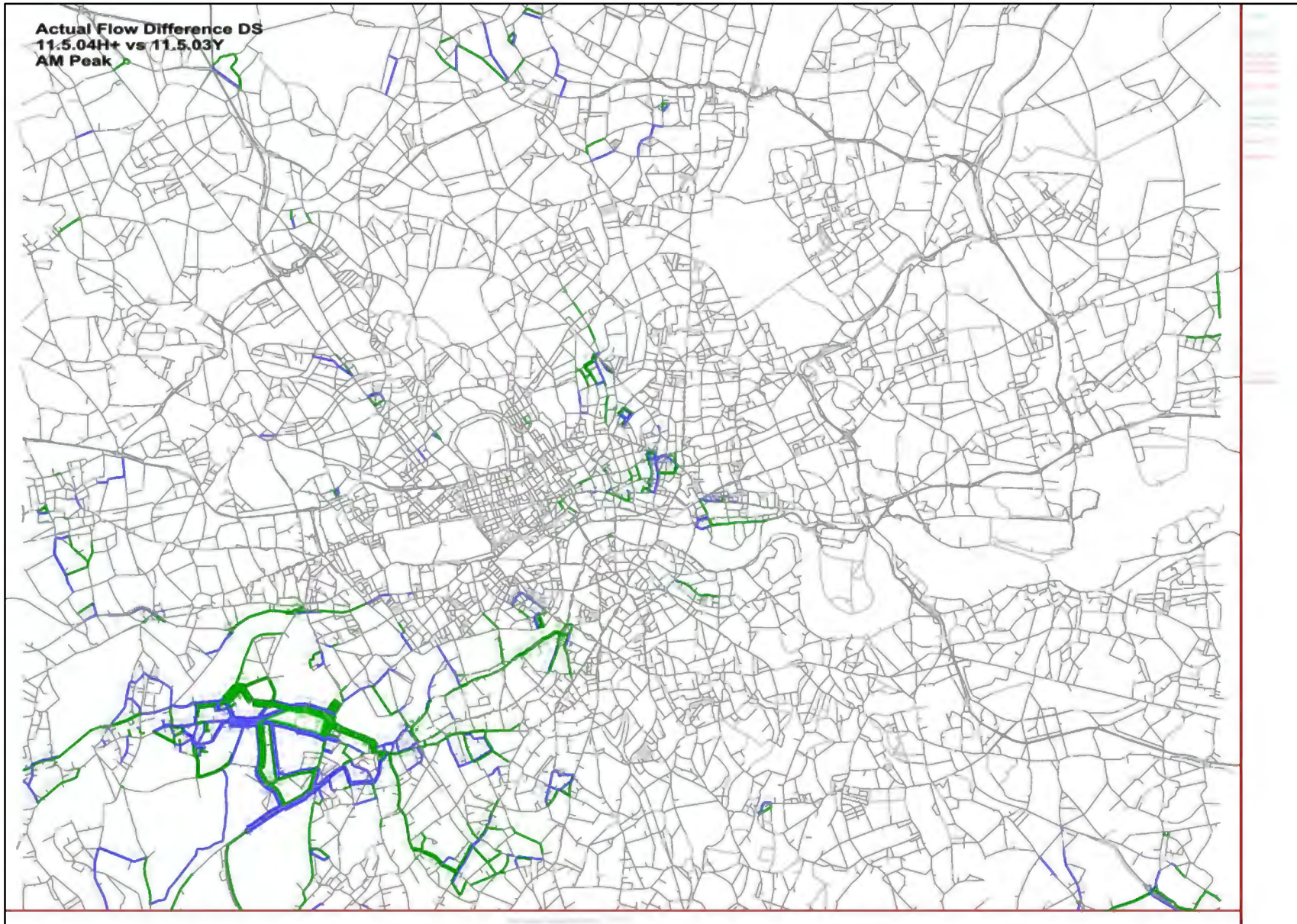


Figure 9: Actual Flow Difference DS – AM Peak



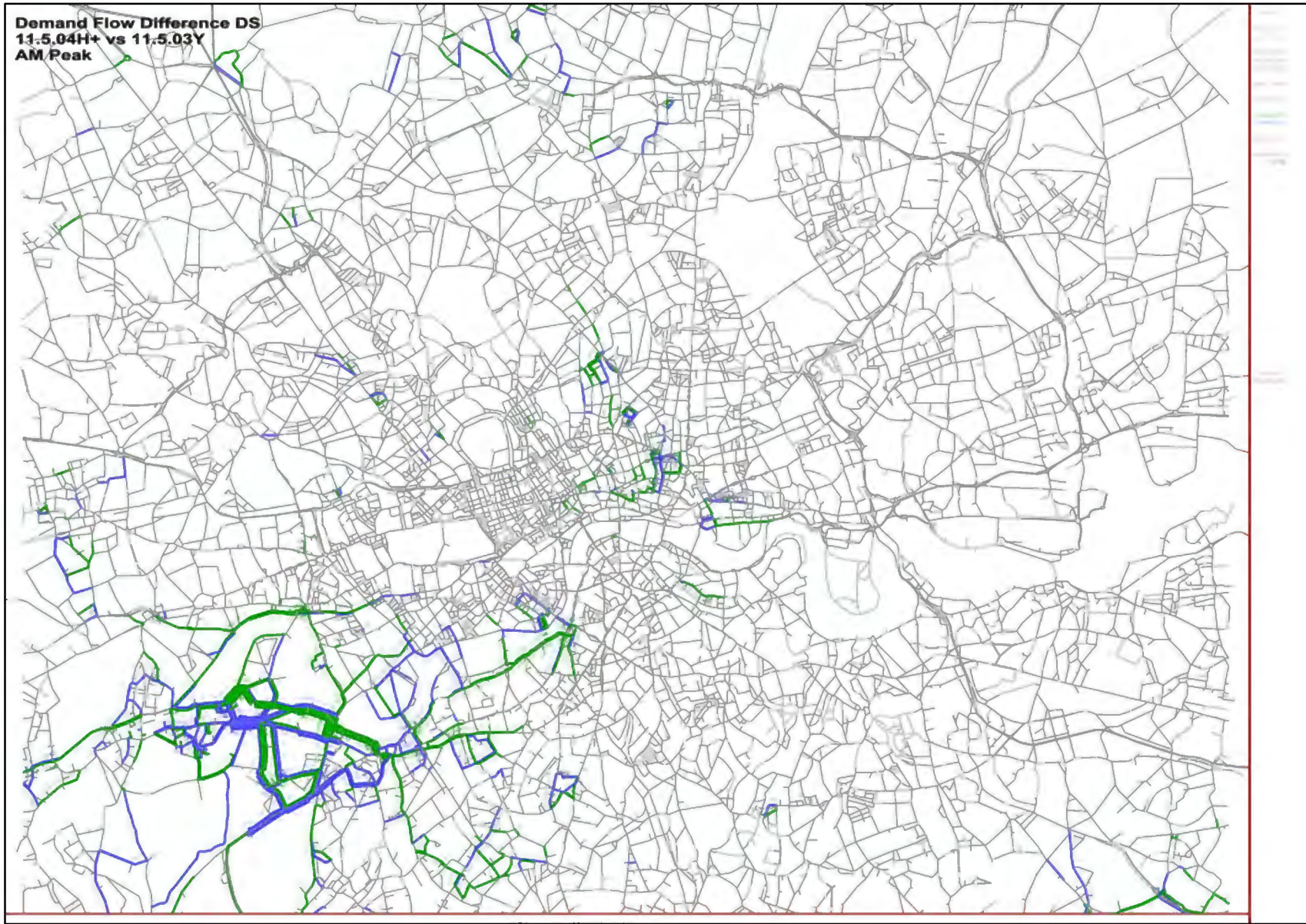
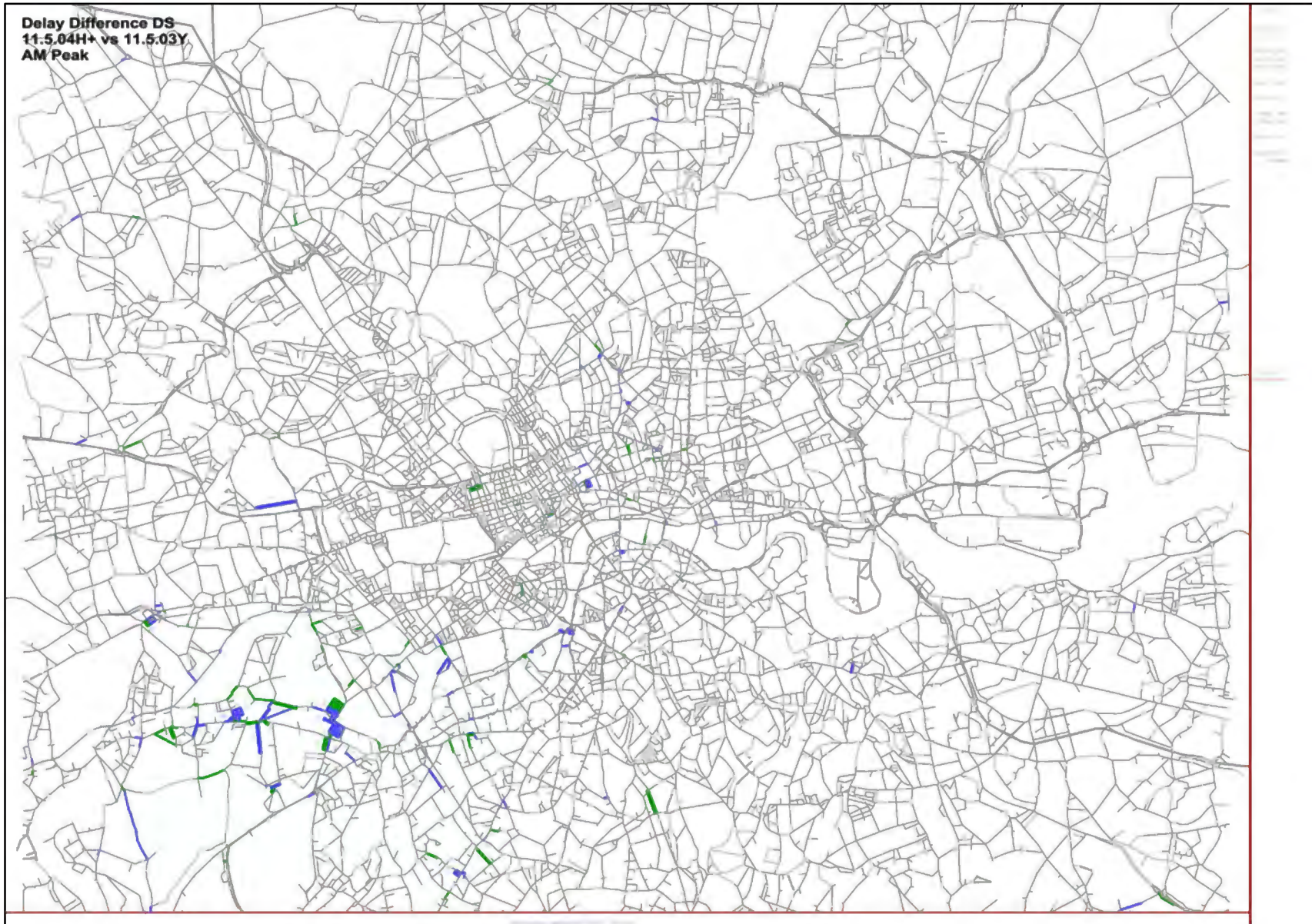


Figure 10: Demand Flow Difference DS – AM Peak



**Figure 11: Delay Difference DS – AM Peak**

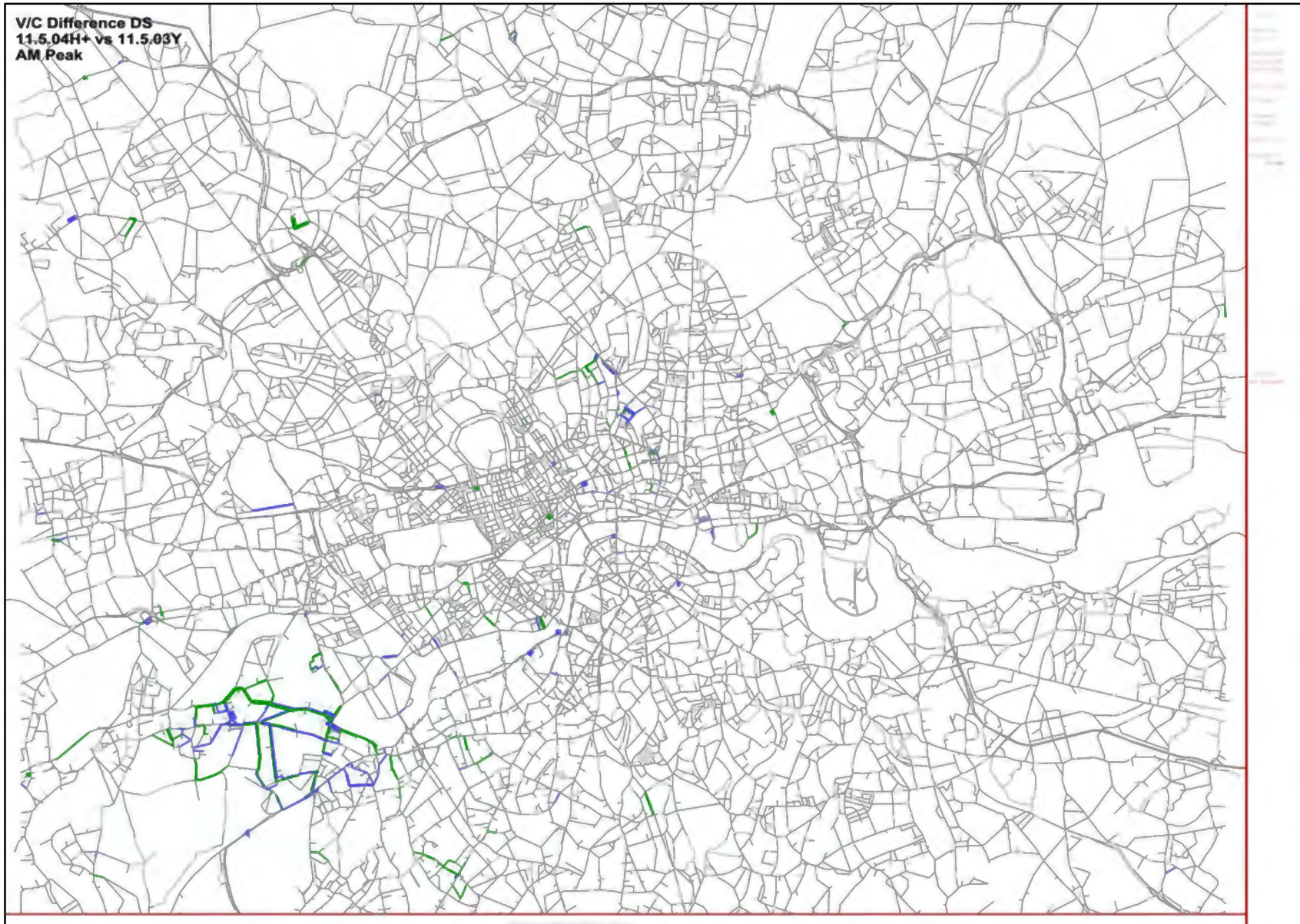


Figure 12: V/C Difference DS – AM Peak

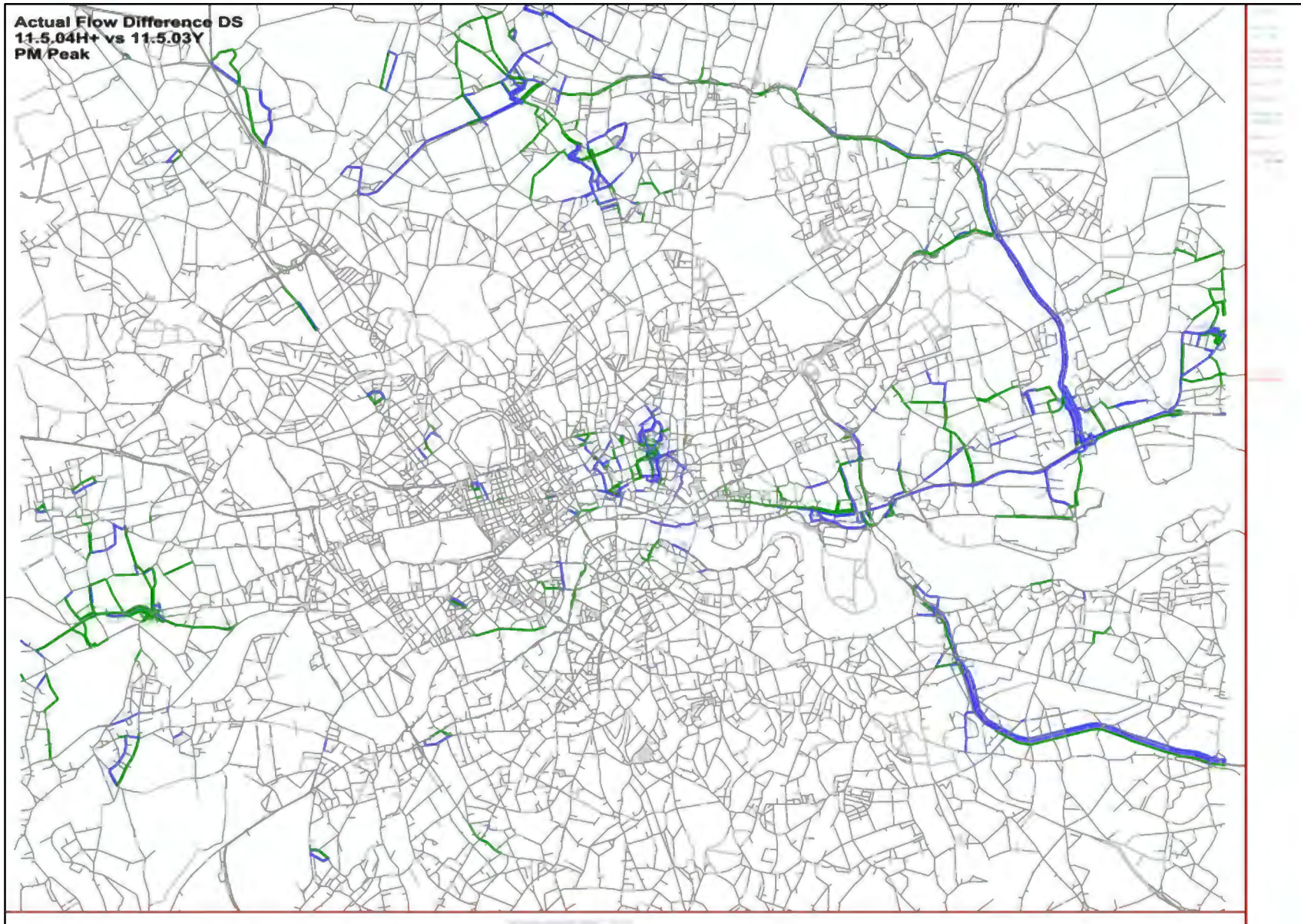


Figure 13: Actual Flow Difference DS – PM Peak

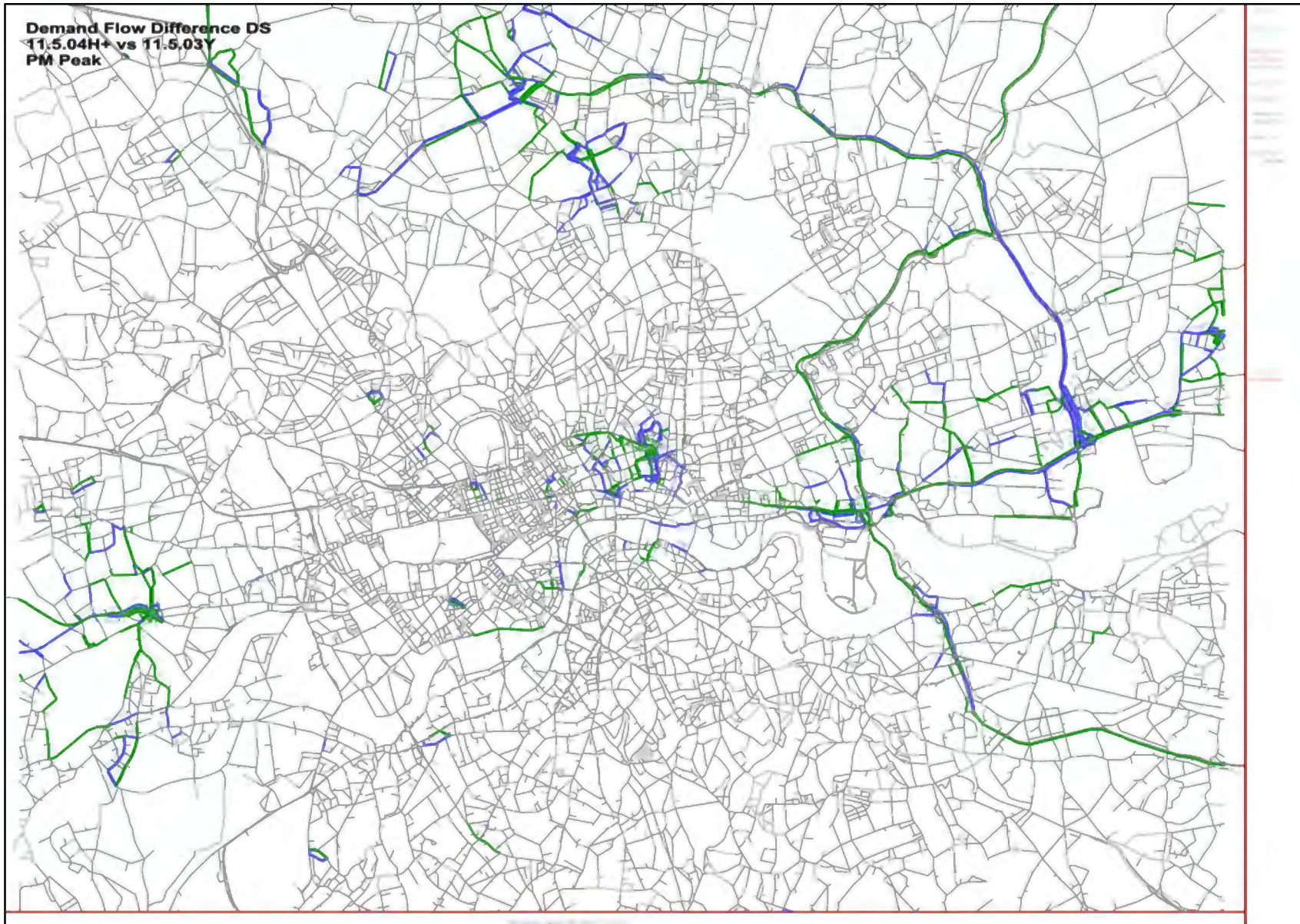


Figure 14: Demand Flow Difference DS – PM Peak

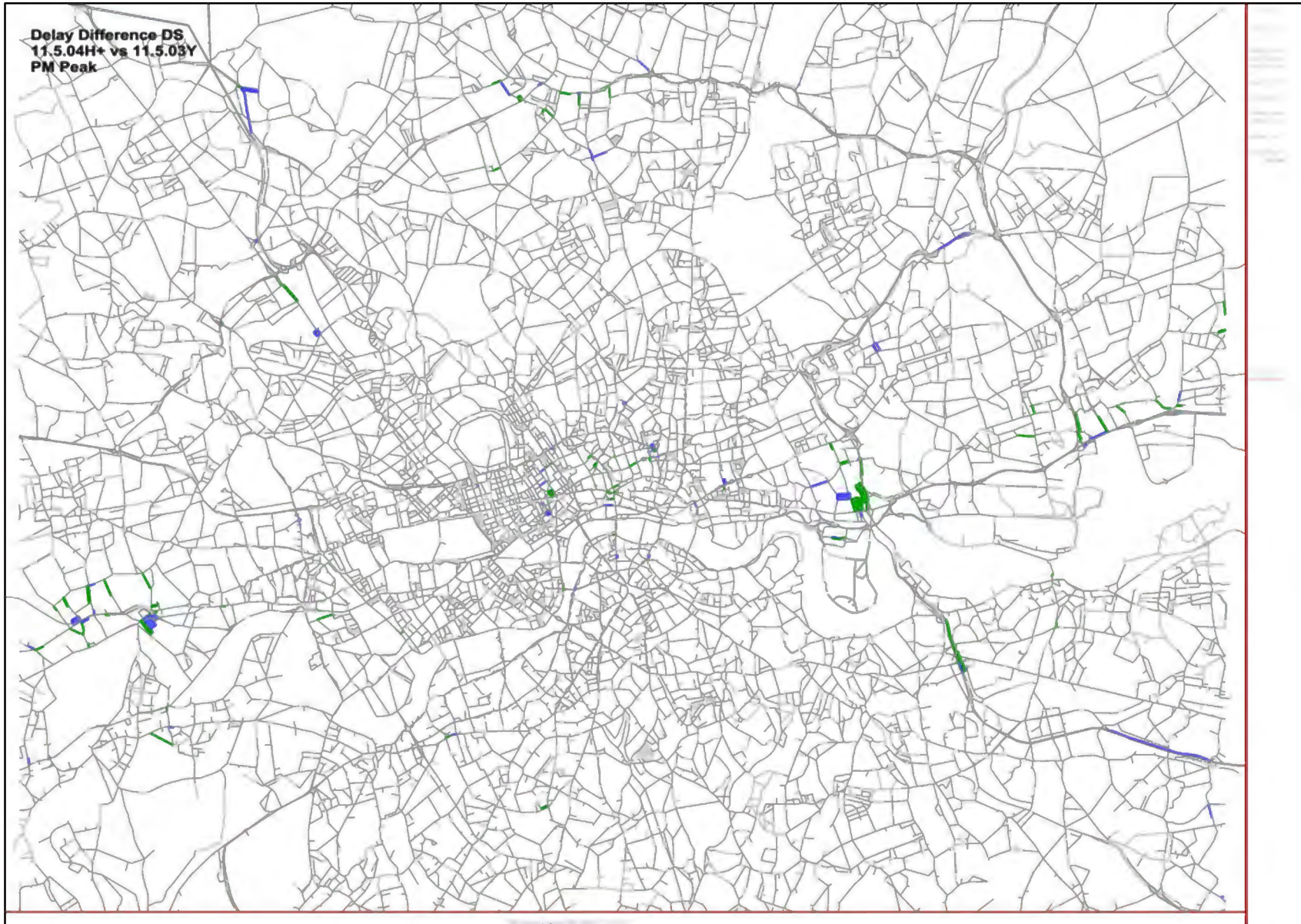


Figure 15: Delay Difference DS – PM Peak

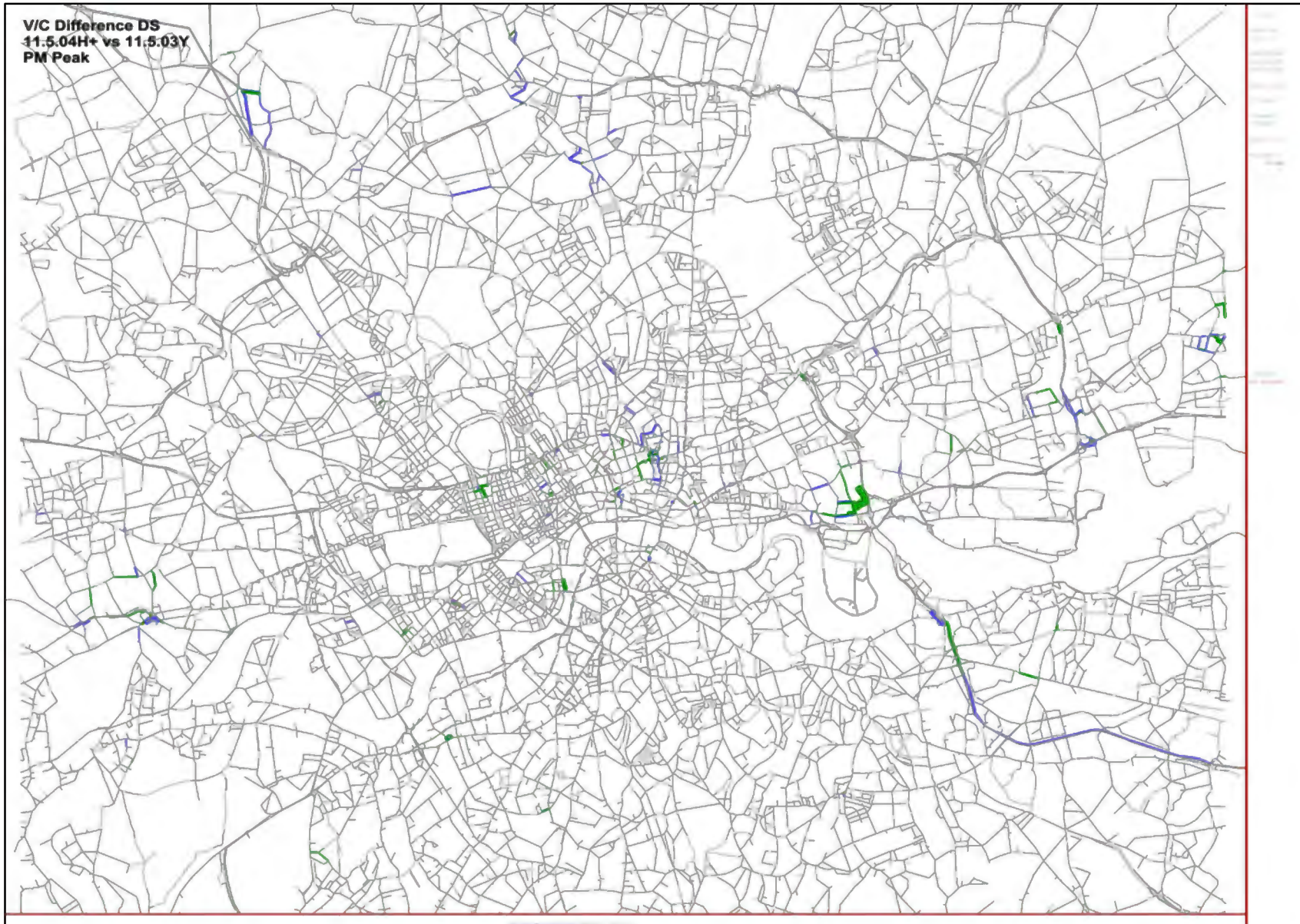


Figure 16: V/C Difference DS – PM Peak

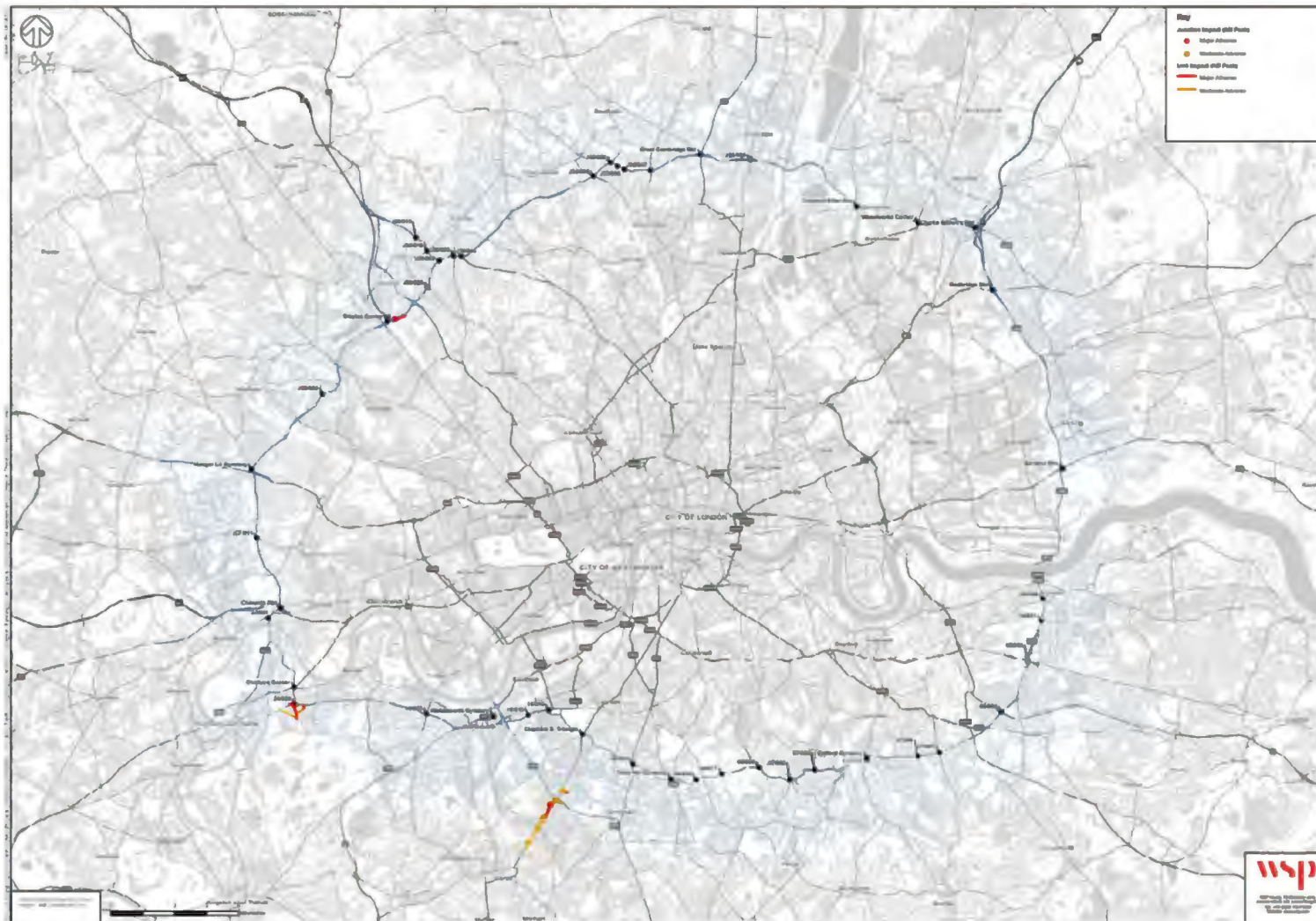


Figure 17: AM Peak Moderate or Significant Adverse Impact in Version 11.5.04H+





Figure 18: PM Peak Moderate or Significant Adverse Impact in Version 11.5.04H+



**Table 1: Impact Summary Table AM Peak**

<b>AM Peak</b>							
SATURN Version	Description	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
11.5.03Y	With original signals	Extensive moderate/significant link/node impacts around Chalkers Corner. No Impacts on A4 corridor.	Moderate/significant link/node impacts on A24 corridor (convergence issues).	Isolated moderate link impact at A205/Ha-ha Road Junction.	Isolated moderate link/node impacts at Hangar Lane Gyratory.	Isolated significant link/node impacts at Staples Corner.	No link or node impact.
11.5.04H	With original signals	Extensive moderate/significant link/node impacts around Chalkers Corner. No Impacts on A4 corridor.	Moderate/significant link/node impacts on A24 corridor (convergence issues).	Isolated moderate link impact at A205/Ha-ha Road Junction.	No link or node impact.	Isolated significant link/node impacts at Staples Corner.	No link or node impact.

**Table 2: Impact Summary Table PM Peak**

<b>PM Peak</b>							
SATURN Version	Description	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
11.5.03Y	With original signals	Isolated moderate link/node impacts around Chalkers Corner. Moderate and significant link/node impacts on A4 corridor.	Isolated significant link/node impacts at Clapham South Triangle.	Isolated moderate link impact on A205 corridor. Moderate/significant link/node impacts on A2 corridor.	Isolated significant link/node impacts on A40 corridor.	Significant link/node impacts on A1 corridor.	Isolated significant node impact at Crooked Billet Roundabout.
11.5.04H	With original signals	No link or node impact.	No link or node impact.	Isolated moderate link impact on A205 corridor.	No link or node impact.	No link or node impact.	NEW Isolated significant node/link impacts at A406/A109 junction at New Southgate.



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