

Jacobs

Edinburgh Low Emission Zone

The City of Edinburgh Council

Revised Fleet Composition, Transport Modelling Report

22 February 2021



Edinburgh Low Emission Zone

Project No: B2340202
Document Title: Revised Fleet Composition, Transport Modelling Report
Document No.: 1
Revision: 2
Date: 22 February 2021
Client Name: The City of Edinburgh Council
Client No:
Project Manager: G Davidson
Author: L Bacon / G Davidson
File Name: C:\B3000000 LEZ\Report\Modelling\LEZ Modelling Report 150321.docx

Jacobs Consultancy Ltd.

160 Dundee Street
Edinburgh
T +44 (0)141 243 8000
www.jacobs.com

© Copyright 2021 Jacobs Consultancy Ltd. The concepts and information contained in this document are the property of Jacobs. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright.

Limitation: This report has been prepared on behalf of, and for the exclusive use of Jacobs' Client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the Client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

Document history and status

Revision	Date	Description	By	Review	Approved
1	27.07.20	Draft Report	LB	GD	GD
2	22.02.21	Final Draft Report incorporating CEC comments	LB	GD	GD
3	15.03.21	Final Report	LB	GD	GD

Contents

1.	Introduction.....	1
1.1	Introduction.....	1
1.2	Report Structure.....	1
1.3	Scenarios.....	1
1.4	LEZ Boundaries.....	1
2.	Model Parameters.....	5
2.1	Model Years.....	5
2.2	Model Segmentation.....	5
2.3	Petrol / Diesel Split.....	5
2.4	Fleet Composition.....	5
2.5	Compliance Assumptions.....	6
3.	City Centre Transformation Impacts.....	7
3.1	Introduction.....	7
3.2	Meadows to George Street.....	7
3.3	CCWEL Charlotte Street Trial.....	8
3.4	East End of Princes Street / Waverley Bridge.....	8
3.5	Cockburn Street / Victoria Street / High Street.....	9
4.	Results.....	12
4.1	Overview.....	12
4.2	West End LEZ Diversion Route.....	12
4.3	East End LEZ Diversion Route.....	18
4.4	Key Links.....	24
4.5	Compliance by Diversion Street and Assessment Year.....	31
4.6	Assignment Summary Plots.....	35
5.	Summary.....	48
5.1	Summary.....	48

1. Introduction

1.1 Introduction

This report summarises the traffic modelling undertaken to assess the impact of the Low Emission Zone (LEZ) proposed for Edinburgh city centre.

All modelling has been undertaken in VISUM 18. Base models are those previously created in support of the Edinburgh Tram Final Business case and were last recalibrated in spring 2017. Highway demands make use of November 2016 traffic count data collected on behalf of SEPA.

1.2 Report Structure

The report structure is as follows:

- Chapter 1 – Introduction
- Chapter 2 – Modelling assumptions
- Chapter 3 – Model development
- Chapter 4 - City Centre Transformation
- Chapter 4 – Results
- Chapter 5 – Summary

1.3 Scenarios

Four alternative scenarios have been considered:

- Base
- Original LEZ
- Original LEZ + City Centre Transformation schemes
- Revised LEZ + City Centre Transformation schemes

1.4 LEZ Boundaries

The proposed LEZ boundary has been developed based on a detailed understanding of the air quality issues in Edinburgh from the air quality model. In addition, a key consideration has been the need to provide a clear, logical, and readily signposted diversion route for non-compliant vehicles.

To the north, Queen Street is proposed to be excluded from the LEZ as it provides a suitable alternative route. If Queen Street were included this would encourage additional traffic through Stockbridge (via Hamilton Place / Henderson Row and Brandon Street / Eyre Place). Ferry Road as a further alternative was considered too far from the city centre.

The proposed eastern boundary of the LEZ is defined by Abbeyhill, Holyrood Road, Pleasance and St Leonard's Street. These all lie outside areas with high pollutant concentrations area and provide a suitable diversion. Queen's Drive is not an acceptable diversion as it is closed to general traffic on a Sunday (and at all times for some vehicles).

The proposed western LEZ boundary is complex to define and runs along Earl Grey Street, Morrison Street, West Approach Road and Torphichen Street. Including Haymarket within the zone would result in non-compliant traffic routing via Murieston Place / Murieston Crescent / Russell Road – these narrow residential streets are not a suitable alternative. The next possible boundary would be at Hutchison Crossway / Balgreen Road and was considered to extend too far into the west.

The proposed southern boundary utilises East and West Preston Street and Melville Drive. This provides a relatively straightforward diversion, avoiding the city centre.

The above LEZ boundary area is illustrated in Figure 1.1.

An alternative boundary has also been tested, as shown in Figure 1.2. This is unchanged from Figure 1.1 along the north, east and southern boundaries but the western boundary is revised to be via Lothian Road and South and North Charlotte Street. Although much of the West End lies outside the LEZ area in this option, non-compliant traffic is reduced on a number of key streets including Palmerston Place, Chester Street, Randolph Crescent and Great Stuart Street.

Figure 1.1: Original LEZ boundary

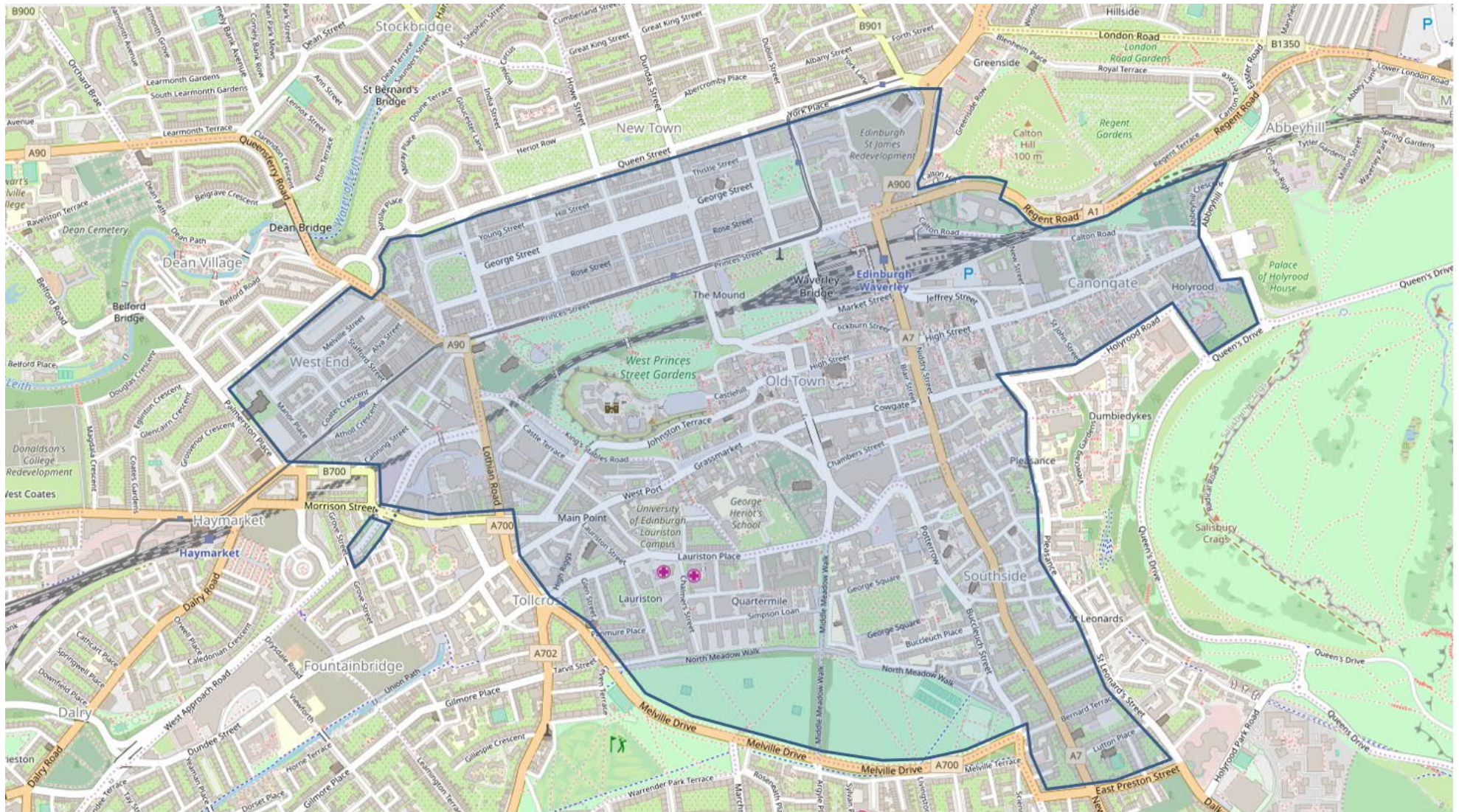
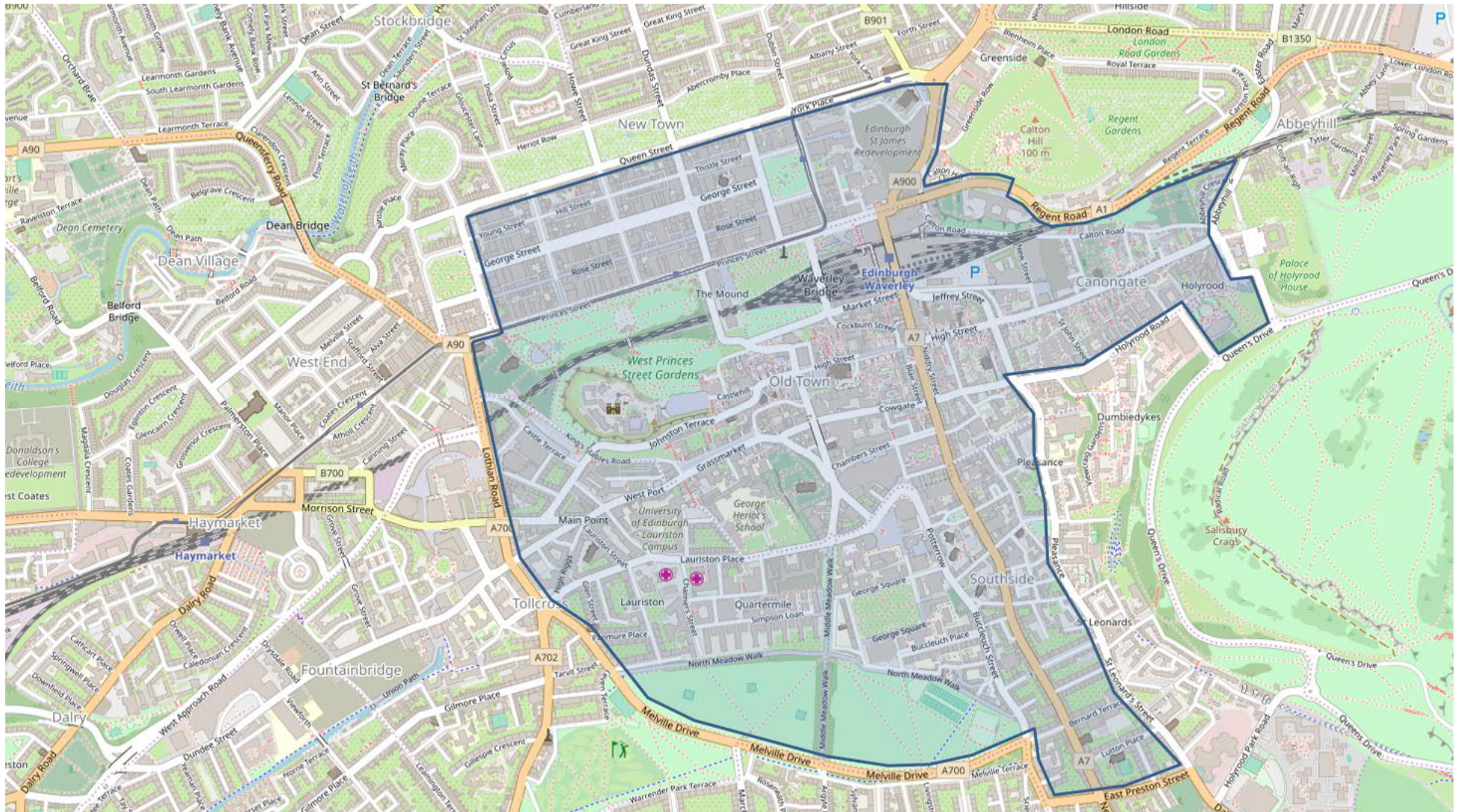


Figure 1.2: Alternative LEZ boundary



2. Model Parameters

2.1 Model Years

Two forecast years have been assessed – 2019 and 2023. Both use 2016 VISUM flows, as agreed with SEPA, so that any change in assignment is a result of changes in fleet mix rather than underlying travel patterns. Having only a limited number of variables enables the impact of the LEZ and changes in fleet mix to be better understood.

In summary, model tests are:

- 2019 base year: 2016 traffic volumes and 2019 fleet mix
- 2023 forecast year: 2016 traffic volumes and 2023 fleet mix

It should be noted that the applied future year fleet mix is an estimate, based on available SEPA / Department for Transport data. Fleet forecasts tend to be optimistic and so the 2023 model represents a likely ‘future year’, post 2023.

2.2 Model Segmentation

Car matrices have been disaggregated to differentiate between petrol and diesel engine types in order that the SEPA model can more accurately calculate emissions by compliant and non-compliant traffic. Given limited data, the disaggregation is based on an agreed global split with no further spatial differentiation.

2.3 Petrol / Diesel Split

The agreed disaggregation between petrol and diesel engine types is given in Table 2.1 below. 2019 Values are from the recent Edinburgh ANPR survey.

Table 2.1: Petrol / Diesel Split

	2019 compliant	2019 non-compliant	2023 compliant	2023 non-compliant
Cars (Diesel)	42.6	57.4	78.1	21.9
Cars (Petrol)	88.4	11.6	99.6	0.4
LGVs	41.2	58.8	81.6	18.4
HGVs	64.4	35.6	91.6	8.4

2.4 Fleet Composition

The base year fleet composition has been updated from previous work, based on summer 2019 ANPR data. The key difference between 2016 and 2019 data is a much higher level of observed LGV compliance.

Proposed 2019 and 2023 values are summarised in Table 2.2.

Table 2.2: Fleet Composition

Car	2019	2023
Diesel Compliant	42.6	78.1
Diesel Non-compliant	57.4	21.9
Petrol Compliant	88.4	99.6
Petrol Non-compliant	11.6	0.4
LGV	2019	2023
Compliant	41.2	81.6
Non-compliant	58.8	18.4
HGV	2019	2023
Compliant	64.4	91.6
Non-compliant	35.6	8.4
Buses	2019	2023
Euro 6	52.0	83.9
Non-compliant	48.0	16.1
Taxi	2019	2023
Euro 6	43.6	100.0
Non-compliant	56.4	

2.5 Compliance Assumptions

All vehicles with an origin or destination within the city centre are assumed to be compliant with LEZ legislation. In addition, non-compliant vehicles which would previously have routed through the city centre now route around the LEZ boundary.

Virtually no non-compliant vehicles are assumed to cross the boundary. In part, this is a model simplification; however, it also reflects the high cost of the proposed penalty charge which is intended to be prohibitive to almost all drivers.

Table 2.3: Compliance Assumptions

Vehicle Type	Modelled Assumption
Car	100% Car switch from non-compliant to compliant for origin and destination zones within the LEZ
LGV	100% LGV switch from non-compliant to compliant for origin and destination zones within the LEZ
HGV	100% HGV switch from non-compliant to compliant for origin and destination zones within the LEZ

Buses are coded as fixed routes in the model and are assumed to be 100% compliant within the city centre.

Separate compliant and non-compliant vehicle matrices have been created for each vehicle type.

3. City Centre Transformation Impacts

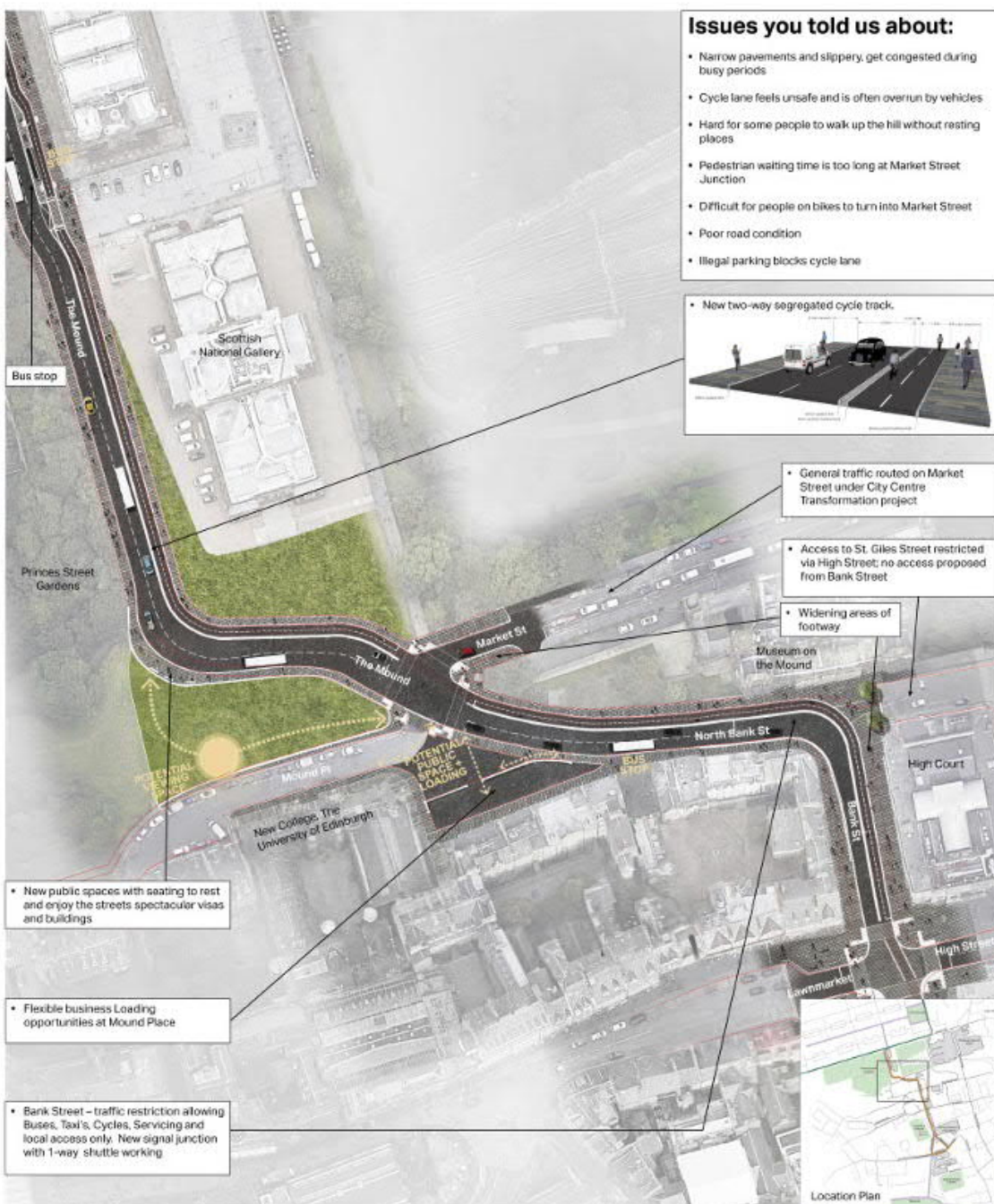
3.1 Introduction

Edinburgh City Centre Transformation (ECCT) proposals, due to be implemented by or shortly after implementation of the LEZ, have been captured in the revised modelling. Key scheme changes are summarised below.

3.2 Meadows to George Street

The Meadows to George Street scheme is included within forecast years. An indicative layout is given in Figure 3.1; it includes a bus / taxi gate on Bank Street and the closure of Forrest Road to all traffic except cycles.

Figure 3.1: Meadows to George Street Scheme (including Bank Street bus / taxi gate)



Improvements (single lane approaches on each arm) are proposed at the George Street / Hanover Street junction supporting the George Street public realm scheme.

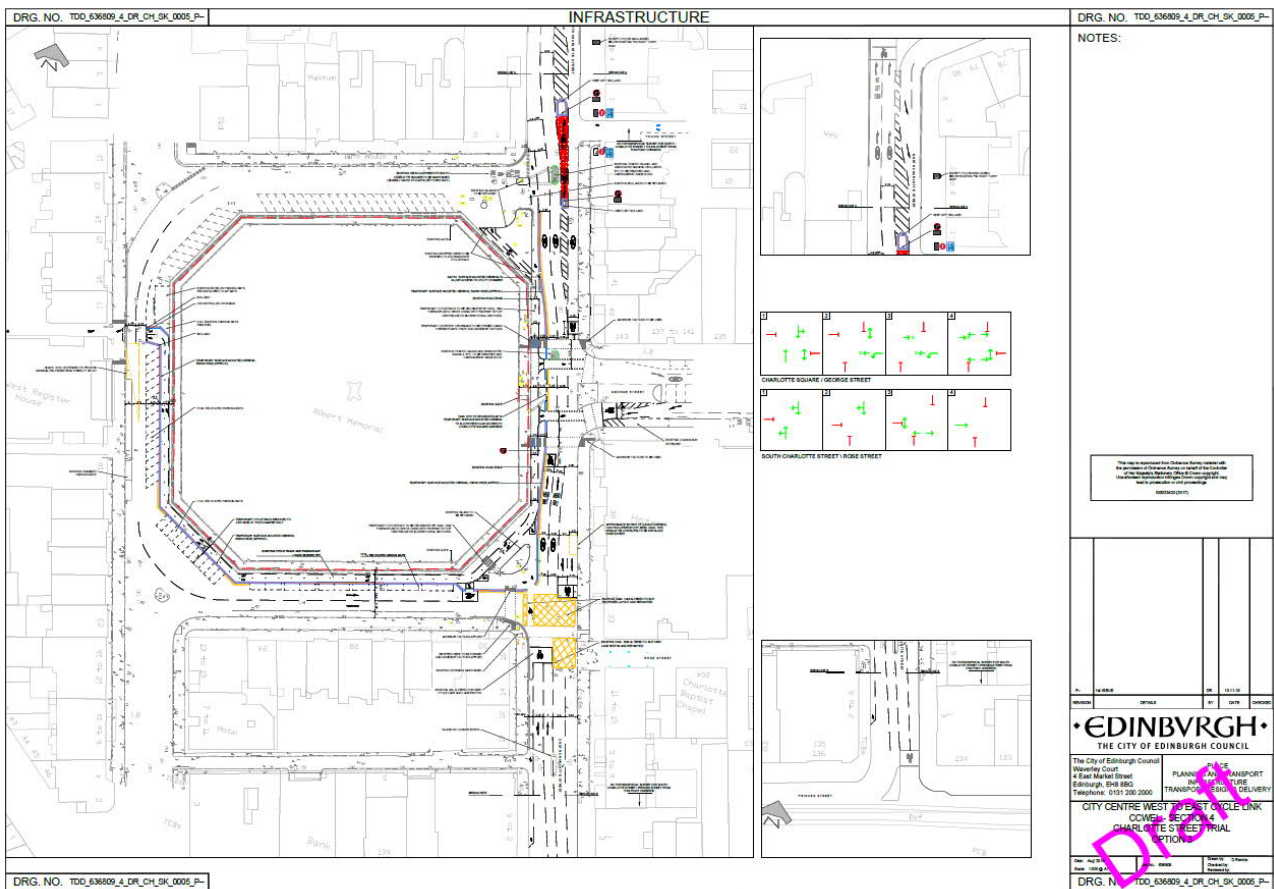
In addition, the Meadow to George Street proposal now includes the closure of Market Street to through traffic (access to the station is maintained) and this change is included within the ECCT model scenario.

3.3 CCWEL Charlotte Street Trial

The City Centre West to East Link creates a new safe, direct cycle route from Roseburn to York Place.

At Charlotte Square, a trial is proposed, reducing the number of southbound lanes from two to one, as shown in Figure 3.2. This restriction is on the route of the alternative LEZ boundary and so the impact will be tested with both boundary scenarios.

Figure 3.2: Charlotte Street Trial Layout

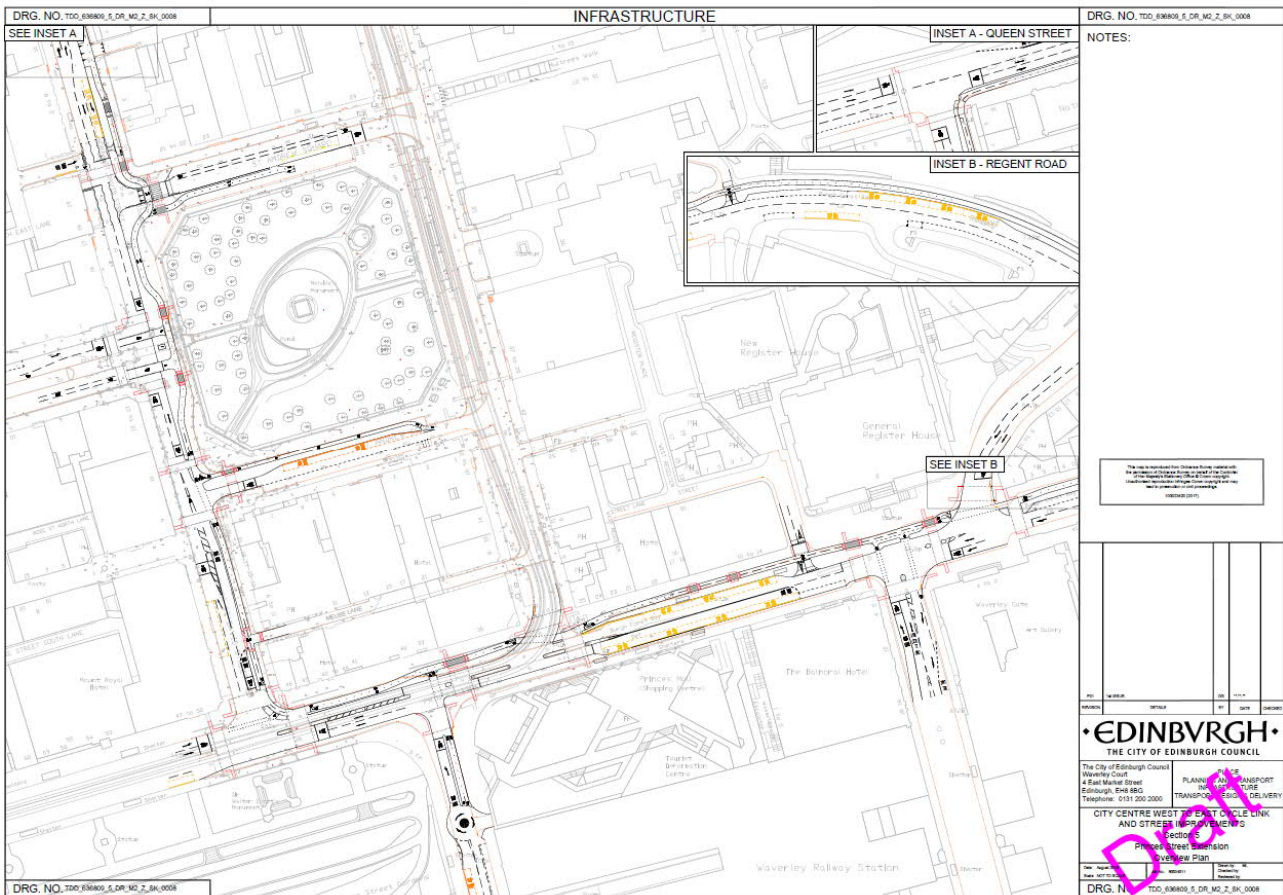


3.4 East End of Princes Street / Waverley Bridge

An experimental closure of the East End of Princes Street to general traffic and the full closure of Waverley Bridge has been implemented over summer 2020. This provides an improved pedestrian environment, more reliable public transport journey times and helps support construction work at York Place.

In the medium term, a permanent solution is proposed, similar to the layout shown in Figure 3.3.

Figure 3.3: Princes St East Trial Layout



East Princes Street / Waverley Bridge traffic management is included within the modelled package of ECCT measures. This scheme, and the Meadows to George Street closure, displaces traffic to Picardy Place, which is already close to capacity. A key output from the modelling will be to understand what further impact the LEZ scheme has in terms of the operation of this junction above other ECCT impacts.

3.5 Cockburn Street / Victoria Street / High Street

Cockburn Street and Victoria Street are assumed to be closed under ECCT proposals. In practice, local access for deliveries is permitted between 06:30 and 10:30, similar to High Street restrictions.

An additional closure is included on the High St, west of the Jeffrey Street / St Mary's Street junction. Again, local delivery access will be maintained.

Figure 3.4: ECCT Key North / South Capacity Reductions

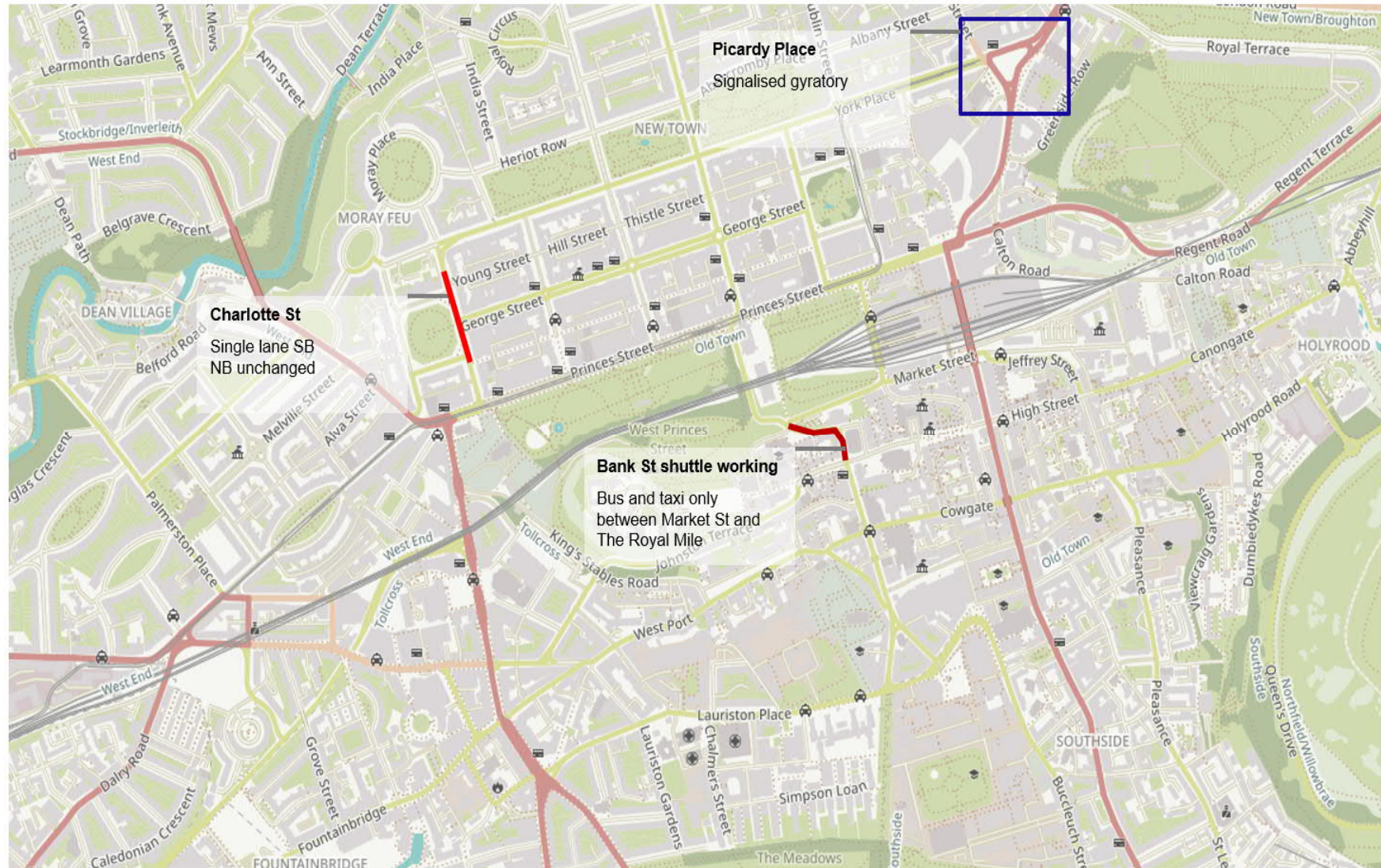
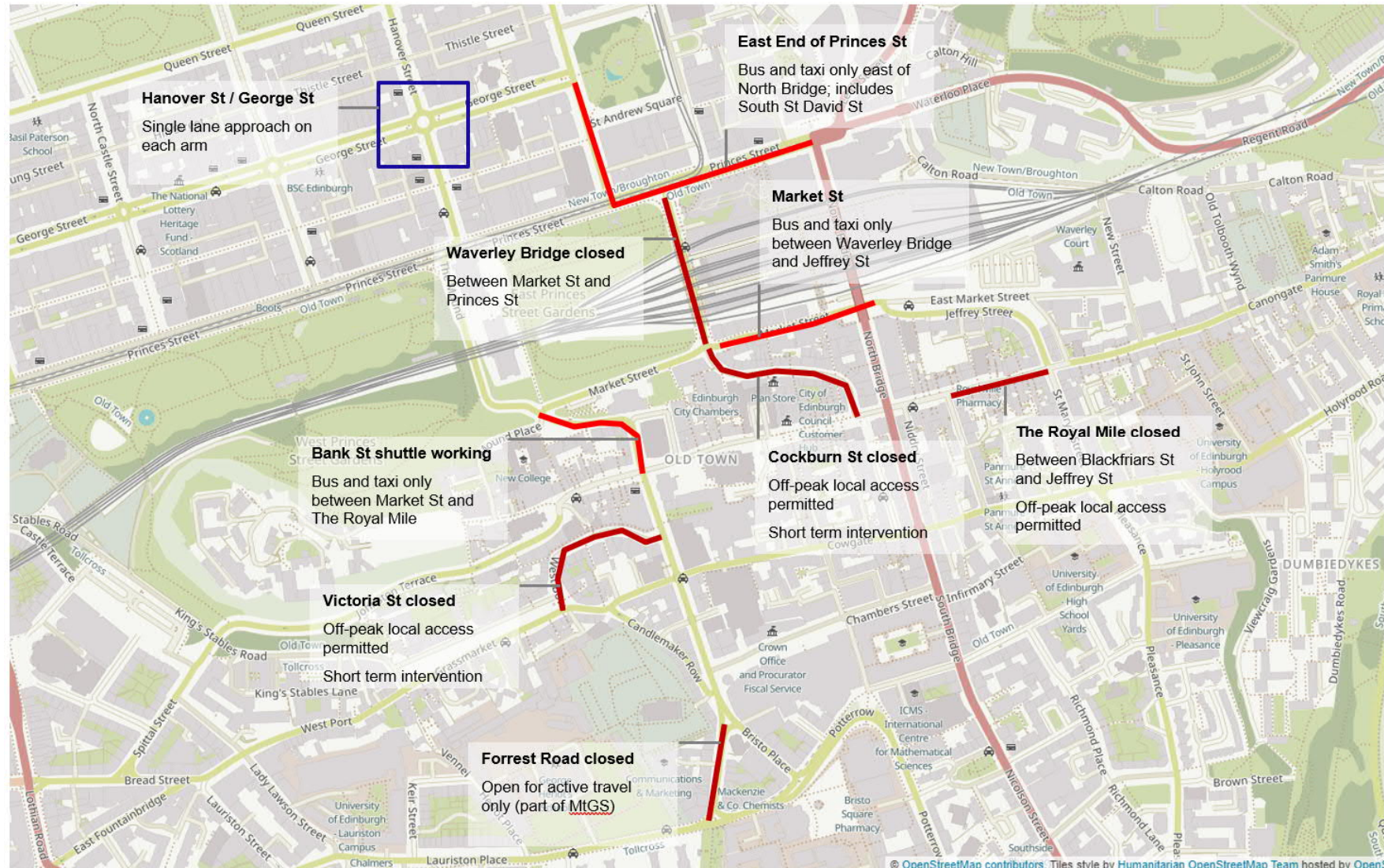


Figure 3.5: ECCT Detailed City Centre Measures



4. Results

4.1 Overview

A VISUM model assignment has been undertaken for each scenario and time period, with traffic flows and speeds subsequently extracted and analysed.

Each LEZ scenario has been compared to the corresponding Base models for a number of key links around the scheme boundary. These links have been selected on the basis that they comprise the major routes throughout the city in proximity to the proposed LEZ boundary.

This chapter summarises the key points from the analysis, by time period.

This analysis only considers the effect of the LEZ on traffic flows. A separate Air Quality modelling exercise will be undertaken by SEPA to consider the impact in emissions and concentrations at the locations referred to in this section.

4.2 West End LEZ Diversion Route

Non-compliant traffic wishing to travel through the west side of the city centre is required to use a diversion route including Semple Street (NB only), Morrison Street, Palmerston Place, Chester Street and St Colme Street.

The changes in total two-way traffic flow and compliance level between the base and scenario models have been assessed in detail along the West End diversion route.

4.2.1 AM Peak

Figure 4.1 and Figure 4.2 present the change in western diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.1: West End Total Traffic Flow Change Relative to 2019 Base – AM 2019 Original LEZ + ECCT

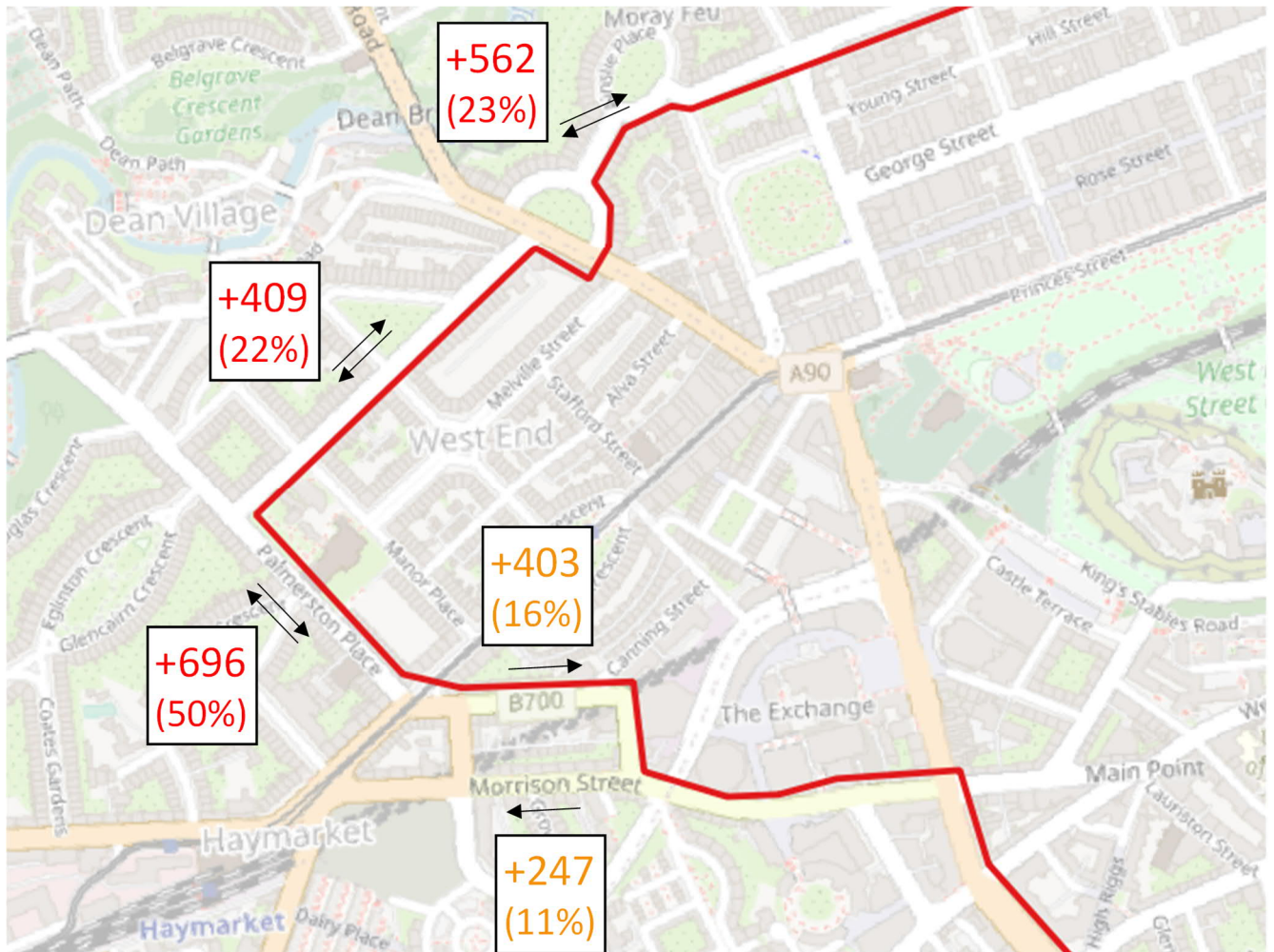


Figure 4.1 indicates that, in the 2019 AM peak, the model predicts a significant increase in traffic along the western diversionary route with the LEZ in place, relative to the Base model. This is due to non-compliant traffic that wishes to travel through the city centre choosing to travel, as anticipated, along the nearest routes to the edge of the LEZ boundary.

Figure 4.2: West End Total Traffic Flow Change Relative to 2023 Base – AM 2023 Original LEZ + ECCT

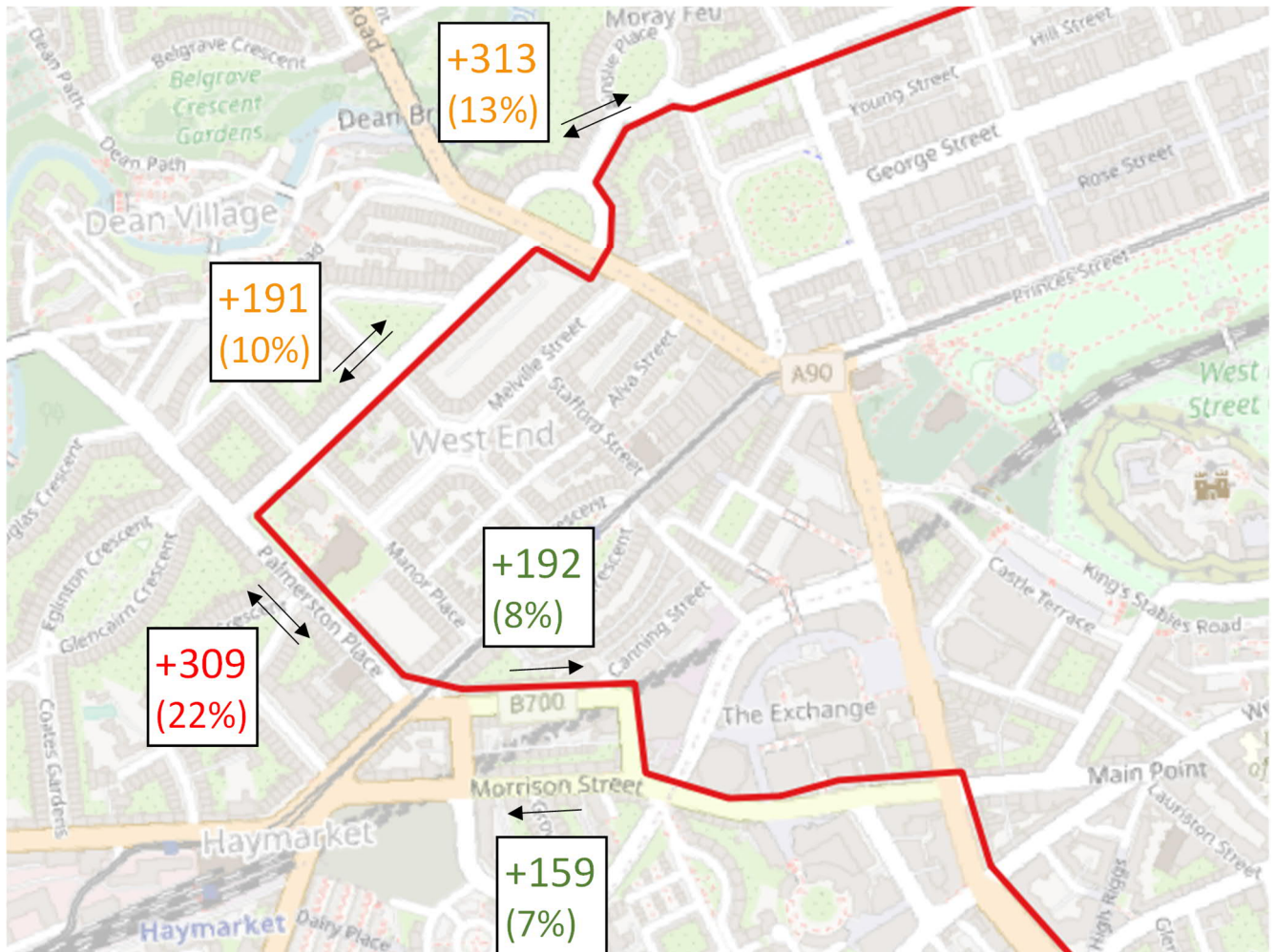


Figure 4.2 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

4.2.2 Inter Peak

Figure 4.3 and Figure 4.4 present the change in western diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.3: West End Total Traffic Flow Change Relative to 2019 Base – IP 2019 Original LEZ + ECCT

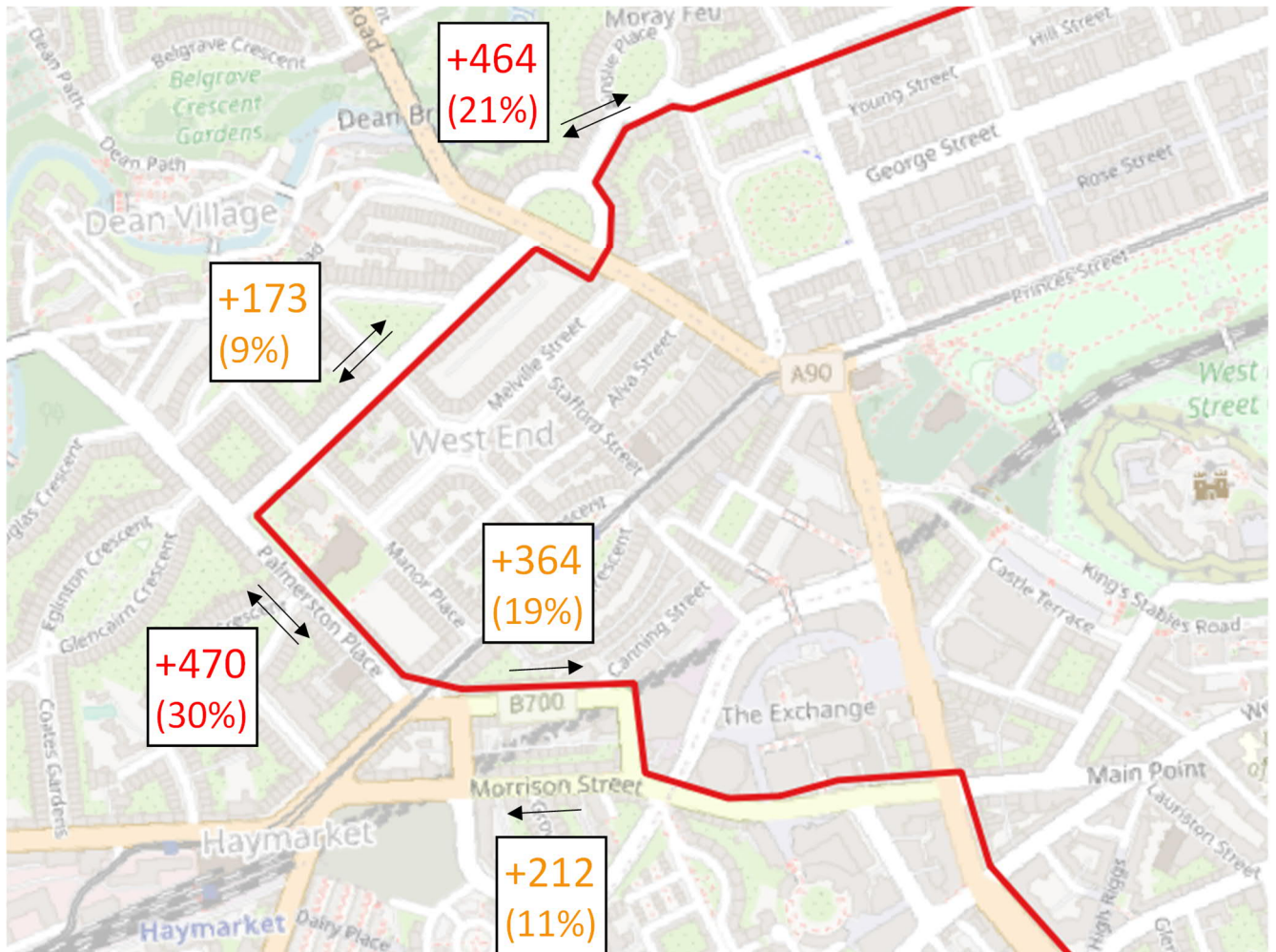


Figure 4.3 above, indicates that, in the 2019 inter-peak, the model predicts a significant increase in traffic along the western diversionary route with the LEZ in place, relative to the Base model. This is due to non-compliant traffic that wishes to travel through the city centre choosing to travel, as anticipated, along the nearest routes to the edge of the LEZ boundary.

Figure 4.4: West End Total Traffic Flow Change Relative to 2023 Base – IP 2023 Original LEZ + ECCT

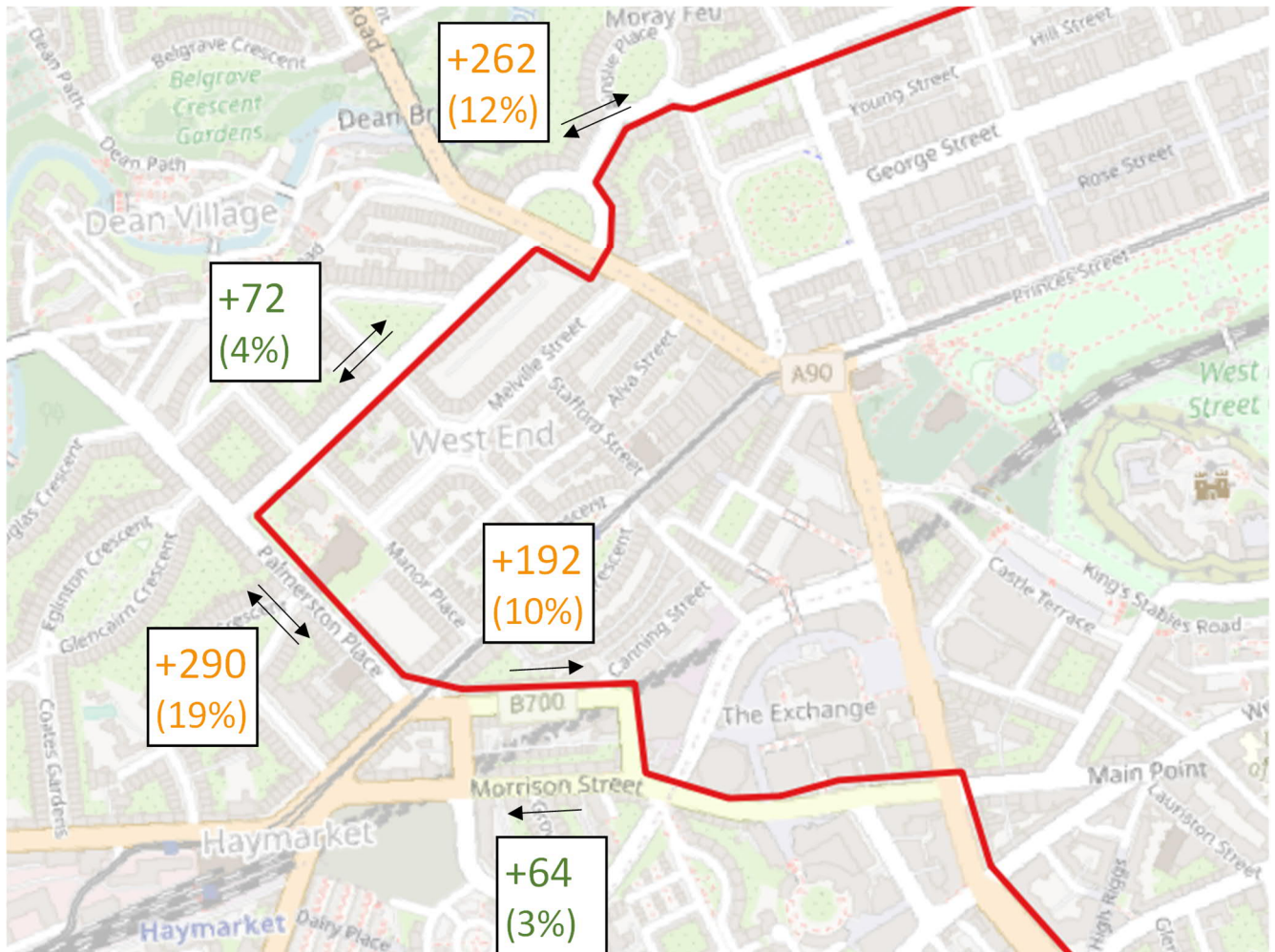


Figure 4.4 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

4.2.3 PM Peak

Figure 4.5 and Figure 4.6 present the change in western diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.5: West End Total Traffic Flow Change Relative to 2019 Base – PM 2019 Original LEZ + ECCT

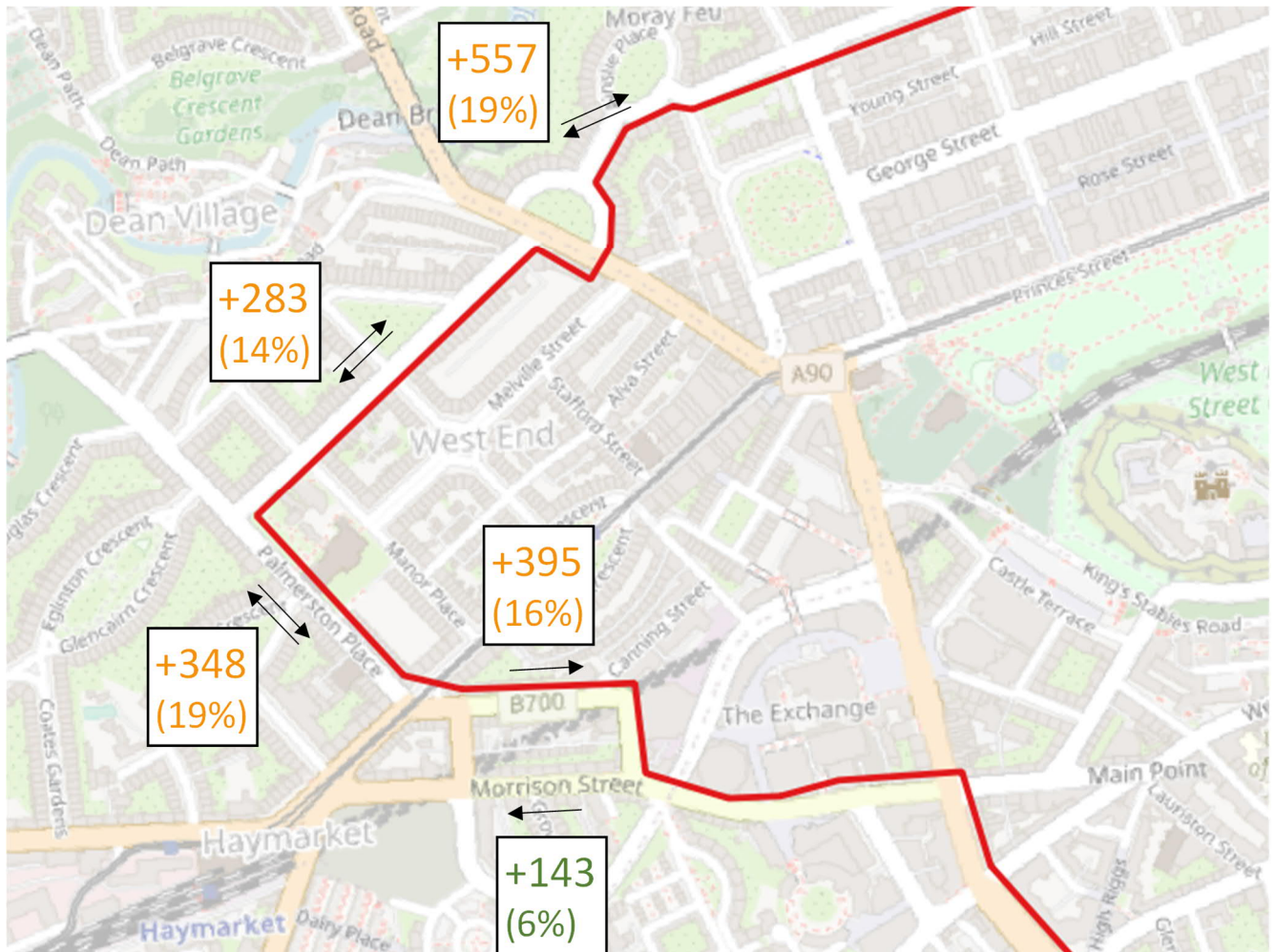


Figure 4.5 above, indicates that, in the 2019 PM peak, the model predicts a significant increase in traffic along the western diversionary route with the LEZ in place, relative to the Base model. This is due to non-compliant traffic that wishes to travel through the city centre choosing to travel, as anticipated, along the nearest routes to the edge of the LEZ boundary.

Figure 4.6: West End Total Traffic Flow Change Relative to 2023 Base – PM 2023 Original LEZ + ECCT

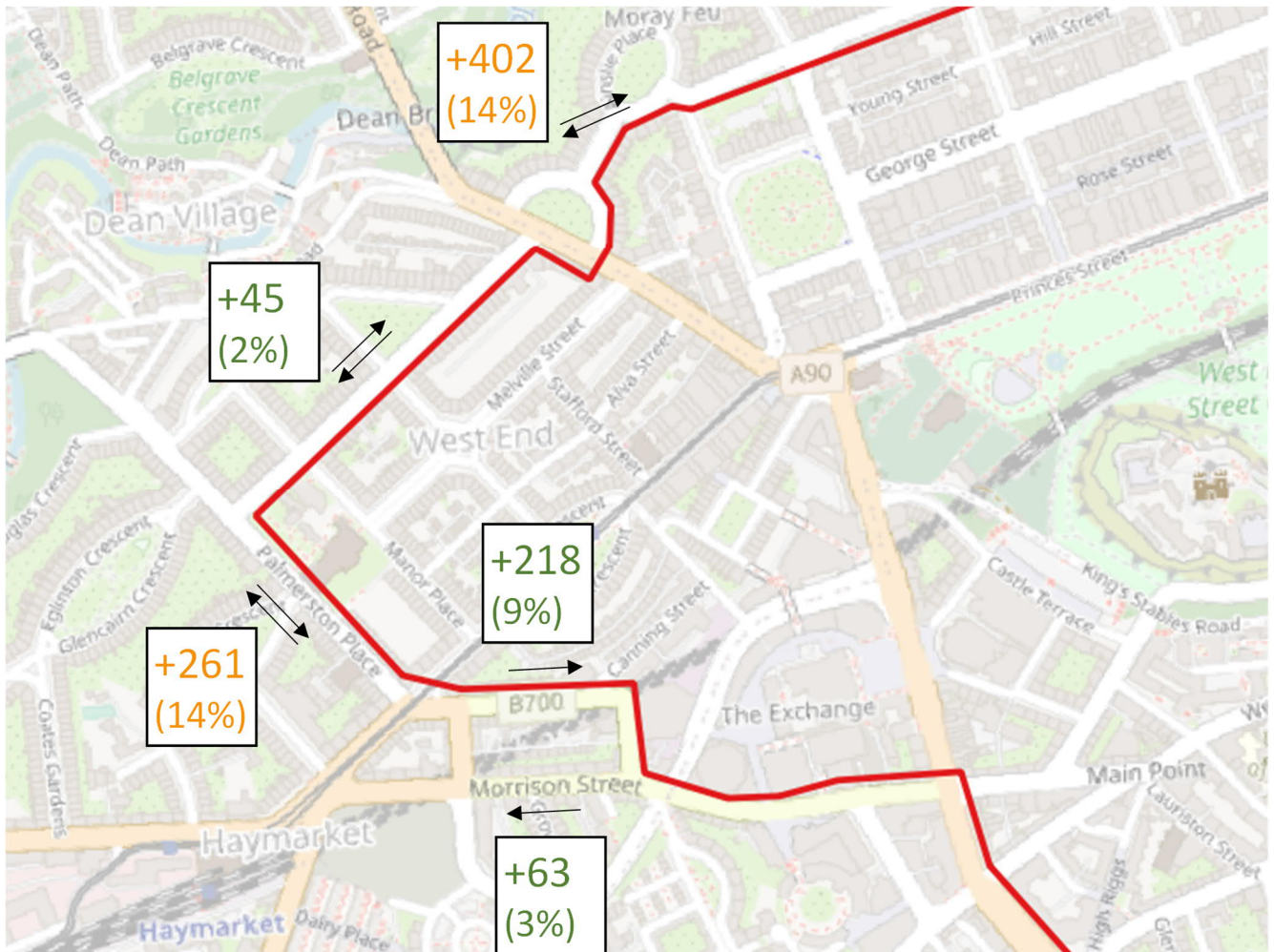


Figure 4.6 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

4.3 East End LEZ Diversion Route

Non-compliant traffic wishing to travel through the city centre is required to use a diversion route including London Road, Abbeyhill, Horse Wynd (Holyrood Palace) and Queen’s Drive.

The changes in total two-way traffic flow and compliance level between the base and scenario models have been assessed in detail along the East End diversion route.

4.3.1 AM Peak

Figure 4.7 and Figure 4.8 present the change in eastern diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.7: East End Total Traffic Flow Change Relative to 2019 Base – AM 2019 Original LEZ + ECCT

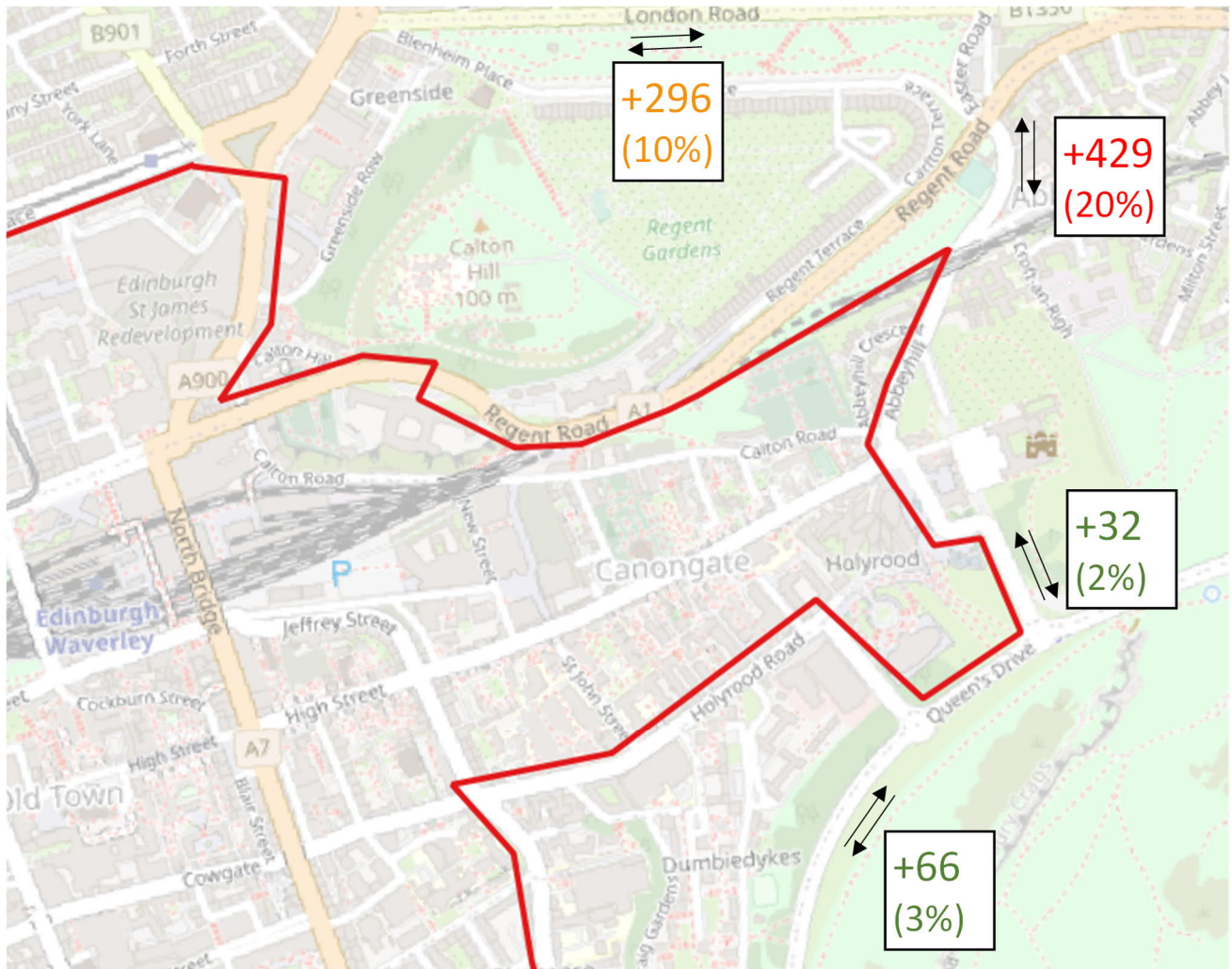


Figure 4.8: East End Total Traffic Flow Change Relative to 2023 Base – AM 2023 Original LEZ + ECCT

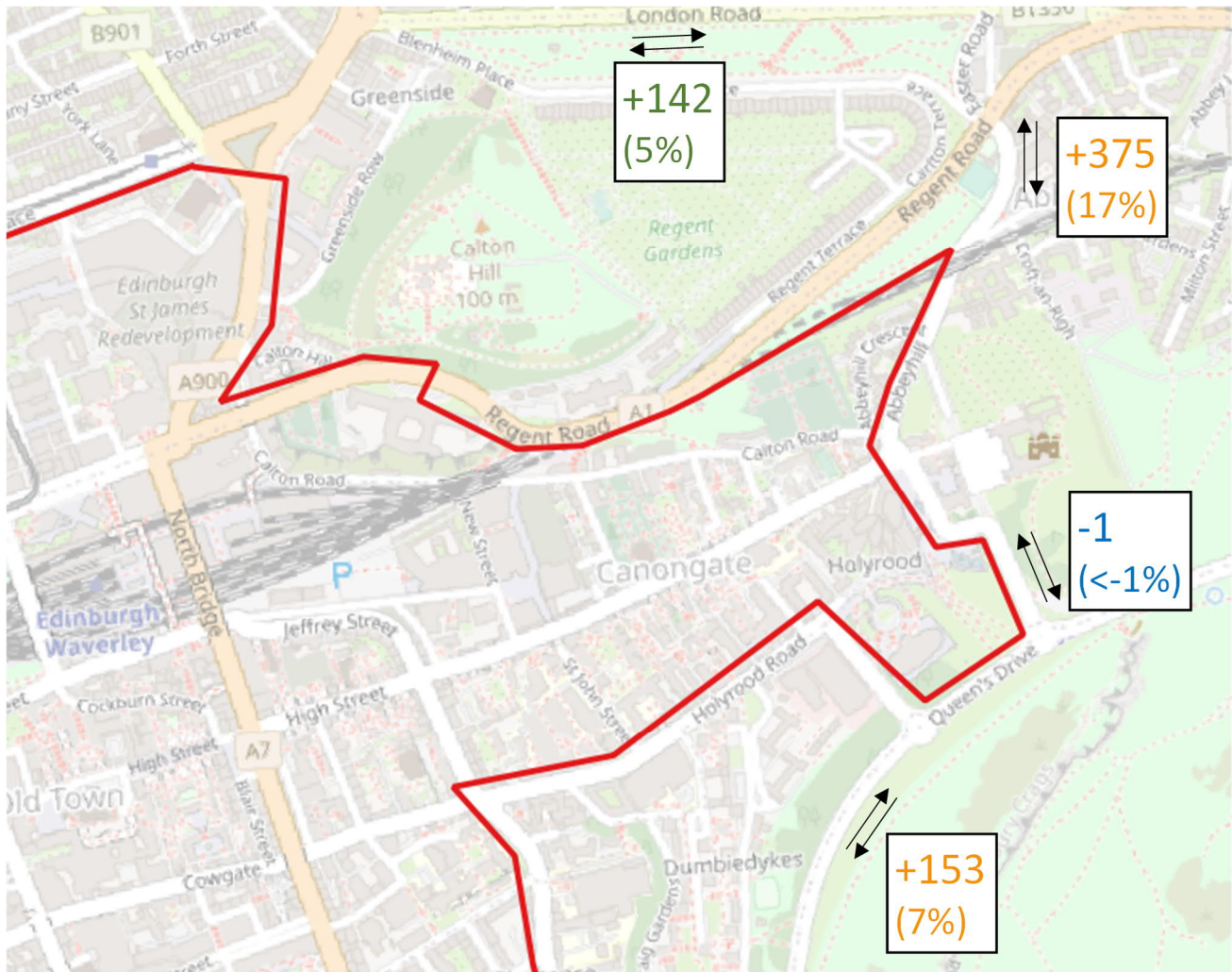


Figure 4.7, above, indicates that, in the 2019 AM peak, the model predicts a significant increase in traffic along the eastern diversionary route with the LEZ in place, relative to the Base model. This is due to non-compliant traffic that wishes to travel through the city centre choosing to travel, as anticipated, along the nearest routes to the edge of the LEZ boundary.

Figure 4.8 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

4.3.2 Inter Peak

Figure 4.9 and Figure 4.10 present the change in eastern diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.9: East End Total Traffic Flow Change Relative to 2019 Base – IP 2019 Original LEZ + ECCT

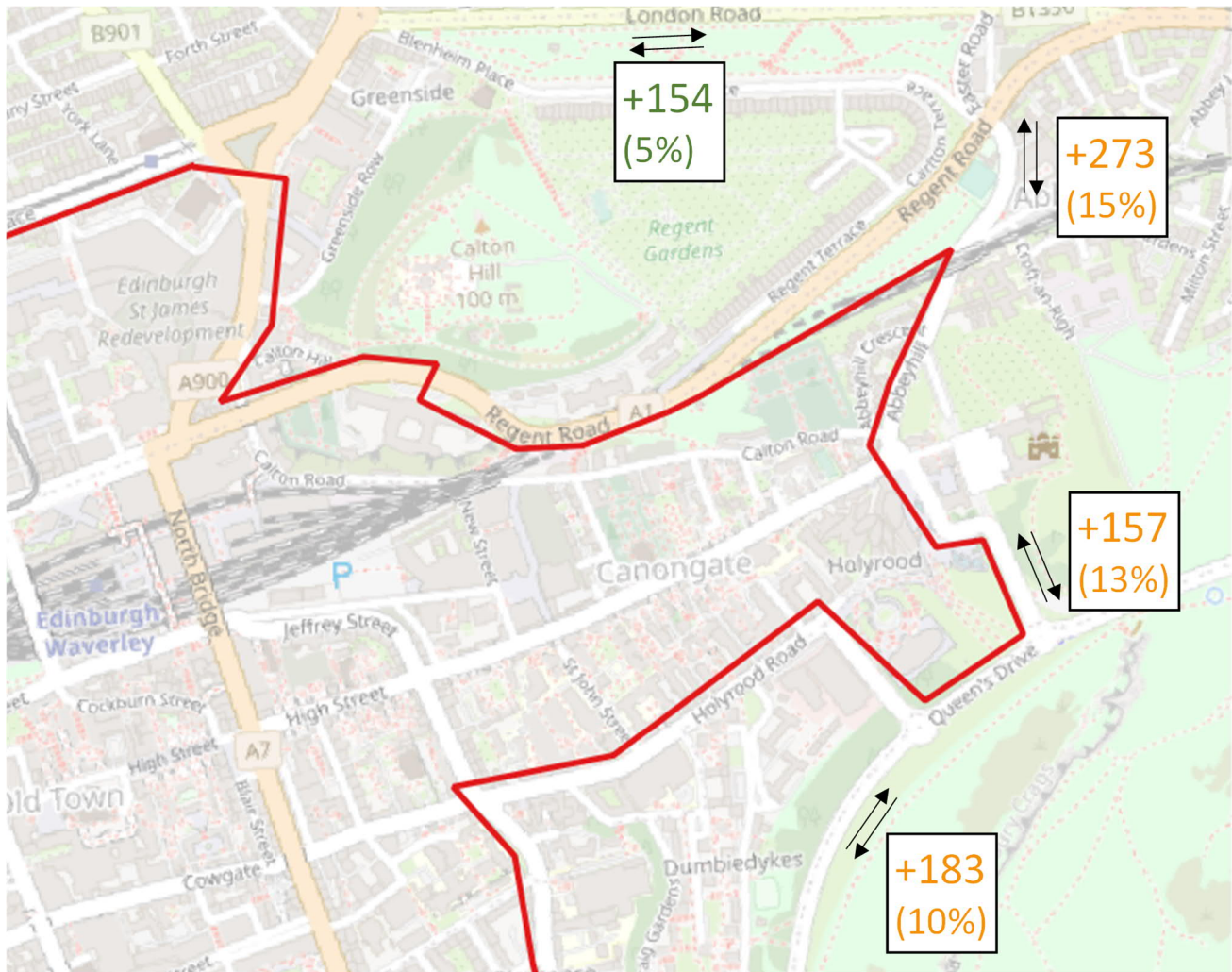


Figure 4.9 indicates that the model predicts an increase in traffic along the eastern diversionary route with the LEZ in place, relative to the Base model. As noted for the AM peak, this is due to non-compliant traffic that wishes to travel through the city centre choosing to travel along the nearest routes to the edge of the LEZ boundary.

Figure 4.10: East End Total Traffic Flow Change Relative to 2023 Base – IP 2023 Original LEZ + ECCT

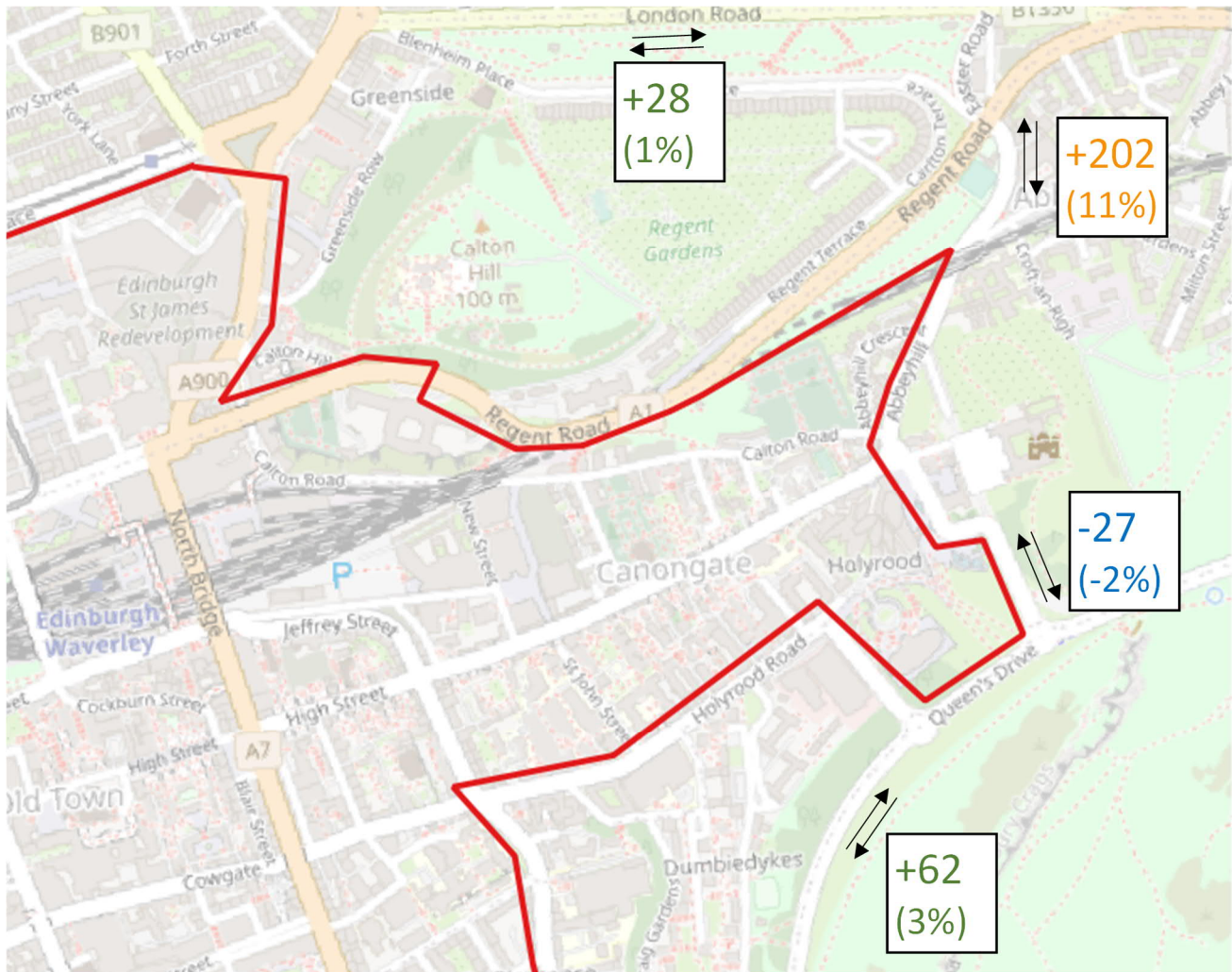


Figure 4.10 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

4.3.3 PM Peak

Figure 4.11 and Figure 4.12 present the change in eastern diversion traffic flows for the original LEZ boundary with ECCT for 2019 and 2023 respectively, relative to their Base models.

Figure 4.11: East End Total Traffic Flow Change Relative to 2019 Base – PM 2019 Original LEZ + ECCT

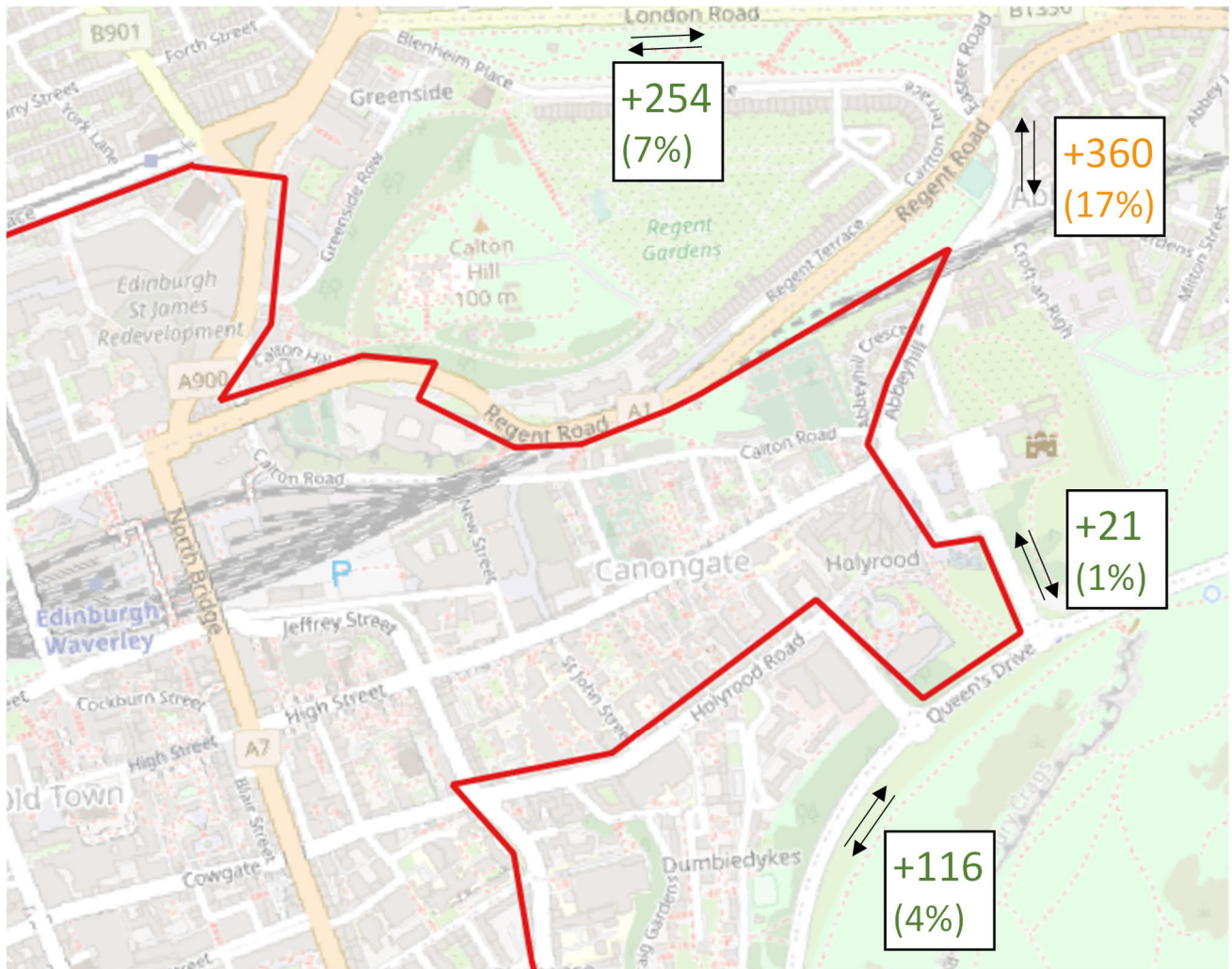


Figure 4.11, above, demonstrates broadly the same pattern of traffic volume changes as noted for the other time periods, i.e. that non-compliant traffic that wishes to travel through the city centre chooses to travel, as anticipated, along the nearest routes to the edge of the LEZ boundary.

Figure 4.12: East End Total Traffic Flow Change Relative to 2023 Base – PM 2023 Original LEZ + ECCT

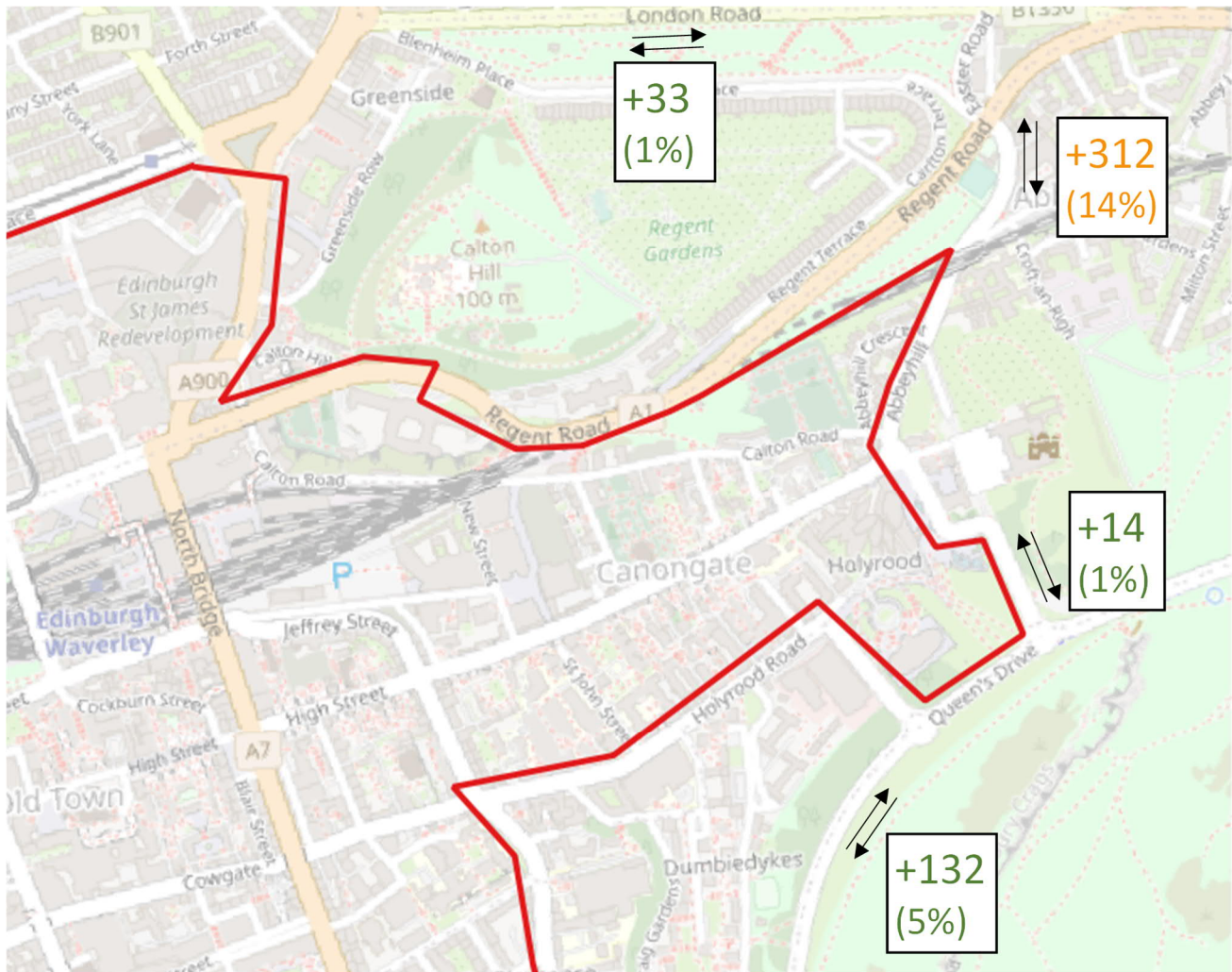


Figure 4.12 demonstrates that the increase in traffic flow observed in the 2019 data is slightly reduced in 2023, so that a smaller increase is observed on the diversionary links relative to the Base model.

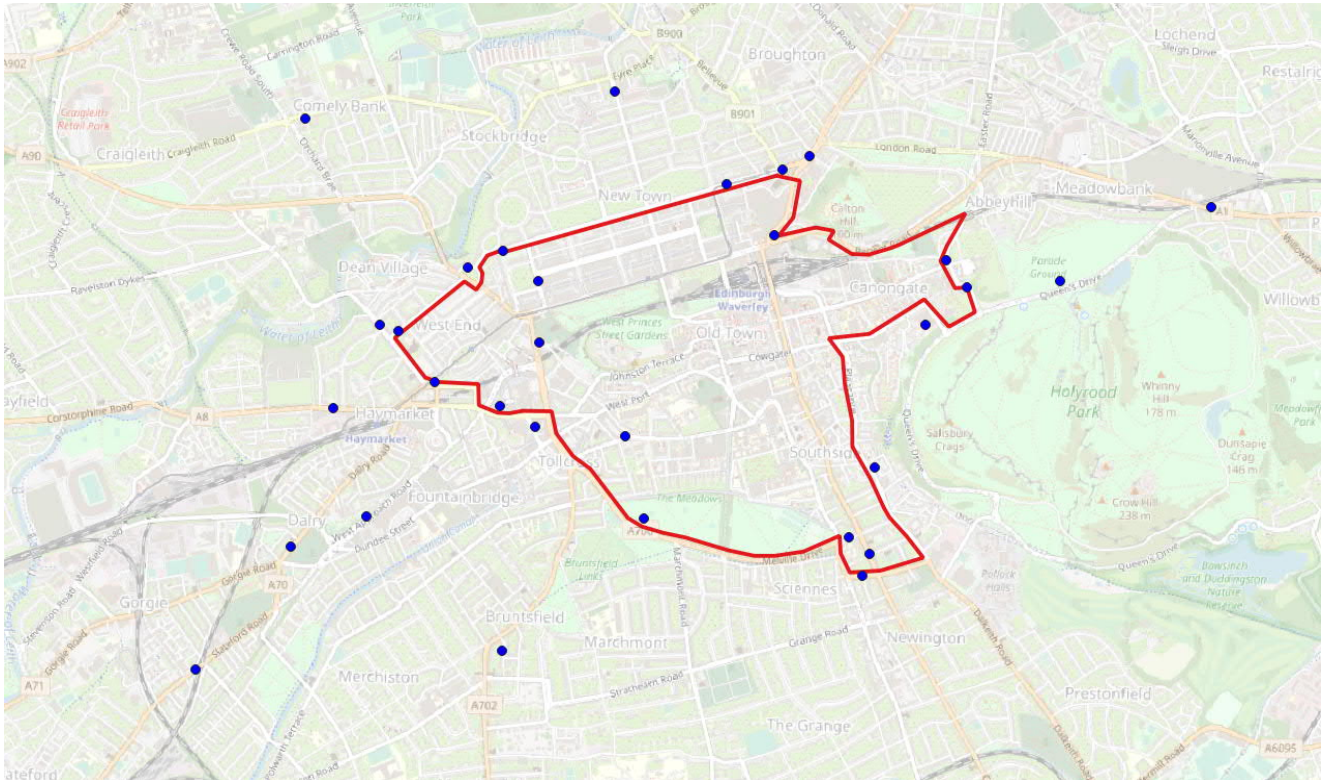
4.4 Key Links

In addition to reviewing the diversion routes, the traffic flows and compliance levels have been assessed for 20 key roads around central Edinburgh, in order to give a broader overview of how the traffic flows and compliance rates change in Edinburgh as a result of the LEZ.

The majority of the 20 key links referenced in this section were also used in the previous 2019 LEZ modelling task undertaken by Jacobs, and so, for consistency, these routes have also been used for this modelling exercise.

The LEZ boundary and key assessment links are illustrated in Figure 4.13.

Figure 4.13: LEZ Boundary and Key Assessment Links



4.4.1 AM Peak

Two-way AM compliant and non-compliant flows by link are summarised for the original LEZ boundary with ECCT option for 2019 and 2023 respectively in Table 4.1 and Table 4.2 below.

Table 4.1: Two-way Traffic Flow – AM 2019, Original LEZ + ECCT

2019 AM		Two-way traffic flow in vehicles (07:00-09:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	1,210	923	2,133	-88	+210	+122	57%	43%
2	Palmerston Place	2,654	1,204	3,858	+160	-183	-23	69%	31%
3	Great Stuart Street	1,648	23	1,671	+444	-636	-192	99%	1%
4	York Place	2,025	583	2,608	+656	-212	+444	78%	22%
5	Dundas Street	1,282	248	1,530	-19	-504	-523	84%	16%
6	Leith Walk	2,674	835	3,509	+483	-410	+73	76%	24%
7	London Road	1,564	674	2,238	+171	-49	+122	70%	30%
8	Queen's Drive	1,493	386	1,879	+452	-217	+235	79%	21%
9	South Clerk Street	1,413	0	1,413	+417	-545	-128	100%	0%
10	Melville Drive	1,761	849	2,610	+87	-64	+23	67%	33%
11	Lothian Road	3,220	340	3,560	+1185	-764	+421	90%	10%
12	Bruntsfield Place	1,825	498	2,323	+219	-343	-124	79%	21%
13	West Approach Road	3,131	387	3,518	+713	-942	-229	89%	11%
14	Charlotte Square	3,033	3	3,036	+1156	-1045	+111	99%	1%
15	Morrison Street	2,631	833	3,464	+742	-252	+490	76%	24%
16	Randolph Crescent	993	488	1,481	+182	+1	+183	67%	33%
17	Leith Street	2,214	7	2,221	+834	-744	+90	99%	1%
18	Pleasance	1,881	154	2,035	+667	-524	+143	92%	8%
19	Hope Park Terrace	1,051	0	1,051	+301	-427	-126	100%	0%
20	West Preston Street	466	829	1,295	-324	+418	+94	36%	64%

The above demonstrates that the non-compliant traffic flows are lower with the LEZ boundary in place on a significant number of key roads within and surrounding Edinburgh city centre.

Compliance within the city centre is very high, with South Clerk Street and Hope Park Terrace demonstrating 100% compliance. The model uses a 'cost' factor at the entry points to the LEZ for non-compliant vehicles (to replicate the effect of a financial charge). This high perceived 'cost' to non-compliant vehicles deters the vast majority (or all) of them from entering the LEZ, therefore the majority of links within the LEZ experience 100% compliance (or close to it).

The lowest compliance observed in Table 4.1 is on West Preston Street with 36% compliance, followed by Dalry Road with 57% compliance. These compliance levels are to be expected (in 2019) on these roads, as they are located just outside the LEZ boundary and, therefore, they are anticipated to experience an increase in non-compliant traffic when the LEZ is implemented.

Table 4.2: Two-way Traffic Flow – AM 2023, Original LEZ + ECCT

2023 AM		Two-way traffic flow in vehicles (07:00-09:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	1,784	292	2,076	+2	+74	+76	86%	14%
2	Palmerston Place	3,503	371	3,874	+41	-57	-16	90%	10%
3	Great Stuart Street	1,693	5	1,698	+41	-197	-156	100%	0%
4	York Place	2,402	182	2,584	+474	-60	+414	93%	7%
5	Dundas Street	1,500	79	1,579	-332	-153	-485	95%	5%
6	Leith Walk	3,152	247	3,399	+104	-131	-27	93%	7%
7	London Road	1,986	203	2,189	+95	-17	+78	91%	9%
8	Queen's Drive	1,539	119	1,658	+71	-61	+10	93%	7%
9	South Clerk Street	1,469	0	1,469	+94	-168	-74	100%	0%
10	Melville Drive	2,374	280	2,654	+67	0	+67	89%	11%
11	Lothian Road	3,456	111	3,567	+652	-227	+425	97%	3%
12	Bruntsfield Place	2,211	156	2,367	+16	-102	-86	93%	7%
13	West Approach Road	3,516	119	3,635	+223	-285	-62	97%	3%
14	Charlotte Square	3,297	1	3,298	+677	-320	+357	99%	1%
15	Morrison Street	3,182	247	3,429	+542	-83	+459	93%	7%
16	Randolph Crescent	1,196	153	1,349	+47	+3	+50	89%	11%
17	Leith Street	2,407	2	2,409	+509	-227	+282	99%	1%
18	Pleasance	1,809	45	1,854	+150	-161	-11	98%	2%
19	Hope Park Terrace	1,086	0	1,086	+33	-130	-97	100%	0%
20	West Preston Street	923	249	1,172	-178	+119	-59	79%	21%

By 2023, the overall vehicle fleet will be significantly cleaner, and this is reflected in Table 4.2 above. Compliance within the city centre is extremely high, with several links indicating over 99% compliance.

As seen in the 2019 data, the lowest compliance expected in 2023 is on West Preston Street, however, at 79%, this is a much higher compliance level than in 2019. The compliance on Dalry Road has increased to 86%, up 29 percentage points from 2019.

4.4.2 Inter Peak

Two-way IP compliant and non-compliant flows by link are summarised for the original LEZ boundary with ECCT scenario for 2019 and 2023 respectively in Table 4.3 and 4.4 below.

Table 4.3: Two-way Traffic Flow – IP 2019, Original LEZ + ECCT

2019 IP		Two-way traffic flow in vehicles (10:00-12:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	876	574	1,450	-6	+50	+44	60%	40%
2	Palmerston Place	2,020	917	2,937	+136	-164	-28	69%	31%
3	Great Stuart Street	1,339	11	1,350	+346	-557	-211	99%	1%
4	York Place	2,486	512	2,998	+899	-462	+437	83%	17%
5	Dundas Street	1,367	204	1,571	+227	-477	-250	87%	13%
6	Leith Walk	2,962	990	3,952	+505	-504	+1	75%	25%
7	London Road	1,190	591	1,781	+119	-41	+78	67%	33%
8	Queen's Drive	1,624	319	1,943	+398	-367	+31	84%	16%
9	South Clerk Street	1,301	1	1,302	+494	-476	+18	100%	0%
10	Melville Drive	1,973	744	2,717	+347	-190	+157	73%	27%
11	Lothian Road	3,339	337	3,676	+1445	-808	+637	91%	9%
12	Bruntsfield Place	1,461	392	1,853	+263	-320	-57	79%	21%
13	West Approach Road	2,396	225	2,621	+727	-768	-41	91%	9%
14	Charlotte Square	3,036	2	3,038	+1357	-1022	+335	100%	0%
15	Morrison Street	3,663	989	4,652	+1032	-617	+415	79%	21%
16	Randolph Crescent	733	427	1,160	+28	+8	+36	63%	37%
17	Leith Street	2,672	9	2,681	+1019	-951	+68	100%	0%
18	Pleasance	1,087	81	1,168	+304	-396	-92	93%	7%
19	Hope Park Terrace	1,354	0	1,354	+471	-519	-48	100%	0%
20	West Preston Street	437	666	1,103	-247	+304	+57	40%	60%

The above demonstrates that the non-compliant traffic flows are lower with the LEZ boundary in place on a significant number of key roads within and surrounding Edinburgh city centre.

Compliance within the city centre is very high, with several links demonstrating 100% compliance, as noted (and explained) in the AM peak analysis.

Similar to the AM peak, West Preston Street and Dalry Road indicate the lowest compliance levels of the key assessment links, with 40% and 60% respectively for 2019 in the inter-peak.

Table 4.4: Two-way Traffic Flow – IP 2023, Original LEZ + ECCT

2023 IP		Two-way traffic flow in vehicles (10:00-12:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	1,228	179	1,407	-27	+19	-8	87%	13%
2	Palmerston Place	2,658	280	2,938	+17	-48	-31	90%	10%
3	Great Stuart Street	1,436	3	1,439	+43	-168	-125	100%	0%
4	York Place	2,811	159	2,970	+533	-134	+399	95%	5%
5	Dundas Street	1,492	58	1,550	-118	-152	-270	96%	4%
6	Leith Walk	3,576	299	3,875	+71	-152	-81	92%	8%
7	London Road	1,533	171	1,704	+18	-18	0	90%	10%
8	Queen's Drive	1,801	96	1,897	+83	-111	-28	95%	5%
9	South Clerk Street	1,291	0	1,291	+145	-144	+1	100%	0%
10	Melville Drive	2,467	237	2,704	+192	-49	+143	91%	9%
11	Lothian Road	3,475	100	3,575	+788	-248	+540	97%	3%
12	Bruntsfield Place	1,753	121	1,874	+64	-93	-29	94%	6%
13	West Approach Road	2,558	69	2,627	+216	-234	-18	97%	3%
14	Charlotte Square	3,213	0	3,213	+825	-313	+512	100%	0%
15	Morrison Street	4,344	299	4,643	+580	-187	+393	94%	6%
16	Randolph Crescent	1,028	134	1,162	+31	+6	+37	88%	12%
17	Leith Street	2,810	2	2,812	+489	-285	+204	100%	0%
18	Pleasance	1,187	20	1,207	+73	-123	-50	98%	2%
19	Hope Park Terrace	1,416	0	1,416	+188	-156	+32	100%	0%
20	West Preston Street	787	201	988	-159	+89	-70	80%	20%

By 2023, the overall vehicle fleet will be significantly cleaner, and this is reflected in Table 4.4 above. Compliance within the city centre is extremely high, with several links indicating over 99% compliance. All key assessment links demonstrate a significant increase in compliance.

4.4.3 PM Peak

Two-way PM compliant and non-compliant flows by link are summarised the original LEZ boundary with ECCT for 2019 and 2023 respectively in Table 4.5 and 4.6 below.

Table 4.5: Two-way Traffic Flow – PM 2019, Original LEZ + ECCT

2019 PM		Two-way traffic flow in vehicles (16:00-18:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	965	736	1,701	-65	+212	+147	57%	43%
2	Palmerston Place	2,761	1,305	4,066	+82	-55	+27	68%	32%
3	Great Stuart Street	1,326	40	1,366	+274	-511	-237	97%	3%
4	York Place	2,183	659	2,842	+456	-253	+203	77%	23%
5	Dundas Street	1,610	248	1,858	+176	-496	-320	87%	13%
6	Leith Walk	2,813	927	3,740	+342	-386	-44	75%	25%
7	London Road	1,510	615	2,125	+43	-145	-102	71%	29%
8	Queen's Drive	1,973	463	2,436	+486	-340	+146	81%	19%
9	South Clerk Street	1,499	5	1,504	+513	-520	-7	100%	0%
10	Melville Drive	2,498	991	3,489	+310	-167	+143	72%	28%
11	Lothian Road	3,547	381	3,928	+1290	-818	+472	90%	10%
12	Bruntsfield Place	1,973	440	2,413	+287	-422	-135	82%	18%
13	West Approach Road	3,445	452	3,897	+678	-1005	-327	88%	12%
14	Charlotte Square	2,946	8	2,954	+1097	-973	+124	100%	0%
15	Morrison Street	3,520	927	4,447	+657	-591	+66	79%	21%
16	Randolph Crescent	753	509	1,262	-11	+106	+95	60%	40%
17	Leith Street	2,537	39	2,576	+704	-932	-228	98%	2%
18	Pleasance	1,708	69	1,777	+556	-526	+30	96%	4%
19	Hope Park Terrace	1,565	3	1,568	+470	-562	-92	100%	0%
20	West Preston Street	595	941	1,536	-311	+445	+134	39%	61%

The above demonstrates that the non-compliant traffic flows are lower with the LEZ boundary in place on a significant number of key roads within and surrounding Edinburgh city centre.

As seen in the other time periods, compliance within the city centre is very high, with South Clerk Street and Hope Park Terrace demonstrating 100% compliance.

Similar to the other time periods, West Preston Street and Dalry Road indicate the lowest compliance levels of the key assessment links, with 39% and 57% respectively for 2019 in the PM peak.

Table 4.6: Two-way Traffic Flow – AM 2023, Original LEZ + ECCT

2023 PM		Two-way traffic flow in vehicles (16:00-18:00)							
ID	Description	Total Compliant	Total Non-Compliant	All Vehicles	Compliant vs Base	Non-Compliant vs Base	Total vs Base	Compliant %	Non-Compliant %
1	Dalry Road	1,425	235	1,660	+40	+75	+115	86%	14%
2	Palmerston Place	3,621	399	4,020	-1	-22	-23	90%	10%
3	Great Stuart Street	1,379	11	1,390	-57	-160	-217	99%	1%
4	York Place	2,610	202	2,812	+249	-79	+170	93%	7%
5	Dundas Street	1,809	82	1,891	-165	-151	-316	96%	4%
6	Leith Walk	3,355	276	3,631	-31	-130	-161	92%	8%
7	London Road	1,915	188	2,103	-74	-47	-121	91%	9%
8	Queen's Drive	2,163	139	2,302	+128	-109	+19	94%	6%
9	South Clerk Street	1,464	1	1,465	+145	-158	-13	100%	0%
10	Melville Drive	3,214	315	3,529	+227	-43	+184	91%	9%
11	Lothian Road	3,807	124	3,931	+735	-244	+491	97%	3%
12	Bruntsfield Place	2,338	138	2,476	+57	-130	-73	94%	6%
13	West Approach Road	3,861	133	3,994	+78	-321	-243	97%	3%
14	Charlotte Square	3,144	2	3,146	+632	-299	+333	100%	0%
15	Morrison Street	4,171	277	4,448	+268	-190	+78	94%	6%
16	Randolph Crescent	985	161	1,146	-60	+37	-23	86%	14%
17	Leith Street	2,727	11	2,738	+216	-295	-79	100%	0%
18	Pleasance	1,750	19	1,769	+170	-163	+7	99%	1%
19	Hope Park Terrace	1,612	1	1,613	+140	-172	-32	100%	0%
20	West Preston Street	1,130	288	1,418	-110	+134	+24	80%	20%

By 2023, the overall vehicle fleet will be significantly cleaner, and this is reflected in Table 4.6 above. Compliance within the city centre is extremely high, with several links indicating over 99% compliance. All key assessment links demonstrate a significant increase in compliance.

Whilst the tables in this section indicate the anticipated flow changes in each assessment year, in reality changes in travel patterns take time to settle down, rather than overnight, as drivers take time to determine their optimum route. This means that following the implementation of the LEZ, one would not necessarily expect to immediately see the changes described in the above tables, rather these flow changes are likely to occur over a period of weeks/months following LEZ implementation.

When viewing the above tables, it is important to place the changes in traffic flows in context; in the real world, as schemes are approved and constructed, traffic flows on these links will inevitably change. However, the numbers reported in these tables purely capture the effect of the LEZ.

4.5 Compliance by Diversion Street and Assessment Year

Figures 4.14 to 4.16 summarise total vehicle compliance by link for each scenario. They show how the number of compliant vehicles varies and the overall improvement over time.

By 2023, the number of vehicles which do not meet LEZ requirements is lower than in the Base across all links analysed, even though many of these lie on or close the LEZ boundary.

Graphs also highlight the positive impact on compliance through Palmerston Place, Randolph Crescent and Great Stuart Street resulting from the Revised LEZ boundary via Charlotte Square.

Figure 4.14: AM comparison of compliant and non-compliant vehicles by diversion street and assessment year

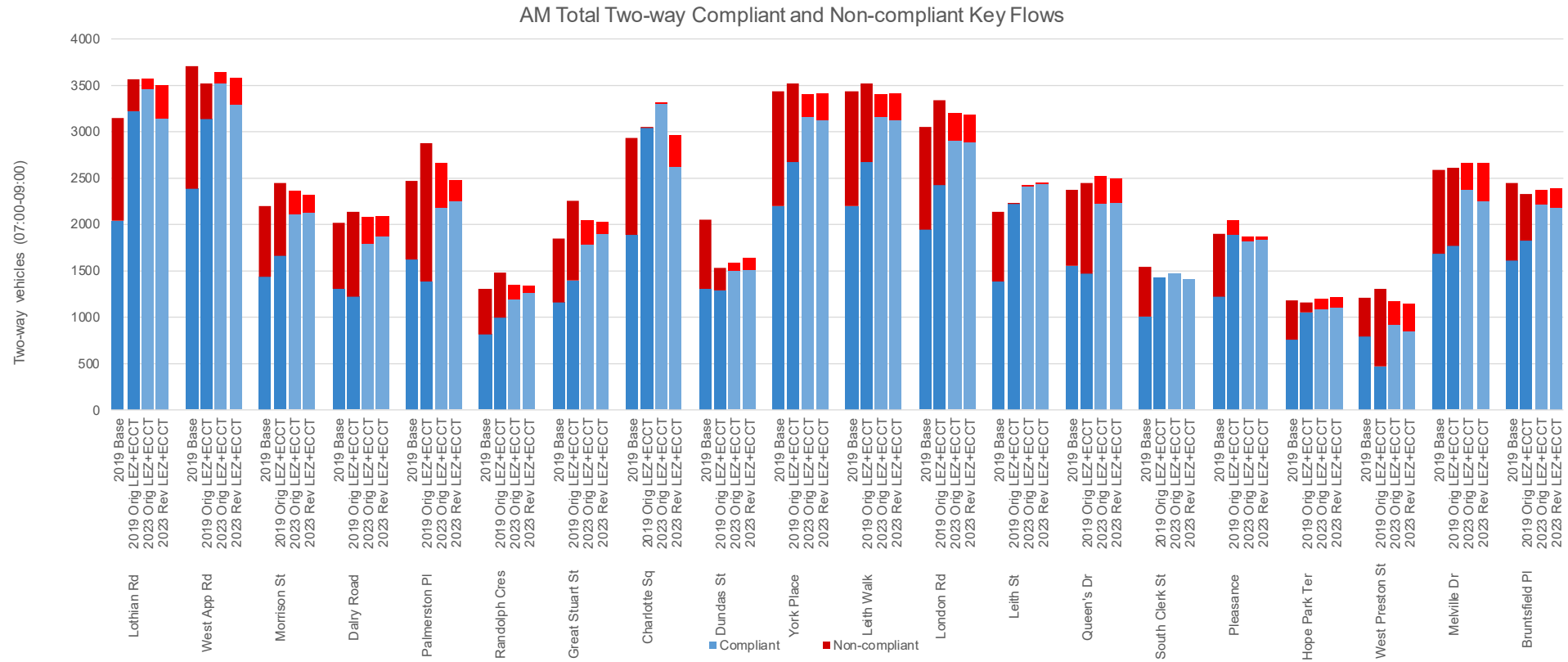


Figure 4.15: IP comparison of compliant and non-compliant vehicles by diversion street and assessment year

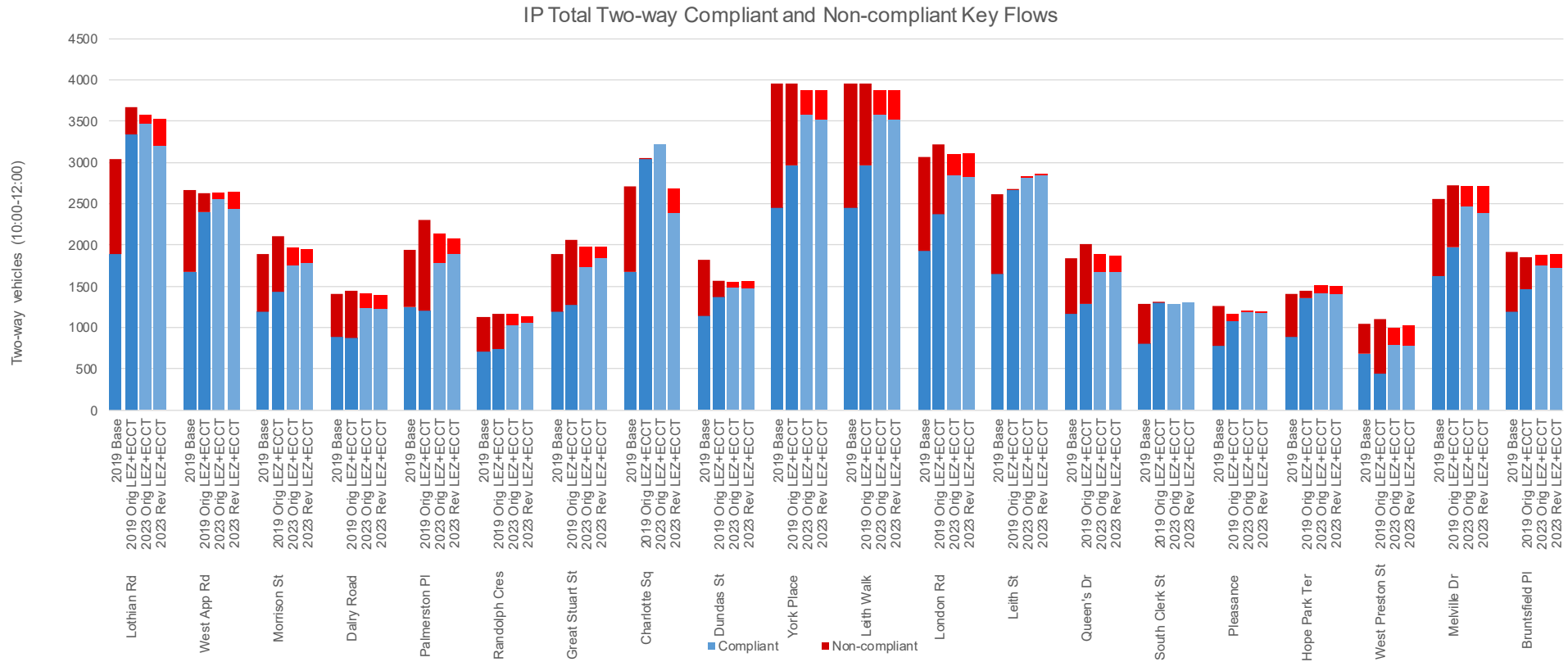
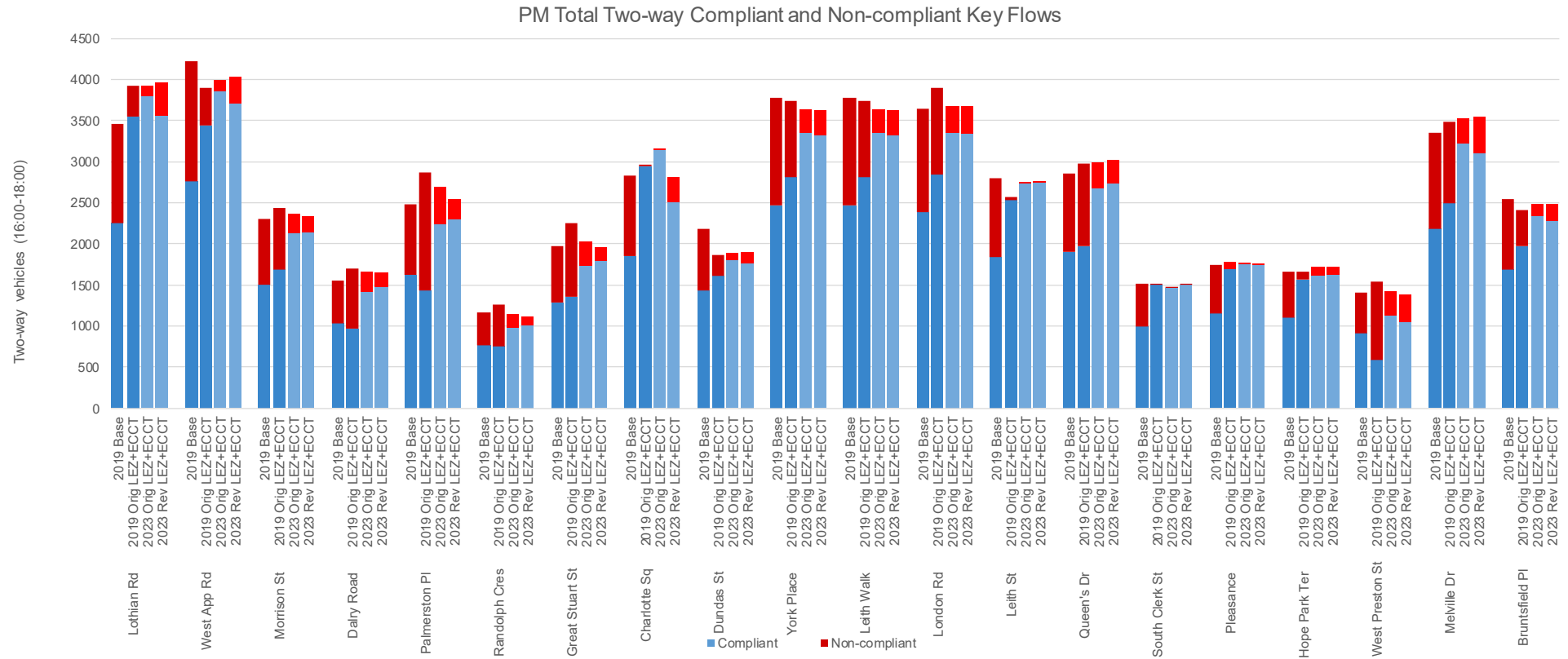


Figure 4.16: PM comparison of compliant and non-compliant vehicles by diversion street and assessment year



4.6 Assignment Summary Plots

Figure 4.17 to Figure 4.24 below illustrate link flows for the Base and Scenario models, in the morning and evening peaks. Compliant vehicles are shown in Blue, non-compliant vehicles are shown in Red.

The general pattern by time period is similar and the assignment; however, the 2023 forecast year plots highlight the significant reduction in non-compliant vehicles across the network.

The impact of the revised LEZ boundary (via Lothian Road and South Charlotte Street) with 2019 compliance rates is shown in Figure 4.25 and 4.26 for the morning and evening peaks respectively. Figures 4.27 and 4.28 highlight the reduced levels of diverted traffic resulting from 2023 vehicle compliance.

Figure 4.17: AM (07:00-09:00) Original LEZ (no ECCT) – 2016 traffic volumes and 2019 fleet composition

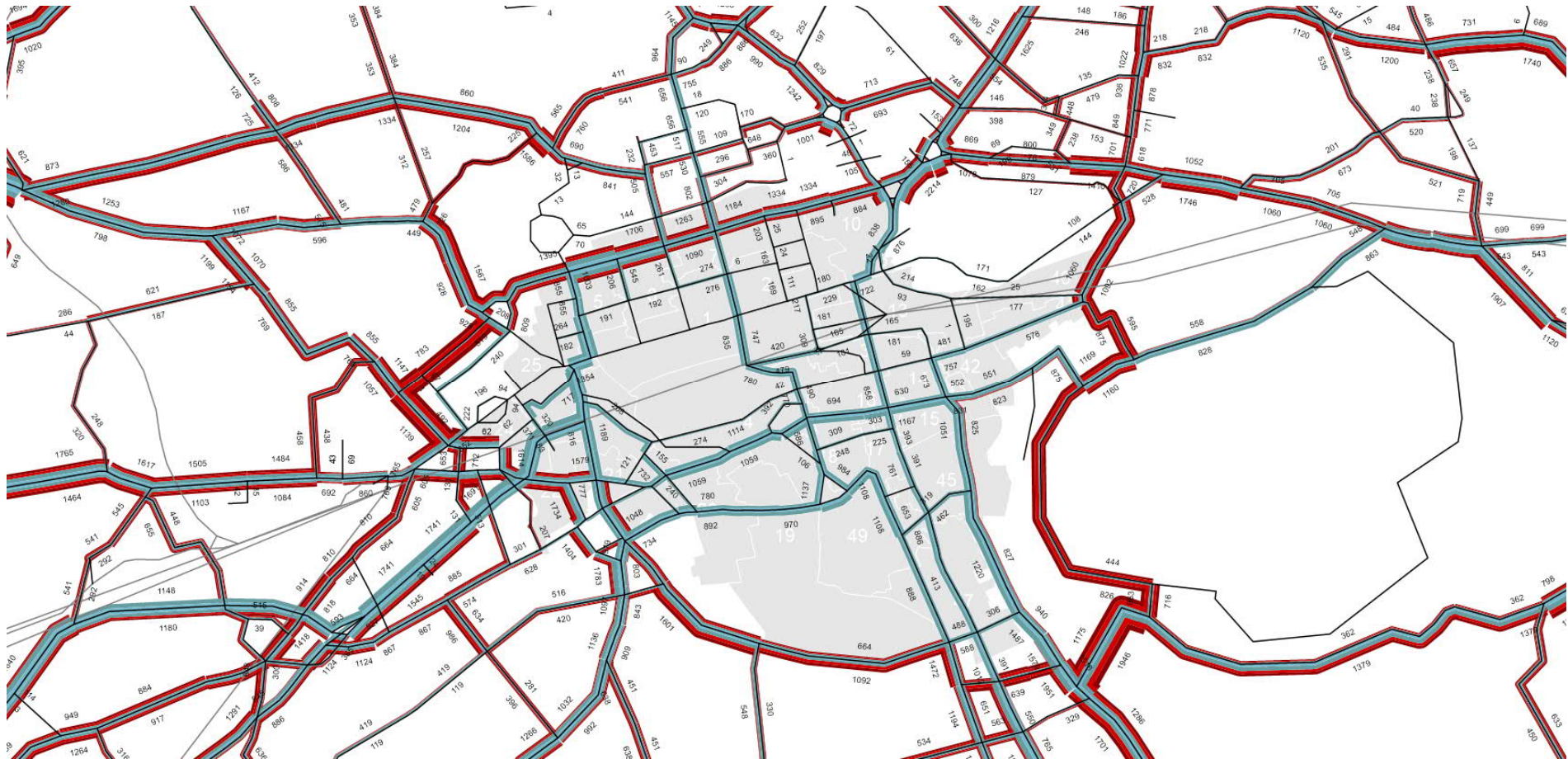


Figure 4.18: AM (07:00-09:00) Original LEZ + ECCT – 2016 traffic volumes and 2019 fleet composition



Figure 4.19: PM (16:00-18:00) Original LEZ (no ECCT) – 2016 traffic volumes and 2019 fleet composition

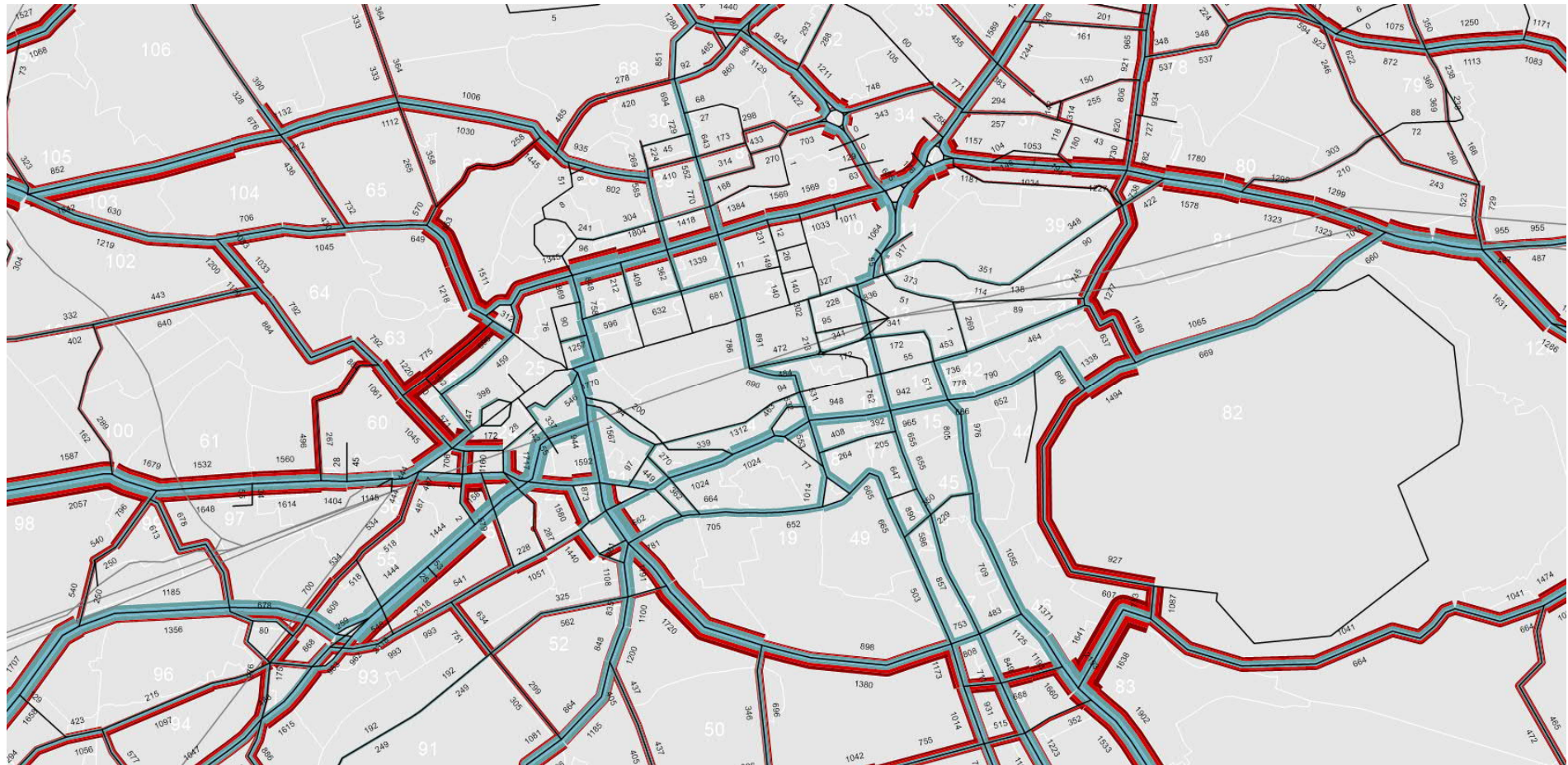


Figure 4.20: PM (16:00-18:00) Original LEZ + ECCT – 2016 traffic volumes and 2019 fleet composition

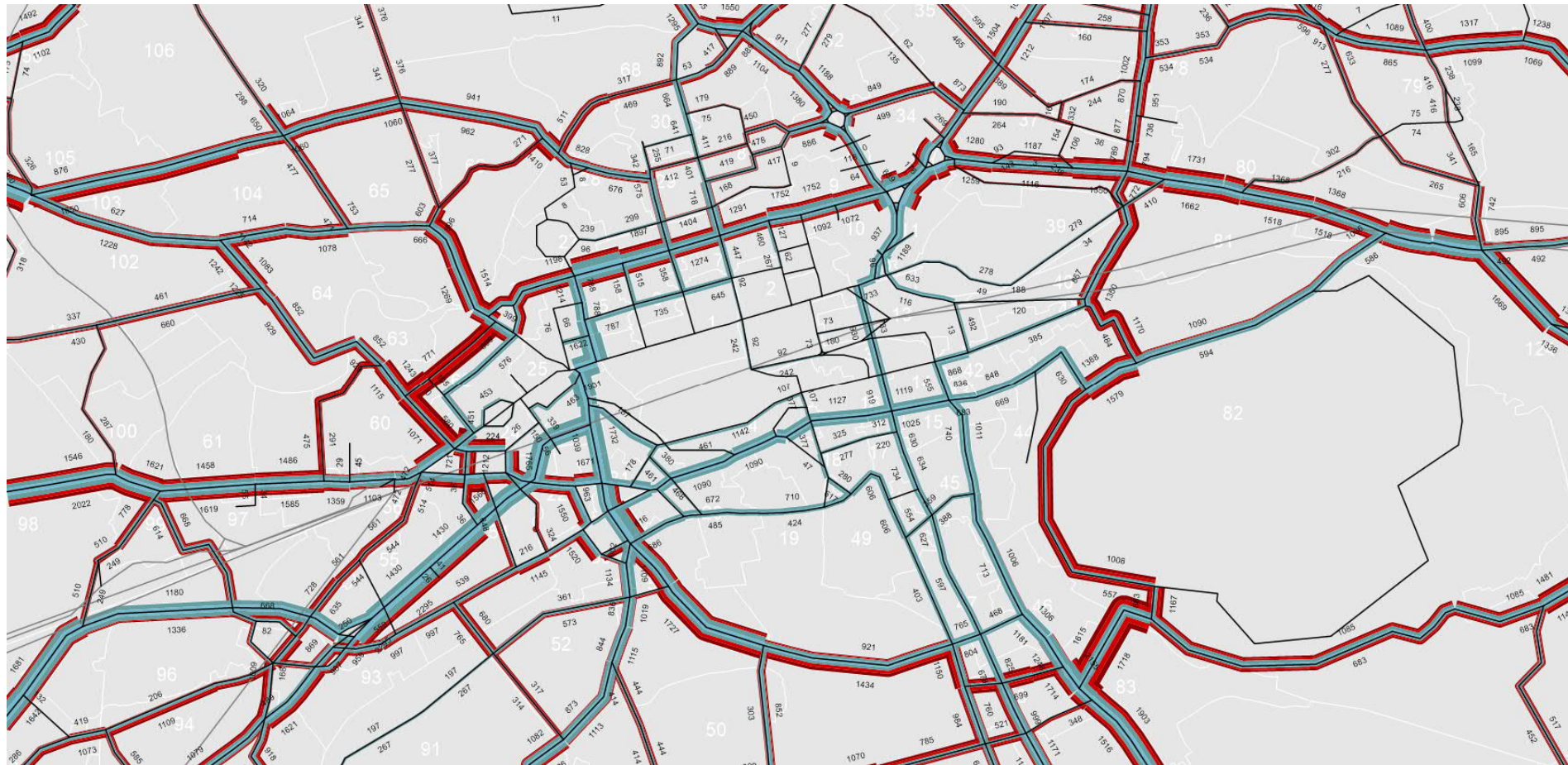


Figure 4.21: AM (07:00-09:00) Original LEZ (no ECCT) – 2016 traffic volumes, 2023 fleet composition



Figure 4.22: AM (07:00-09:00) Original LEZ + ECCT – 2016 traffic volumes, 2023 fleet composition



Figure 4.23: PM (16:00-18:00) Original LEZ (no ECCT) – 2016 traffic volumes, 2023 fleet composition

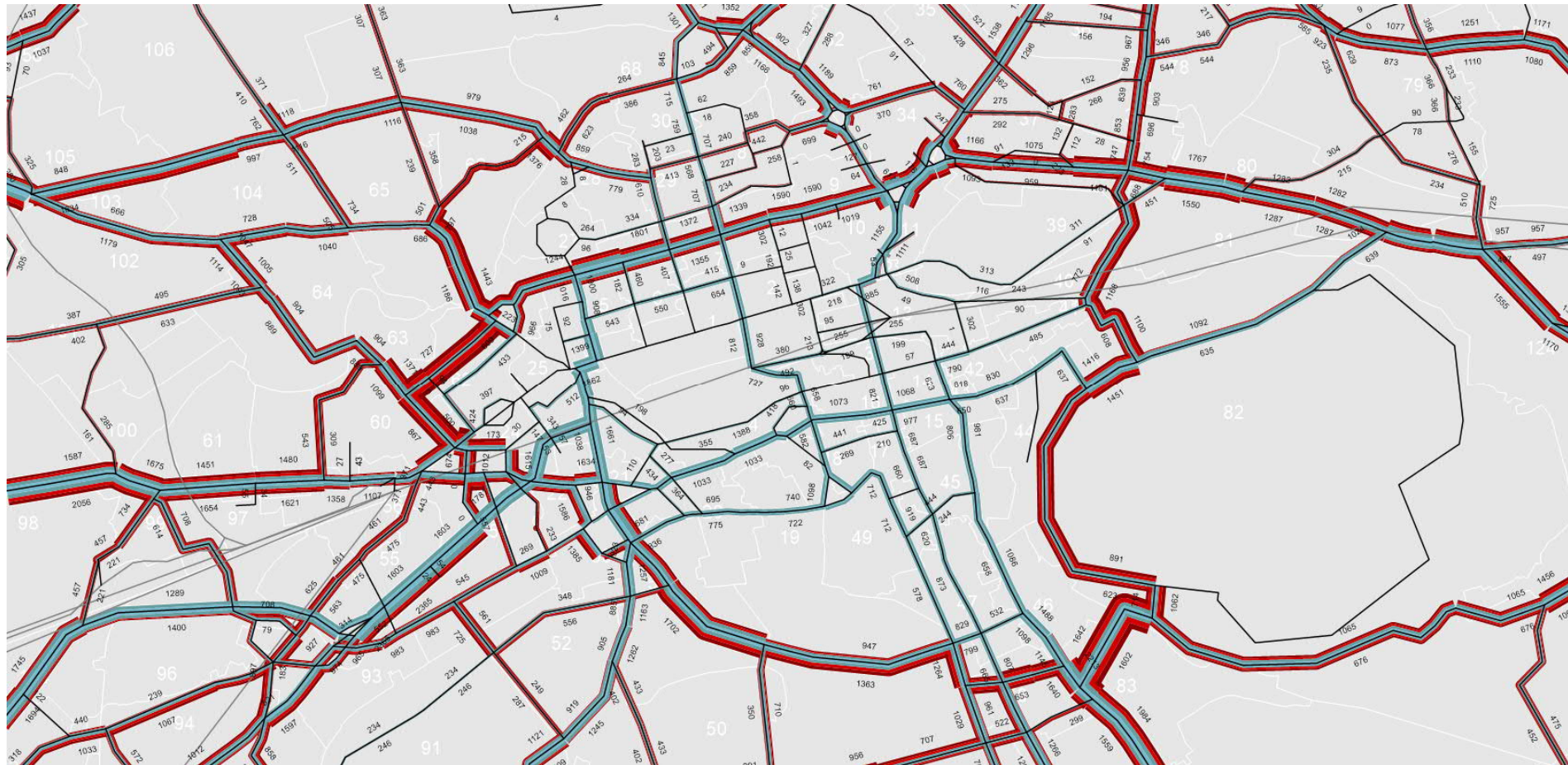


Figure 4.24: PM (16:00-18:00) Original LEZ + ECCT – 2016 traffic volumes, 2023 fleet composition

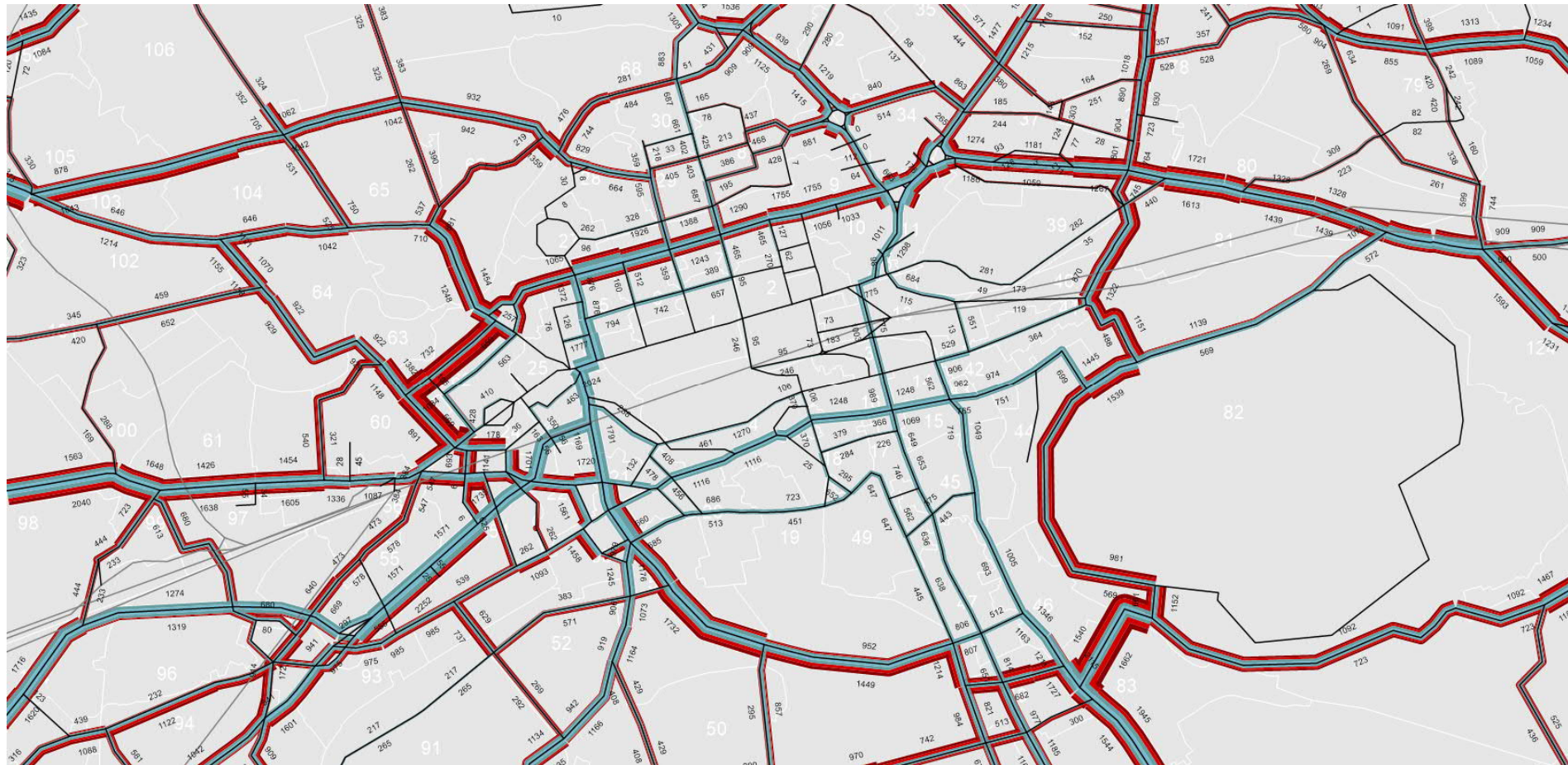


Figure 4.25: AM (08:00-09:00) Revised LEZ + ECCT – 2016 traffic volumes, 2019 fleet composition

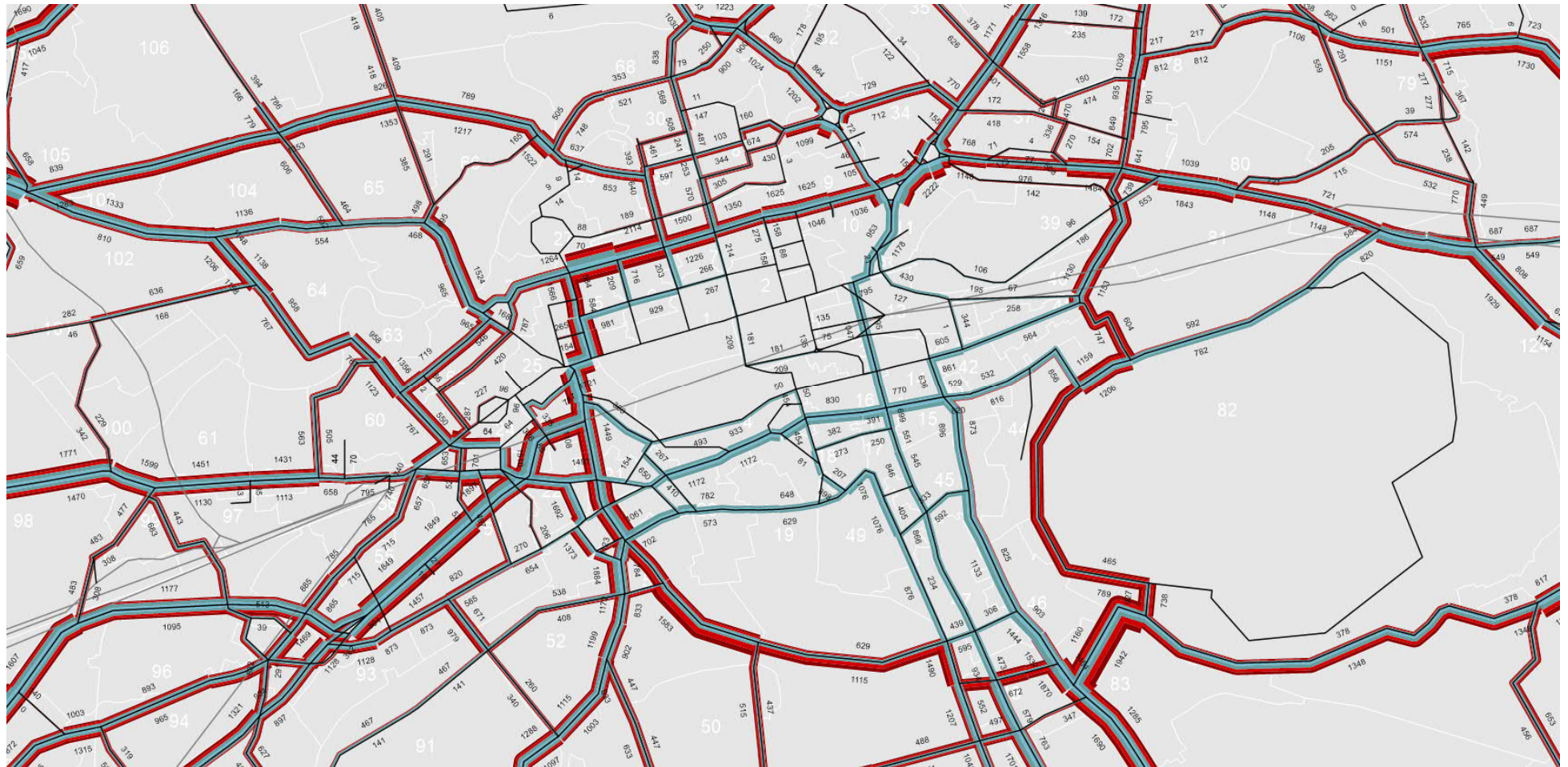


Figure 4.26: PM (17:00-18:00) Revised LEZ + ECCT – 2016 traffic volumes, 2019 fleet composition

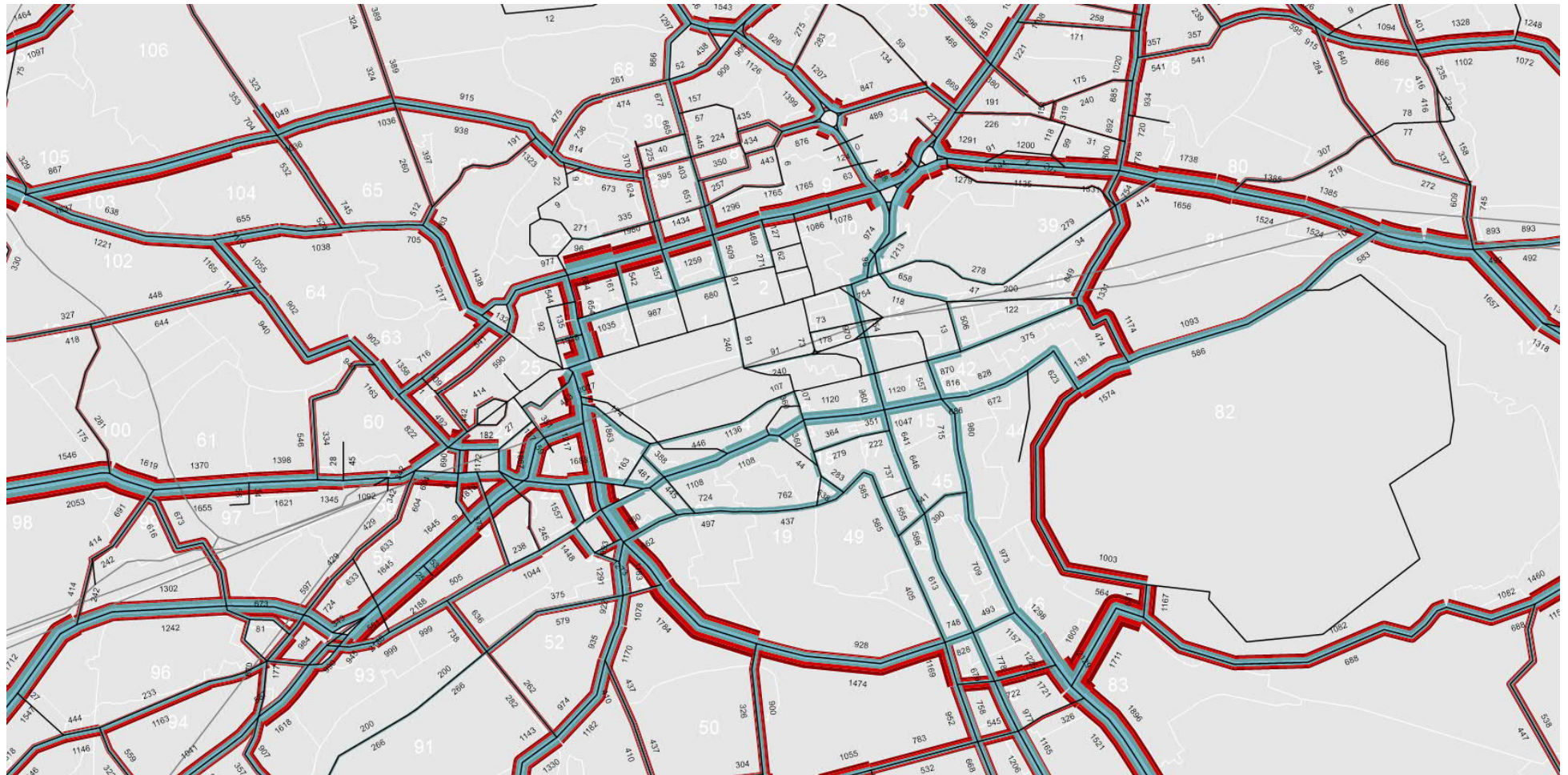
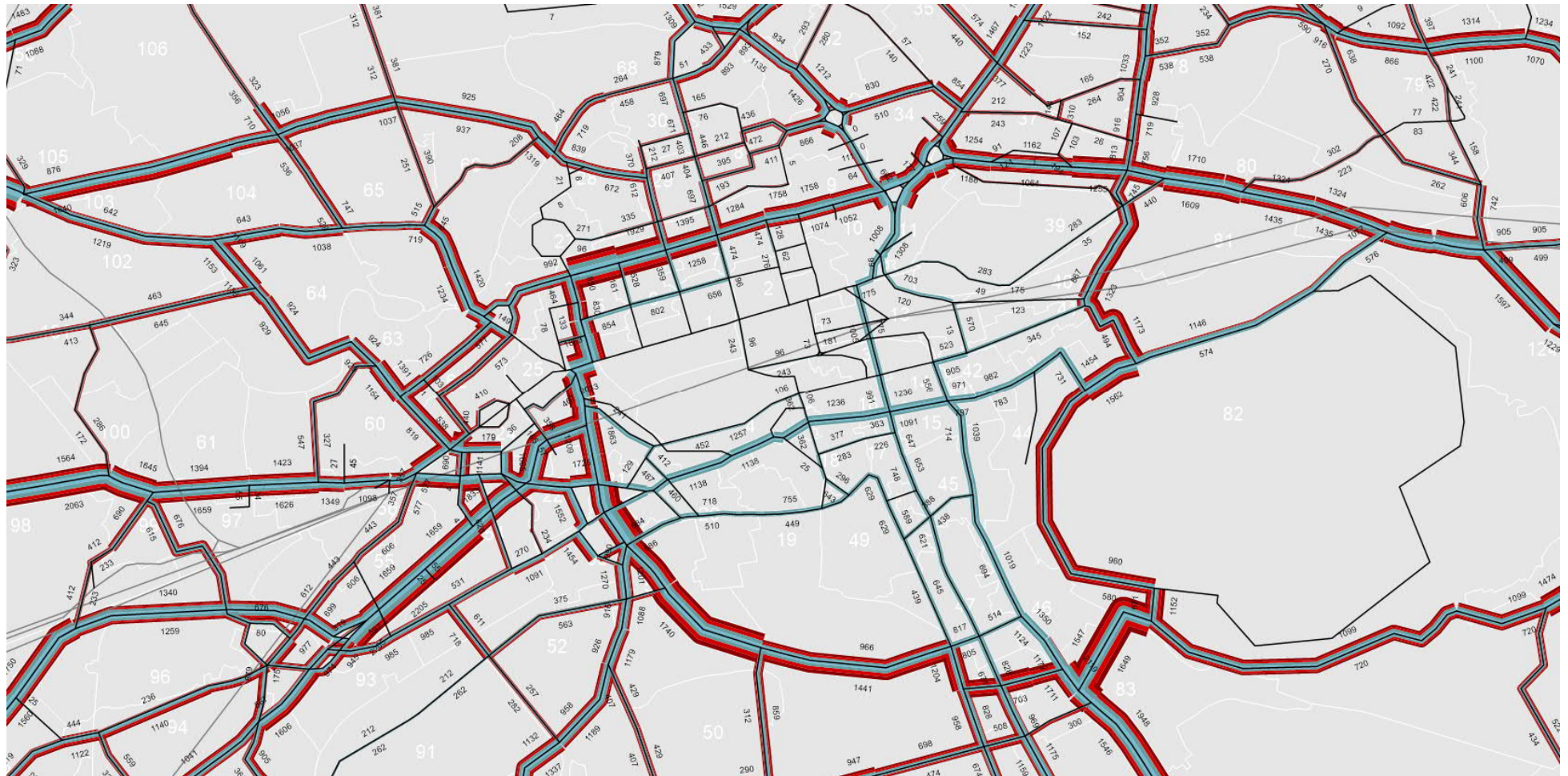


Figure 4.27: PM (17:00-18:00) Revised LEZ + ECCT – 2016 traffic volumes, 2023 fleet composition



Figure 4.28: PM (17:00-18:00) Revised LEZ + ECCT – 2016 traffic volumes, 2023 fleet composition



5. Summary

5.1 Summary

This report summarises the traffic modelling undertaken to assess the impact of the Low Emission Zone (LEZ) proposed for Edinburgh city centre.

Four alternative scenarios have been considered:

- Base
- Original LEZ
- Original LEZ + City Centre Transformation schemes
- Alternative LEZ + City Centre Transformation schemes

Two forecast years have been assessed – 2019 and 2023. Both use 2016 VISUM flows, as agreed with SEPA, so that any change in assignment is a result of changes in fleet mix rather underlying travel patterns.

The base year fleet composition has been updated from previous work, based on summer 2019 ANPR data. The key difference between 2016 and 2019 data is a much higher level of observed LGV compliance. Car matrices have been disaggregated by petrol and diesel engine types in order that the air quality model can more accurately calculate emissions by compliant and non-compliant traffic.

All vehicles with an origin or destination within the city centre are assumed to be compliant with LEZ legislation. In addition, non-compliant vehicles which would previously have routed through the city centre now route around the LEZ boundary.

With a 2019 fleet composition, a number of streets are especially affected by the proposals including Palmerston Place, Chester St, Randolph Crescent and St Colme Street along the north west of the boundary. There are also impacts around Queens Drive and Hope Park Terrace to the east and south east respectively.

Implementing the alternative LEZ boundary via Lothian Road and Charlotte Square removes the impact of the scheme on Randolph Crescent and Great Stuart Street, although the size of the city centre controlled area is necessarily reduced.

It may be appropriate to implement the alternative boundary initially and expand coverage over time. A preferred approach to mitigation at key air quality hot-spot locations around the LEZ boundary will be informed by the SEPA air quality modelling which is currently being undertaken.

By 2022, ECCT interventions, including the Meadows to George St scheme, result in an increase in traffic around the periphery of the boundary. Nevertheless, a cleaner fleet means that the number of vehicles which do not meet the LEZ criteria is lower than in the base across all links analysed.

Boundary streets benefit both from cleaner vehicles and the fact that a larger number of movements are possible through the LEZ area. Nevertheless, a number of locations remain a concern and air quality analysis will help identify whether there are remaining exceedances which require further assessment and mitigation.