T5: Derby Roadside NO_2 Preferred Option Refinement

This document is comprised of a series of appendices to document T4: Derby's Local Plan Transport Modelling Forecasting Report. These appendices have been predominantly compiled by Systra on behalf of Derby City Council, with input from Derby City Council officers and White Young Green where appropriate. They should be read together with T4 to get a detailed account of the work that has led to the identification and refinement of Derby's preferred option, including the important wider network management elements.

This document includes:

Appendix 1 - Additional Preferred Option Scheme and Modelling detail For Stafford Street. This sets out the scheme specifics and how it has been modelled, including scheme plans created as part of the detailed design process. This information is provided to extend the summary of this information in T4, as requested by JAQU.

Appendix 2: Derby Traffic Management Scheme modelling – Highway and ENEVAL. This sets out the incremental modelling process that led to the identification of a traffic management scheme in the Stafford Street area. This work also identified some risks and negative impacts of the scheme in isolation, leading to the need to build in wider network management as detailed in Appendix 3.

Appendix 3: Option 2.5 Extension and Mitigation – Highway and ENEVAL. This sets out how the traffic model was used to identify and refine the required traffic management on the wider network. This essential wider network management improves the benefits of the scheme elements in the Stafford Street area as well as managing the risks and disbenefits from re-routed traffic resulting from the initial scheme.

SYSTRA

Appendix 1: Additional Preferred Option Scheme and Modelling detail for Stafford Street

Friar Gate/ Stafford Street / Ford Street Junction

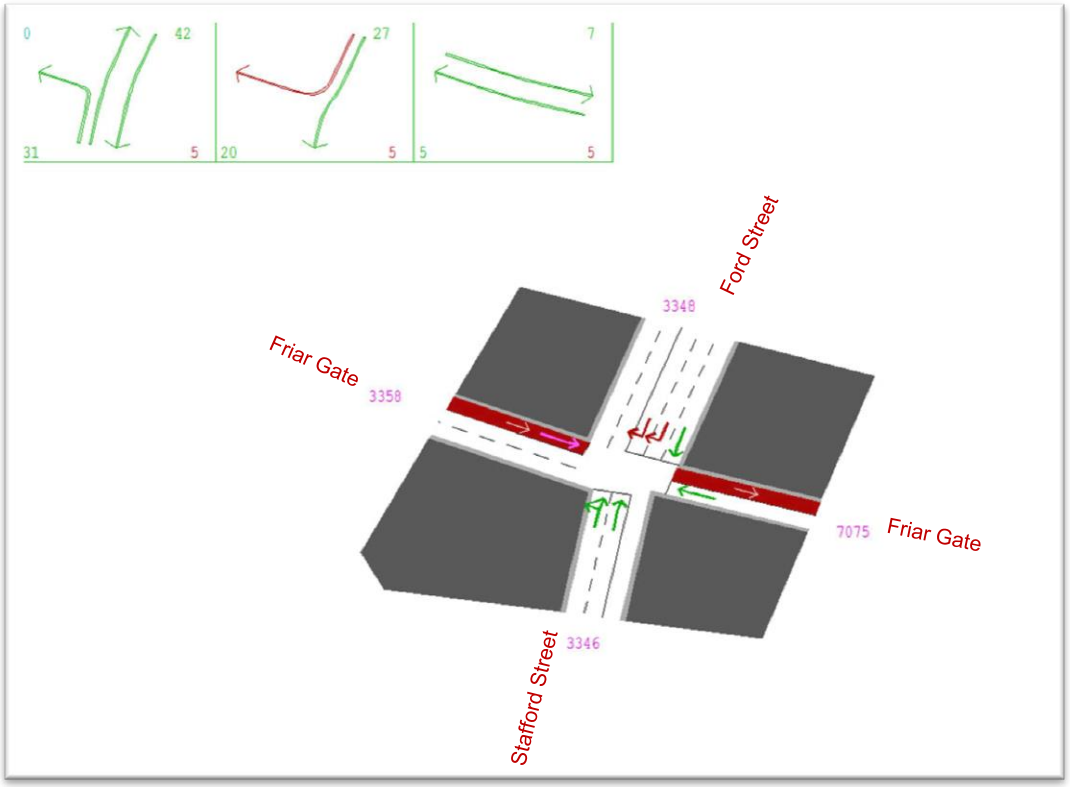
Friar Gate/ Stafford Street / Ford Street Junction

Overview of Preferred Scheme

- No physical changes to the junction such as kerb lines, etc..
- Using the UTC system to change the junction staging and signal times to limit the traffic flow capacity for movements to and from Stafford Street including;
  - Removal of the traffic movement from Ford Street to Stafford Street (southbound) from stage 1 of the signal settings so that this stage only includes movements from Stafford Street to Friar Gate (westbound) and Ford Street (northbound)
  - Increasing the green time available to Friar Gate with a resultant impact on the proportion of green time available for the movements to and from Stafford St

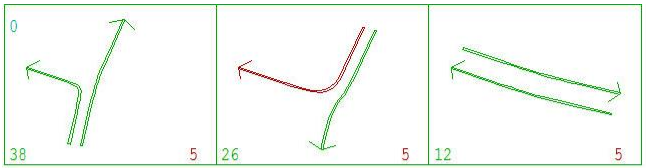
Friar Gate/ Stafford Street / Ford Street Junction

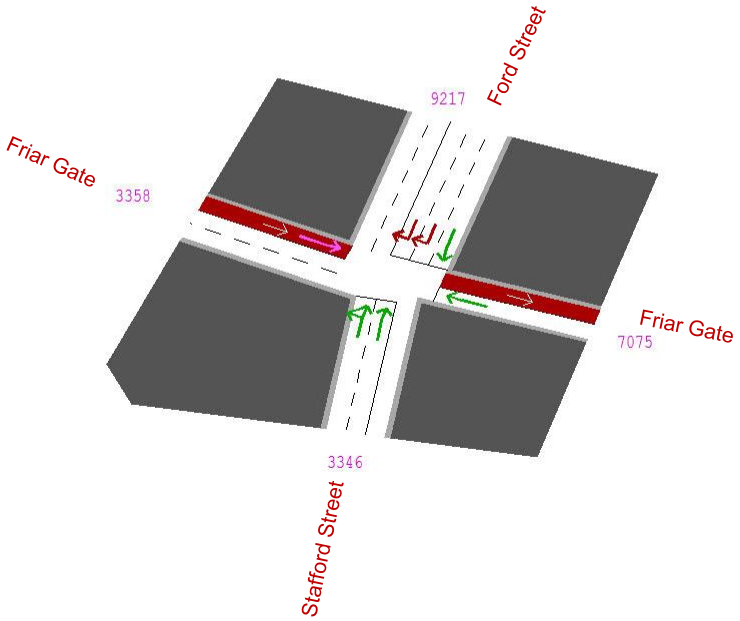
Reference Case (existing) without the proposed scheme



Friar Gate/ Stafford Street / Ford Street Junction

With the Preferred Option





Changes from REF

- Junction layout not changed
- Southbound movement from Ford St to Friar Gate removed in stage 1 of the signal settings
- Cycle time increased by 20 seconds and green times changed accordingly
- Overall amount of time allocated to Friar Gate (stage 3) in an hour increased

Junction Operation Impact of Changes

- Southbound movement from Ford St to Friar Gate removed in stage 1 of the signal settings
  - This reduces the green time available for this movement by around 40% this reducing the capacity for the southbound movement onto Stafford Street significantly.
- Cycle time increased by 20 seconds and green times changed accordingly and overall amount of time allocated to Friar Gate in an hour increased
  - The increase in time to Friar Gate reduces the overall proportion of time allocated to the movements to and from Stafford Street in stages 1 and 2 which further restricts the capacity of traffic movements associated with Stafford Street. **The time allocated to Friar Gate can be increased should further reductions in flow be required allowing the UTC some flexibility over the impacts.**

Overall these changes restrict the available capacity for movements to and from Stafford Street and the resultant impact of this is that movements that can relocate to other routes that are more attractive do so.

Stafford Street/ Uttoxeter New Road / Mercian Way / Curzon Street Roundabout

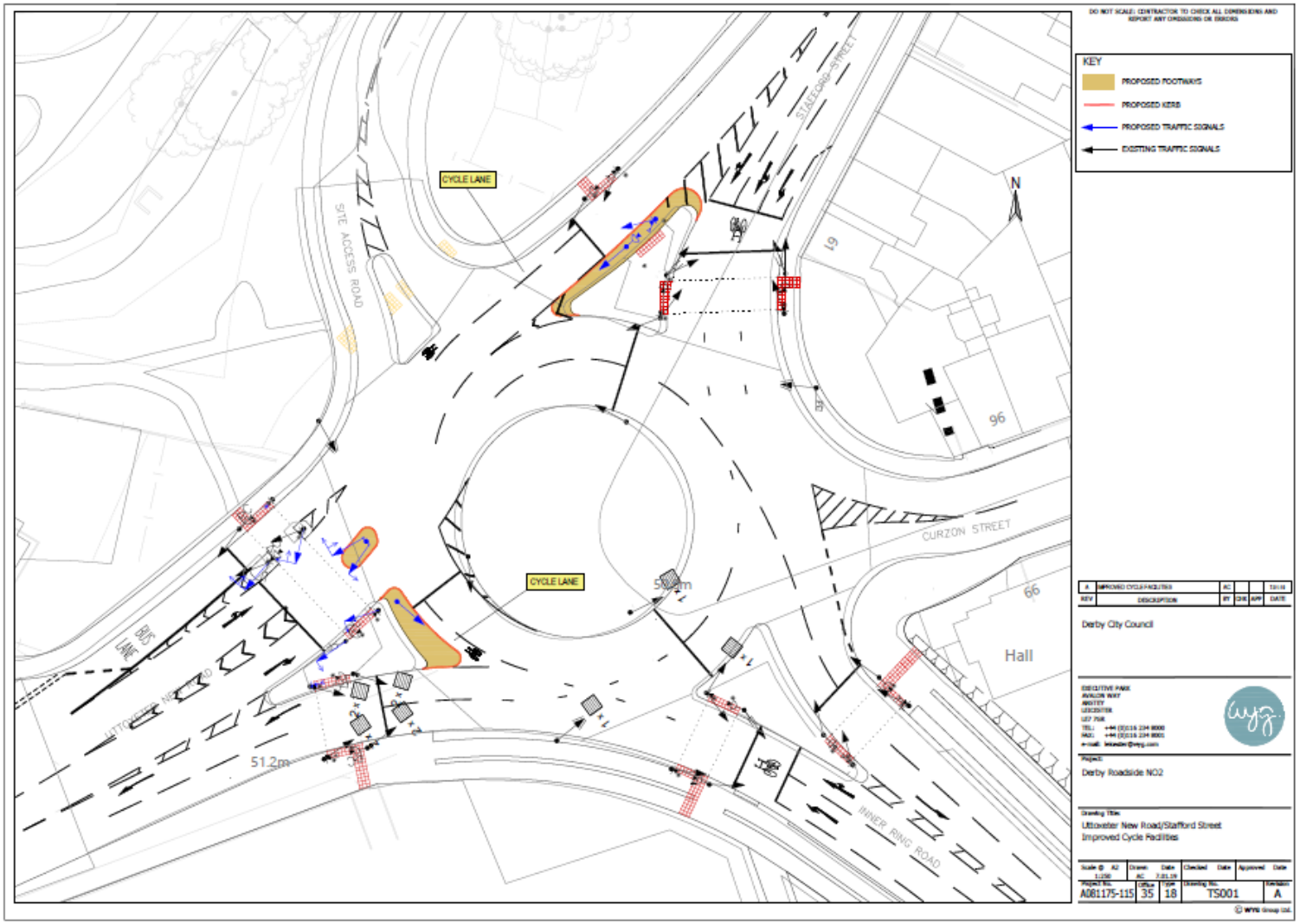
SYSTRA

Stafford St /Uttoxeter New Rd / Mercian Way / Curzon St roundabout

Overview of Preferred Scheme

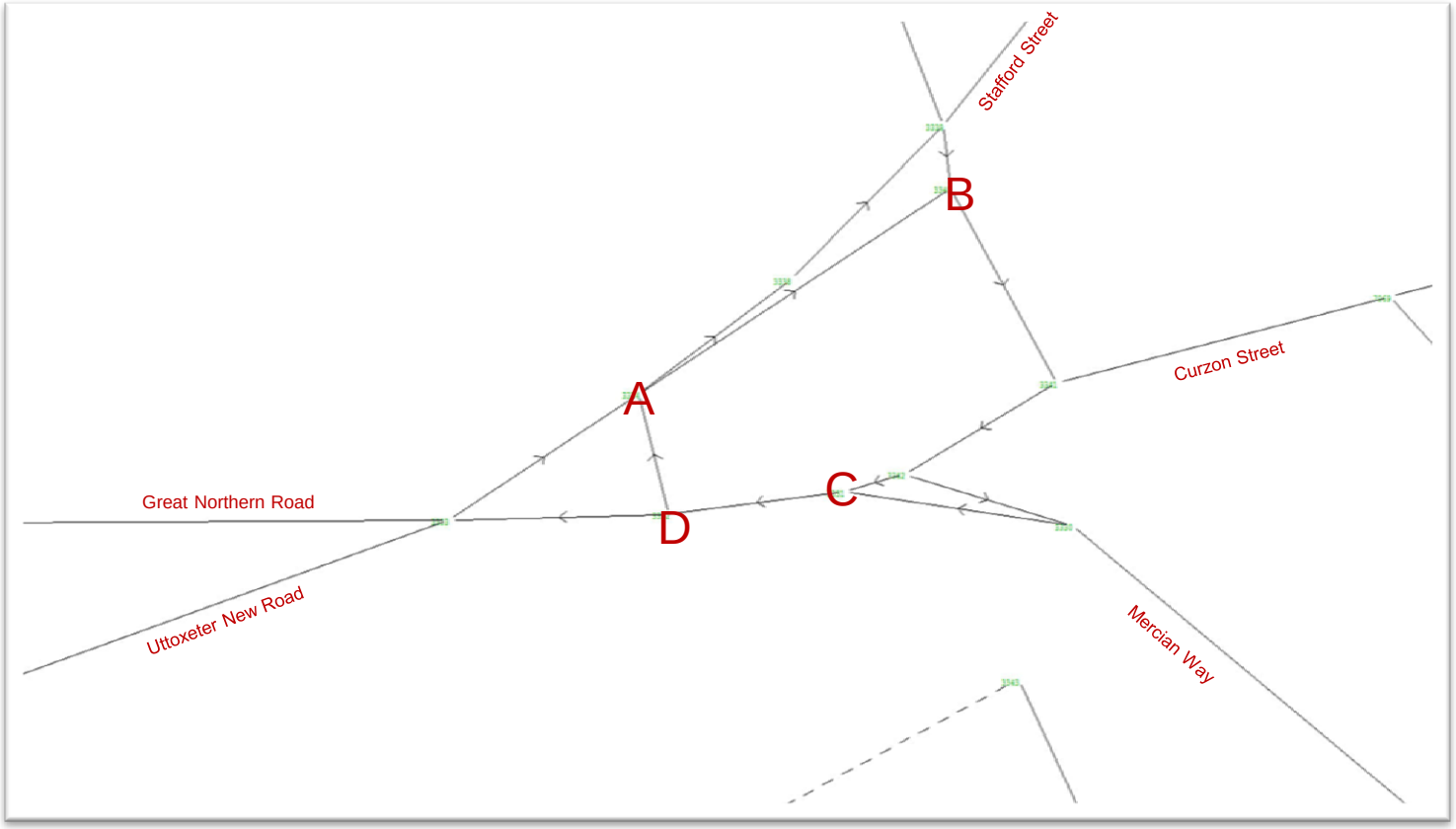
- Stafford Street exit from roundabout (northbound)
  - Removal of a traffic lane to provide a single lane exit
- Uttoxeter New Road Entry
  - Segregation of the movements to Stafford St from the remainder of movements into the junction to allow each movement to have separate signal control
  - Reduction in the green times for the Stafford St movement to limit the northbound flow into Stafford St
  - Increase green time for right turn movements to encourage the use of the southern and western parts of the inner ring road
  - Reduction of the number of lanes on the roundabout accessing Stafford St from 2 to 1 to further throttle flow into Stafford St.
- Stafford St entry to roundabout
  - Reducing the available green time for the movements from Stafford St to assist in limiting the capacity for this movement.
  - Increased green time for the right turn traffic from Uttoxeter New Road to encourage the use of the southern and western parts of the inner ring road

Stafford Street/Uttoxeter New Road/Mercian Way/Curzon St Roundabout Design



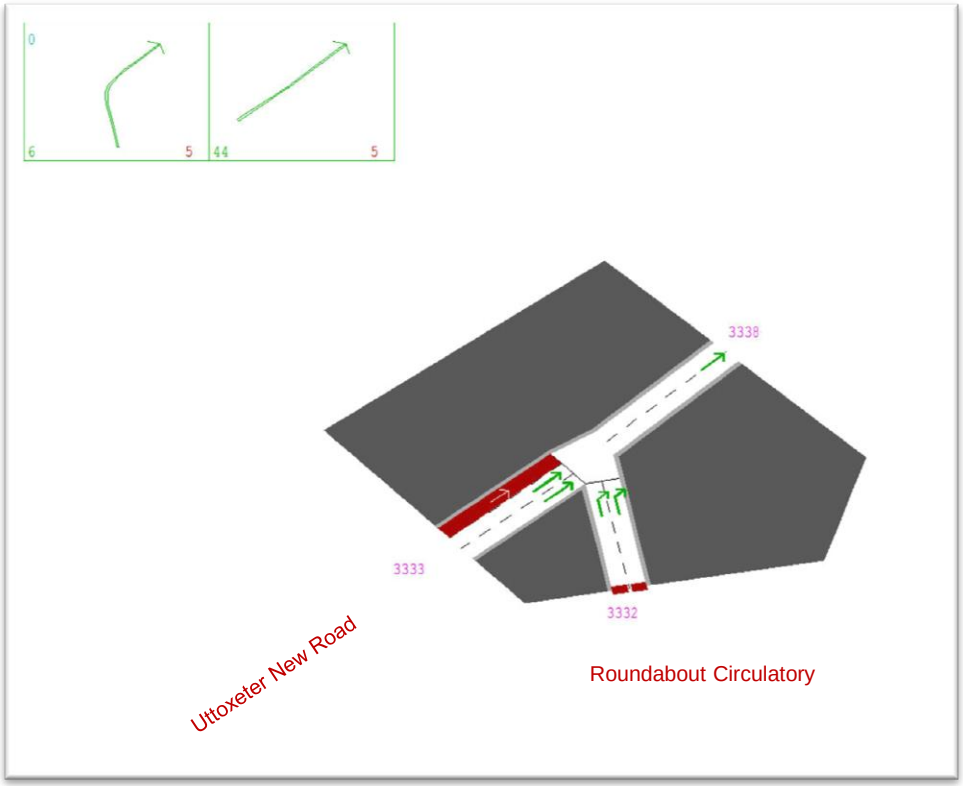
Stafford St/ Uttoxeter New Rd / Mercian Way / Curzon St Roundabout

Overall Junction in the Highway Model



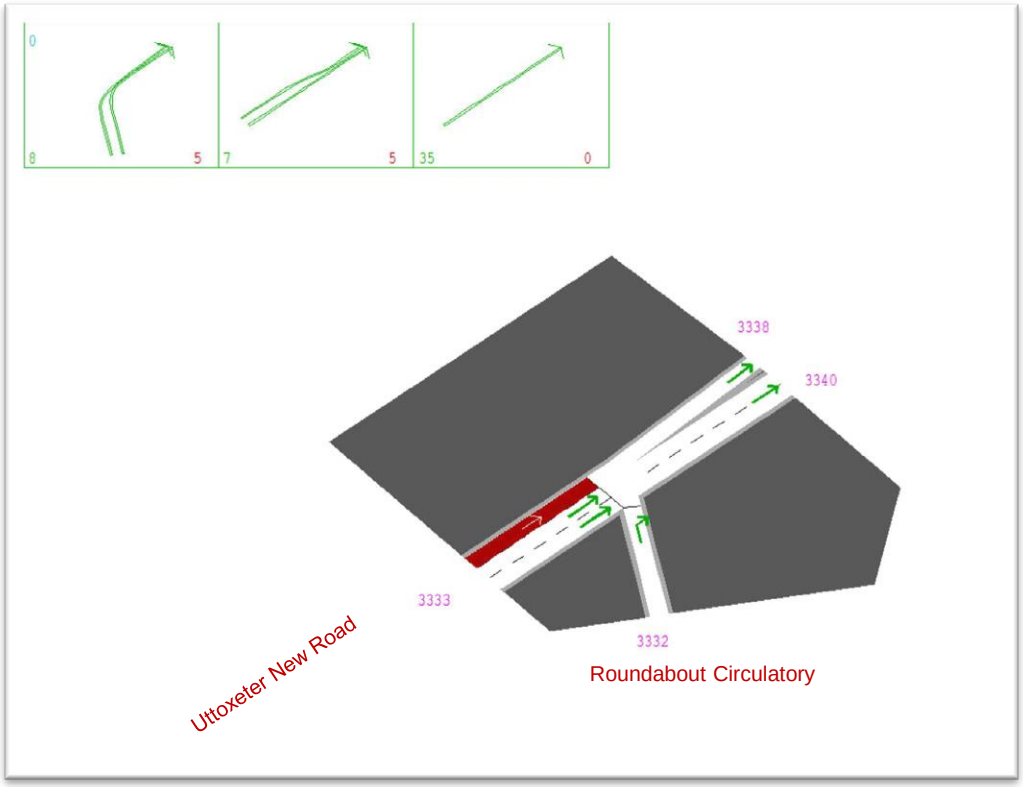
Node A- Uttoxeter New Road entry to roundabout junction

Reference Case (existing) without the proposed scheme



Node A- Uttoxeter New Road entry to the roundabout

With the Preferred Option

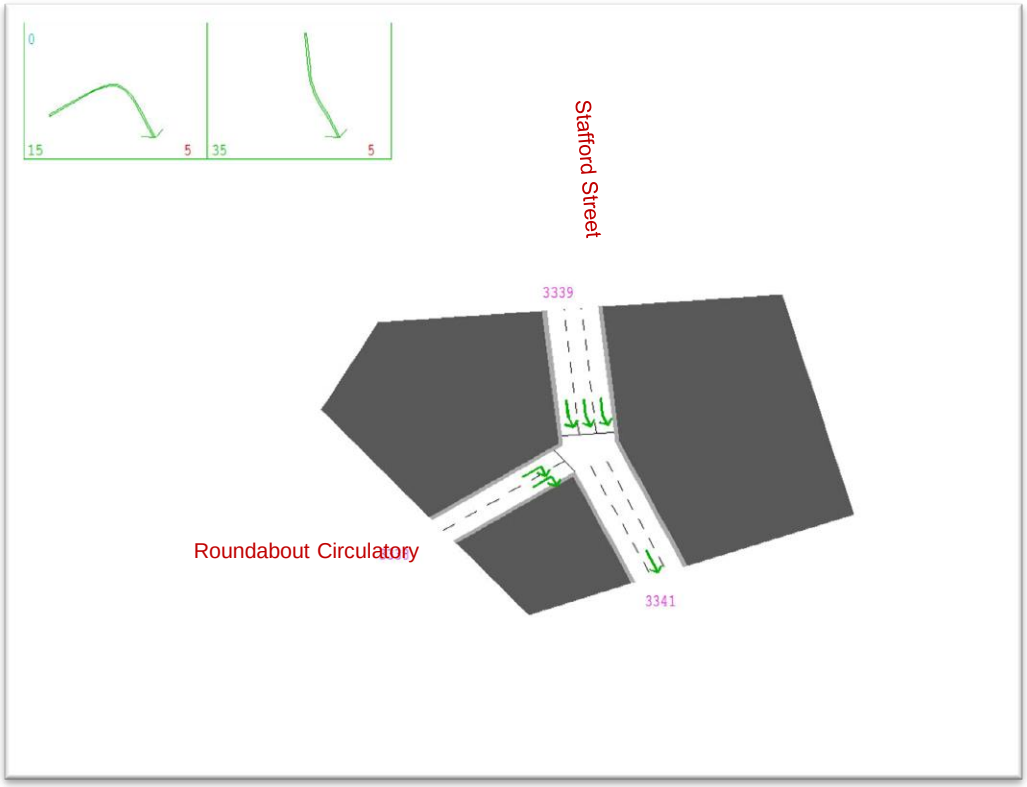


Changes from REF

- Segregation of movements on Uttoxeter New Rd
- Single lane exit to Stafford St rather than two
- Single lane on roundabout circulatory rather than two
- Third signal stage introduced for right turn only from Uttoxeter New Rd
- Green time allocated to Uttoxeter New Rd to Stafford Street movement reduced from 44 seconds to 7 seconds

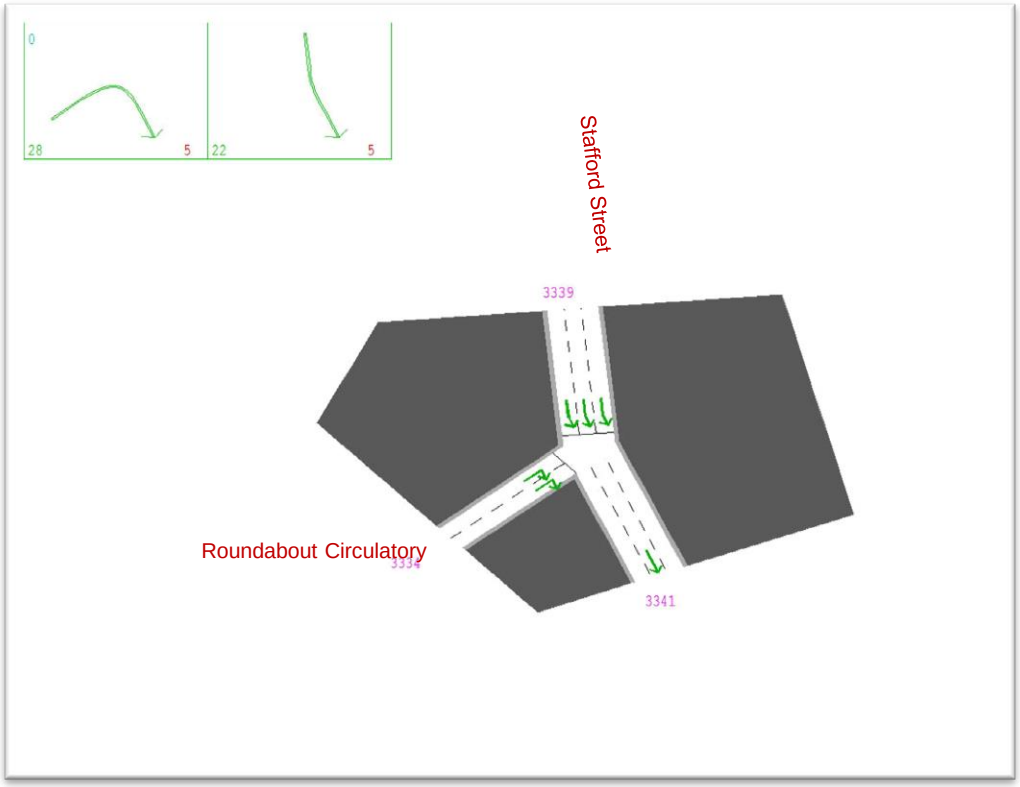
Node B – Stafford Street entry to roundabout

Reference Case without the proposed scheme (existing)



Node B – Stafford Street entry to roundabout

With the Preferred Option



Changes from REF

- No changes to physical layout
- Green time allocated to Stafford Street reduced from 35 seconds to 22 seconds
- Green time allocated to the roundabout circulatory carriageway increased from 15 seconds to 28 seconds

Stafford St/ Uttoxeter New Rd / Mercian Way / Curzon St Roundabout

Junction Operation Impact of Changes

- **Stafford Street changes**
  - This reduces the capacity of the exit from the junction onto Stafford Street limiting the amount of traffic that can utilise the route.
- **Uttoxeter New Road entry**
  - The changes applied to this entry and also the roundabout circulatory carriageway reduces the capacity available for traffic movements to Stafford St by throttling green times for these movements.
- **Stafford Street entry**
  - The reduction in green time for movements from Stafford St reduces the available capacity for these movements.
- **The level of capacity reduction and therefore constraint on flows travelling to and from Stafford Street can be regulated by the UTC system to ensure the air quality aspirations are achieved.**
- Green time is increased for the right turn movements from Uttoxeter New Road encouraging the use of the south and east sections of the inner ring road as an alternative to Stafford Street

Overall these changes restrict the available capacity for movements to/from Stafford St and the resultant impact of this is that movements that can relocate to other routes that are more attractive do so.

Uttoxeter Old Road/ Ashbourne Road / Friar Gate Junction

Uttoxeter Old Road/ Ashbourne Road Junction

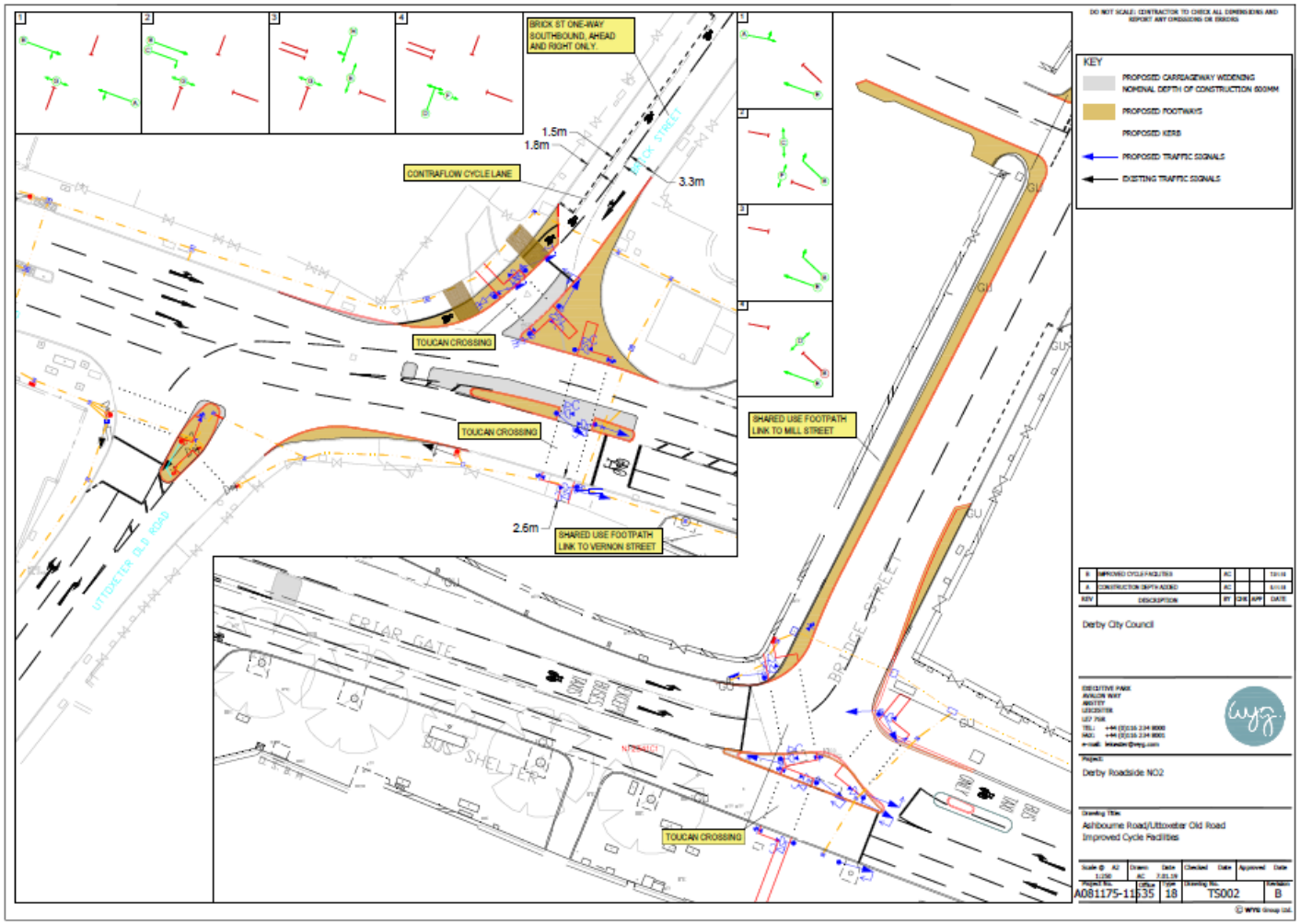
Overview of Preferred Scheme

The proposed measures have been developed to reduce congestion on Uttoxeter Old Road to encourage the use of this route as an alternative to Stafford Street in order to maximise the air quality benefits of the measures on Stafford Street whilst minimising the congestion impacts along Uttoxeter Old Road.

- Uttoxeter Old Road
  - Provision of an additional lane for traffic turning right (eastbound) onto Friar Gate
  - Increased signal green time for movements from Uttoxeter Old Road.

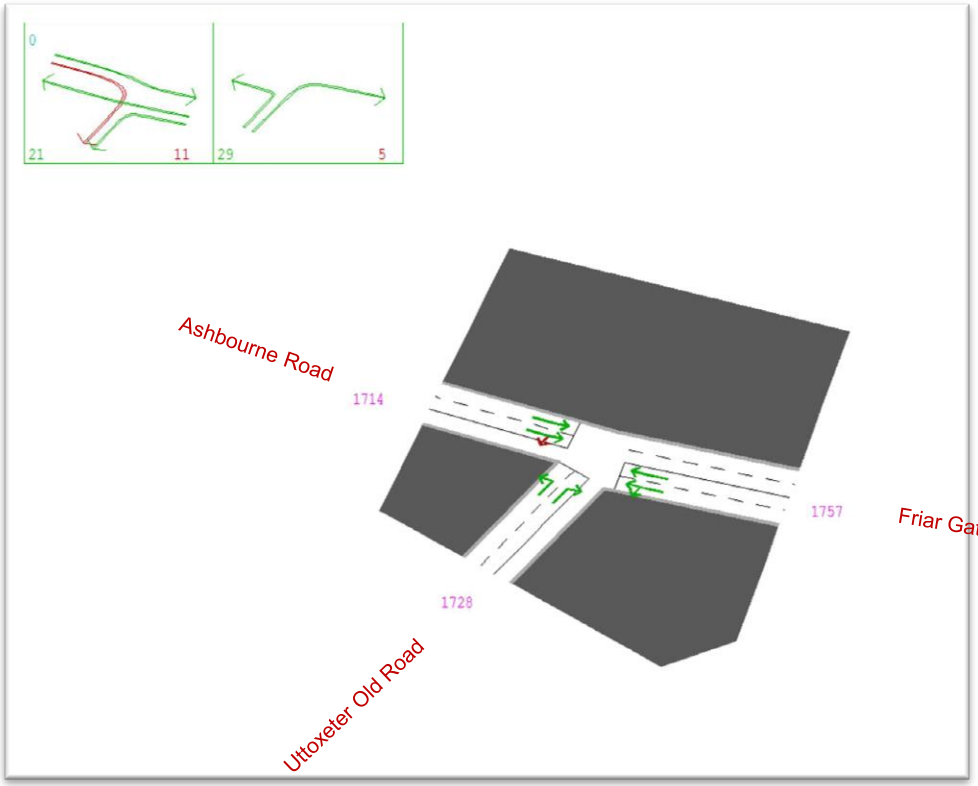
- Friar Gate
  - Provision of a two lane exit from the junction

Uttoxeter Old Road/ Ashbourne Road Junction Design



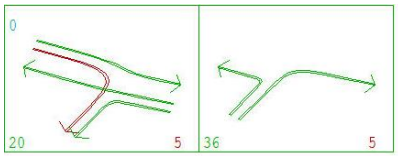
Uttoxeter Old Road/ Ashbourne Road / Friar Gate Junction

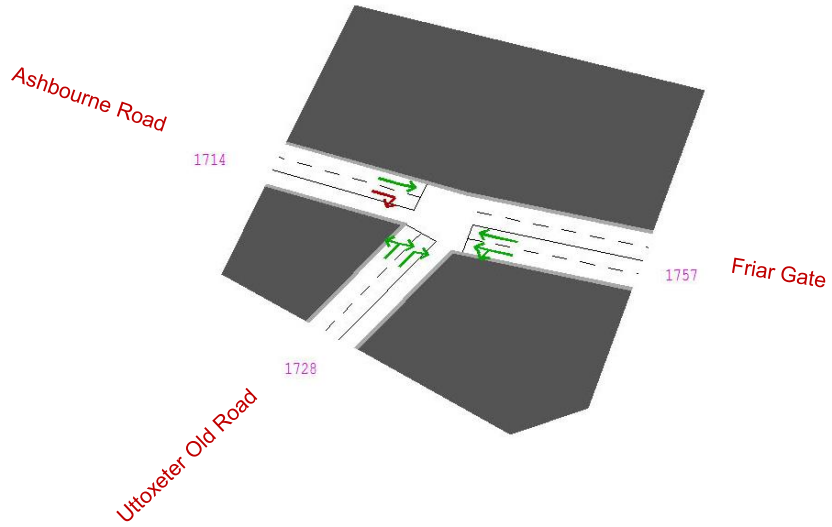
Reference Case without the proposed scheme (existing)



Uttoxeter Old Road/ Ashbourne Road / Friar Gate Junction

With the Preferred Option





Changes from REF

- Additional Right turn lane on Uttoxeter Old Road
- Two Lane exit on Friar Gate
- Green time allocated to Uttoxeter Old Rd increased from 29 to 36 seconds
- Inter-greens reduced to the minimum levels

Uttoxeter Old Road/ Ashbourne Road / Friar Gate Junction

Junction Operation Impact of Changes

- The changes to the junction maximises the capacity of the Uttoxeter Old Road approach to the junction within the confines of existing highway boundaries. This reduces the overall delays at this junction for movements that use this route as an alternative to Stafford Street (i.e. traveling back towards the inner ring road). Hence making it an appropriate alternative route to Stafford street

- This scheme does not significantly affect the capacity and therefore impact of on traffic levels along Ashbourne Road is limited.

Appendix 2: Derby Traffic Management Scheme Modelling – Highway and ENEVAL

SYSTRA

Introduction

- Derby City Council (DCC) has commissioned Systra to produce a series of incremental options, with the aim of testing traffic management schemes to reduce the levels of NOX emissions on Stafford Street.

- Stafford Street represents the only NOX exceedance location in Derby City and it has been estimated that a reduction in emissions of around 42% is required to bring the Air Quality levels into compliance.

- The primary focus of the traffic management schemes is to use both the Stafford Street/Friar Gate and the Mercian Way/Uttoxeter New Road signal controlled junctions at either end of Stafford Street to limit the level of traffic using Stafford Street.

- For each option, data on the following aspects has been produced compared to the 2020 Reference Case situation:
  - Change in Actual Flow plots
  - Change in Congestion plots
  - Change in NOX plots
  - Change in NOX levels

Introduction

- Options tested are as follows:
  - Options 1 - Physical Scheme changes
    - Option 1.1 – All stipulated physical changes* implemented.
    - Option 1.2 – All Stipulated physical changes* implanted bar the removal of the ahead movement from Stafford Street (Northbound – Left Lane).
  - Options 2 – Signal Alterations
    - Option 2.1 – 1.1 + Signal Movement Alteration (Friar Gate)
    - Option 2.3 – 1.2 + Signal Movement Alteration (Friar Gate)
    - Option 2.2 – 1.1 + Signal Timing Alteration (Friar Gate).
    - Option 2.4 – 1.2 + Signal Timing Alteration (Friar Gate).

    *NOX Data displays 2.4 to be the preferred option.
    - Option 2.5 – 2.4 + Signal Stage/Time Alteration (RB)

- The preferred option (2.5) was then utilised as the base for:
  - Option 3.0 - 2.5 + HGV Ban on Stafford Street

* Details are listed in option Summaries

Option 1.1

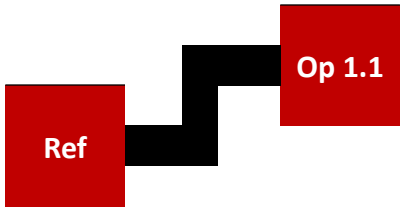
Option 1.1

Introduction

- Option 1.1 includes the physical alterations pertaining to both the Stafford Street/ Uttoxeter New Road / Mercian Way roundabout and the Stafford Street / Friar Gate / Ford Street Junction, as requested by Derby City Council. These include:

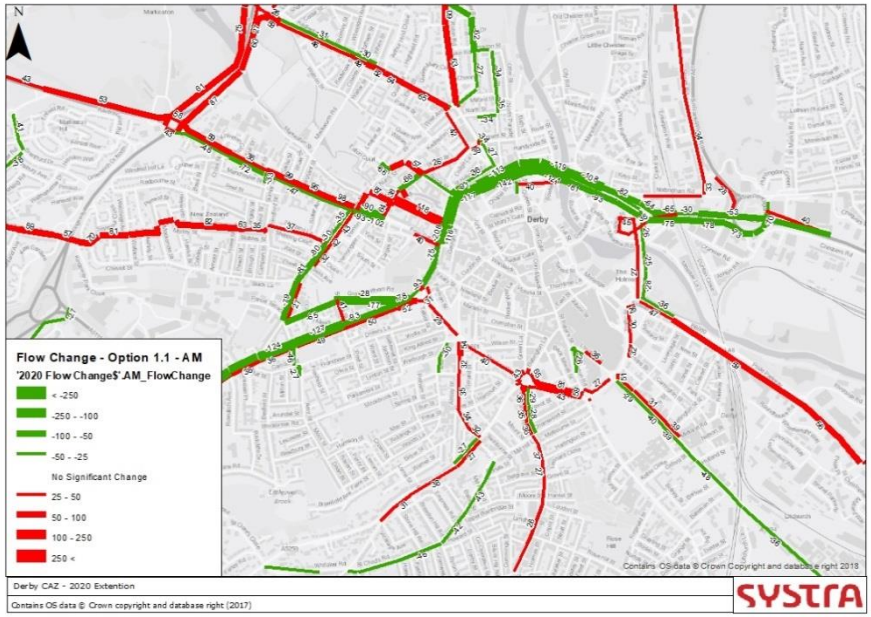
- Stafford Street/ Uttoxeter New Road / Mercian Way roundabout
  - Stafford Street - Northbound exit off the roundabout restricted to one lane.
  - Mercian Way – Left lane approach onto the roundabout restricted to left turn only.
  - Uttoxeter New Road– Right lane approach onto the roundabout restricted to right turn only.

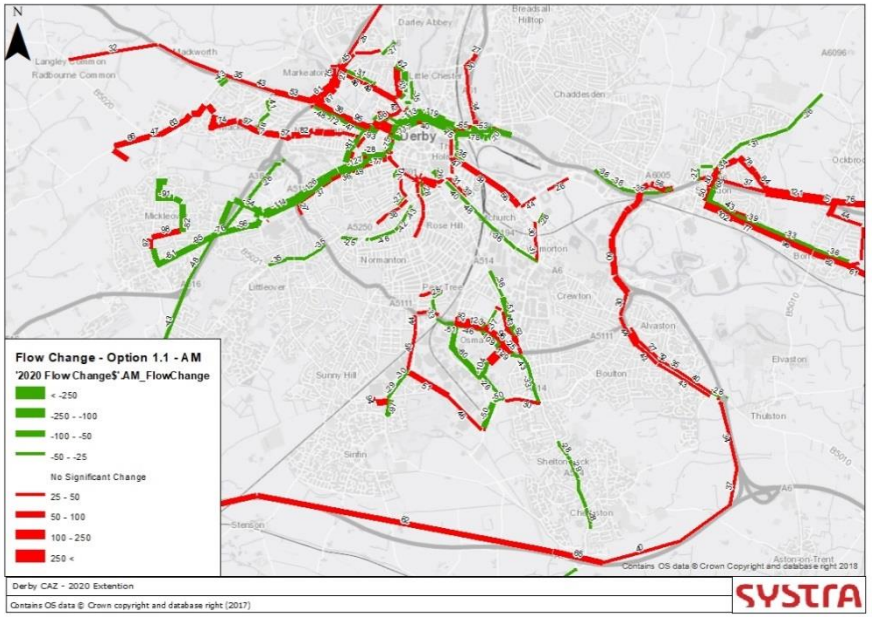
- Stafford Street/ Friar Gate / Ford Street
  - Northbound on Stafford Street – Left lane changed to left turn only.
  - Northbound on Ford Street – Number of lanes reduced from two to one, with the reduction extending 30 metres Northbound from the Stafford Street/ Friar gate junction, on Ford Street.



Option 1.1

Flow Change - AM

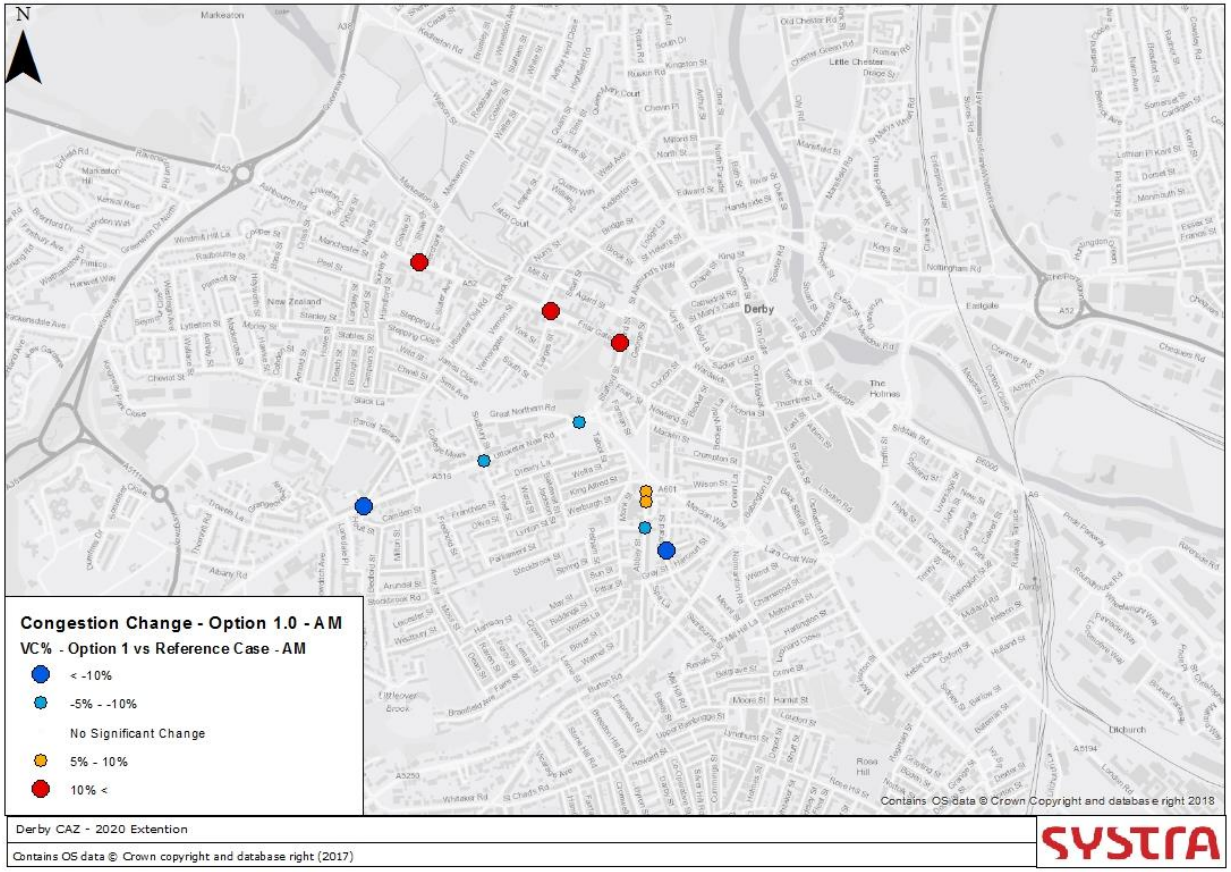




SYSTRA

Option 1.1

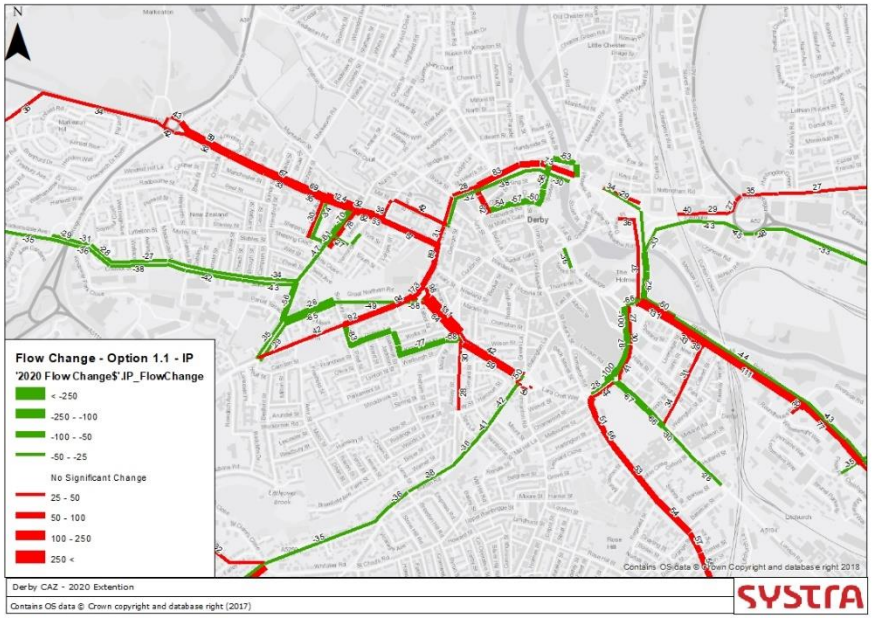
Congestion Change - AM

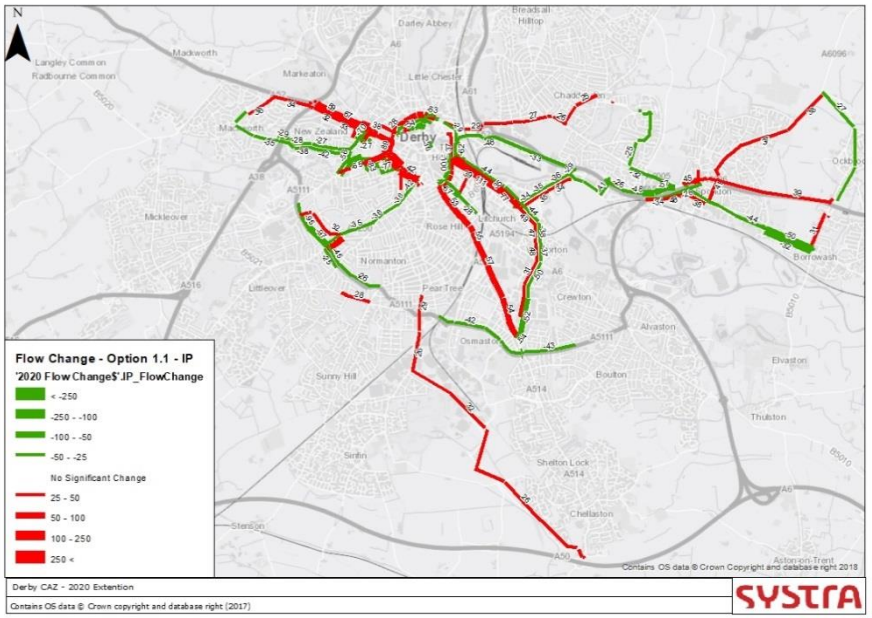


SYSTRA

Option 1.1

Flow Change - IP

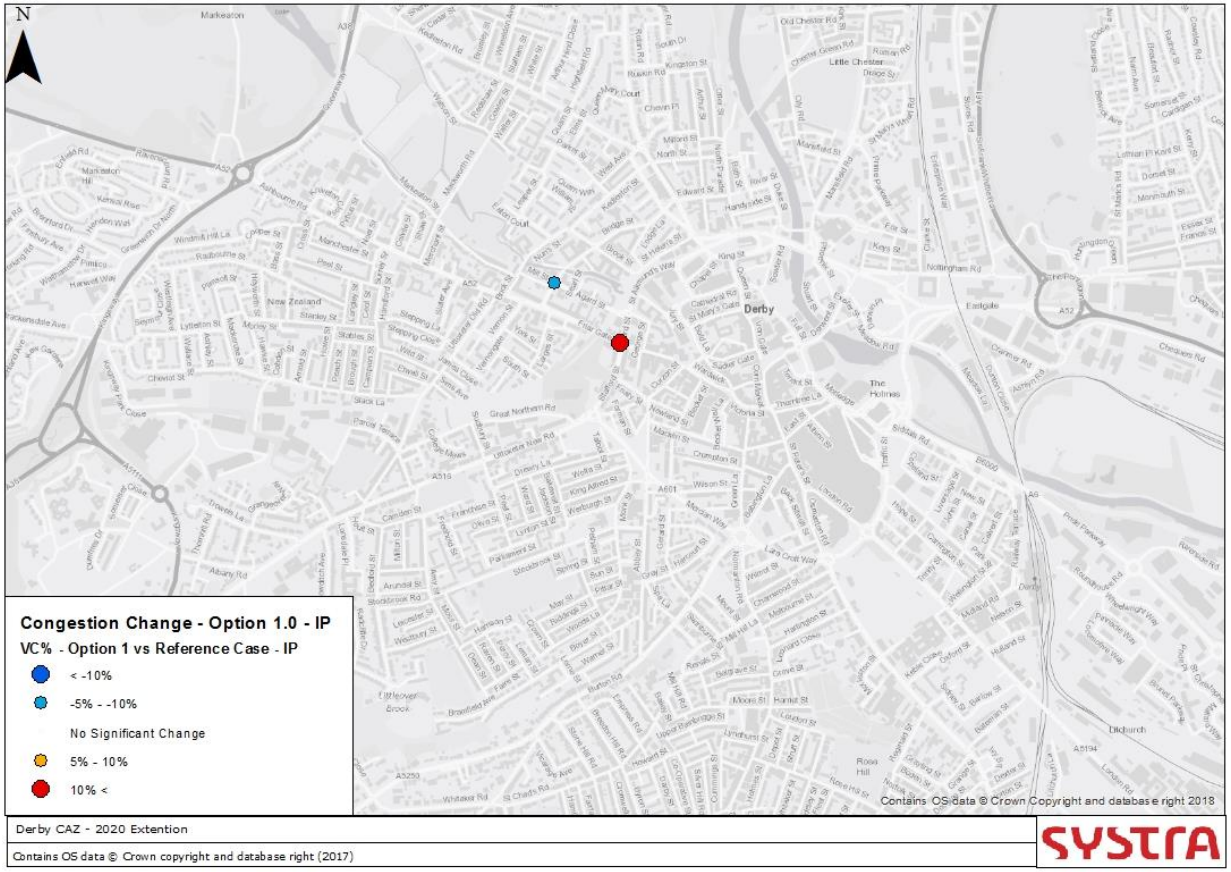




SYSTRA

Option 1.1

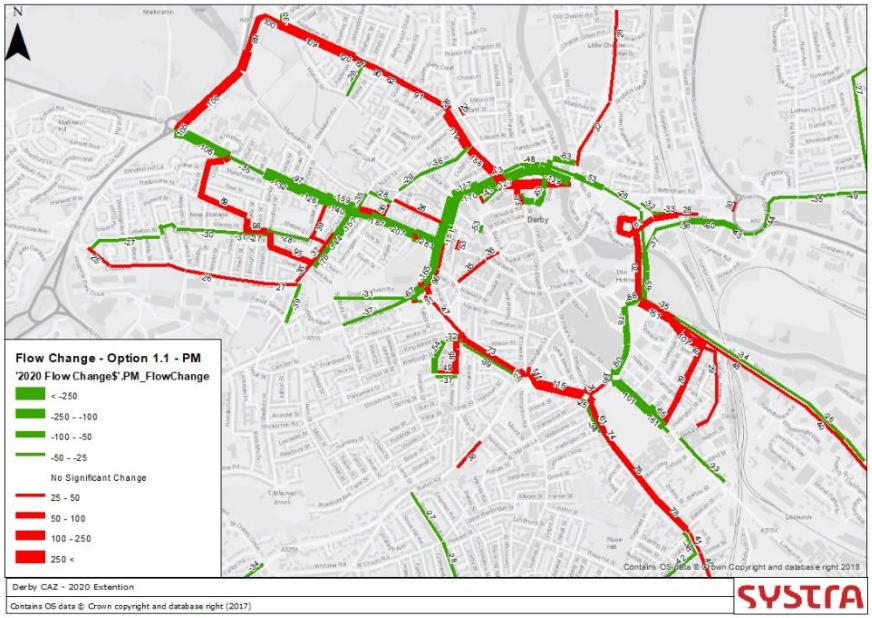
Congestion Change - IP

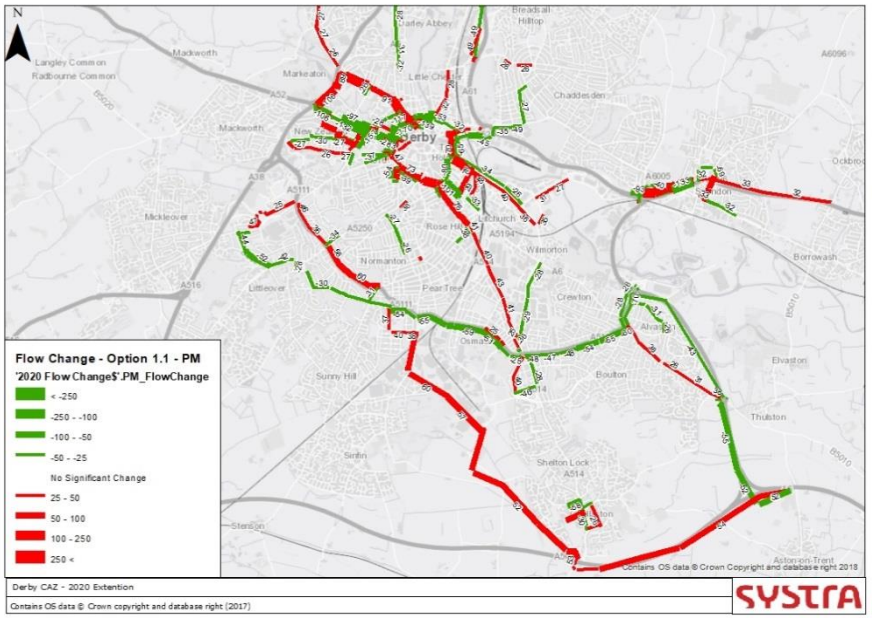


SYSTRA

Option 1.1

Flow Change - PM





SYSTRA

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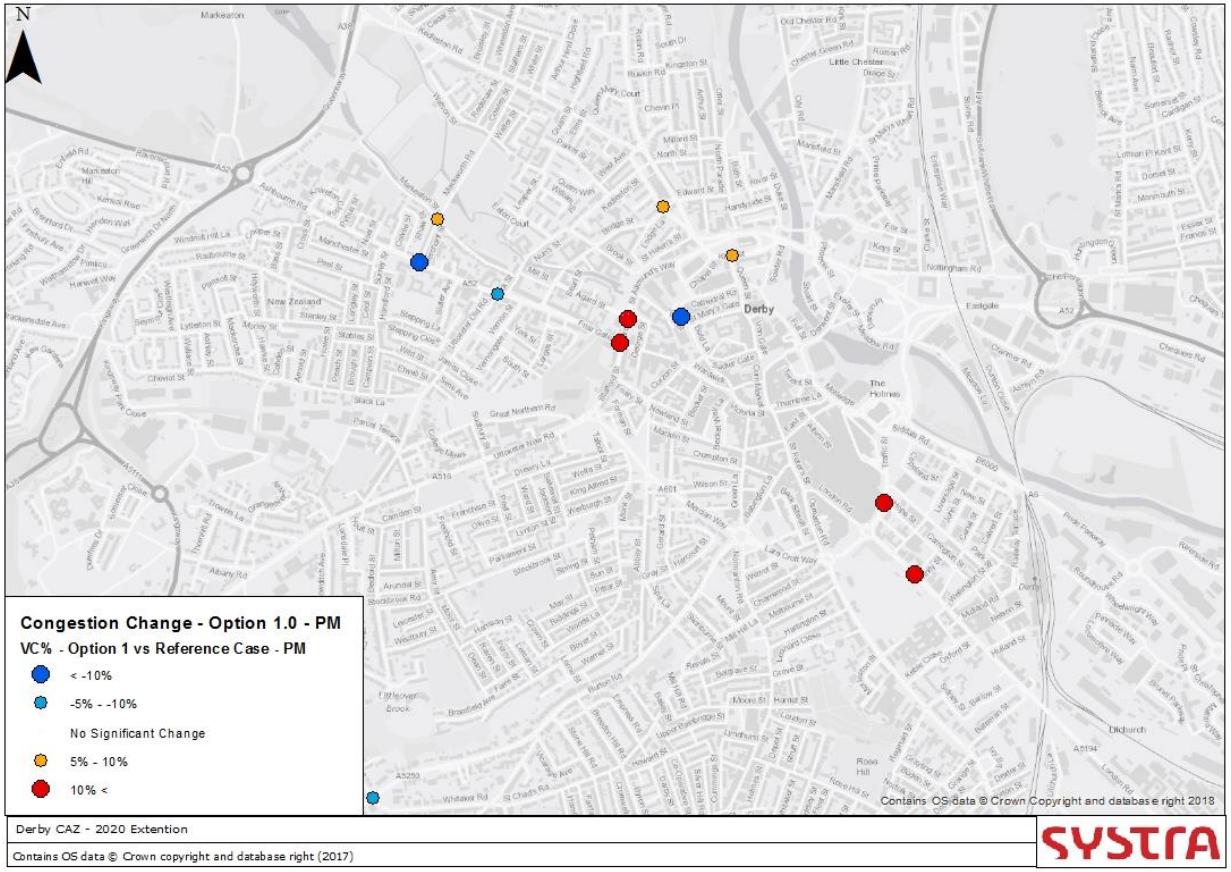
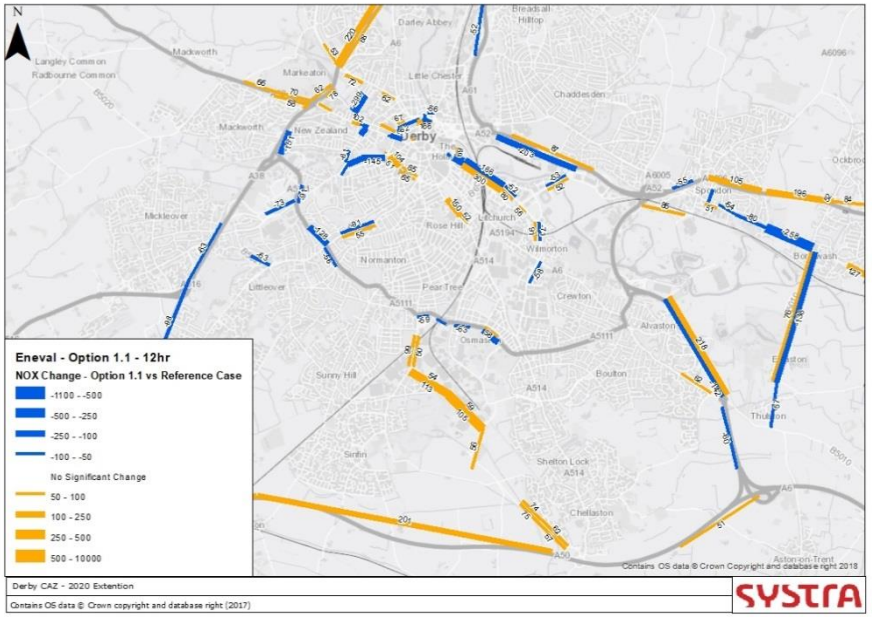
Congestion Change - PM



SYSTRA

Option 1.1

Eneval



Physical Infrastructure				
Op 1.1	NOX		Diff	% Diff
	Ref	Op 1.1		
NB	571	584	14	2%
SB	324	331	8	2%
Total	895	916	21	2%

SYSTRA

Option 1.1

Summary

- Restricting access to Stafford Street transfers trips to the Eastern part of the Inner Ring Road, with trips still accessing the A38 diverting along Kedleston Road.
- There is however an increase in trips on Stafford Street in the Interpeak when traffic levels are less constrained by the capacity reductions.
- The segregation of the left lane from the ahead lane on the Northbound carriageway of Stafford Street increases the levels of traffic undertaking this manoeuvre.
- The change in trips on Stafford Street does not have a significant impact on NOX emissions ,with values increasing by 2% in both the NB and SB directions. This increase is likely due to the increased congestion and reductions in speeds leading to increased emission rates.

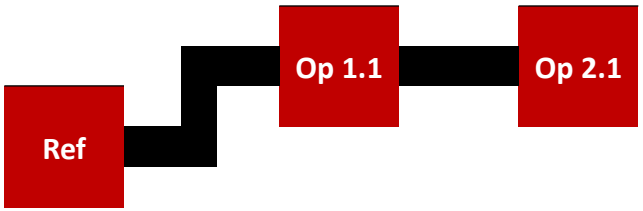
Option 2.1

Option 2.1

Introduction

- Option 2.1 builds on Option 1.1 by removing the Ford Street to Stafford Street ahead movement that exists in stage 1 of the Friar Gate junction signals.

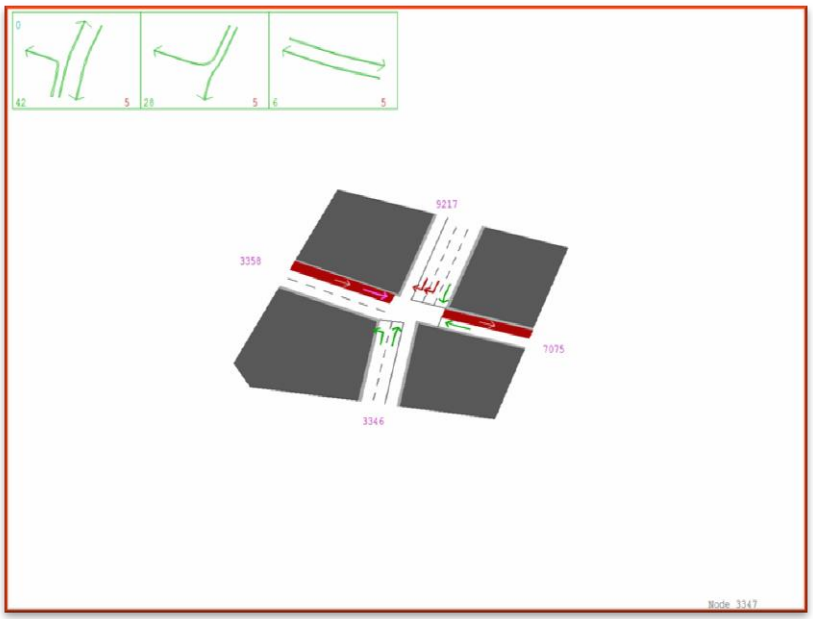
- This acts to limit the green time for trips traveling from Ford Street to Stafford Street, thus limiting the capacity of this movement.

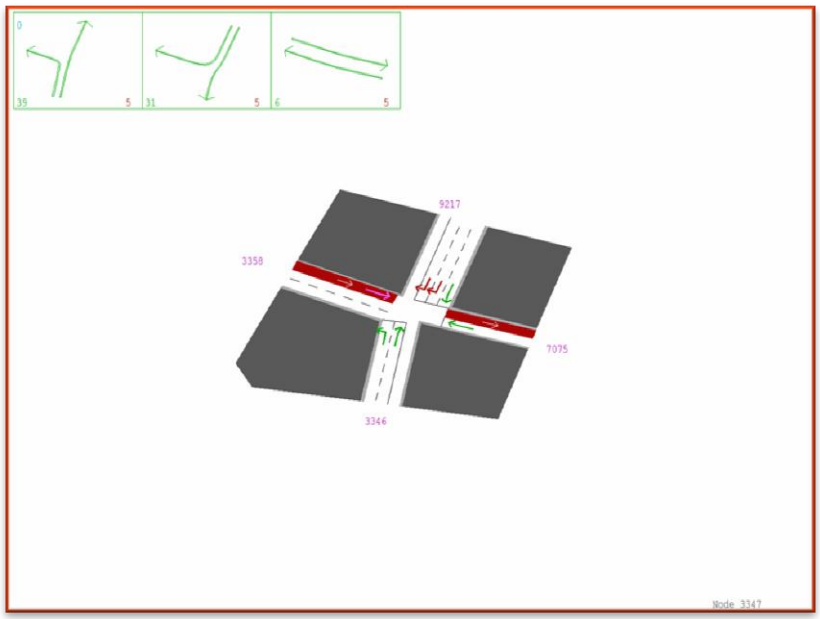


Options 2.1

Introduction

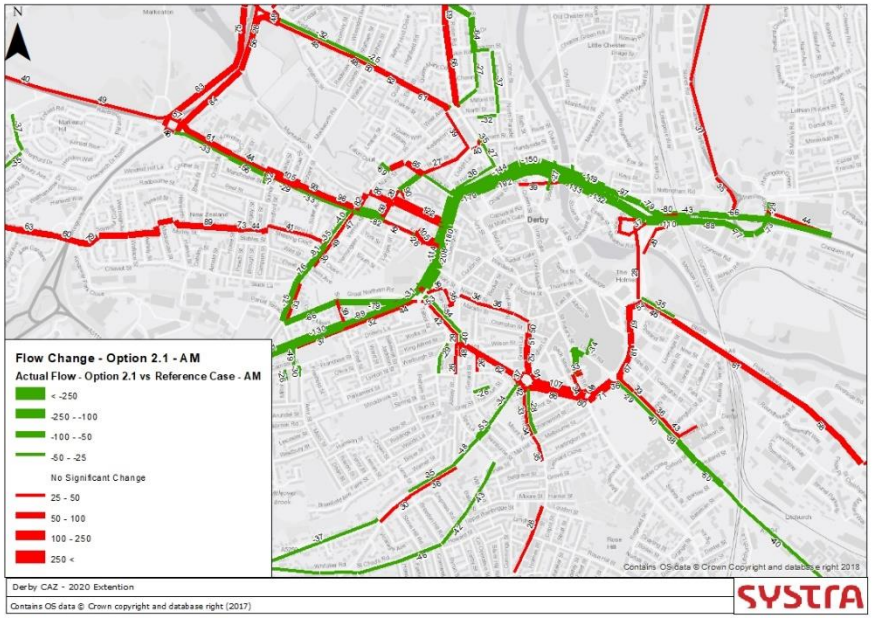
- The image on the left displays the original stage layout (Taken from 1.1), the right displays the stage alteration (2.1). Note the top left corner of each image of signal stages.

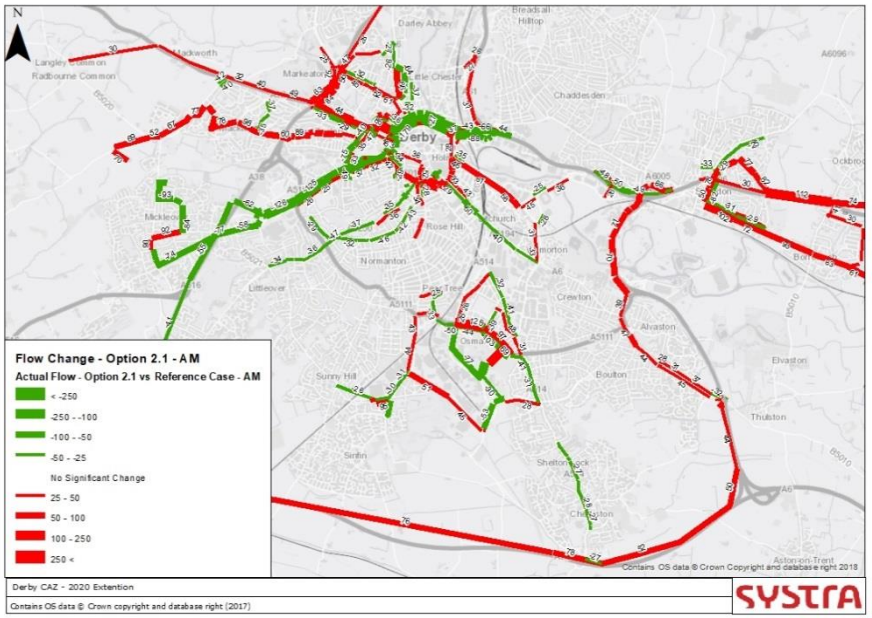




Option 2.1

Flow Change - AM

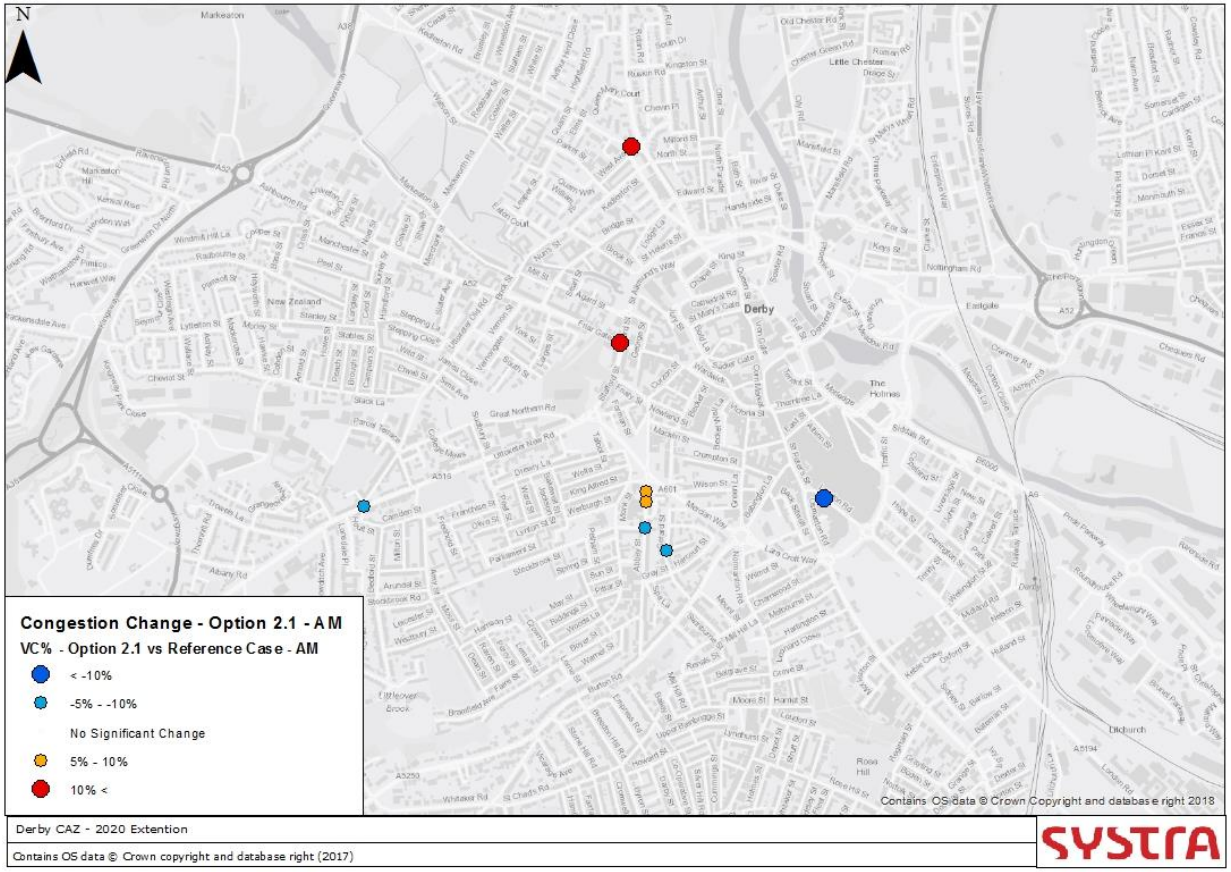




SYSTRA

Option 2.1

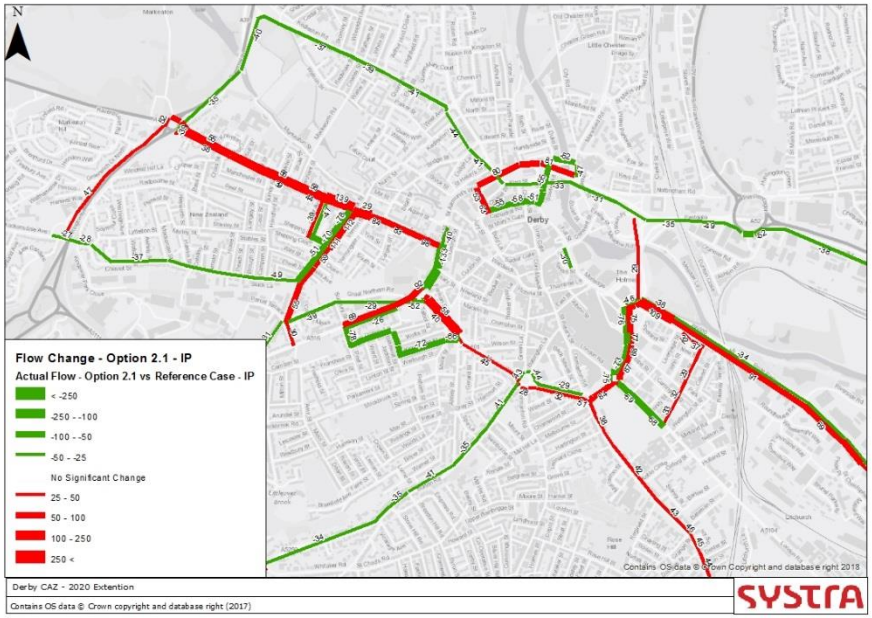
Congestion Change - AM

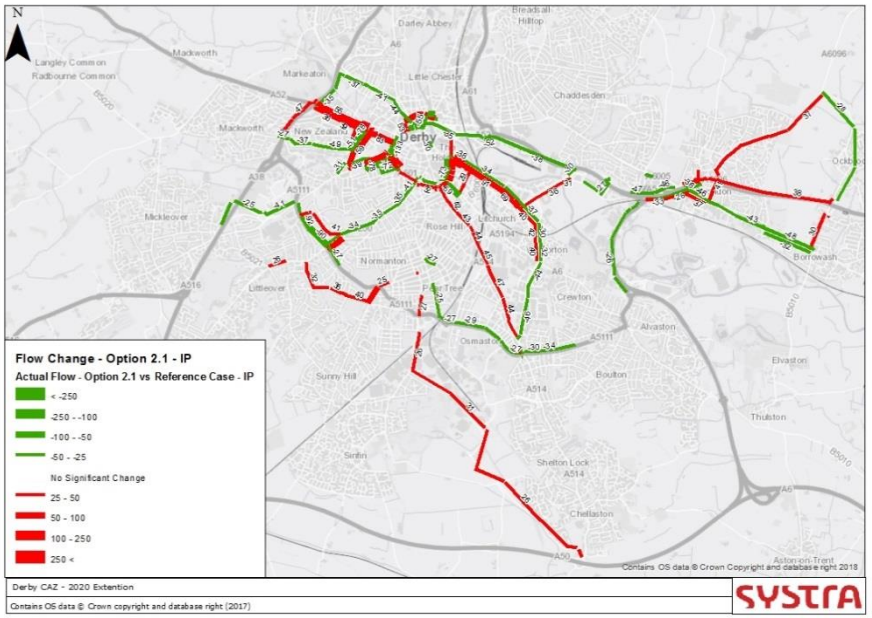


SYSTRA

Option 2.1

Flow Change - IP

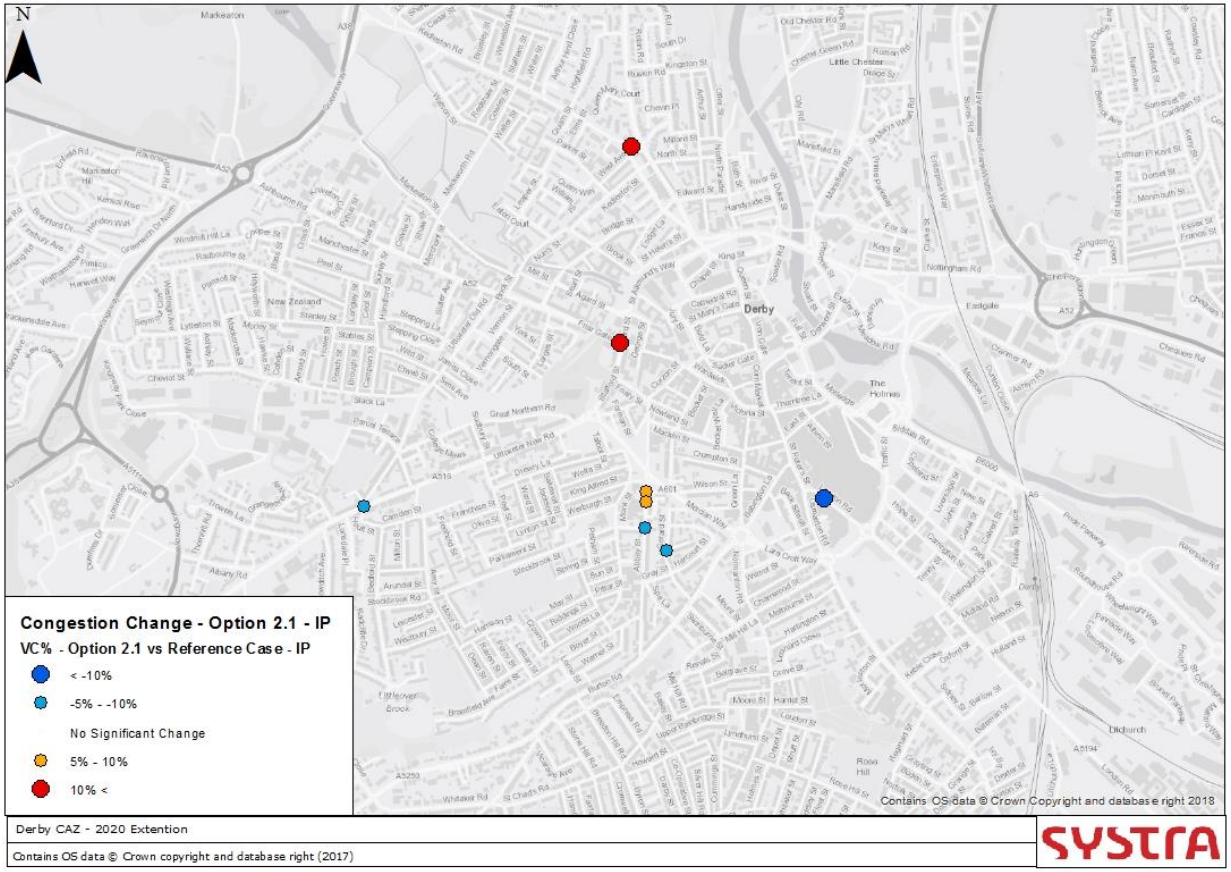




SYSTRA

Option 2.1

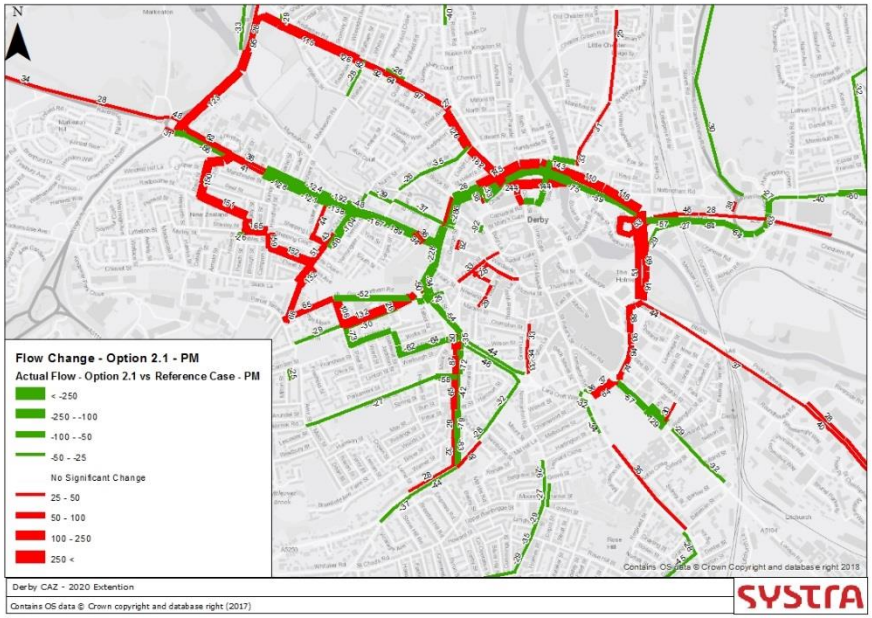
Congestion Change - IP

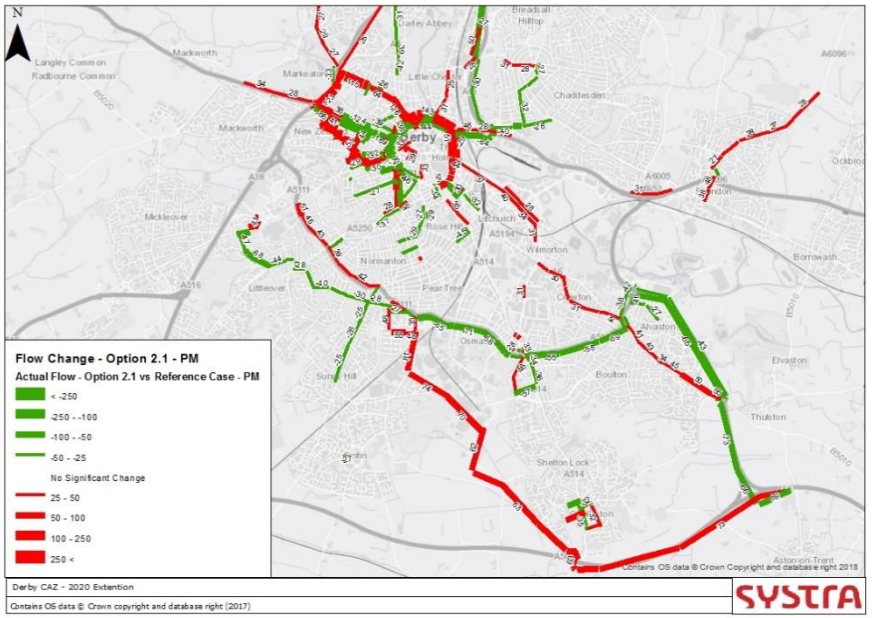


SYSTRA

Option 2.1

Flow Change - PM





SYSTRA

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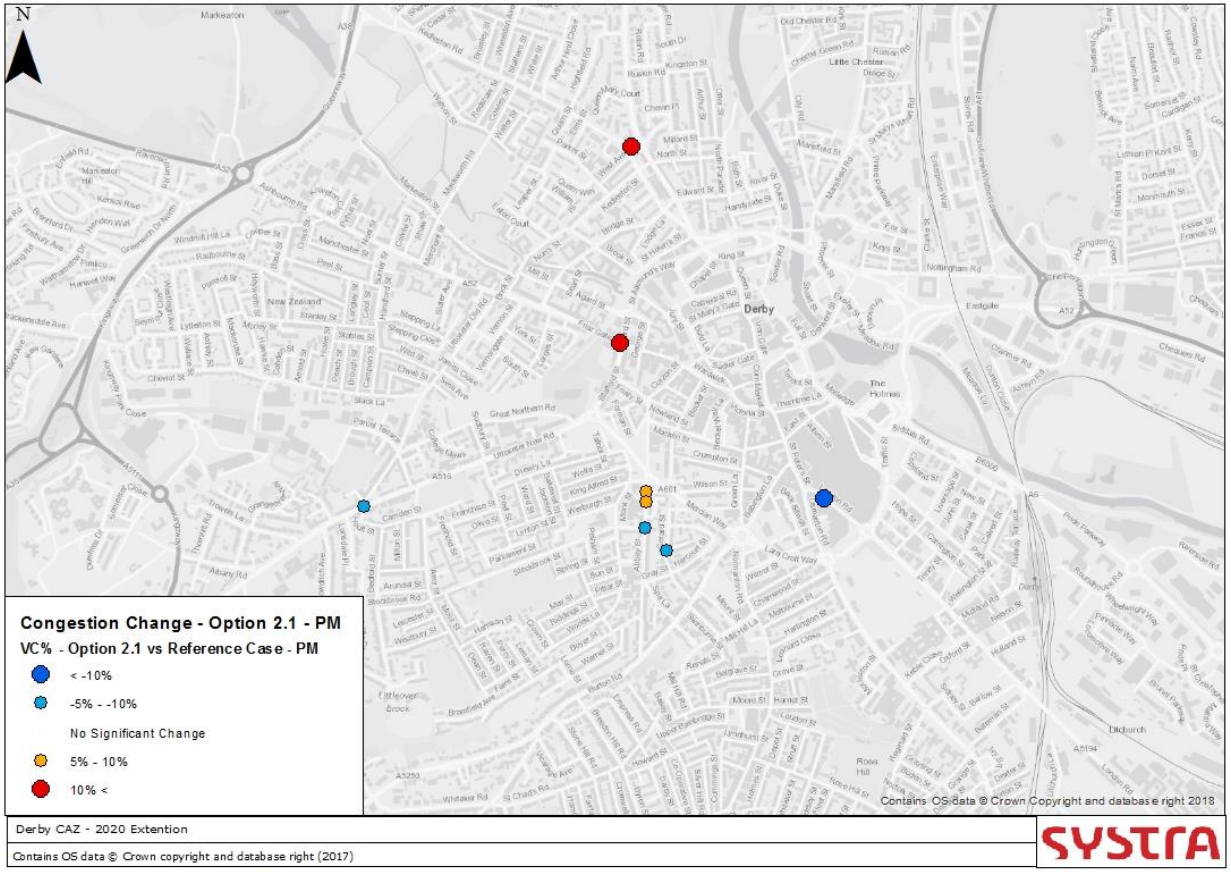
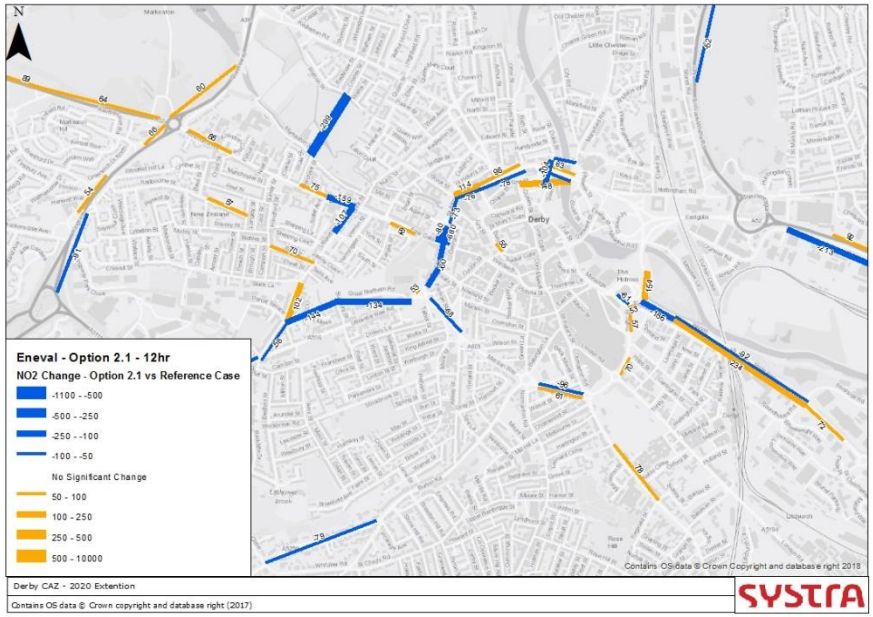
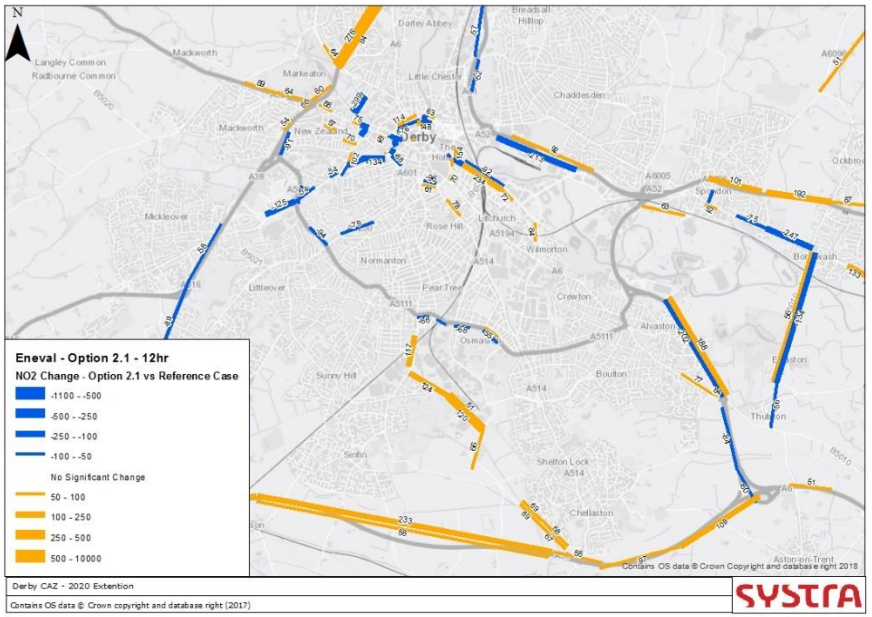


SYSTRA

Option 2.1

Eneval





Stage Alteration				
Op 2.1	NOX		Diff	% Diff
	Ref	Op 2.1		
NB	571	616	45	8%
SB	324	217	-107	-33%
Total	895	833	-62	-7%

SYSTRA

Options 2.1

Summary

- The removal of the ‘Straight ahead movement’ from Ford Street into Stafford Street in Stage 1 of the Friar Gate signal stages results in a reduction in southbound traffic flow on Stafford Street.

- This reduction in flow results in a corresponding reduction in Southbound NOX values, with a total reduction 7% , substantially below the 42% reduction target.

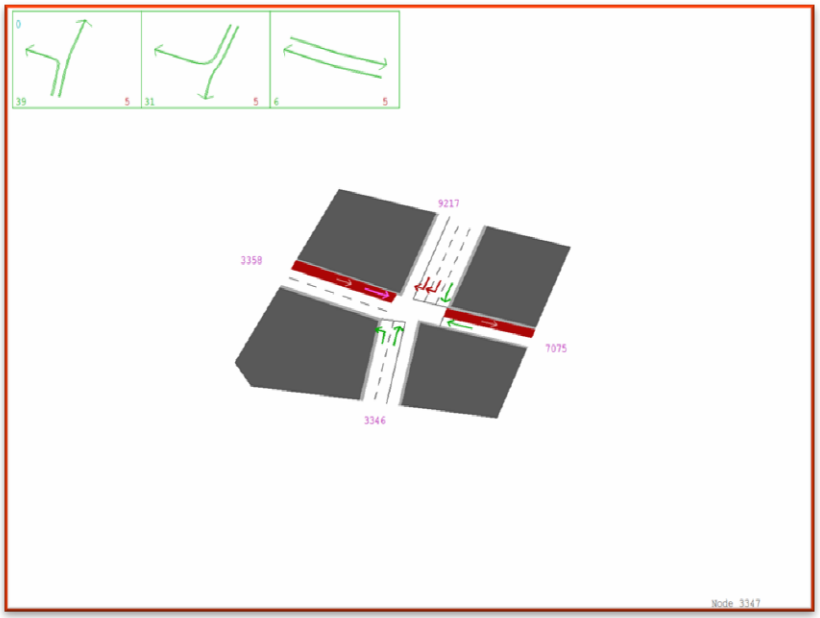
- This option has no significant impact on Northbound traffic movements with NOX values increasing due to increased congestion and reduced speeds in this direction.

Option 2.2

Option 2.2

Introduction

- Option 2.2 builds on Option 2.1 but reduces the green times for the Ford Street arm of the junction.

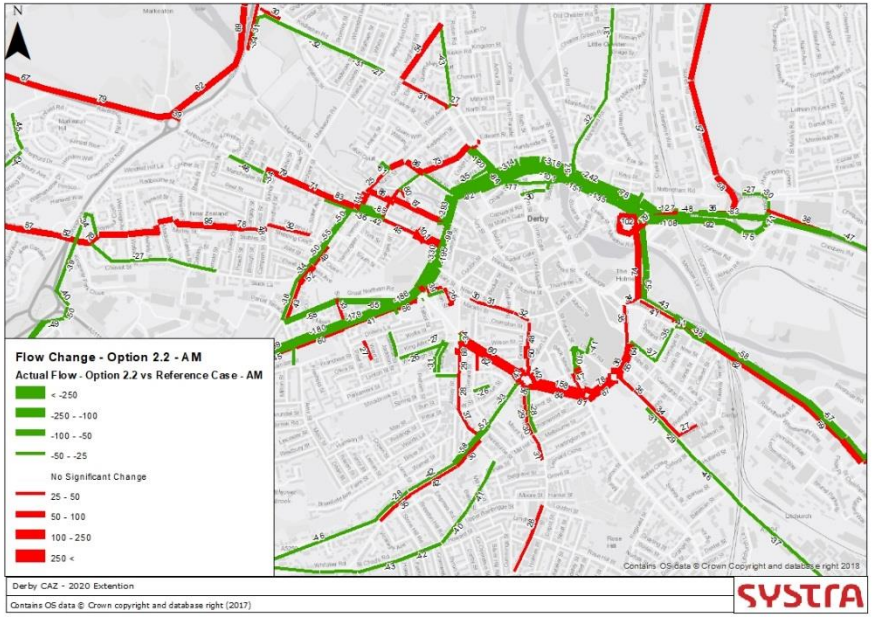


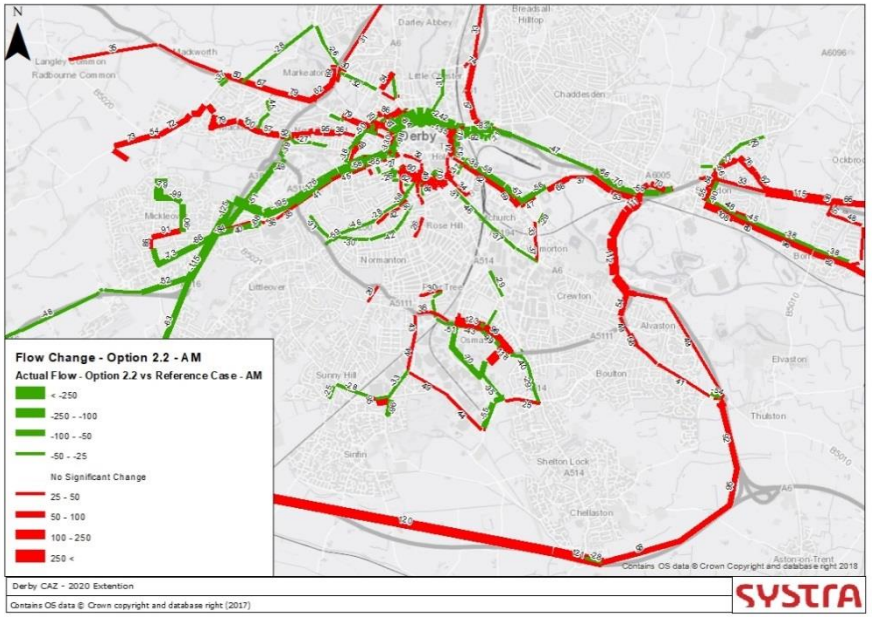
- Stage 1 (Stafford Street) – remains unchanged
- Stage 2 (Ford Street) – 6 second reduction in green time.
- Stage 3 (Friar Gate) – 6 seconds added to green time *.

*Time has been added to the Friar Gate stage, however this could be transferred to the pedestrian movements across the Ring Road.

Option 2.2

Flow Change - AM

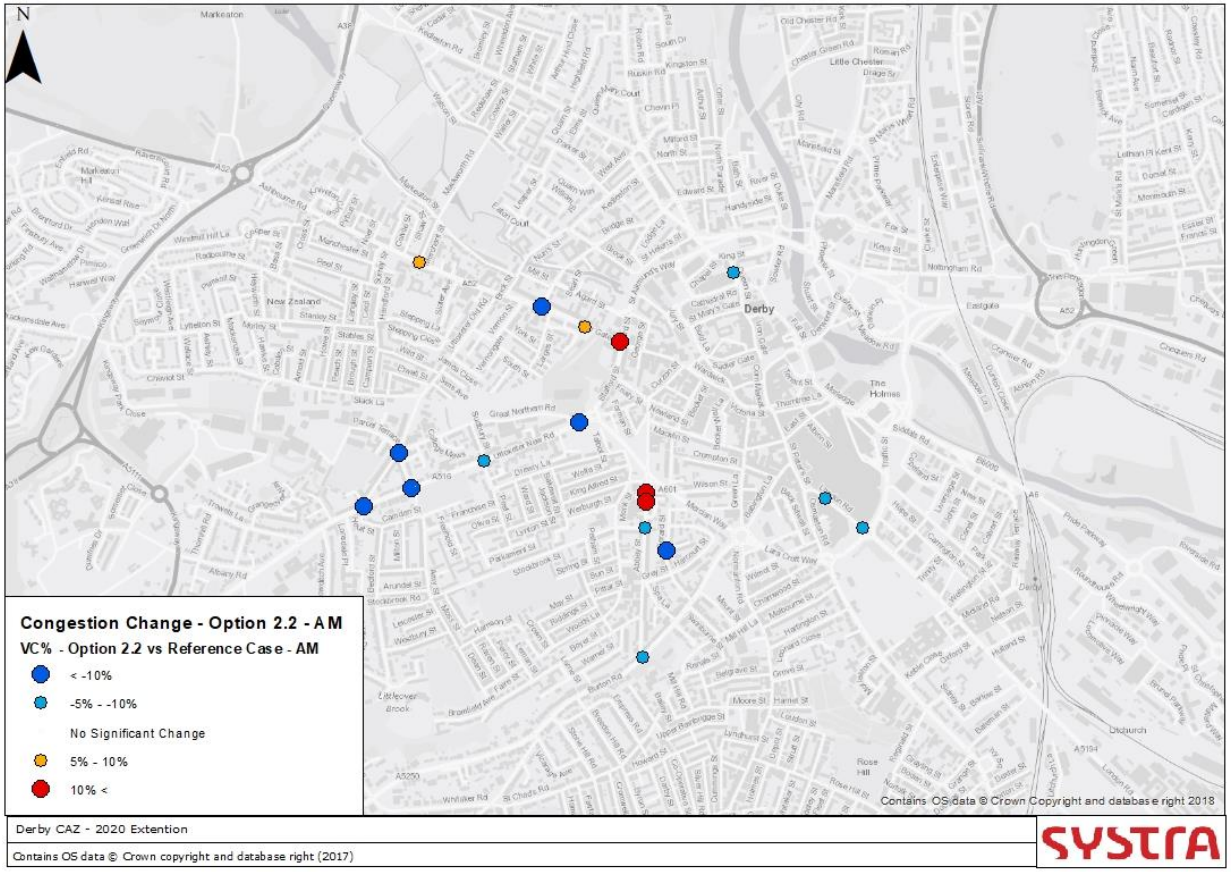




SYSTRA

Option 2.2

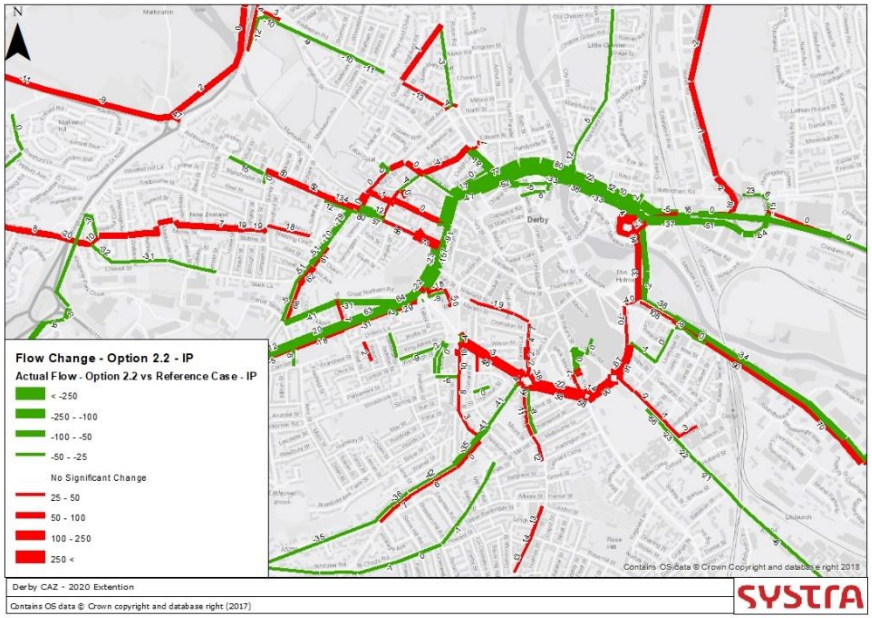
Congestion Change - AM

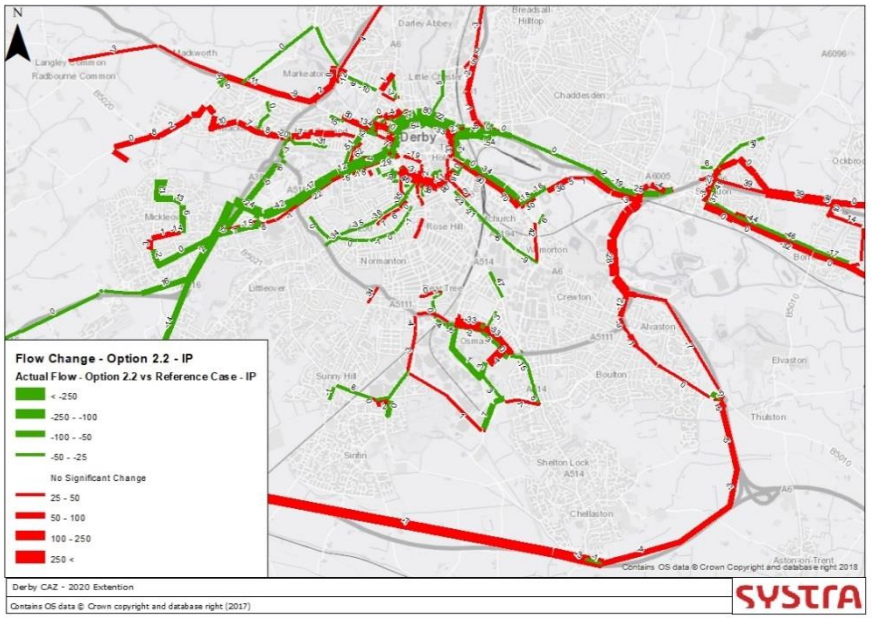


SYSTRA

Option 2.2

Flow Change - IP

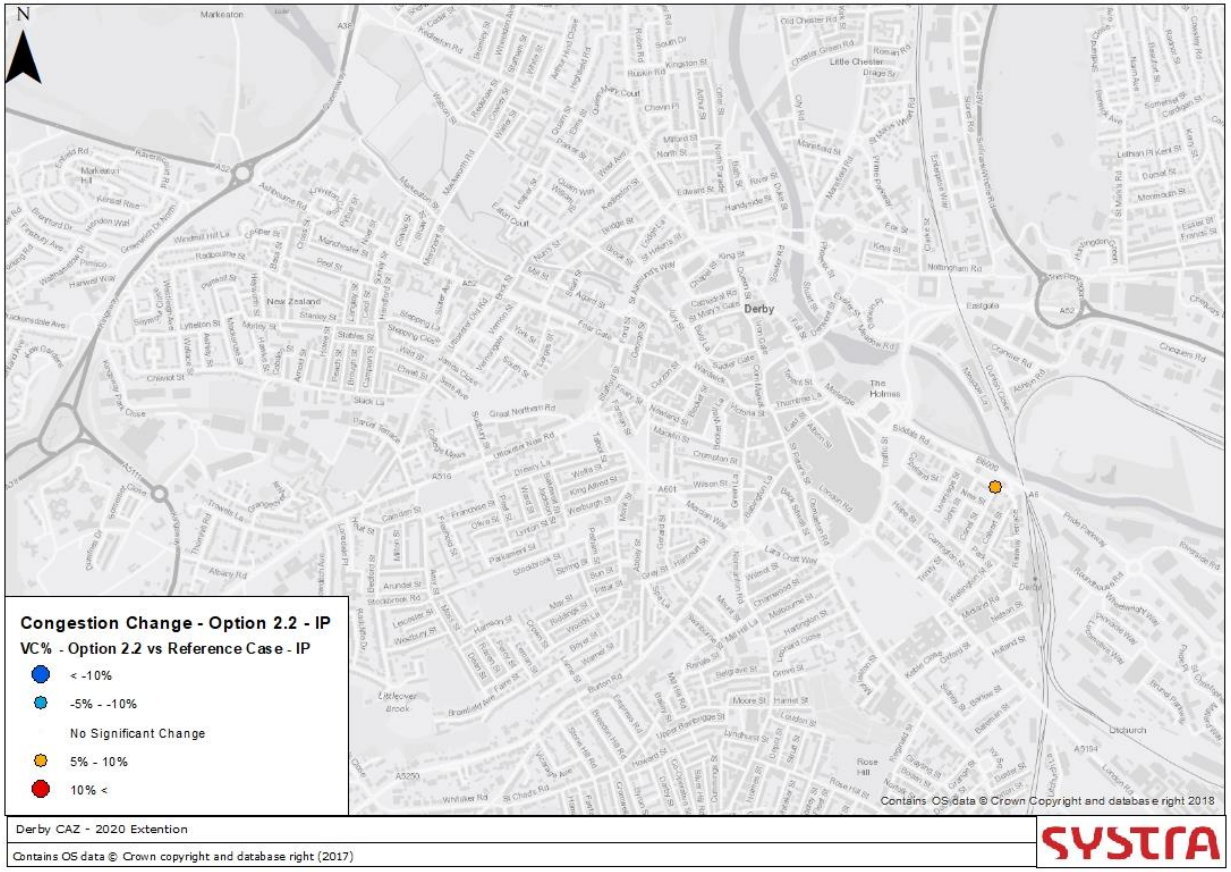




SYSTRA

Option 2.2

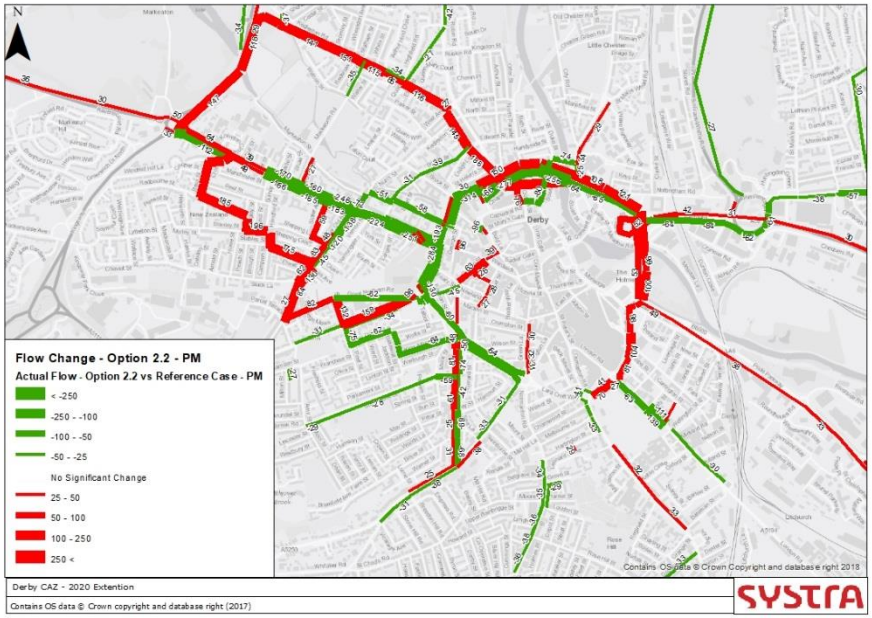
Congestion Change - IP

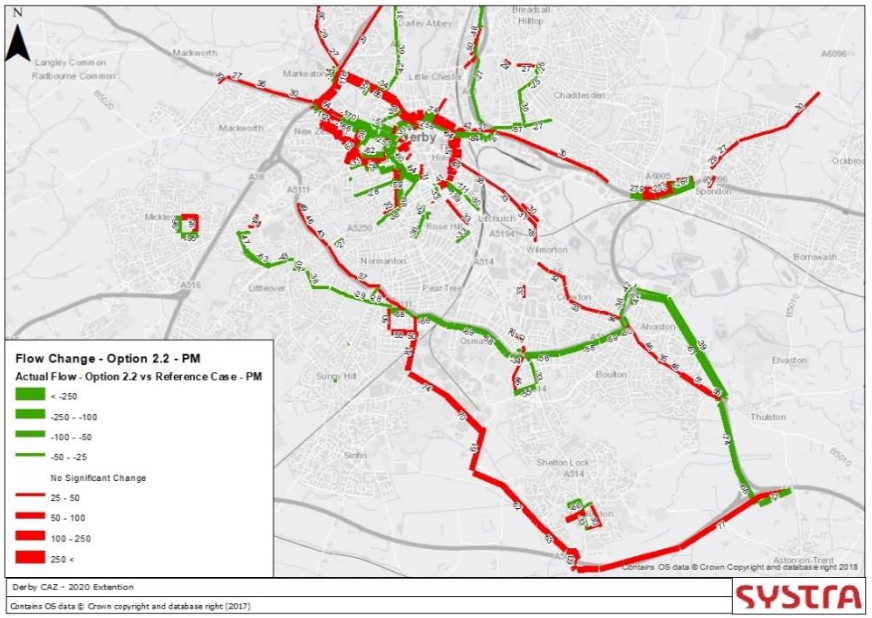


SYSTRA

Option 2.2

Flow Change - PM

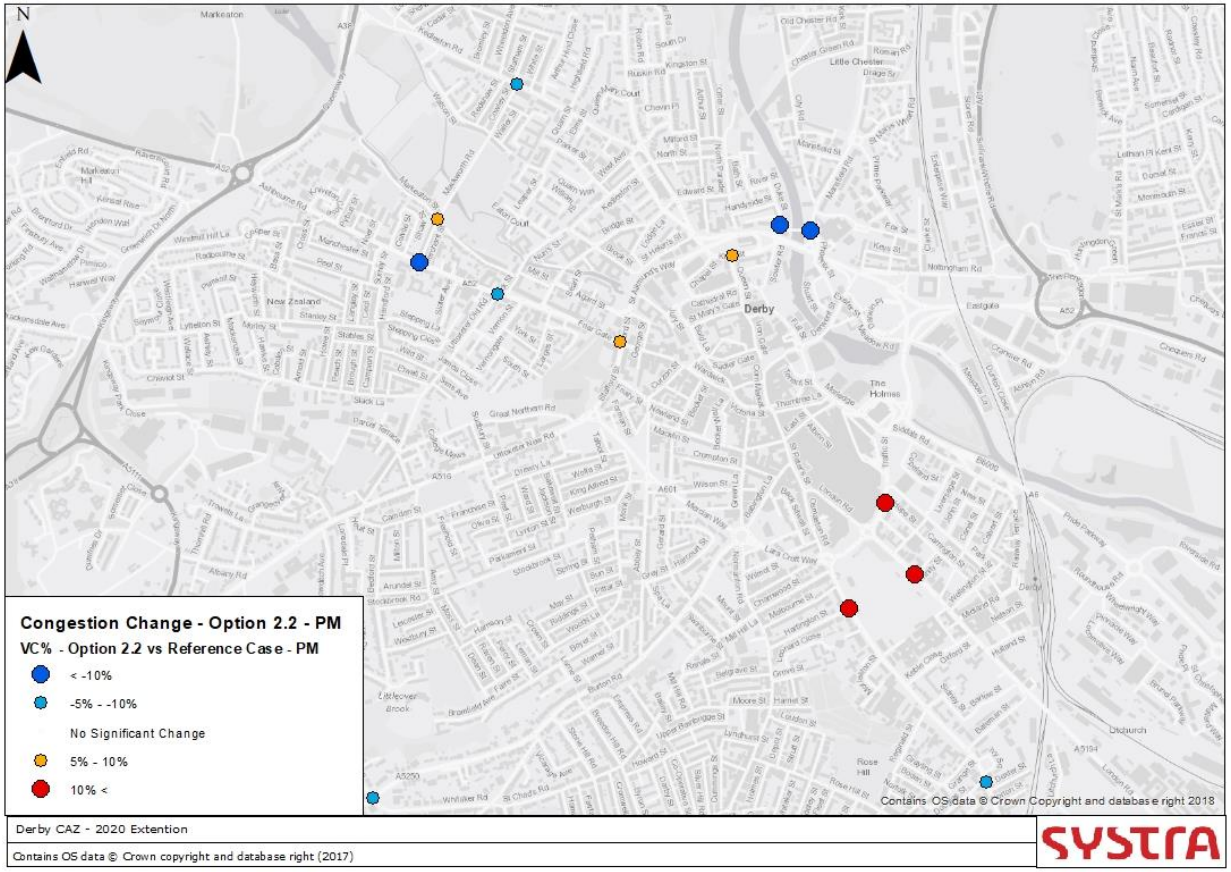




SYSTRA

Option 2.2

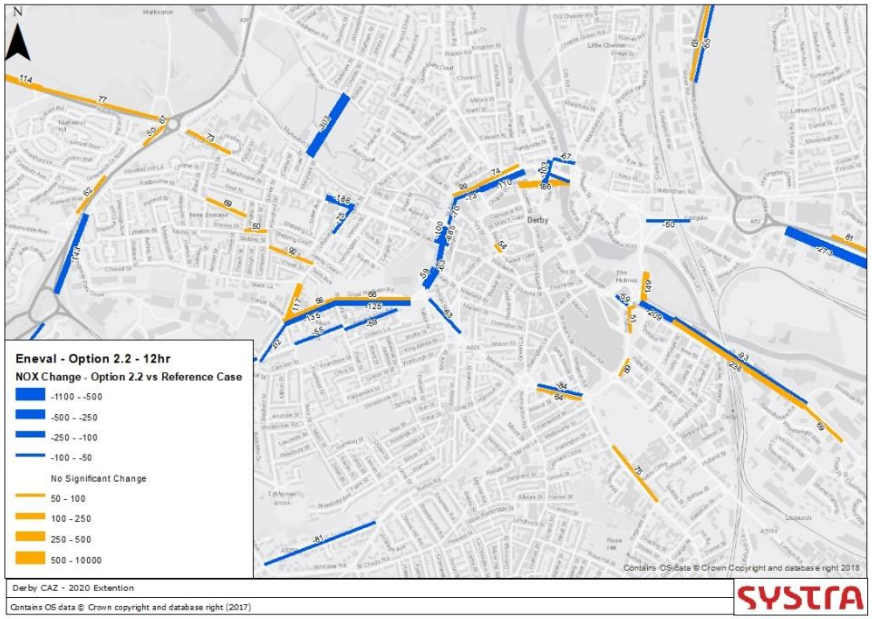
Congestion Change - PM

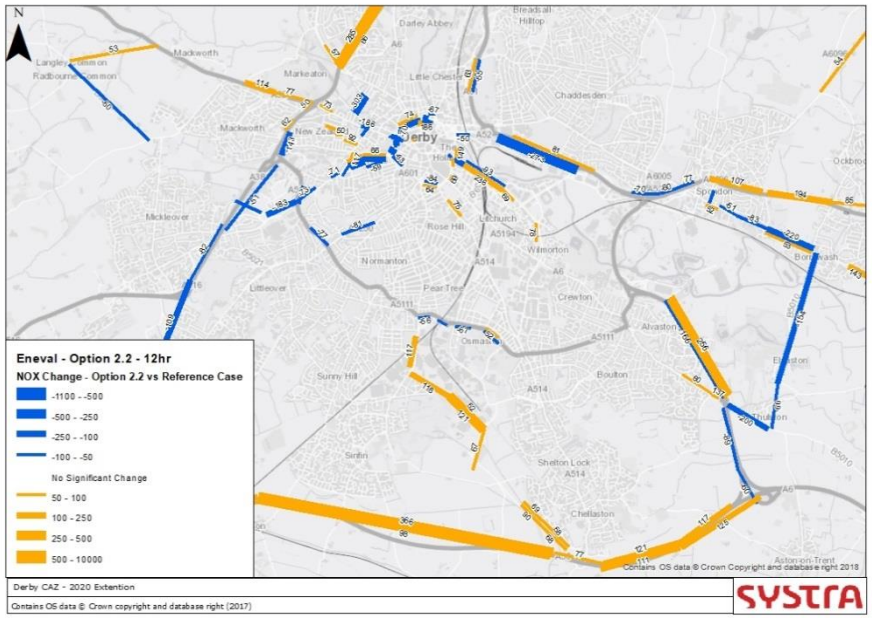


SYSTRA

Option 2.2

Eneval





Timing alteration				
Op 2.2	NOX		Diff	% Diff
	Ref	Op 2.2		
NB	571	601	30	5%
SB	324	190	-134	-41%
Total	895	791	-104	-12%

SYSTRA

Options 2.2

Summary

- In Option 2.2, overall NOX totals have reduced to -12%, still below the -42% target.
- There is however a 41% reduction in NOX on the Southbound direction which is close to the target for this direction.
- NOX levels in the Northbound direction on Stafford Street reduce slightly compared to the previous option, but remain above the Reference Case levels.

General Improvements				
Ref	NOX		Diff	% Diff
	Base	Ref		
NB	557	571	13	2%
SB	380	324	-56	-15%
Total	938	895	-43	-5%

Physical Infrastructure				
Op 1.1	NOX		Diff	% Diff
	Ref	Op 1.1		
NB	571	584	14	2%
SB	324	331	8	2%
Total	895	916	21	2%

Stage Alteration				
Op 2.1	NOX		Diff	% Diff
	Ref	Op 2.1		
NB	571	616	45	8%
SB	324	217	-107	-33%
Total	895	833	-62	-7%

Timing alteration (Friar Gate)				
Op 2.2	NOX		Diff	% Diff
	Ref	Op 2.2		
NB	571	601	30	5%
SB	324	190	-134	-41%
Total	895	791	-104	-12%

Option 1.2

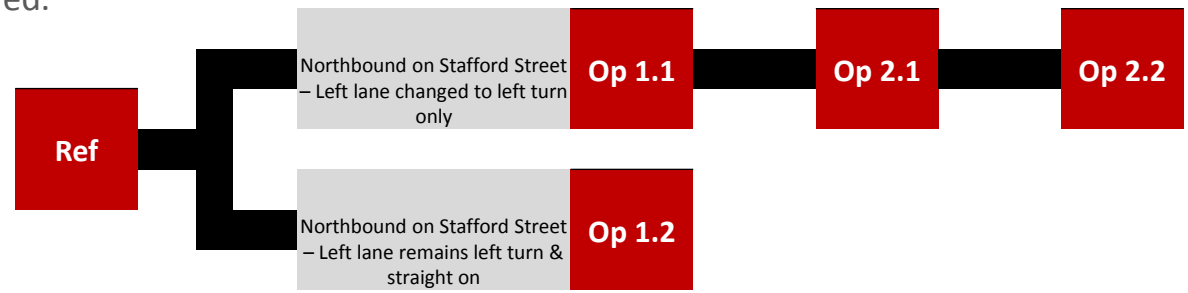
Option 1.2

Introduction

- Option 1.2, includes all physical alterations pertaining to the Stafford Street/ Uttoxeter New Road / Mercian Way roundabout only:
  - Stafford Street - Northbound exit from roundabout into Stafford Street restricted to one lane.
  - Mercian Way – Left lane approach to the roundabout restricted to left turn only into Uttoxeter New Rd .
  - Uttoxeter New Road– Right lane approach to the roundabout restricted to right turn only to Mercian Way.

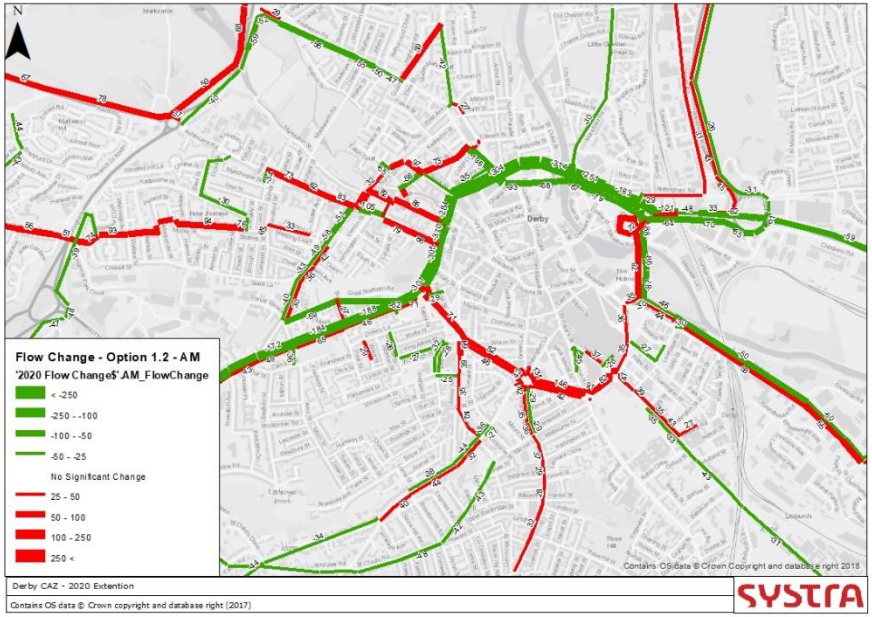
- The changes to the Friar Gate junction have been excluded within Option 1.2 as they allow greater levels of traffic to turn left onto Ashbourne Road with a similar reduction on Northbound ahead movement thus having no significant impacts on the overall northbound traffic flow on Stafford Street. This factor combined with the increases in congestion results in an overall increase in NOX emissions compared to the Reference Case.

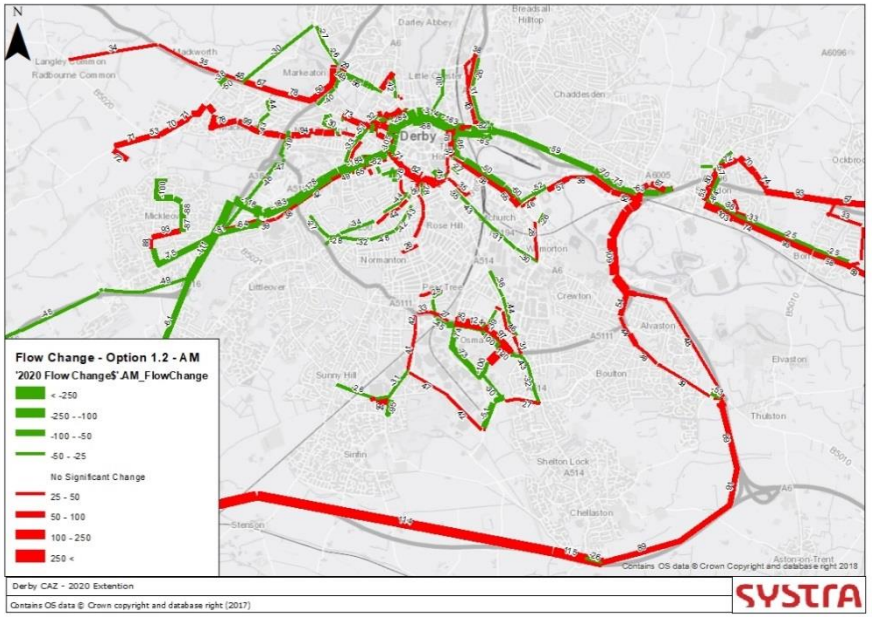
- It is this analysis that leads to the formation of 1.2, in which the NB Stafford Street at Friar Gate remains unaltered.



Option 1.2

Flow Change - AM

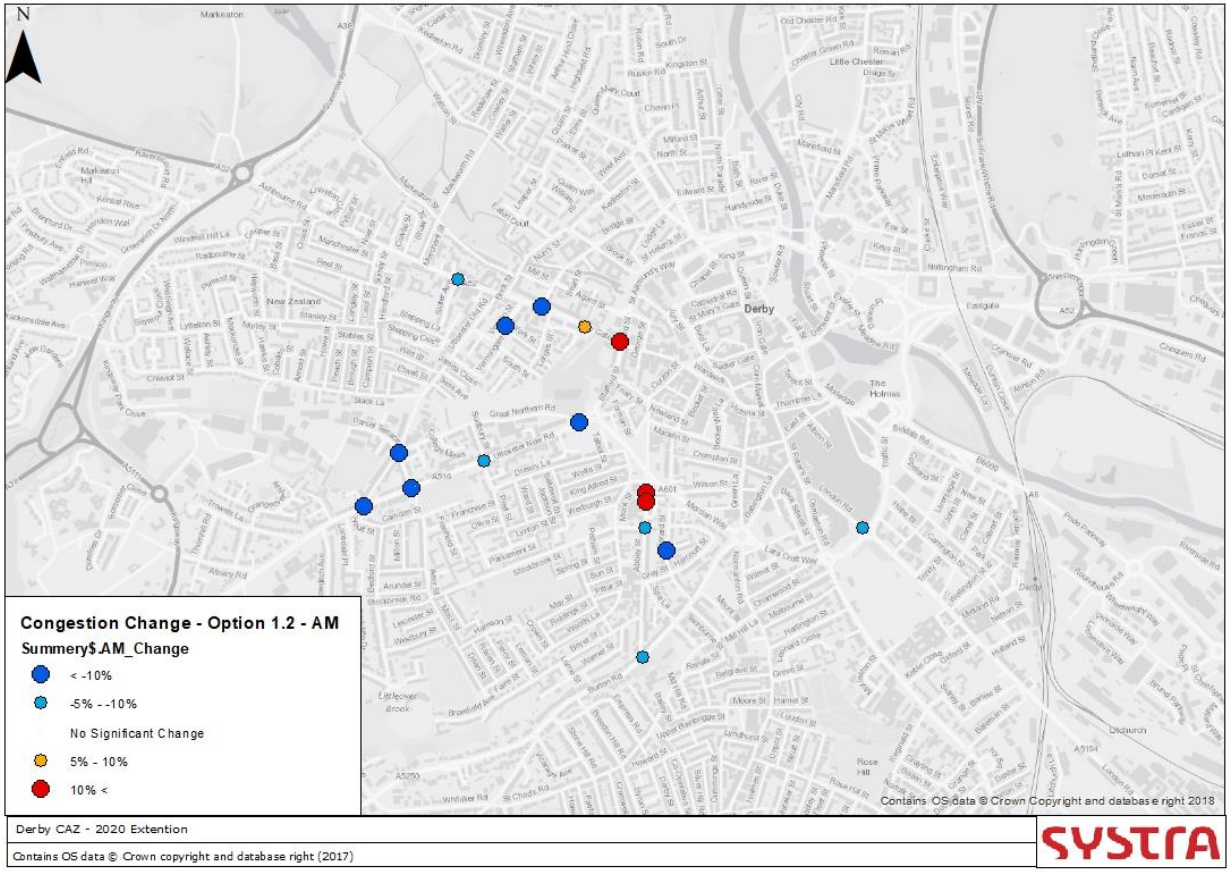




SYSTRA

Option 1.2

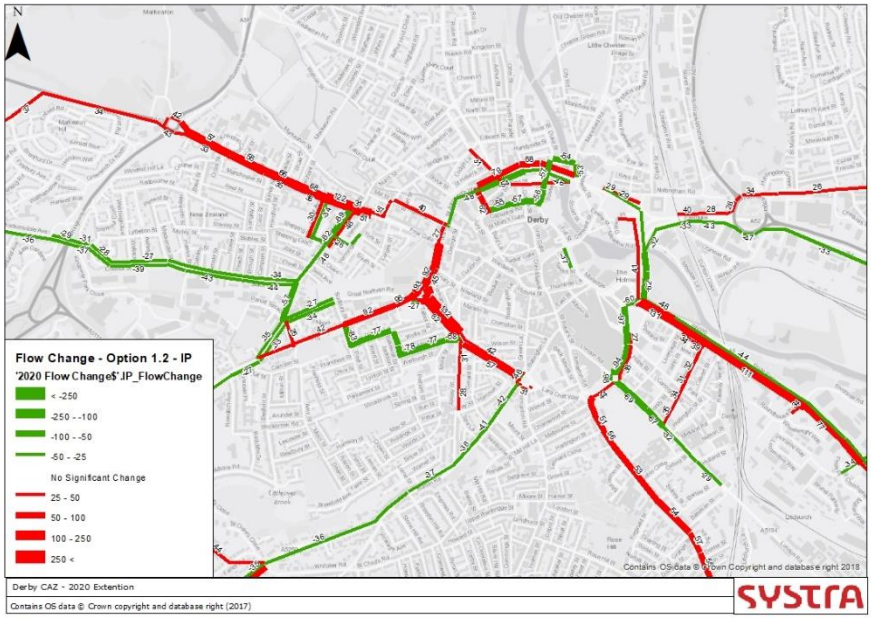
Congestion Change - AM

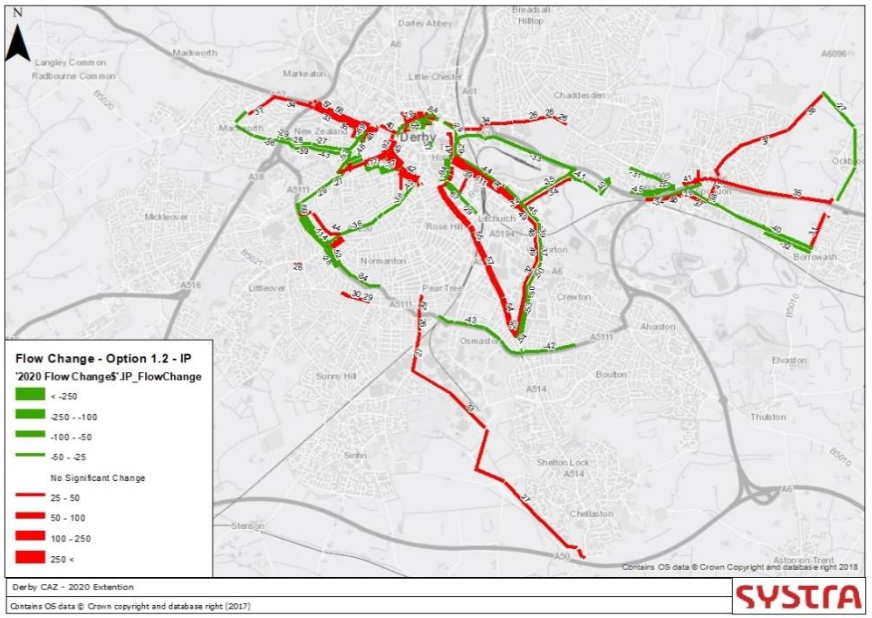


SYSTRA

Option 1.2

Flow Change - IP

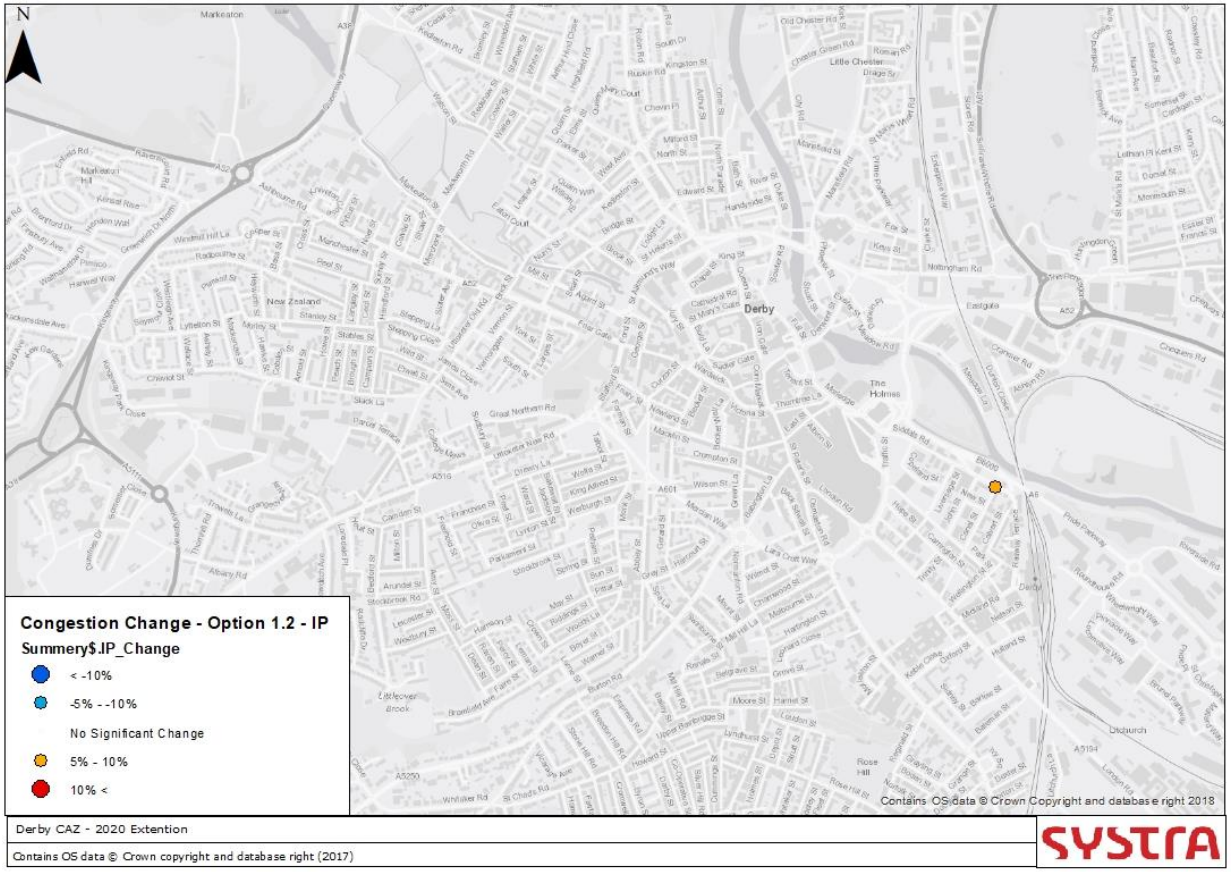




SYSTRA

Option 1.2

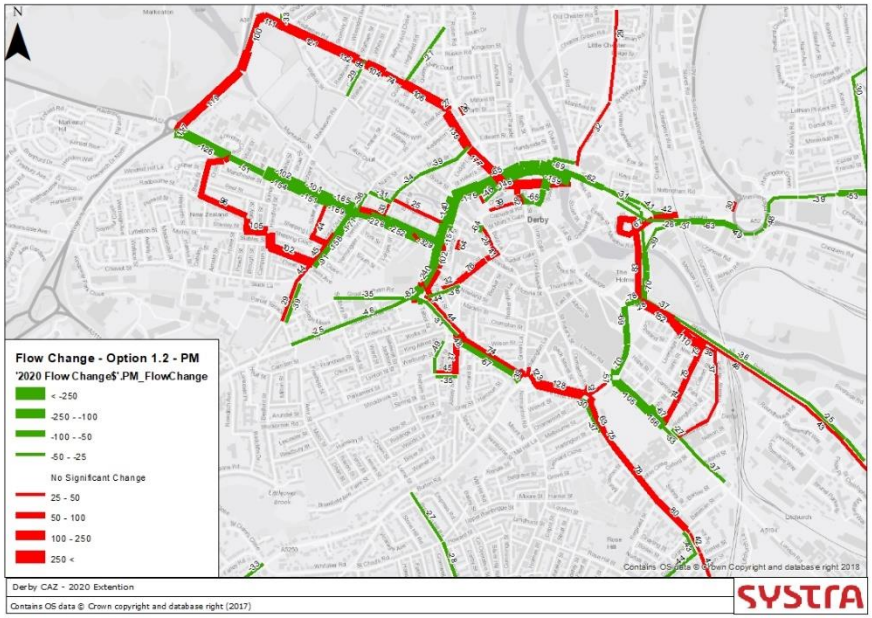
Congestion Change - IP

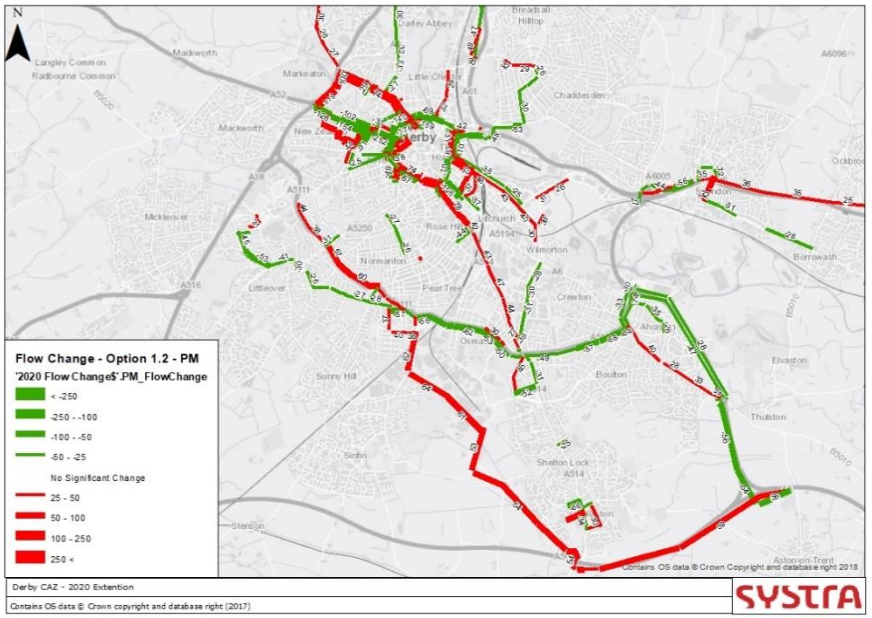


SYSTRA

Option 1.2

Flow Change - PM

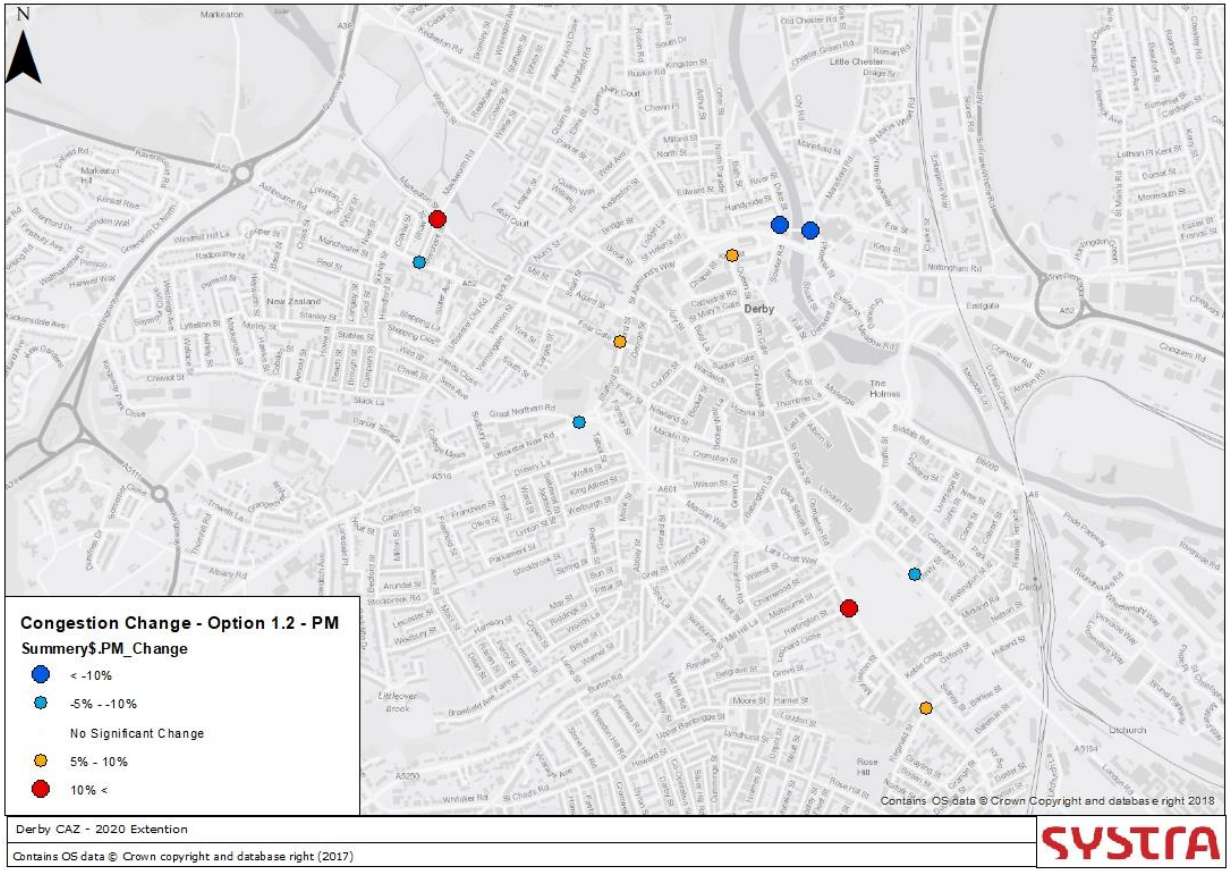




SYSTRA

Option 1.2

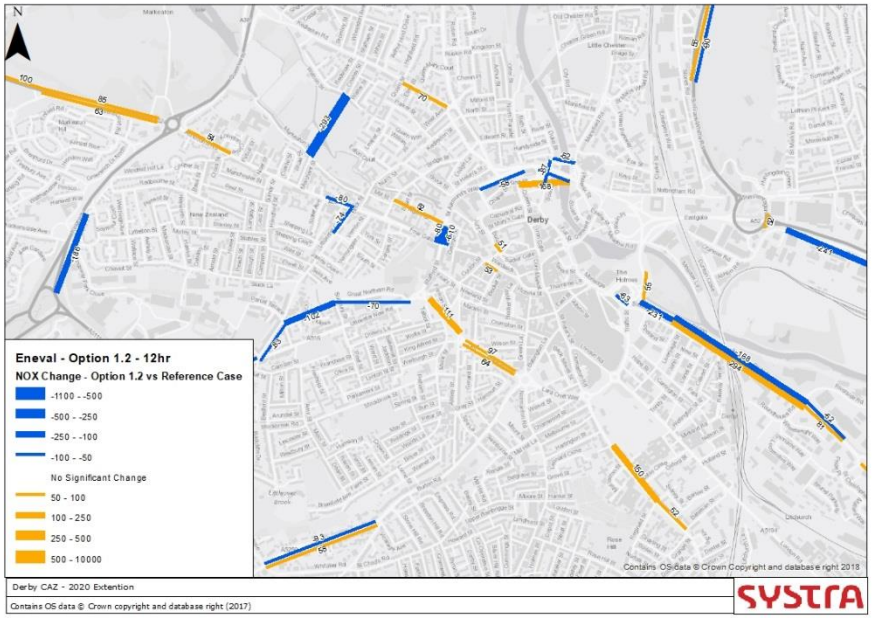
Congestion Change - PM

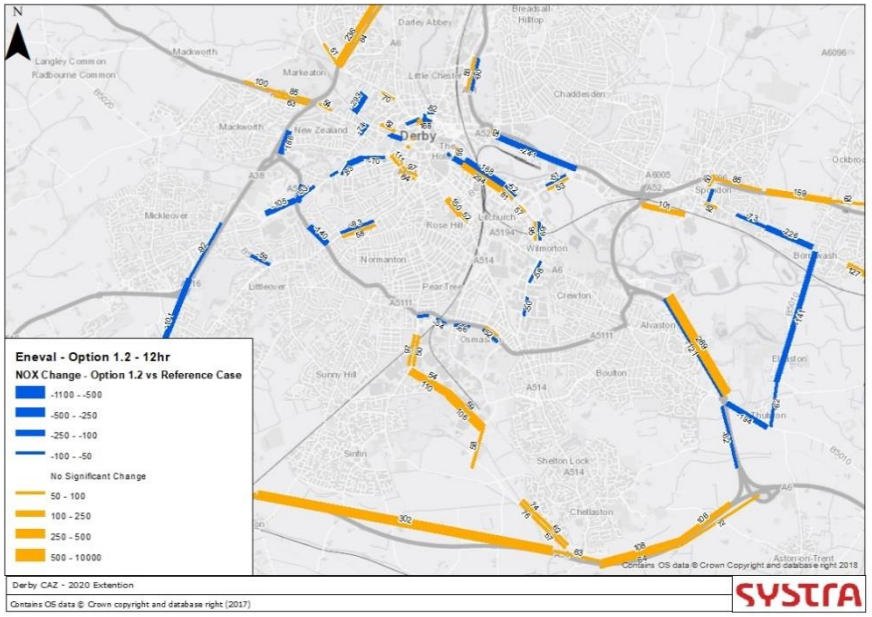


SYSTRA

Option 1.2

Eneval





Physical Infrastructure				
Op 1.2	NOX		Diff	% Diff
	Ref	Op 1.2		
NB	571	559	-12	-2%
SB	324	348	25	8%
Total	895	908	13	1%

Option 1.2

Summary

- The NOX value on Stafford Street shows an increase overall of around 1% compared to the Reference Case, however there is a reduction for the Northbound direction of -2% which did not occur with the segregated left turn lane on the northbound Stafford Street approach to Friar Gate.

- This suggests that the best option for the layout of this junction (Stafford St / Friar Gate) in terms of NOX emissions on Stafford Street is to leave it unaltered in terms of the northbound lanes.

Option 2.3

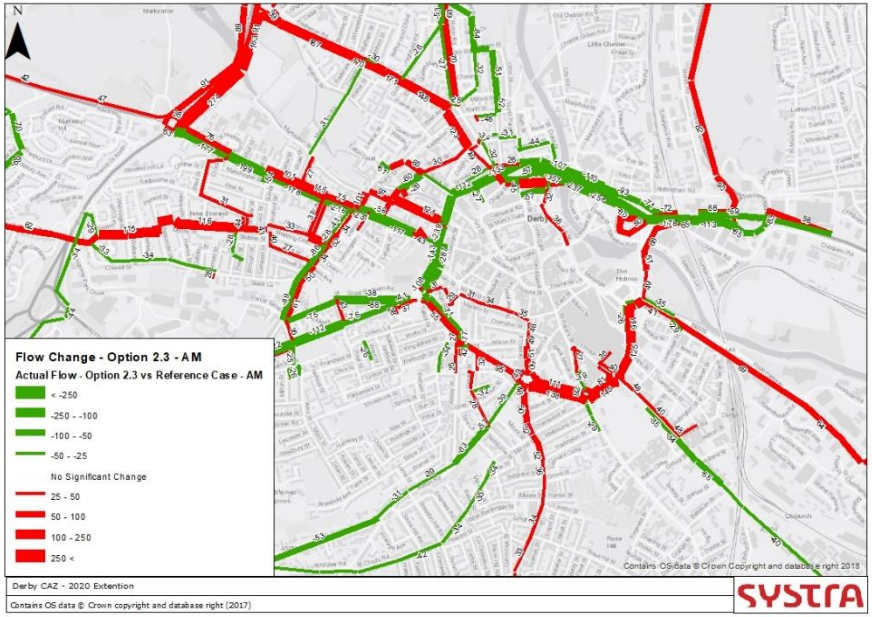
Option 2.3

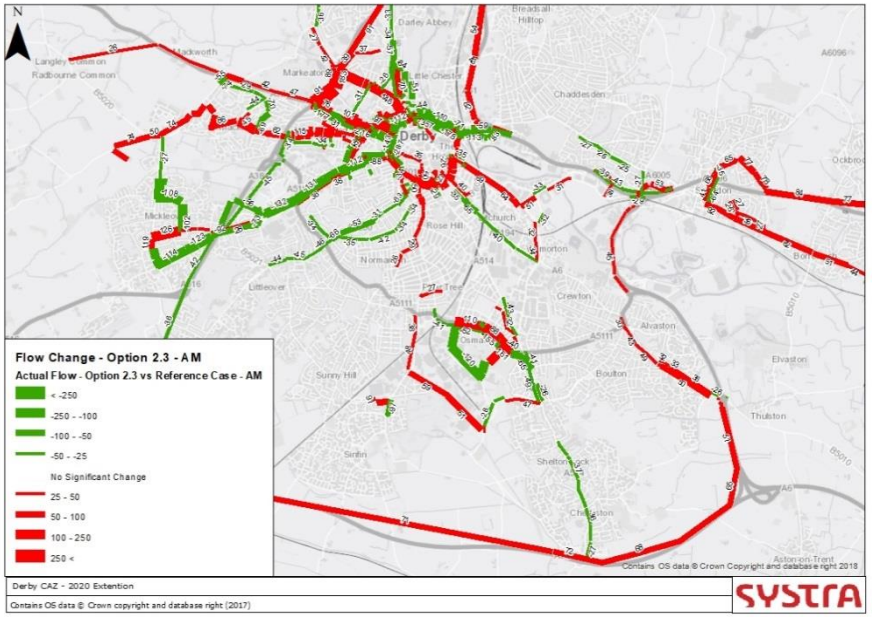
Introduction

- Option 2.3 builds on Option 1.2 but removes the straight ahead southbound movement from Ford Street to Stafford Street during stage 1, similar to Option 2.1.
- Removal of this movement within stage 1 acts to limit the green time for trips traversing from Ford Street to Stafford Street, thus limiting the ability of trips to utilise the route.
- As the model variant was ran with Signal optimisation turned on, signal timings are subject to alterations, however they have not yet been manually altered.

Option 2.3

Flow Change - AM

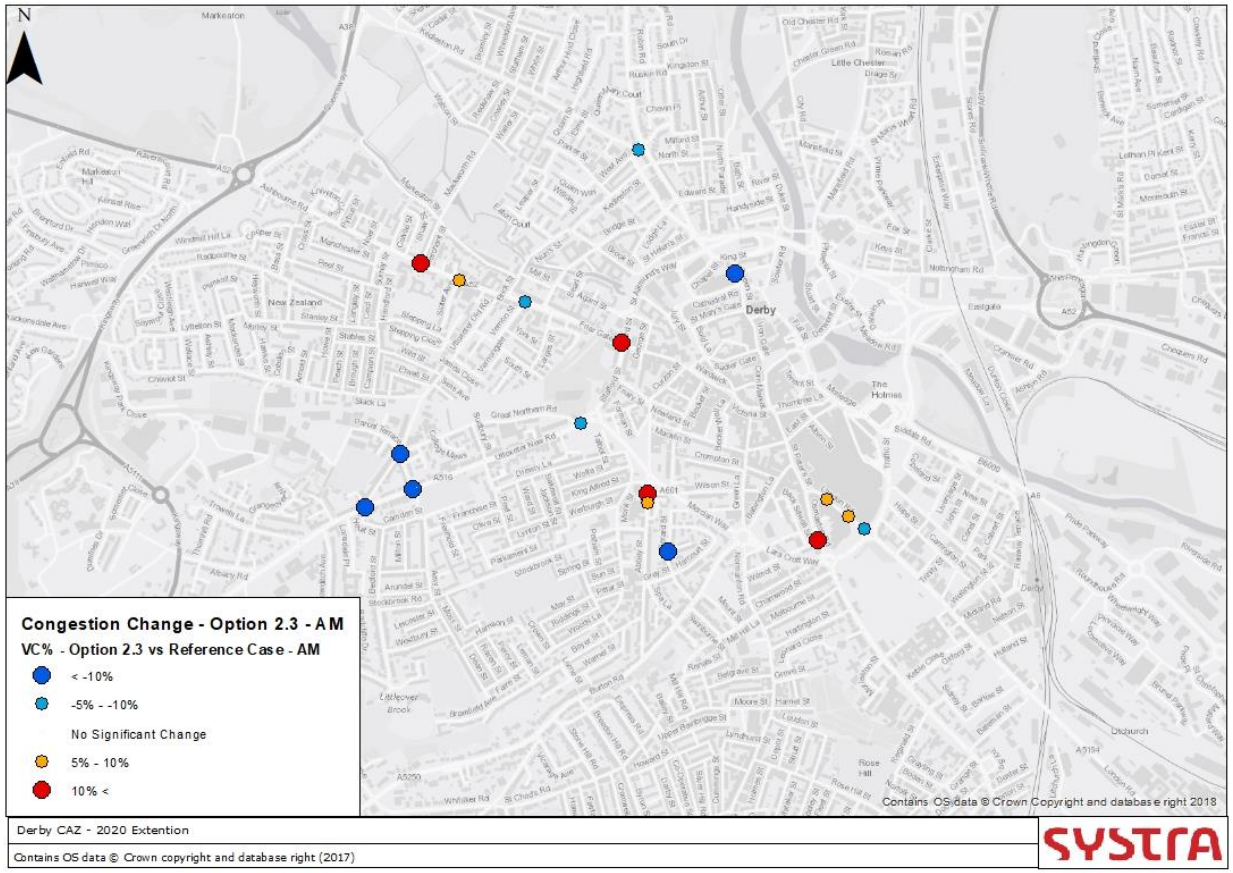




SYSTRA

Option 2.3

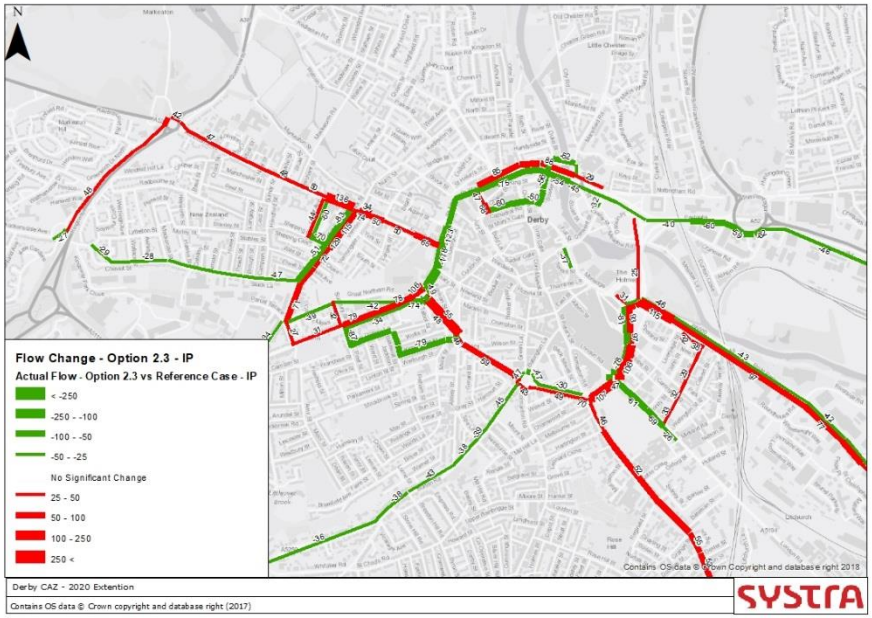
Congestion Change - AM

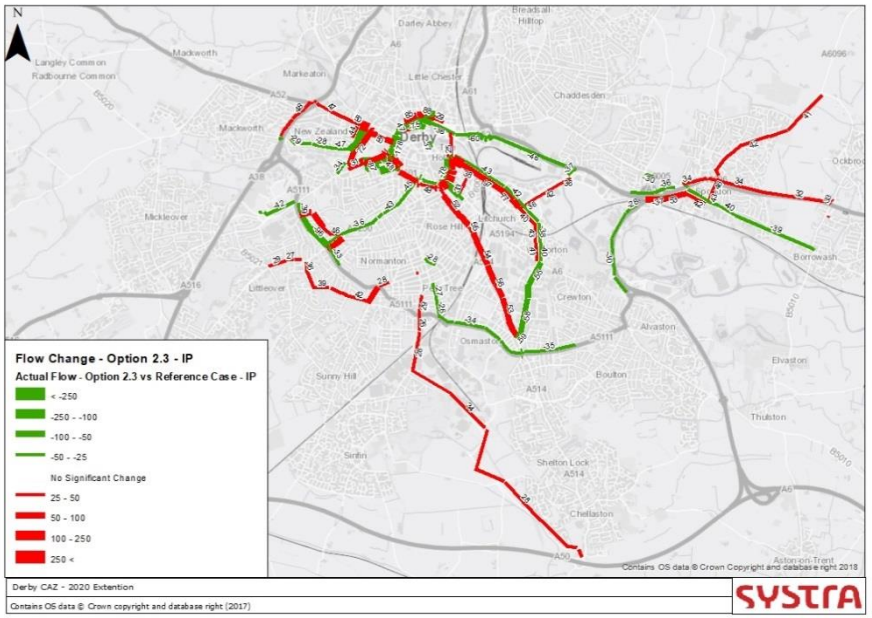


SYSTRA

Option 2.3

Flow Change - IP

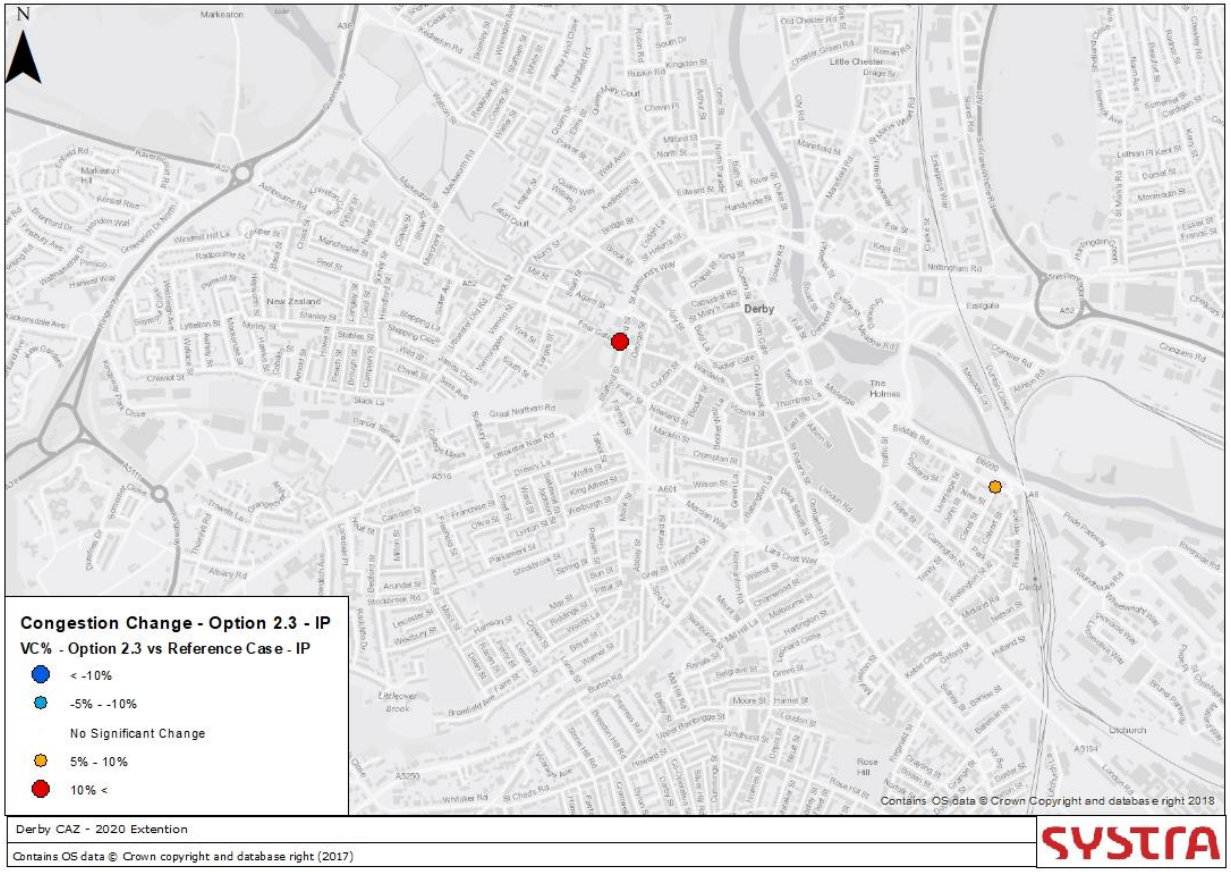




SYSTRA

Option 2.3

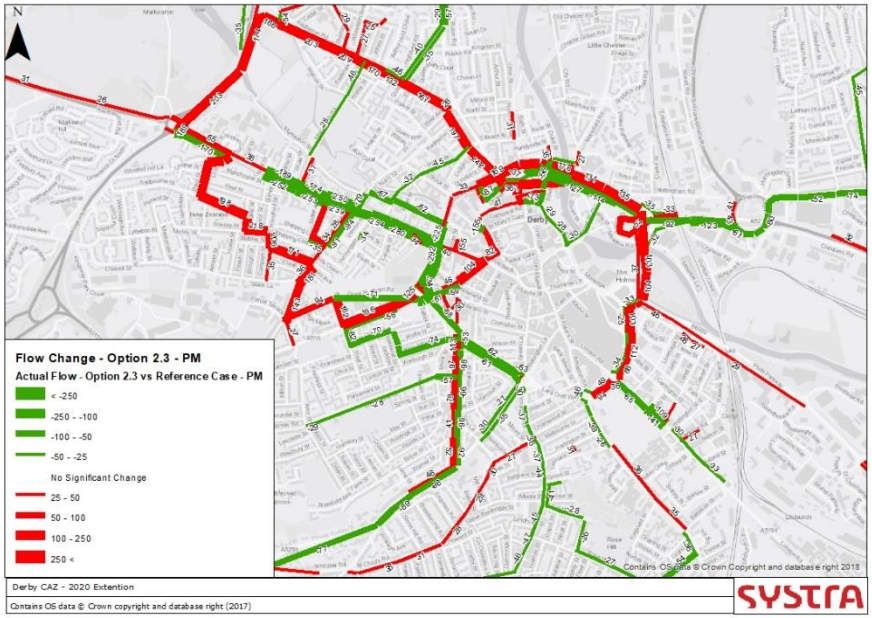
Congestion Change - IP

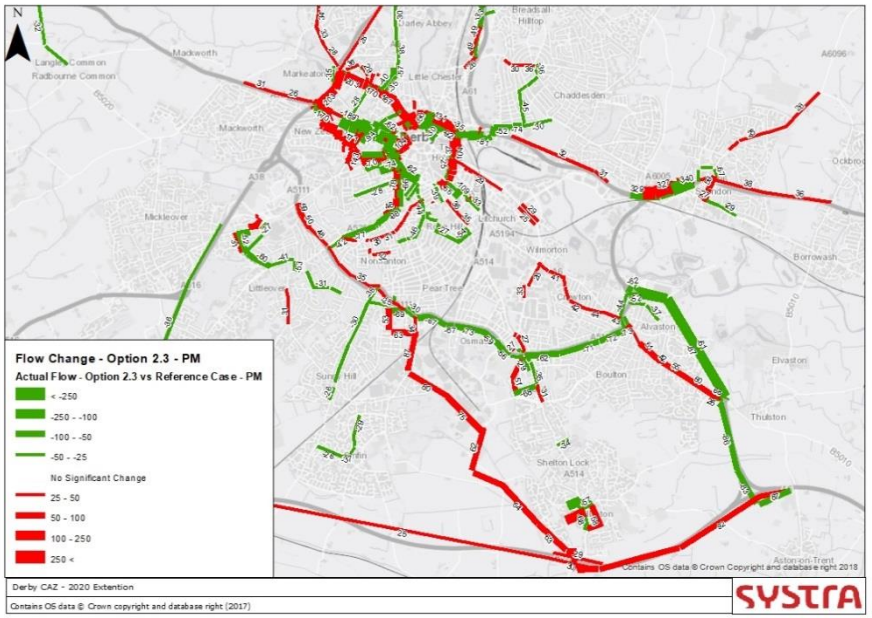


SYSTRA

Option 2.3

Flow Change - PM

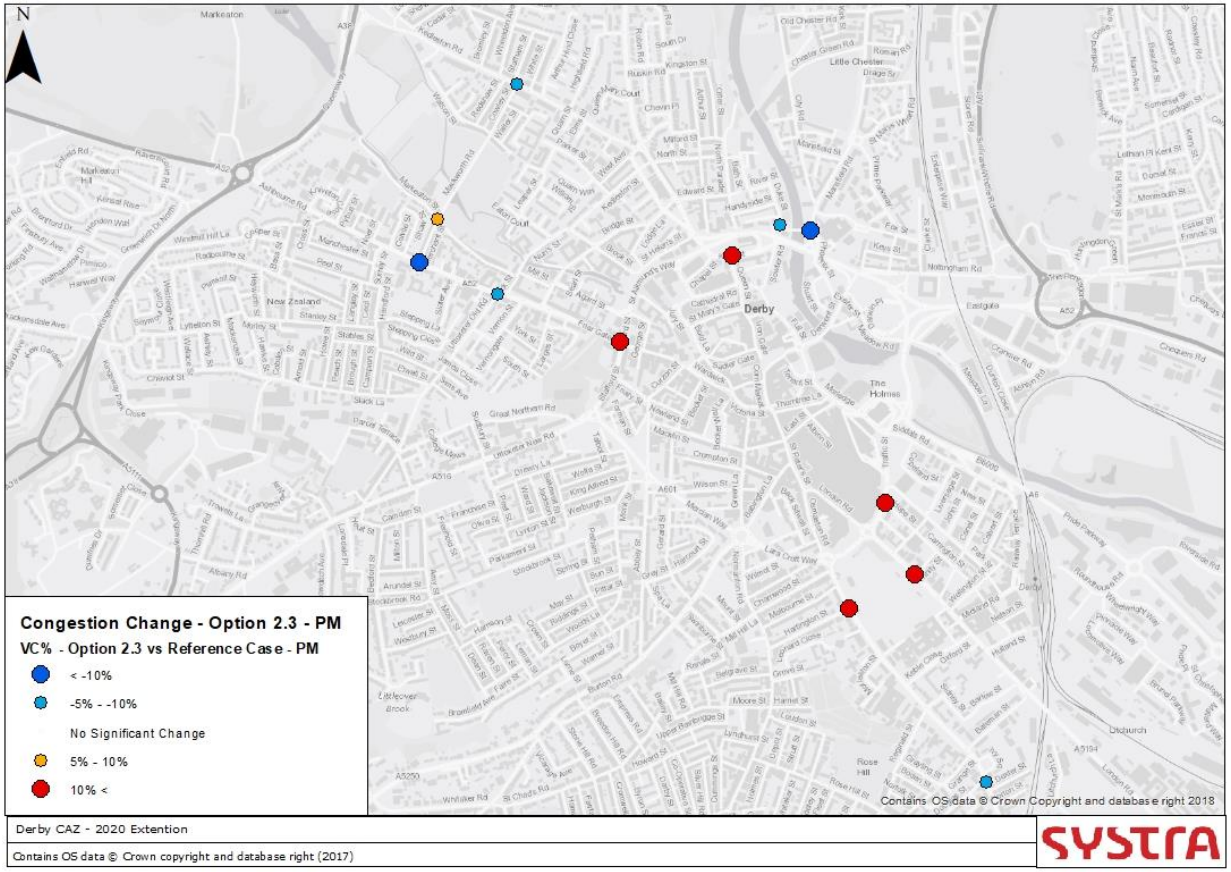




SYSTRA

Option 2.3

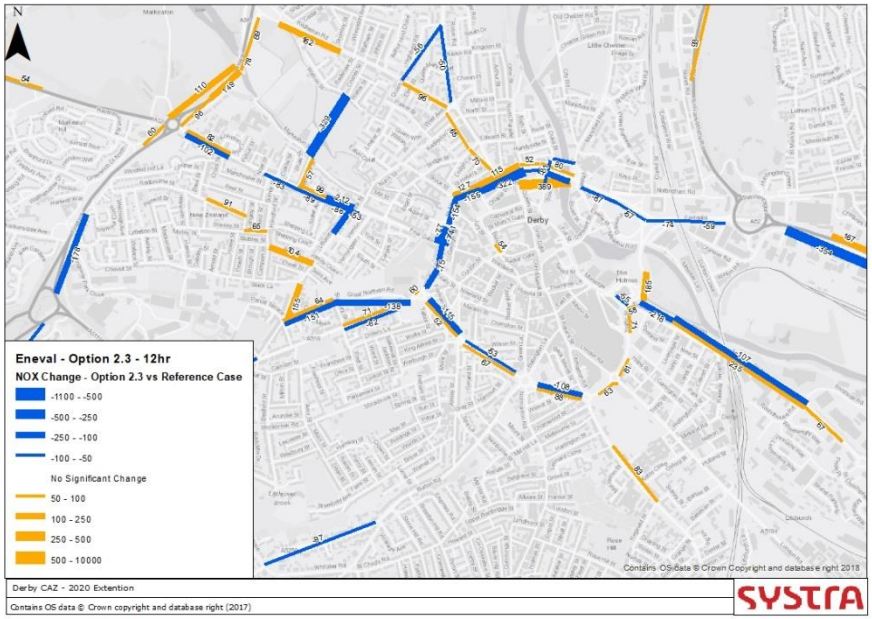
Congestion Change - PM

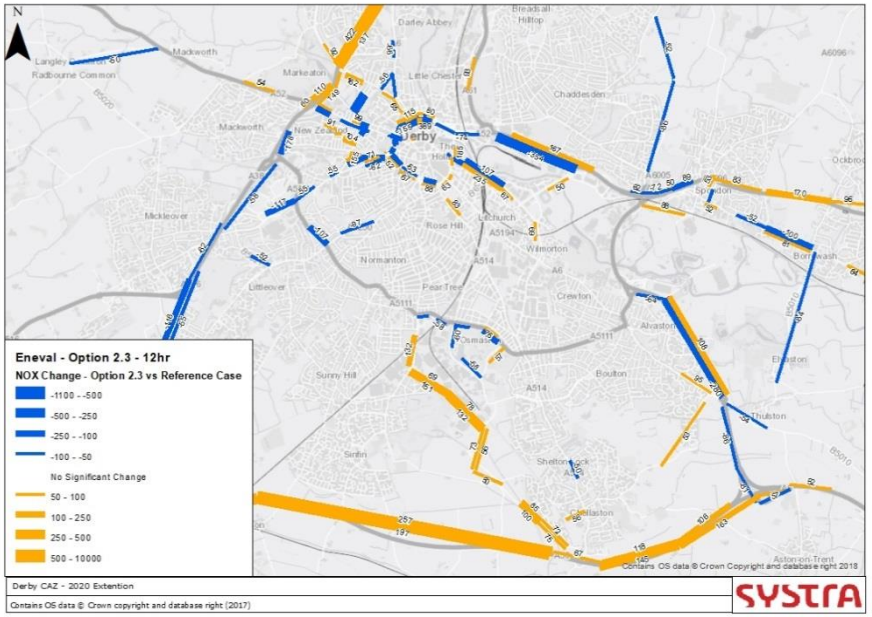


SYSTRA

Option 2.3

Eneval





Stage Alteration				
Op 2.3	NOX		Diff	% Diff
	Ref	Op 2.3		
NB	571	576	5	1%
SB	324	211	-113	-35%
Total	895	787	-107	-12%

Options 2.3

Summary

- As seen in Option 2.1, the removal of the straight ahead southbound movement into Stafford Street from stage 1 results in a reduction in trips traveling Southbound on Stafford Street.

- This reduction in flow results in a corresponding reduction in NOX values, with total changes of -12%, an improvement on the -7% resulting from Option 2.1.

- This is especially significant when looking at each direction individually. Northbound NOX levels increase from option 1.2 levels, whilst southbound NOX levels drops close to target levels, at -35 %.

- By restricting access to Ashbourne Road via Stafford Street, reinstating existing infrastructure in 1.2, a number of trips are instead encouraged to navigate via the northern part of the Inner Ring Road. The same is achieved for trips traveling from Ashbourne Road.

Option 2.4

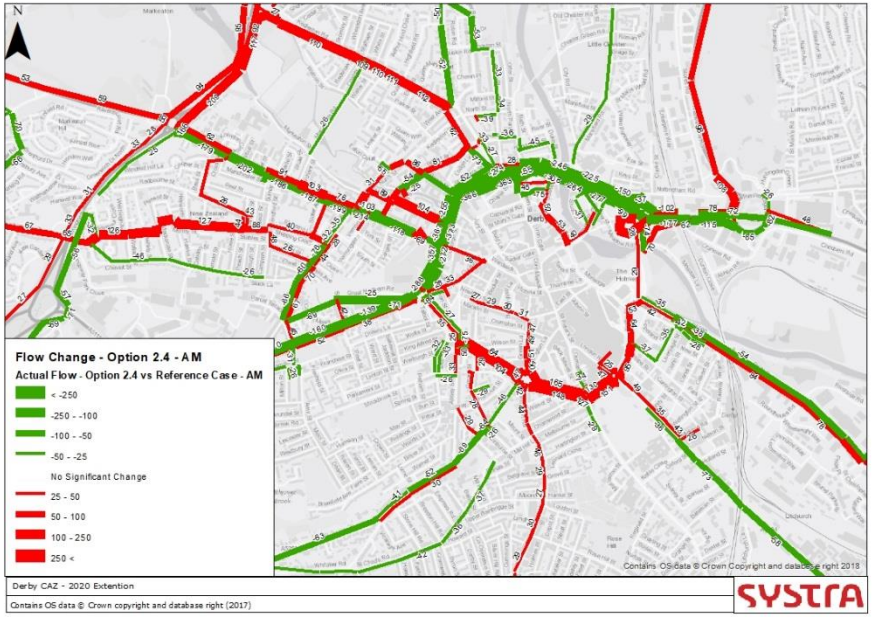
Option 2.4

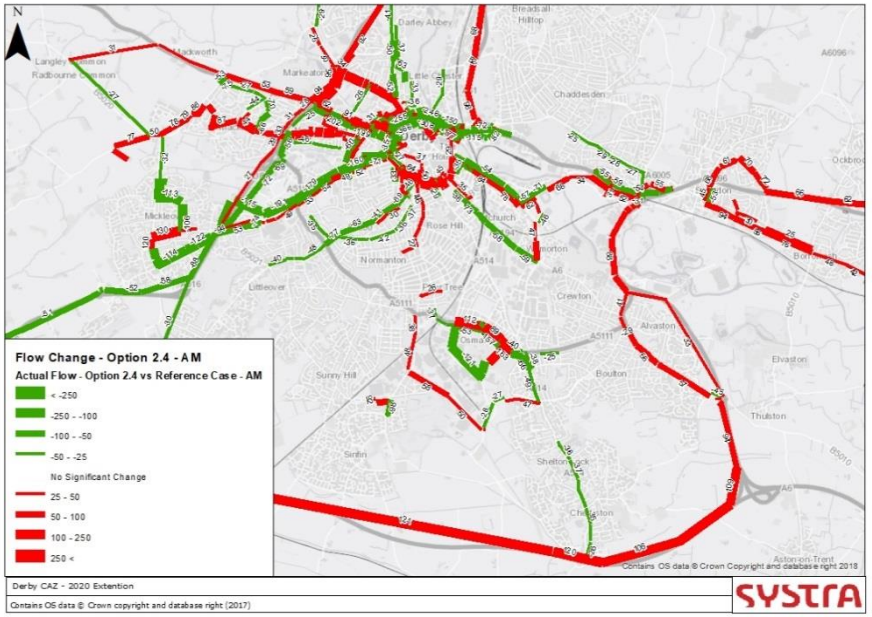
Introduction

- Option 2.4, builds on Option 2.3, but reduces the green times for the Ford Street arm of the junction. This is undertaken in the same way as for option 2.2.

Option 2.4

Flow Change - AM

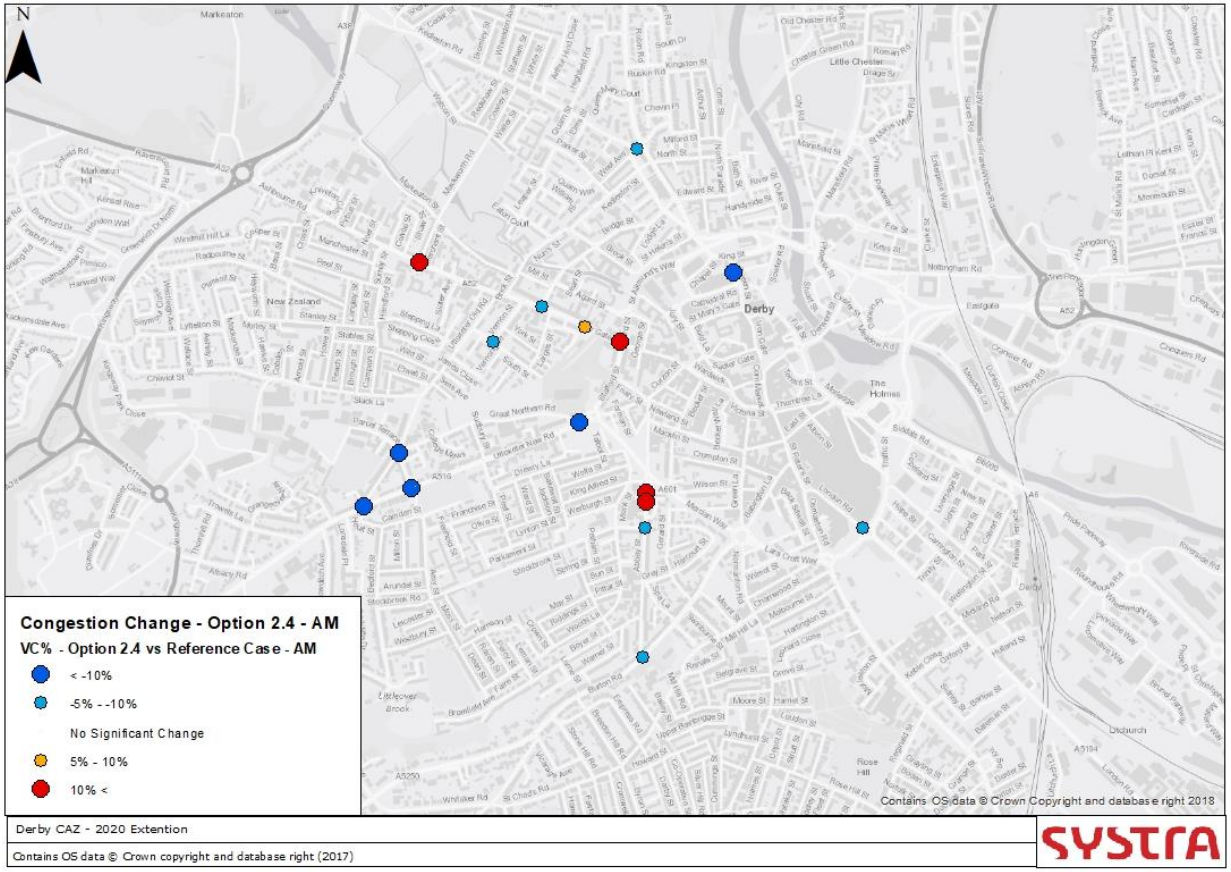




SYSTRA

Option 2.4

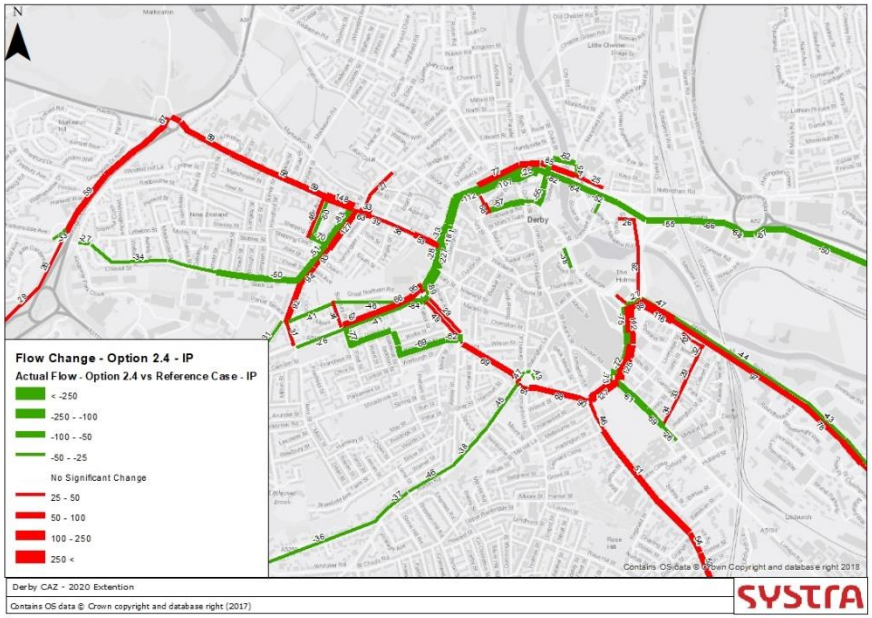
Congestion Change - AM

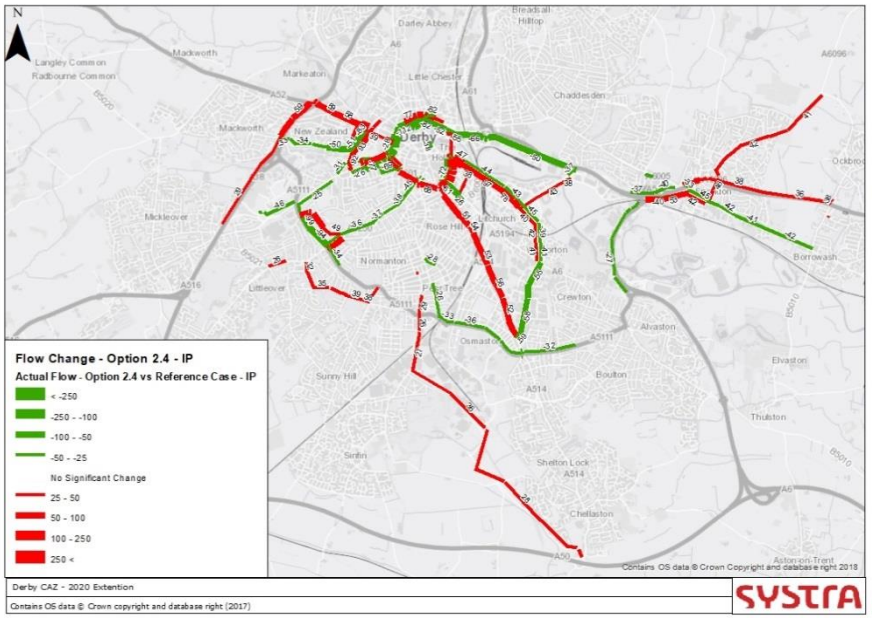


SYSTRA

Option 2.4

Flow Change - IP

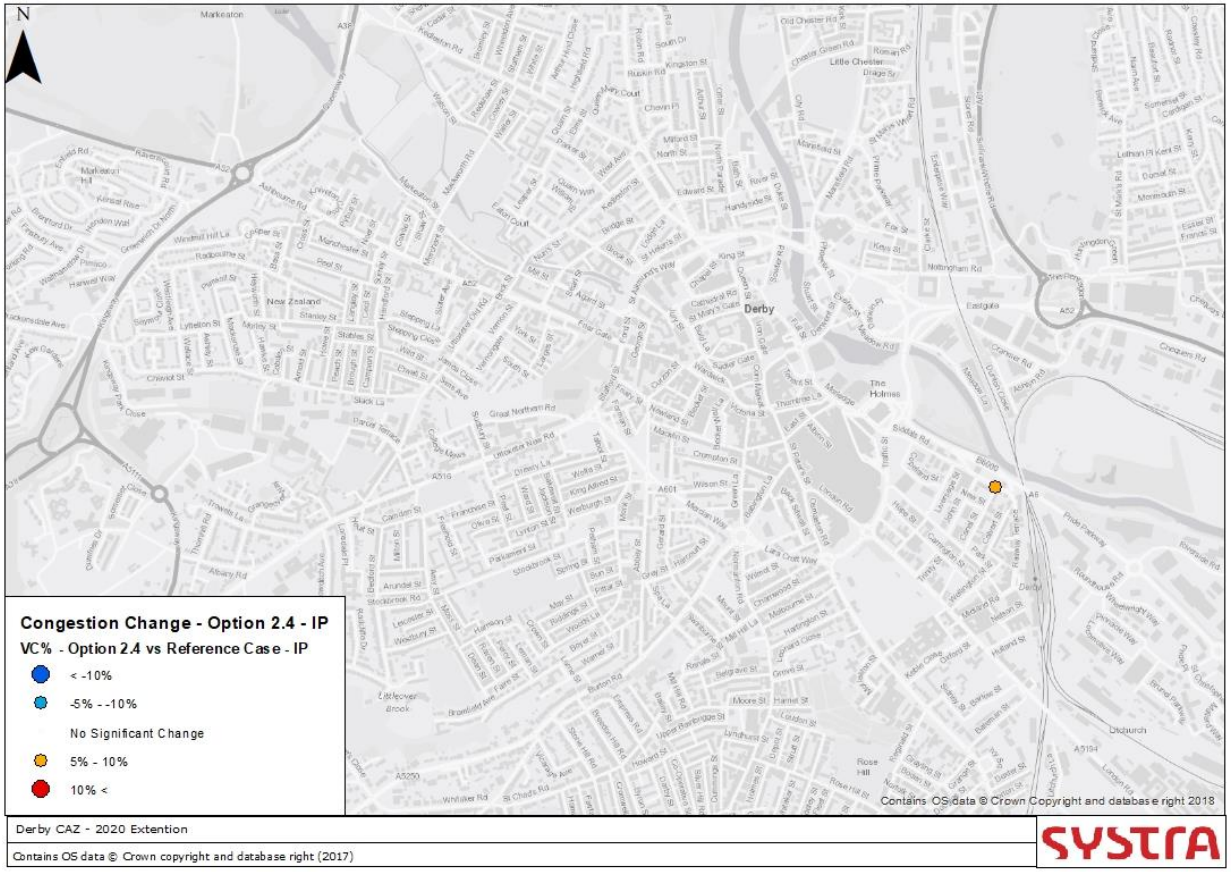




SYSTRA

Option 2.4

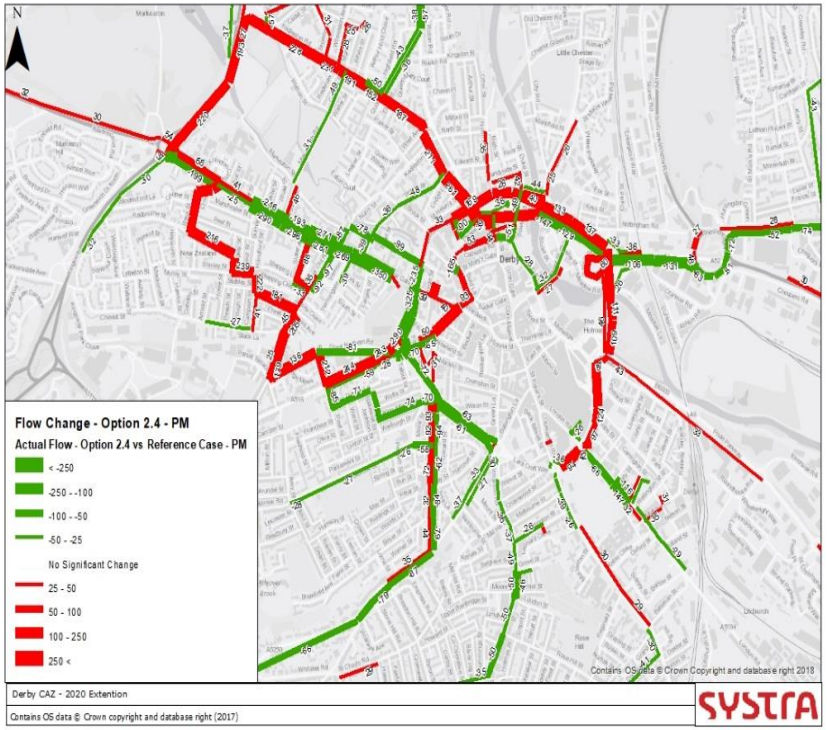
Congestion Change - IP

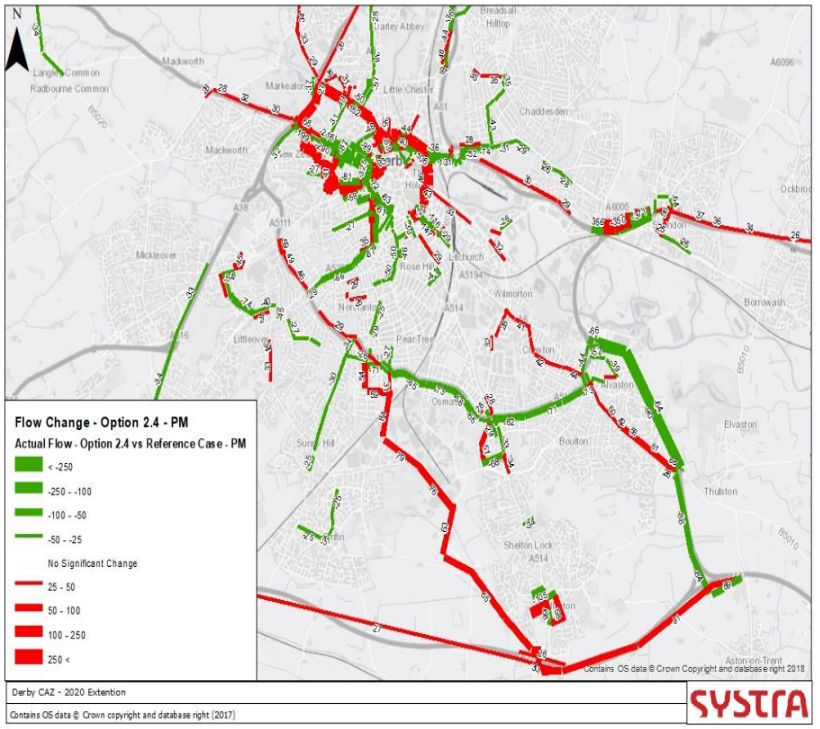


SYSTRA

Option 2.4

Flow Change - PM

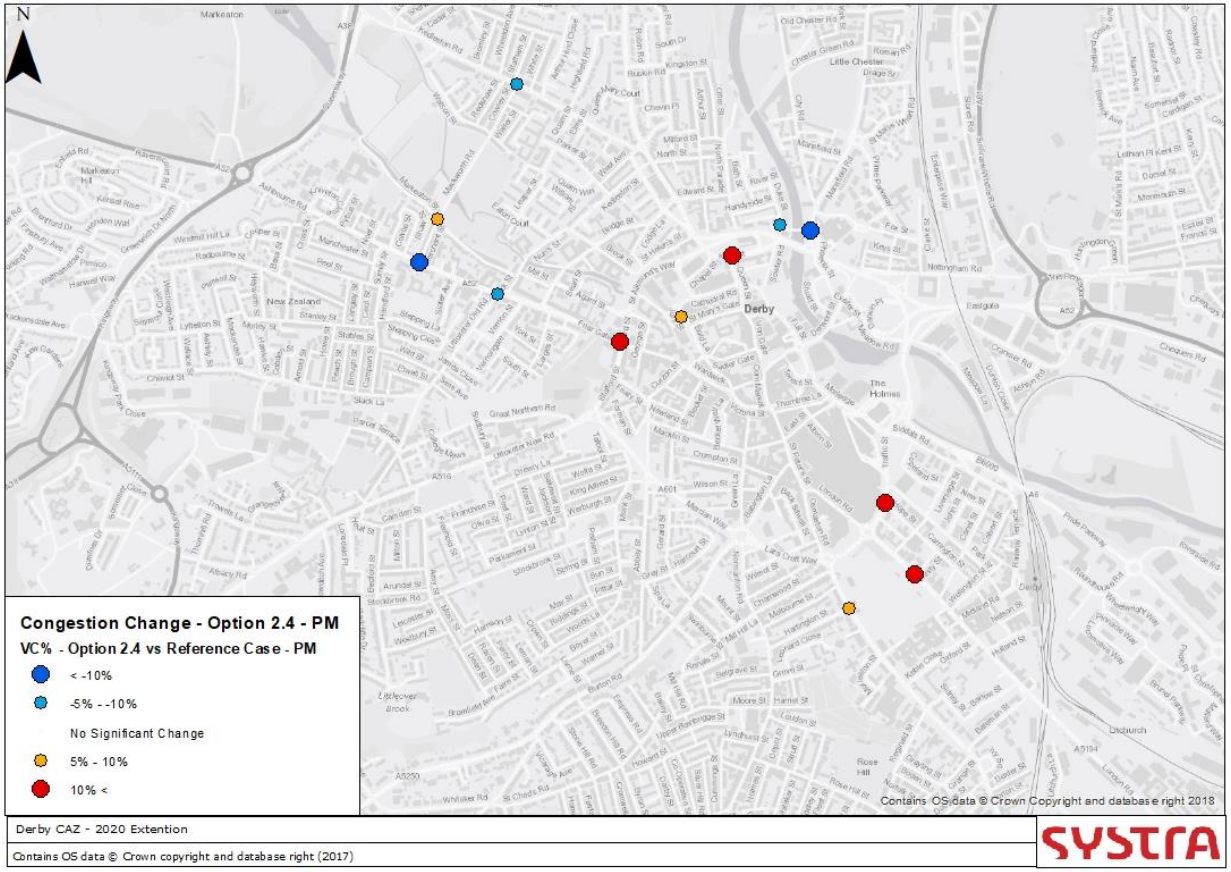




SYSTRA

Option 2.4

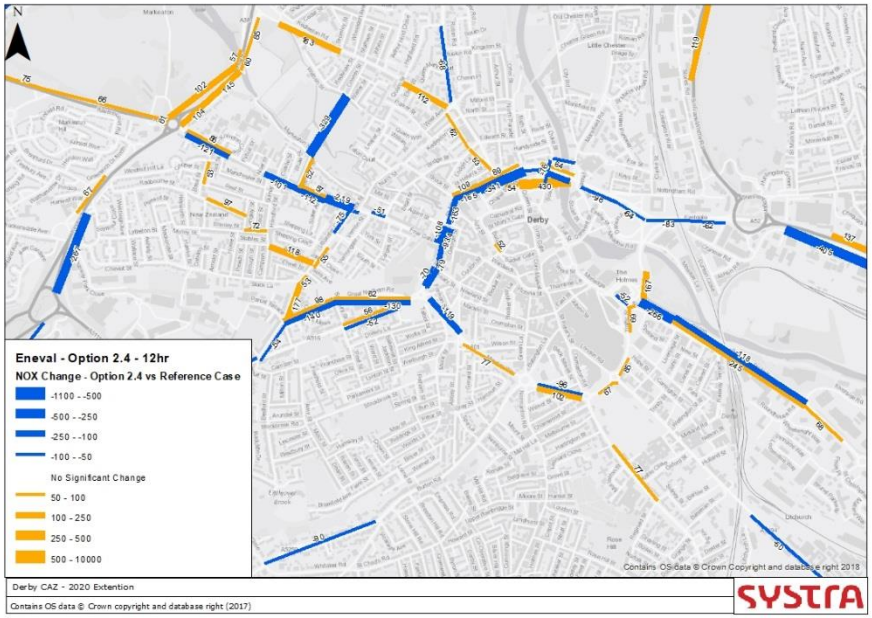
Congestion Change - PM

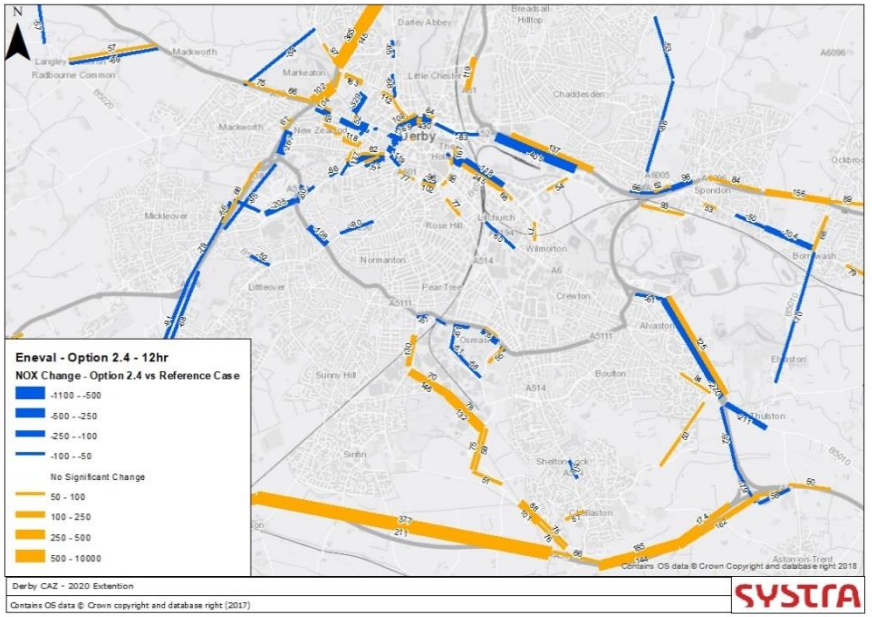


SYSTRA

Option 2.4

Eneval





Timing alteration				
Op 2.4	NOX		Diff	% Diff
	Ref	Op 2.4		
NB	571	555	-16	-3%
SB	324	183	-141	-44%
Total	895	737	-157	-18%

Options 2.4

Summary

- In Option 2.4, NOX totals are 18% lower than the Reference Case, still below the 42% reduction target.
- The composition of individual (NB/SB) values is more encouraging, with a 44% reduction in the Southbound direction. This suggests that alterations to the Ford Street signal timings are having a significant impact on southbound NOX levels. In addition this is the first option where a NOX reduction in both directions on Stafford Street has been predicted.
- It is in light of this that scenarios based in the removal of the ahead manoeuvre on Stafford Street (Left Lane NB at Friar Gate), shall no longer be carried forth, having sufficiently demonstrated the benefits of its retention. These benefits are seen not just in the NOX values, but also in the flow and congestion plots.
- **Thus Option 2.4 is to be carried forward for further option testing.**

Option 2.5

Option 2.5

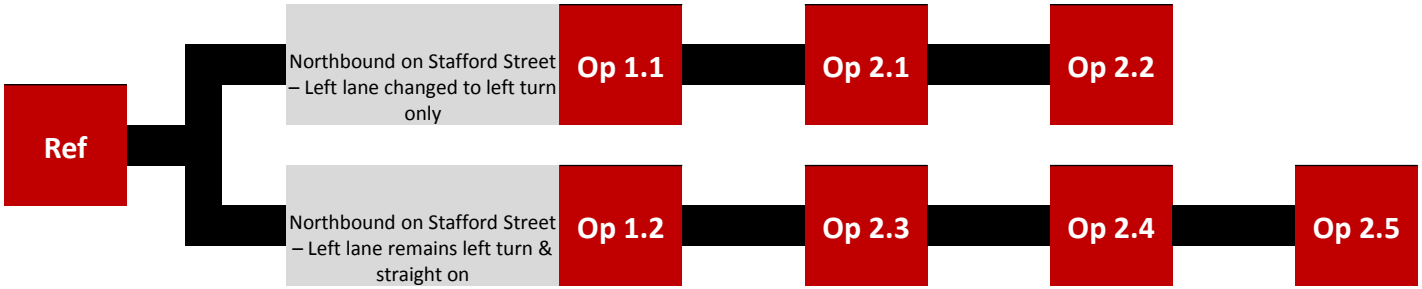
Introduction

- Option 2.5 focusses on the restriction of Northbound flow into Stafford Street from the Mercian Way/ Uttoxeter New Road roundabout, thus attempting to address the Northbound Stafford Street NOX issue.

- Select link analysis on Option 2.4 suggests that the majority of traffic heading Northbound along Stafford Street originates from Uttoxeter New Road. Thus, it is the signal control on this arm that has been focussed on for this option test.

- Initial tests pertaining to the alteration of the signal timings alone, led to no noticeable benefit, leading instead to an alteration of the stages. The two stages previously modelled for the Uttoxeter New Road arm were extended to three to enable the left and right movements on Uttoxeter New Road to be separately signalled.

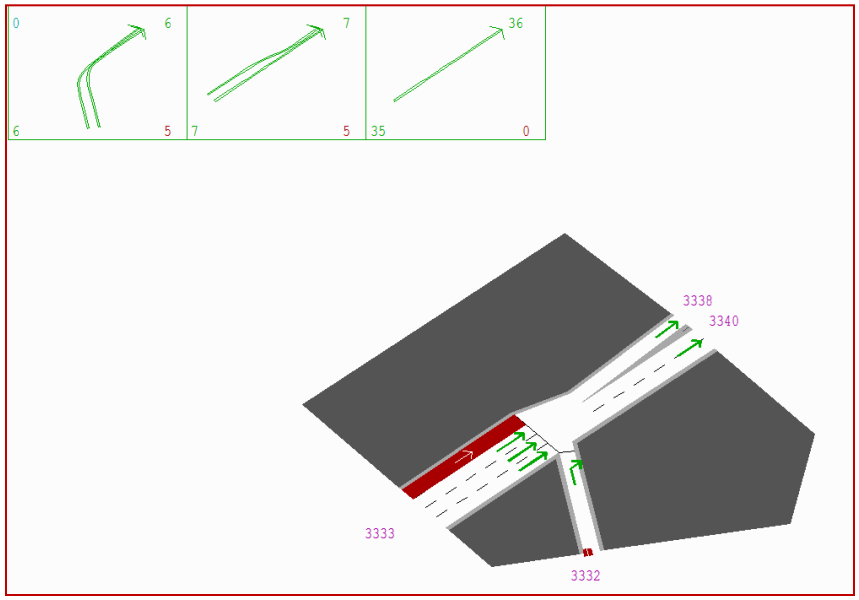
- The existing infrastructure at the roundabout is not able to accommodate the desired 'Left turn only' stage, thus physical alterations to the junction will be required to enable this.



Option 2.5

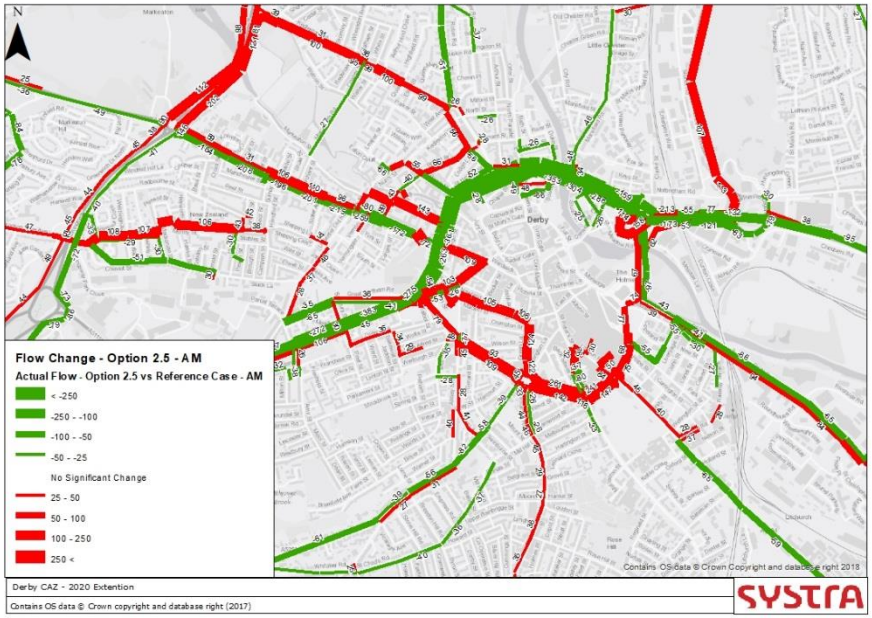
Introduction

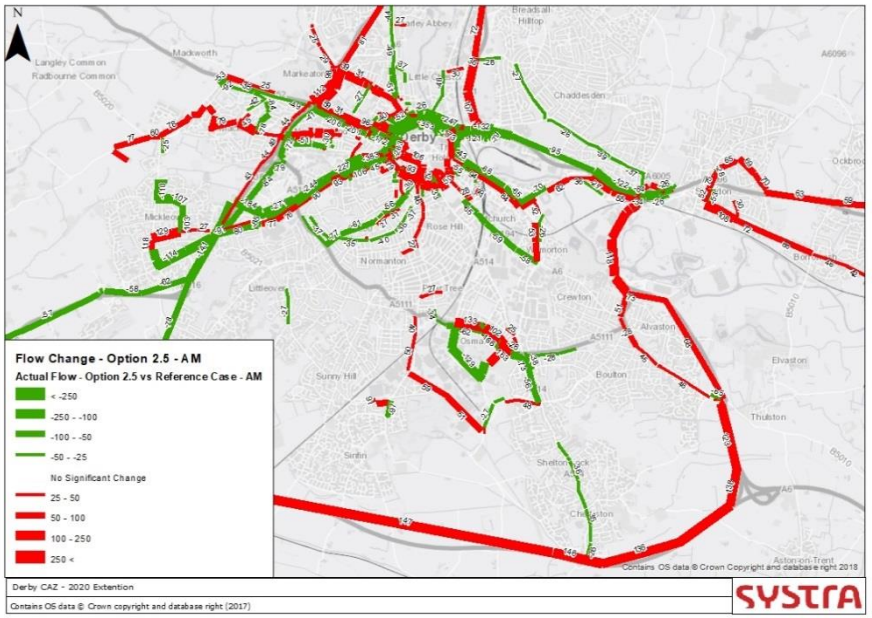
- This option includes 3 stages for the Uttoxeter New Road approach as follows:
  - Stage 1 - Roundabout circulatory carriageway movements
  - Stage 2 – Uttoxeter New Road Access to Stafford Street and the Circulatory carriageway of the roundabout
  - Stage 3 - Uttoxeter New Road Access to Circulatory carriageway only



Options 2.5

Flow Change - AM

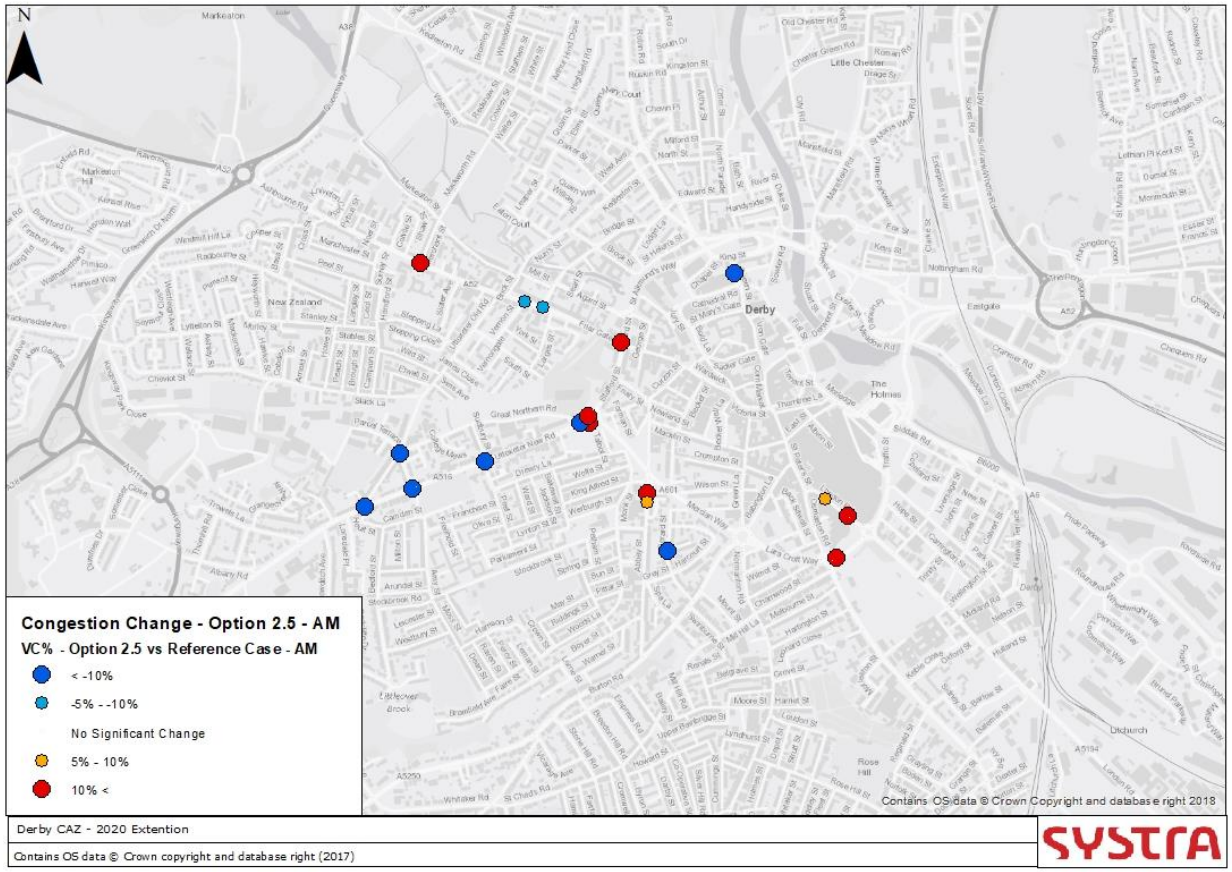




SYSTRA

Options 2.5

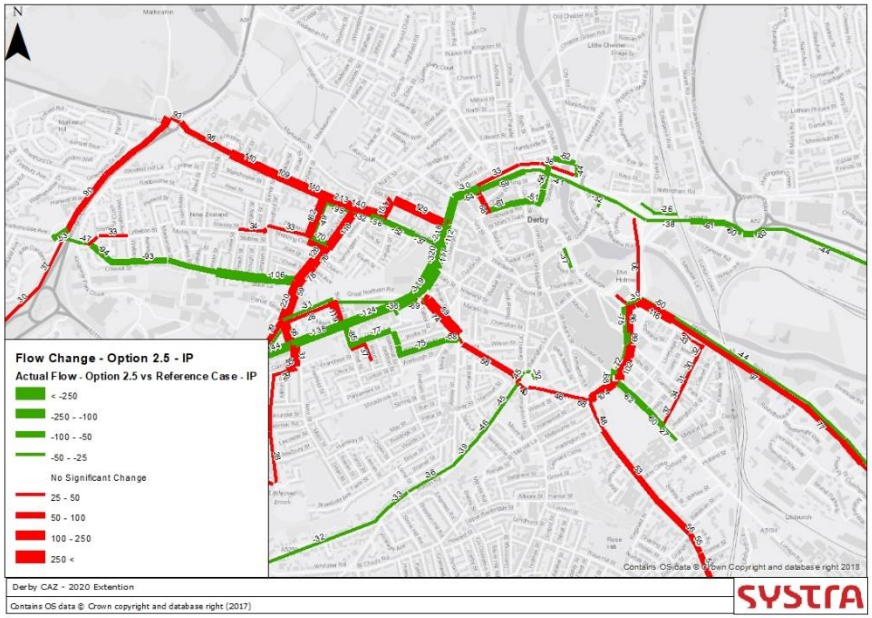
Congestion Change - AM

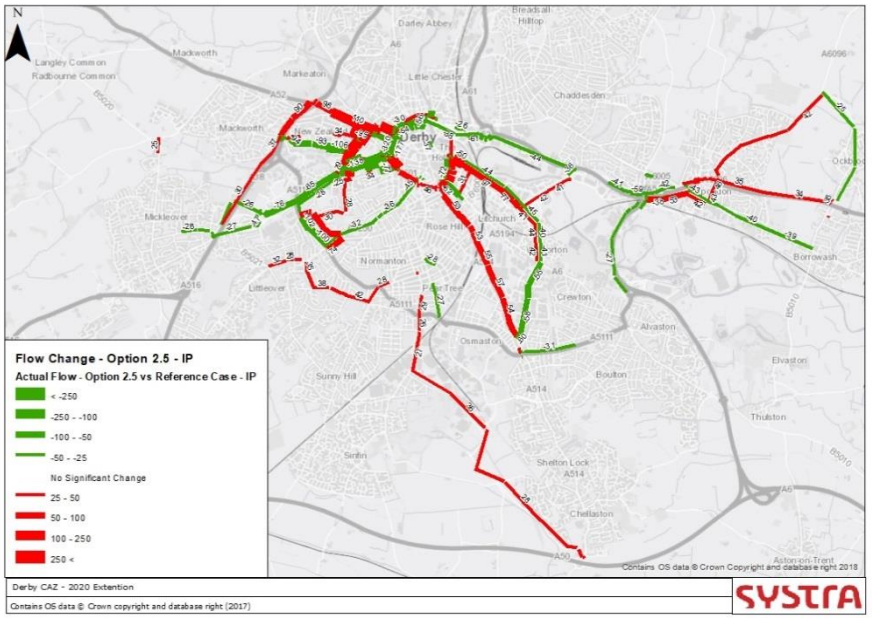


SYSTRA

Options 2.5

Flow Change - IP

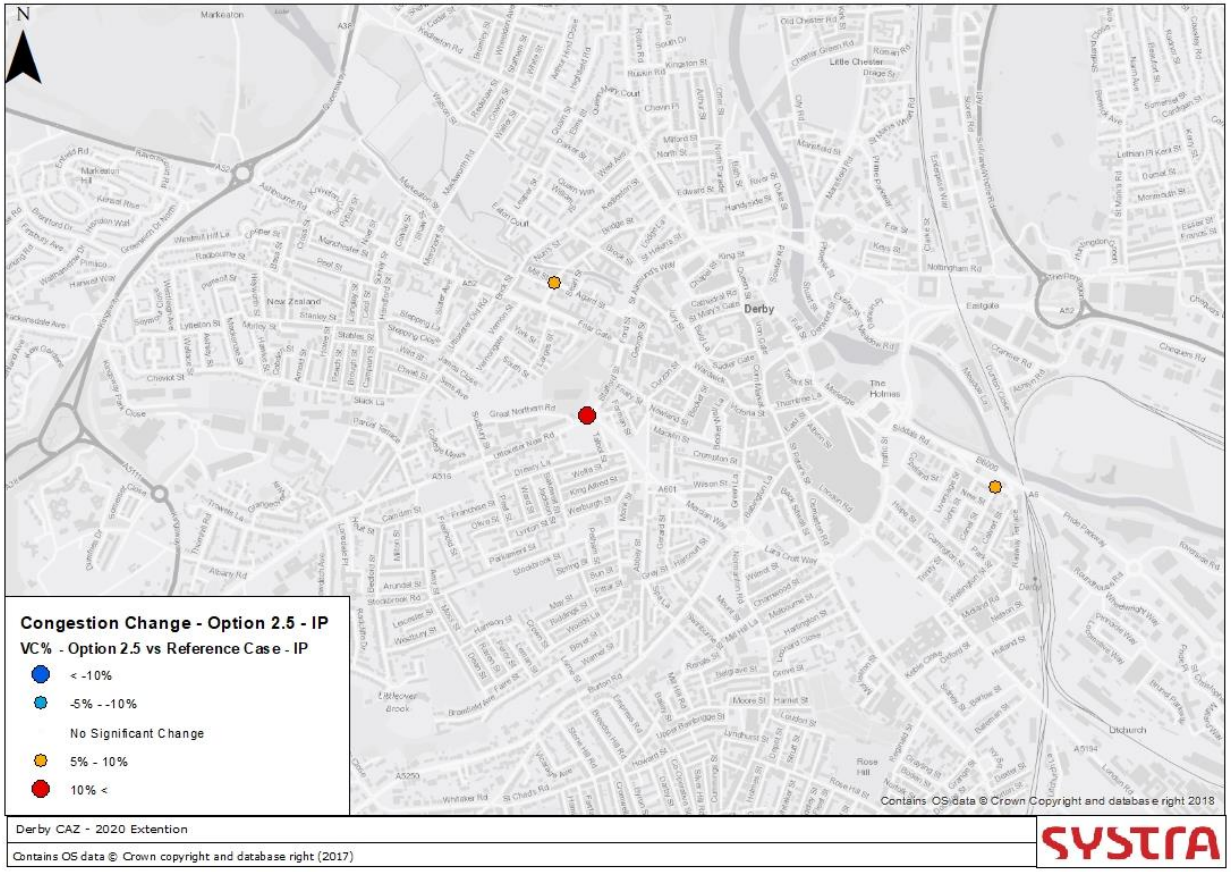




SYSTRA

Options 2.5

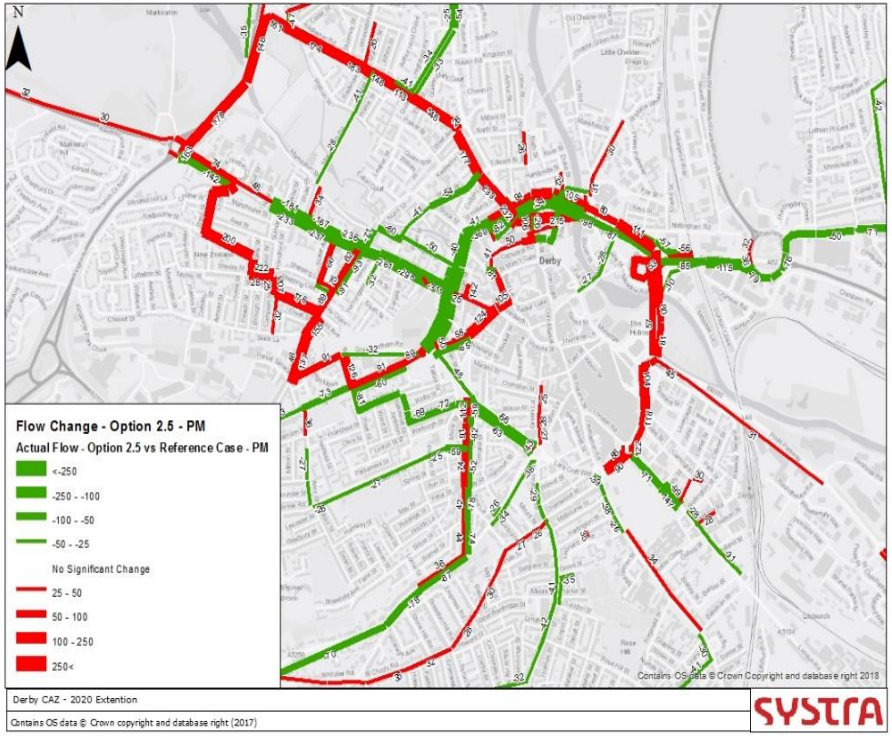
Congestion Change - IP

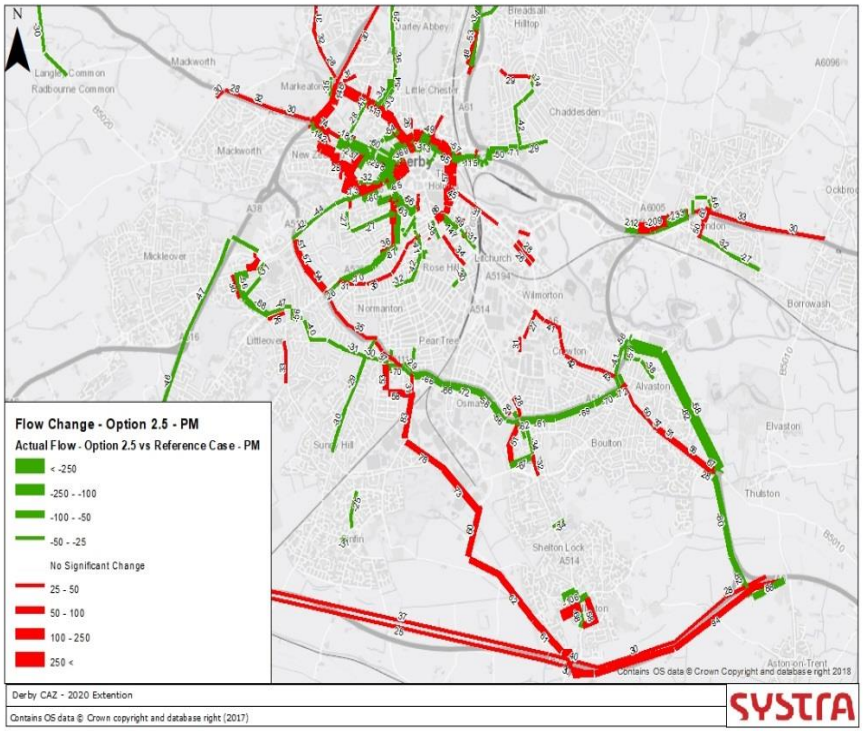


SYSTRA

Options 2.5

Flow Change - PM

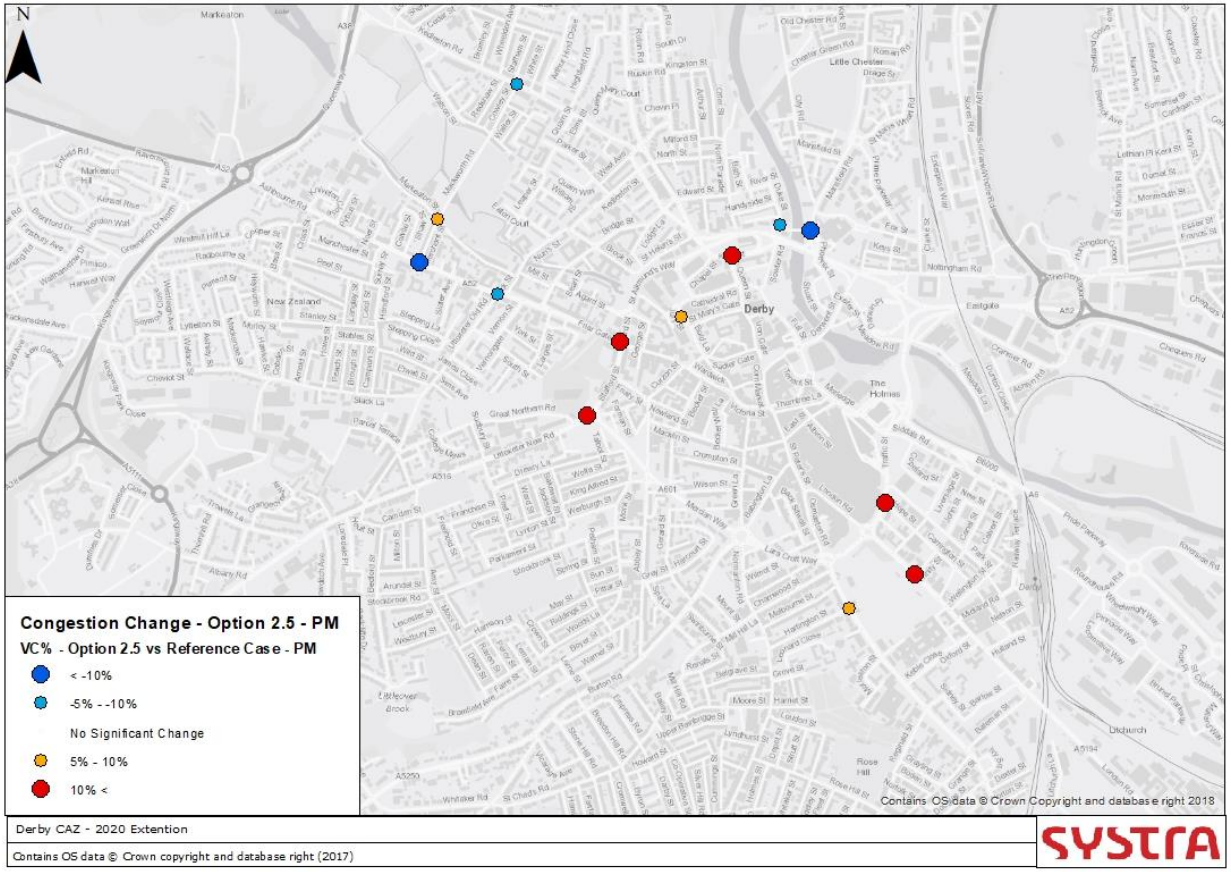




SYSTRA

Options 2.5

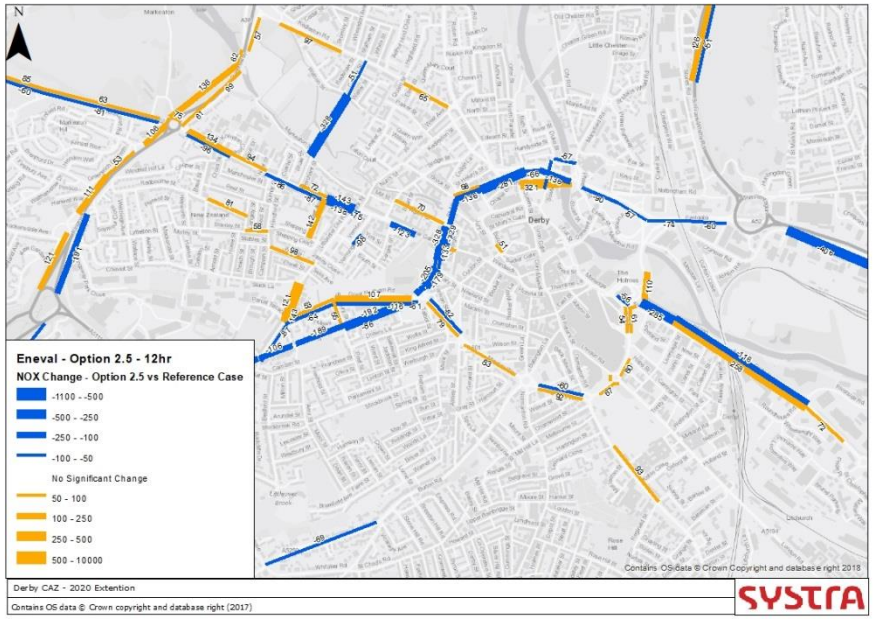
Congestion Change - PM

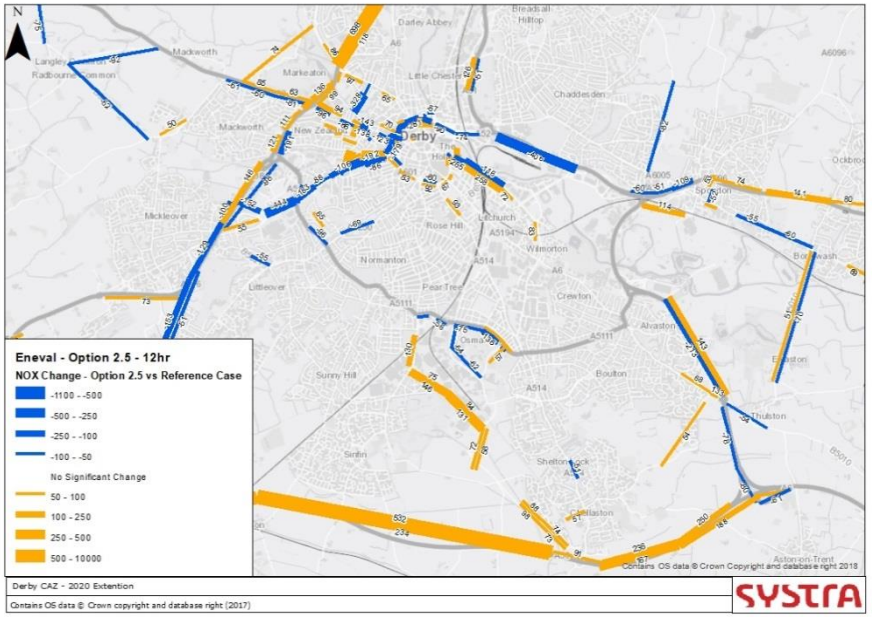


SYSTRA

Option 2.5

Eneval





Signal Alteration (RB)				
Op 2.5	NOX		Diff	% Diff
	Ref	Op 2.5		
NB	571	340	-231	-40%
SB	324	191	-133	-41%
Total	895	531	-364	-41%

SYSTRA

Option 2.5

Summary

- Option 2.5 is predicted to result in significant reductions in NOX emission levels along Stafford Street, with a 41% total reduction compared to a target of 42%. This reduction is split equally between the NB and SB directions with values of -40% and 41% respectively.

- By segregating the left turn access from Uttoxeter New Road, flow values drop dramatically, reducing through movement from the A52 to Uttoxeter New Road and instead pushing trips onto the A50. This shift is predominantly carried via the A6, however in the PM period traffic utilises Infinity Park Way as an alternate means of travelling from the A50/A38 to the city centre, a trend seen in previous options.

- Congestion shows increases at the Stafford Street / Mercian Way/ Uttoxeter New Road junction, to be expected given the changes to the signals at this location.

- Also evident is congestion levels rising around the eastern part of the Inner Ring Road, a result of increased flows along this section of highway.

Option 3.0

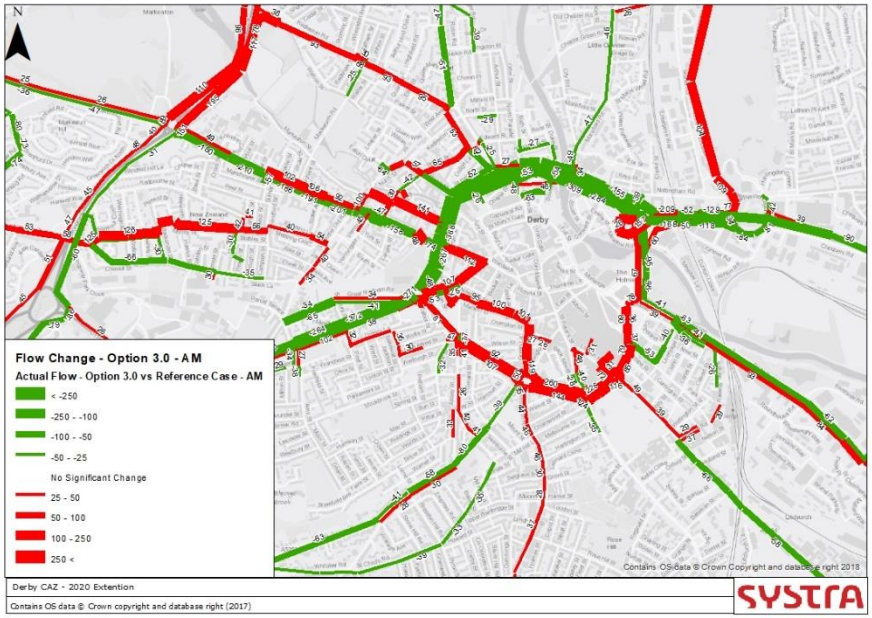
Option 3.0

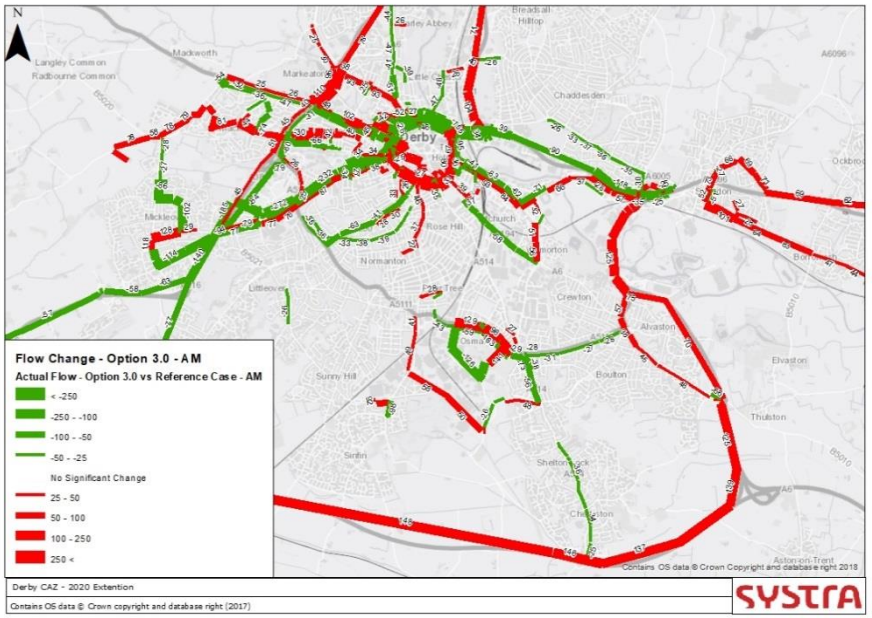
Introduction

- Option 3 builds upon Option 2.5 and includes a HGV ban along the length of Stafford Street in both directions.

Options 3.0

Flow Change - AM

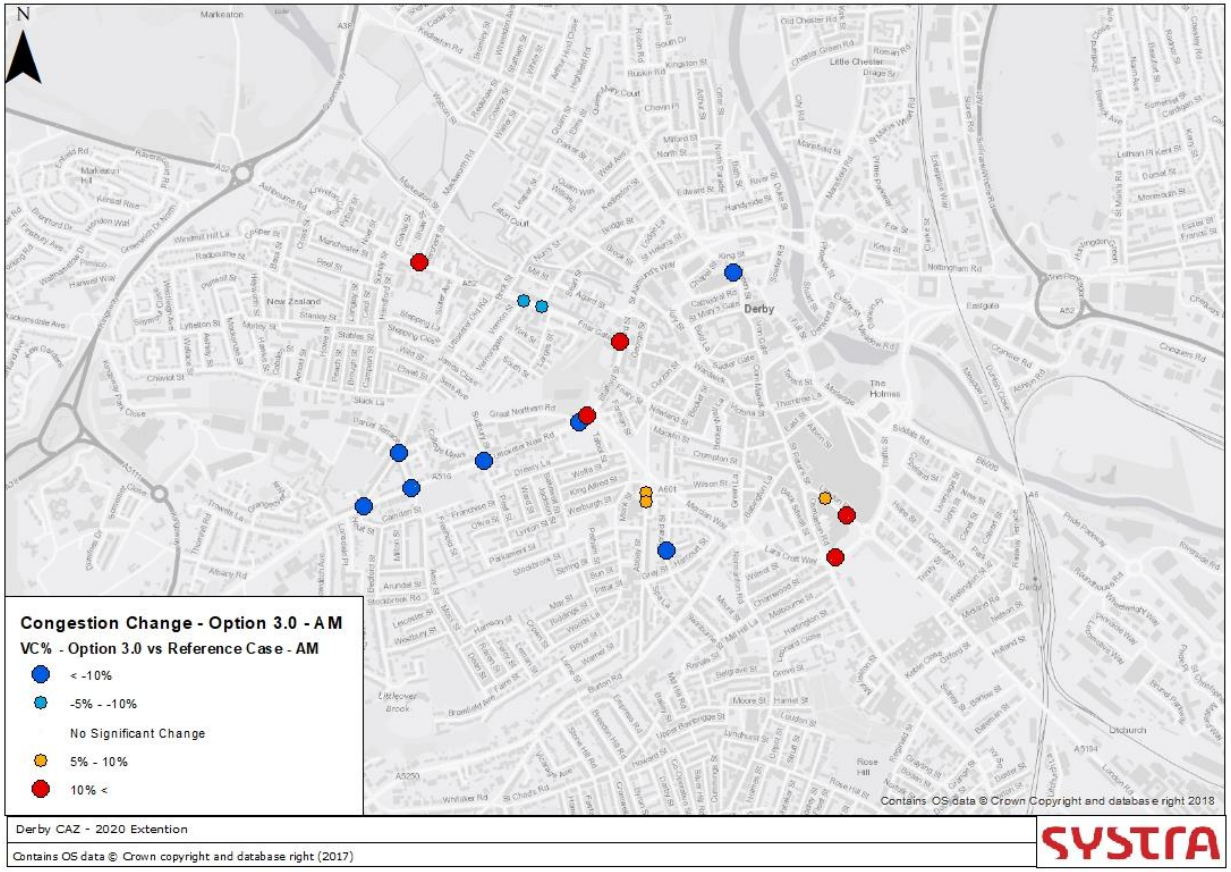




SYSTRA

Options 3.0

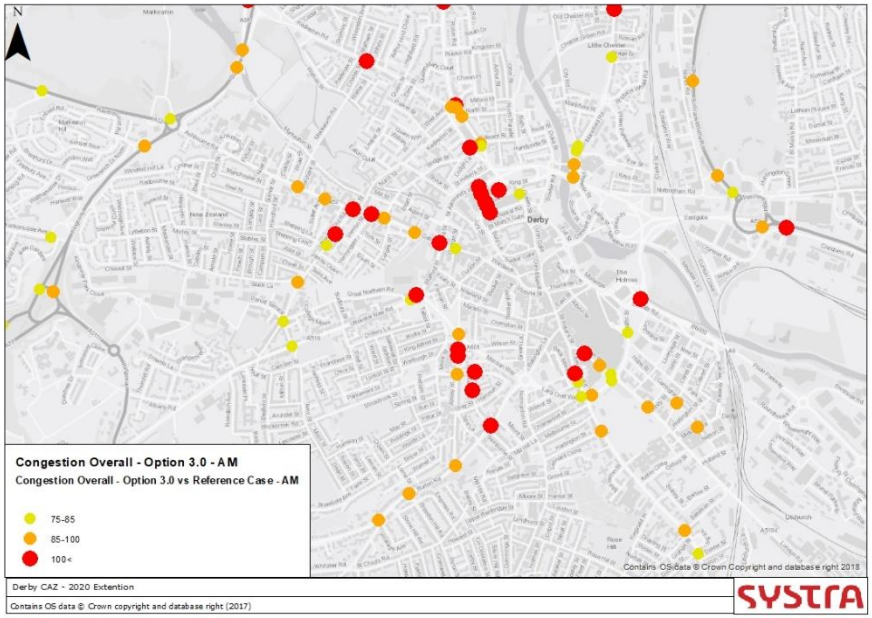
Congestion Change - AM

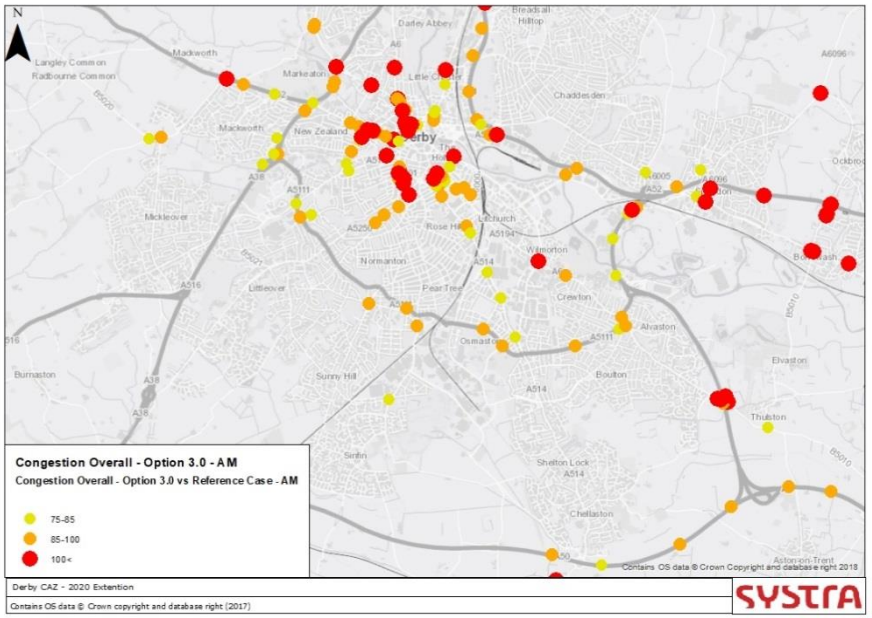


SYSTRA

Options 3.0

Overall Congestion- AM

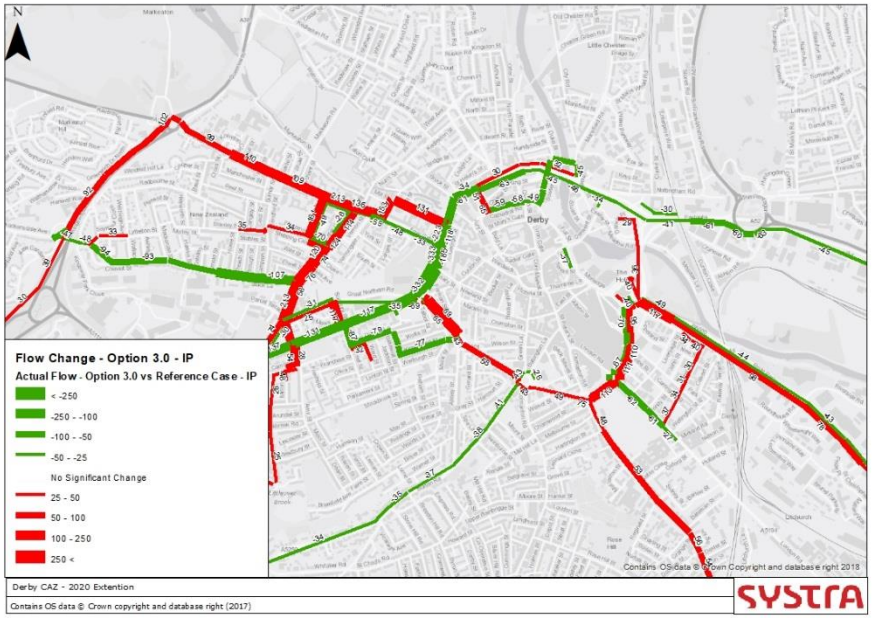


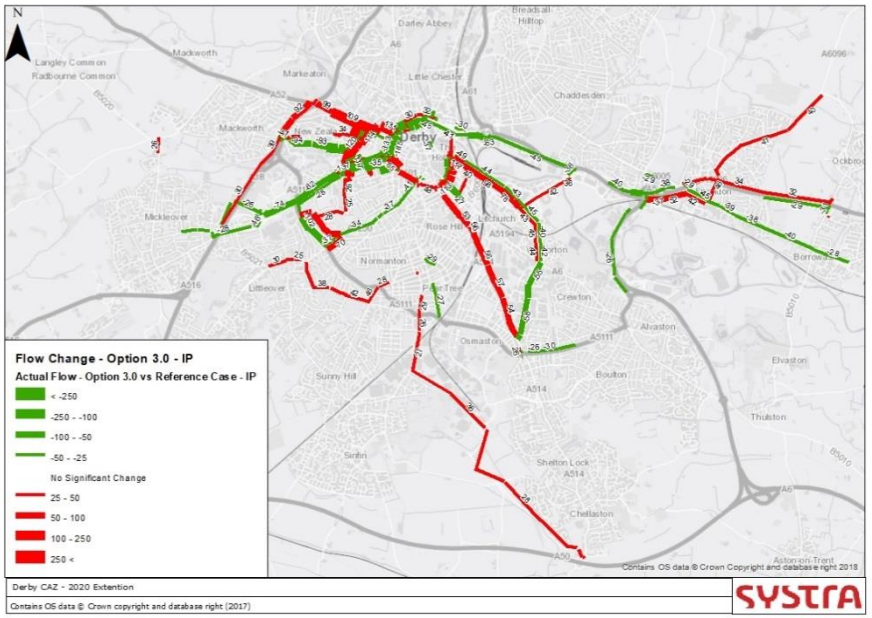


SYSTRA

Options 3.0

Flow Change - IP

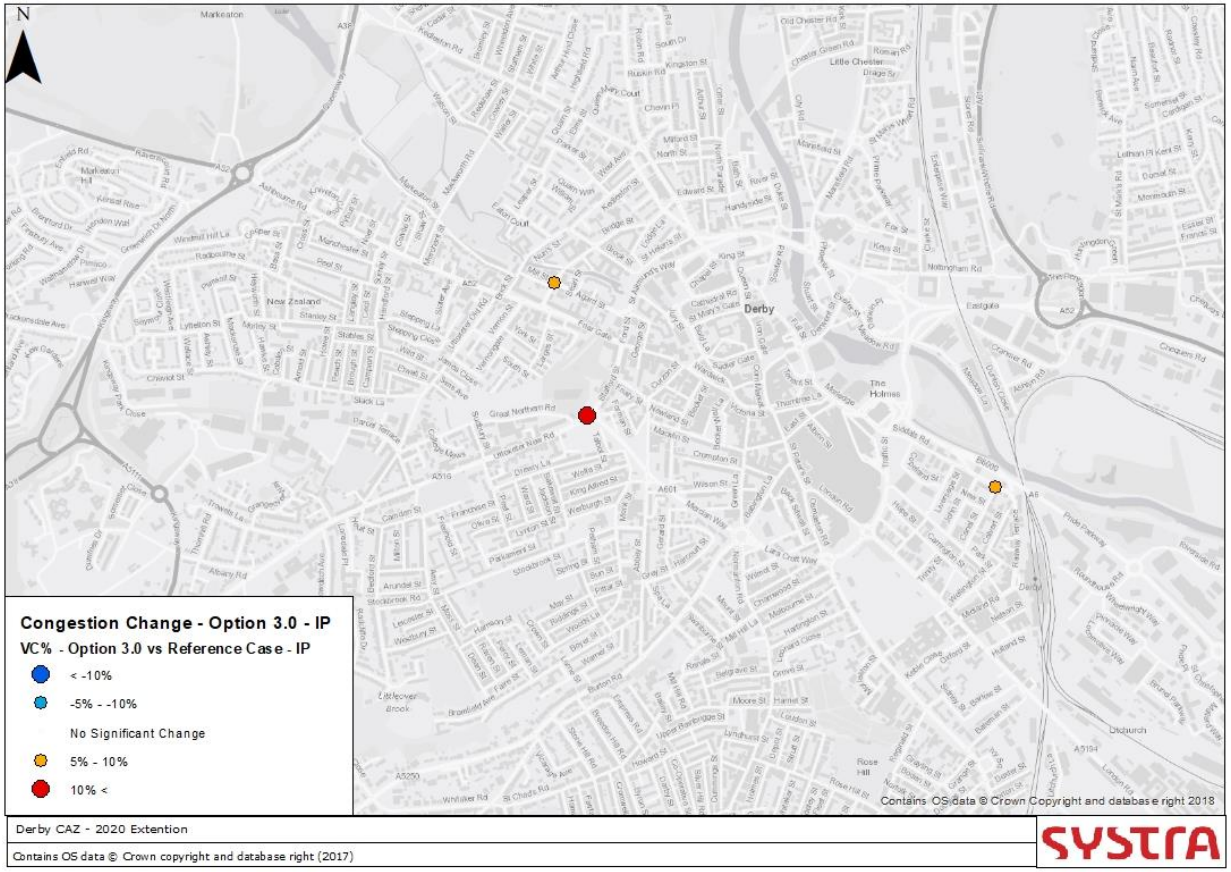




SYSTRA

Options 3.0

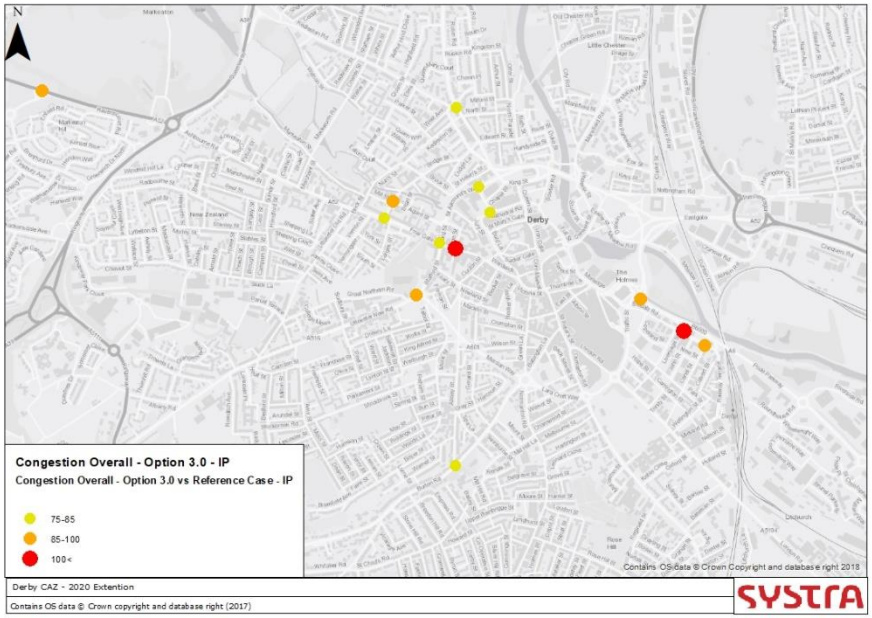
Congestion Change - IP

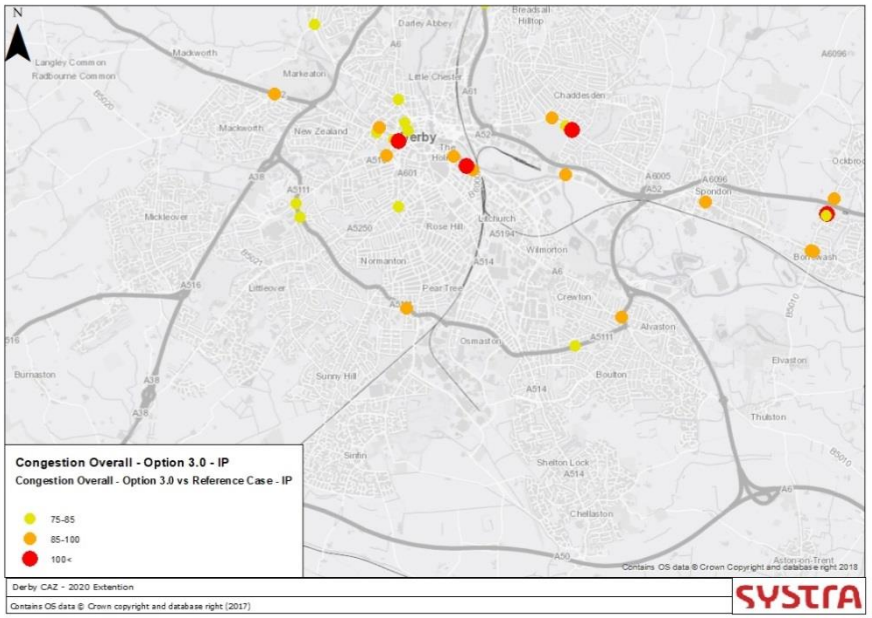


SYSTRA

Options 3.0

Overall Congestion- IP

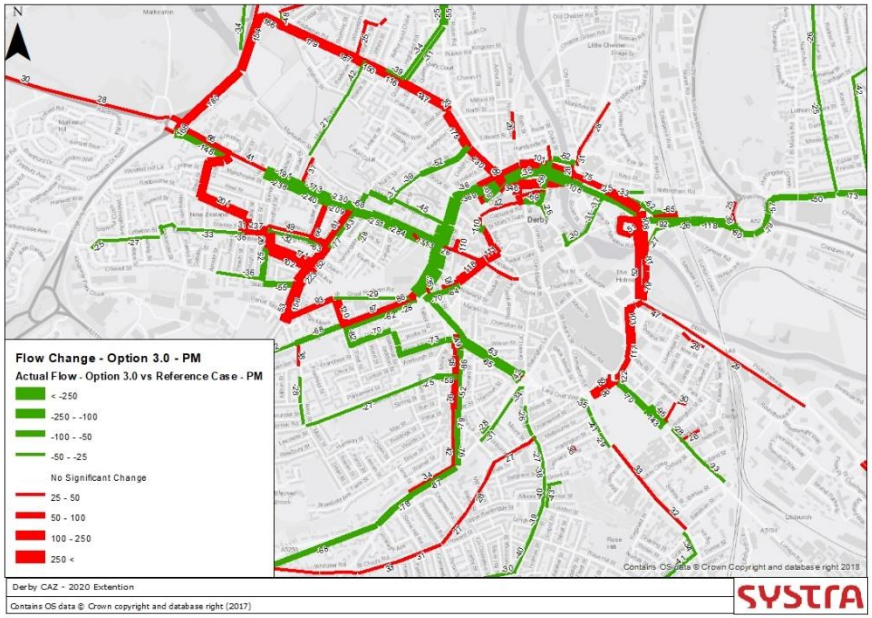


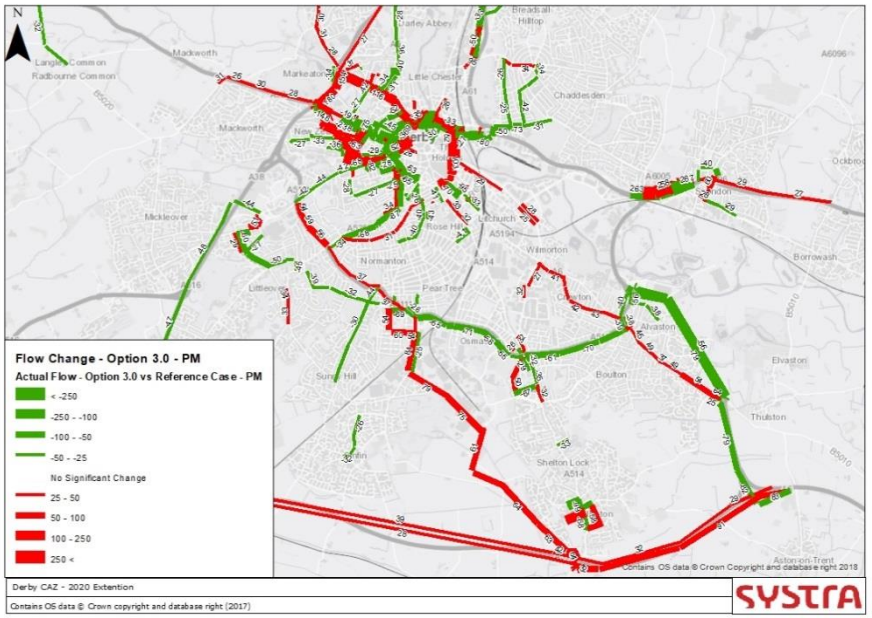


SYSTRA

Options 3.0

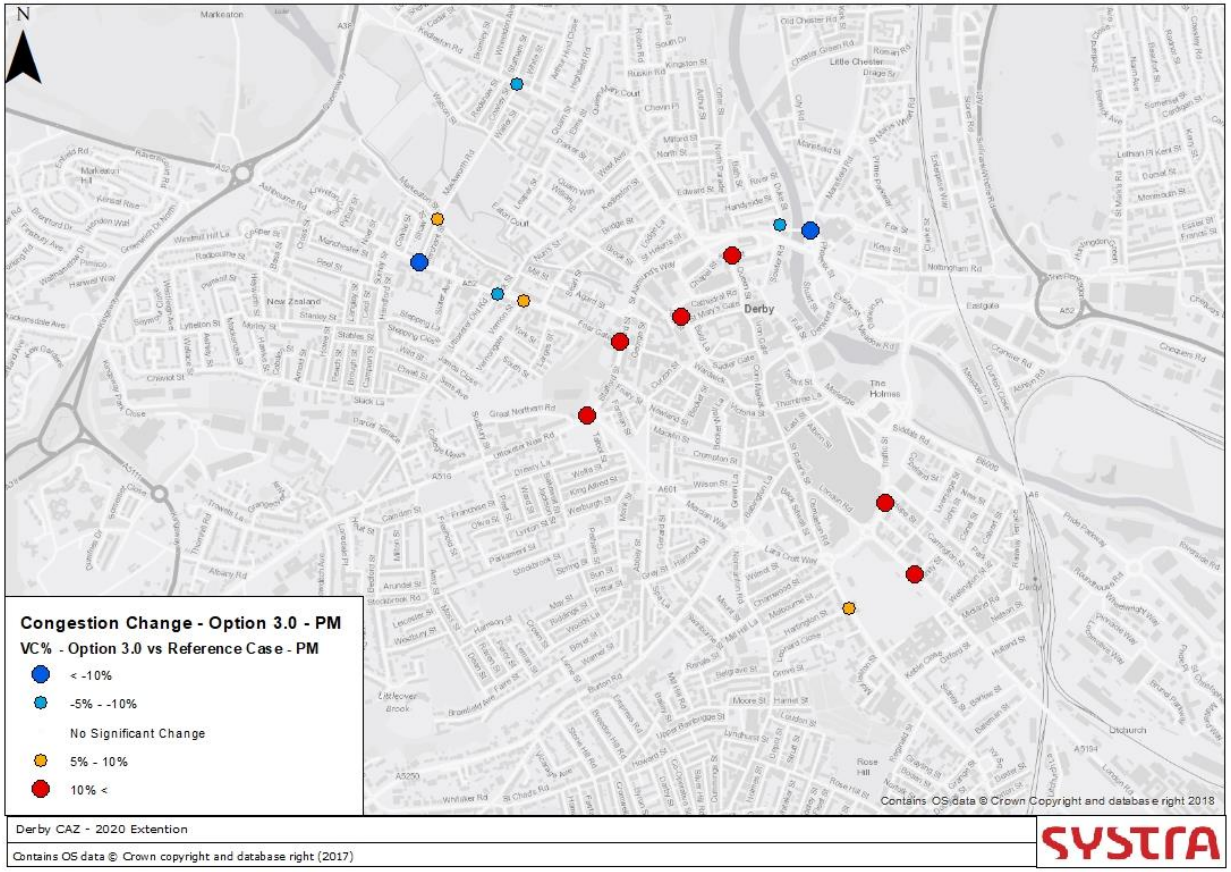
Flow Change - PM





Options 3.0

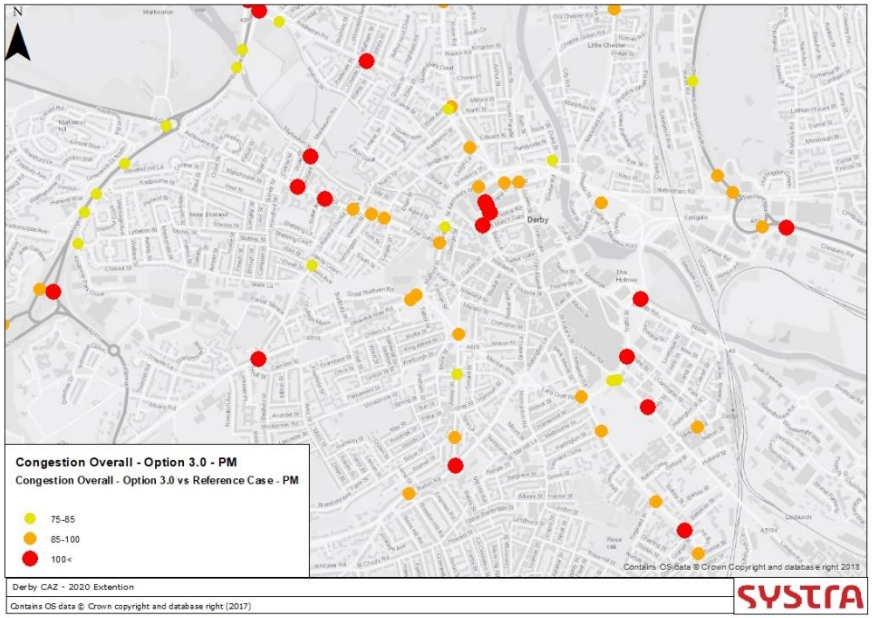
Congestion Change - PM

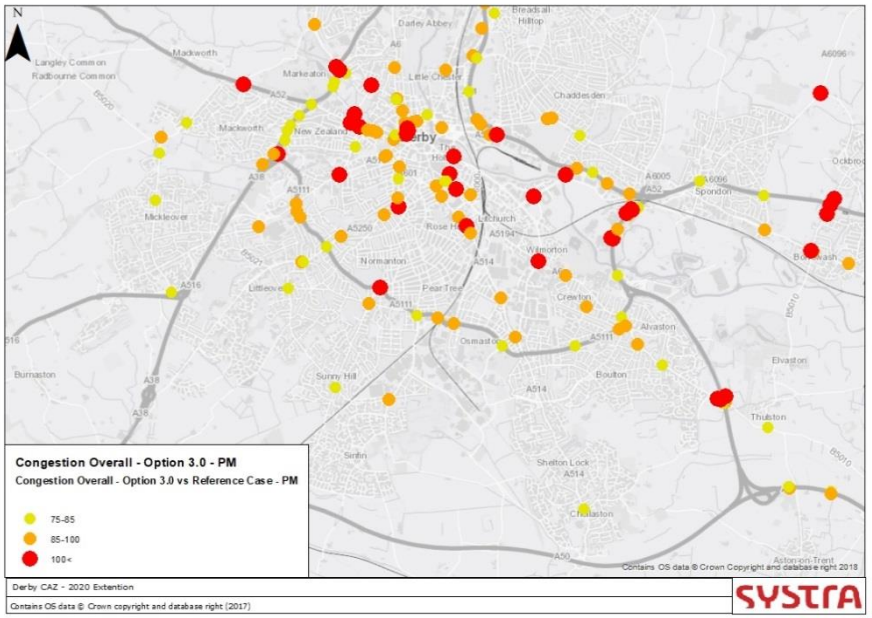


SYSTRA

Options 3.0

Overall Congestion- PM

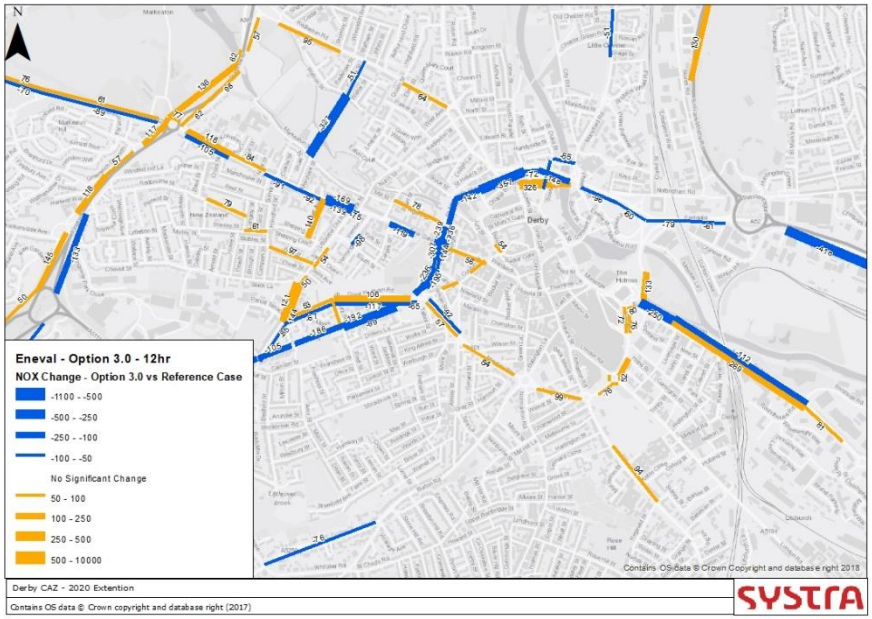


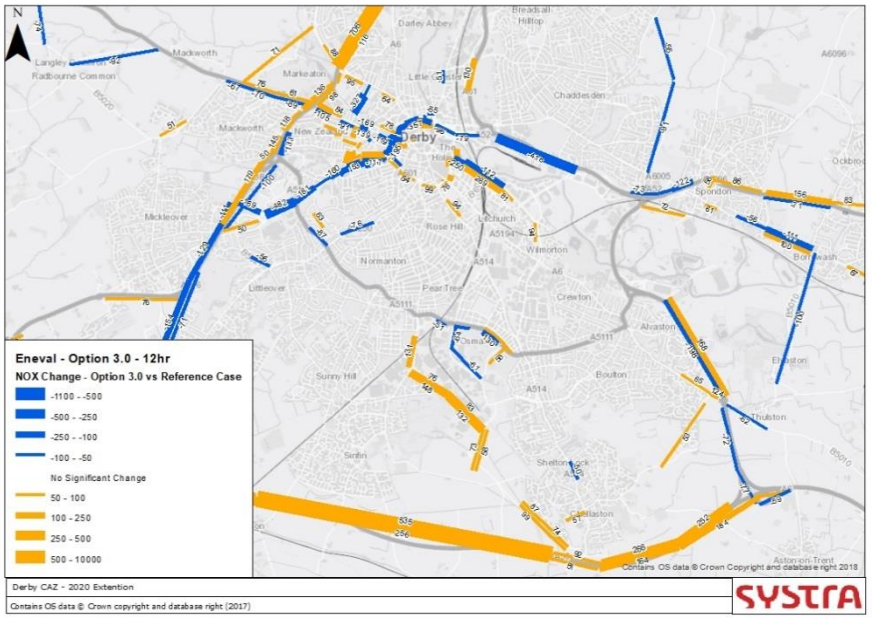


SYSTRA

Option 3.0

Eneval





HGV Ban				
Op 3.0	NOX		Diff	% Diff
	Ref	Op 3.0		
NB	571	264	-307	-54%
SB	324	180	-144	-44%
Total	895	443	-451	-50%

SYSTRA

Option 3.0 Conclusion

Summary

- The banning of HGVs enhances the benefits already seen in Option 2.5, bringing the total NOX reductions to 50%. This comprises a 54% reduction in the Northbound direction and a 44% reduction in the Southbound direction. This exceeds the initial target reduction of 42% target in both directions.

- Overall trends regarding flow and congestion remain broadly unaltered from Option 2.5, with increased levels of congestion at the entrances to Stafford Street despite the significantly decreased level of trips passing through the area.

- A detailed cumulative summary of both NOX emissions and Actual Flow changes can be found in the following slides.

Overall Summary

Eneval – Total NOX Emissions all Options

General Improvements	Ref
NB	571
SB	324
Total	895

Northbound on Stafford Street – Left lane changed to left turn only

Physical Infrastructure	NOX			
Op 1.1	Ref	Op 1.1	Diff	% Diff
NB	571	584	14	2%
SB	324	331	8	2%
Total	895	916	21	2%

Stage Alteration	NOX			
Op 2.1	Ref	Op 2.1	Diff	% Diff
NB	571	616	45	8%
SB	324	217	-107	-33%
Total	895	833	-62	-7%

Timing alteration (Friar Gate)	NOX			
Op 2.2	Ref	Op 2.2	Diff	% Diff
NB	571	601	30	5%
SB	324	190	-134	-41%
Total	895	791	-104	-12%

Northbound on Stafford Street – Left lane remains left turn & straight on

Physical Infrastructure	NOX			
Op 1.2	Ref	Op 1.2	Diff	% Diff
NB	571	559	-12	-2%
SB	324	348	25	8%
Total	895	908	13	1%

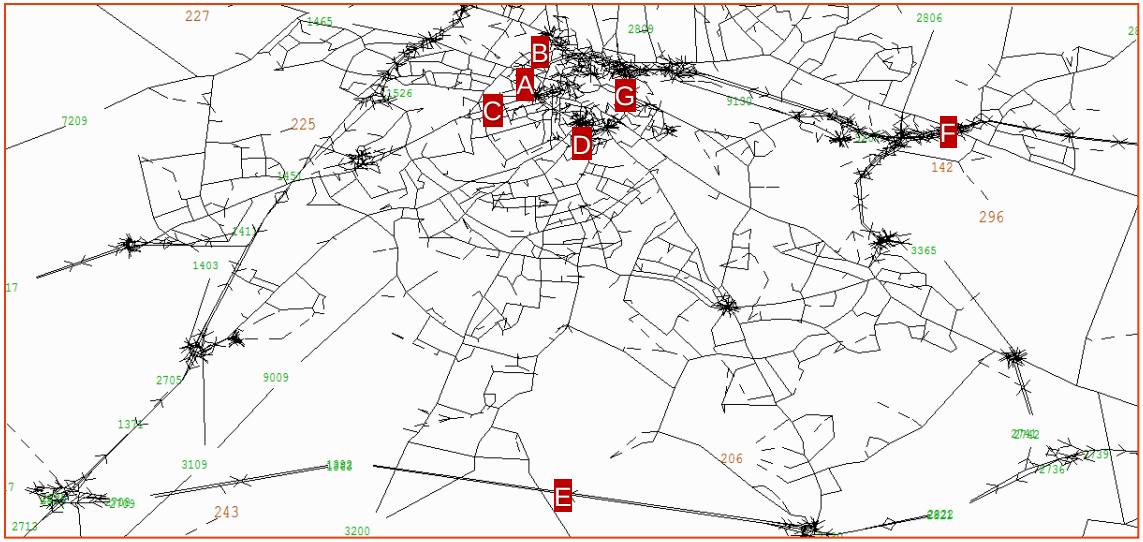
Stage Alteration	NOX			
Op 2.3	Ref	Op 2.3	Diff	% Diff
NB	571	576	5	1%
SB	324	211	-113	-35%
Total	895	787	-107	-12%

Timing alteration (Friar Gate)	NOX			
Op 2.4	Ref	Op 2.4	Diff	% Diff
NB	571	555	-16	-3%
SB	324	183	-141	-44%
Total	895	737	-157	-18%

Signal Alteration (RB)	NOX			
Op 2.5	Ref	Op 2.5	Diff	% Diff
NB	571	340	-231	-40%
SB	324	191	-133	-41%
Total	895	531	-364	-41%

HGV Ban	NOX			
Op 3.0	Ref	Op 3.0	Diff	% Diff
NB	571	264	-307	-54%
SB	324	180	-144	-44%
Total	895	443	-451	-50%

Option 3.0 Flow Changes



- The table on the following slide depicts flow difference between the Reference Case an option 3.0 at key location across the model area.
- Locations are marked on the adjacent image.
- In general, Flows decrease across the Western section of the Inner Ring Road, and increase along the Eastern section.

Option 3.0 Conclusion

Changes in Actual Flow

Changes in Actual Flow																	
Description		Anode	Bnode	Link	Ref Case			Option 3.0			Difference					
											AM		IP		PM	
					AM	IP	PM	AM	IP	PM	Diff	% Diff	Diff	% Diff	Diff	% Diff
(A) Stafford Street	Northbound	3346	3347	3346_3347	1284	846	975	594	513	541	-690	-54%	-333	-39%	-434	-44%
	Southbound	3347	3346	3347_3346	805	628	1097	538	443	624	-267	-33%	-185	-29%	-473	-43%
(B) Ford Street	Northbound	3348	3350	3348_3350	1847	1534	1775	1342	1500	1739	-505	-27%	-34	-2%	-36	-2%
	Southbound	3350	3348	3350_3348	1808	726	2216	1399	665	1847	-409	-23%	-61	-8%	-369	-17%
(C) Uttoxeter New Road	Northbound	3142	3333	3142_3333	1484	757	462	1099	528	548	-385	-26%	-229	-30%	86	19%
	Southbound	3333	3142	3333_3142	1076	629	995	1130	595	967	54	5%	-34	-5%	-28	-3%
(D) Mercian Way	Northbound	3328	3330	3328_3330	915	632	693	995	697	710	81	9%	65	10%	17	2%
	Southbound	3330	3328	3330_3328	463	510	708	482	579	656	19	4%	69	13%	-53	-7%
(E) A50	Eastbound	1392	2720	1392_2720	3639	970	2516	3787	966	2555	148	4%	-4	0%	39	2%
	Westbound	2721	1863	2721_1863	2248	898	2522	2267	900	2550	19	1%	2	0%	28	1%
(F) A52	Eastbound	2486	2516	2486_2516	2581	1742	2498	2578	1776	2527	-2	0%	34	2%	29	1%
	Westbound	2519	2480	2519_2480	2845	1555	3016	2827	1539	3019	-18	-1%	-15	-1%	3	0%
(G) Bradshaw Way	Northbound	6037	3404	6037_3404	1349	210	677	1574	208	762	224	17%	-1	-1%	85	12%
	Southbound	3404	6037	3404_6037	1428	797	1485	1585	910	1581	157	11%	113	14%	96	6%

Mitigation

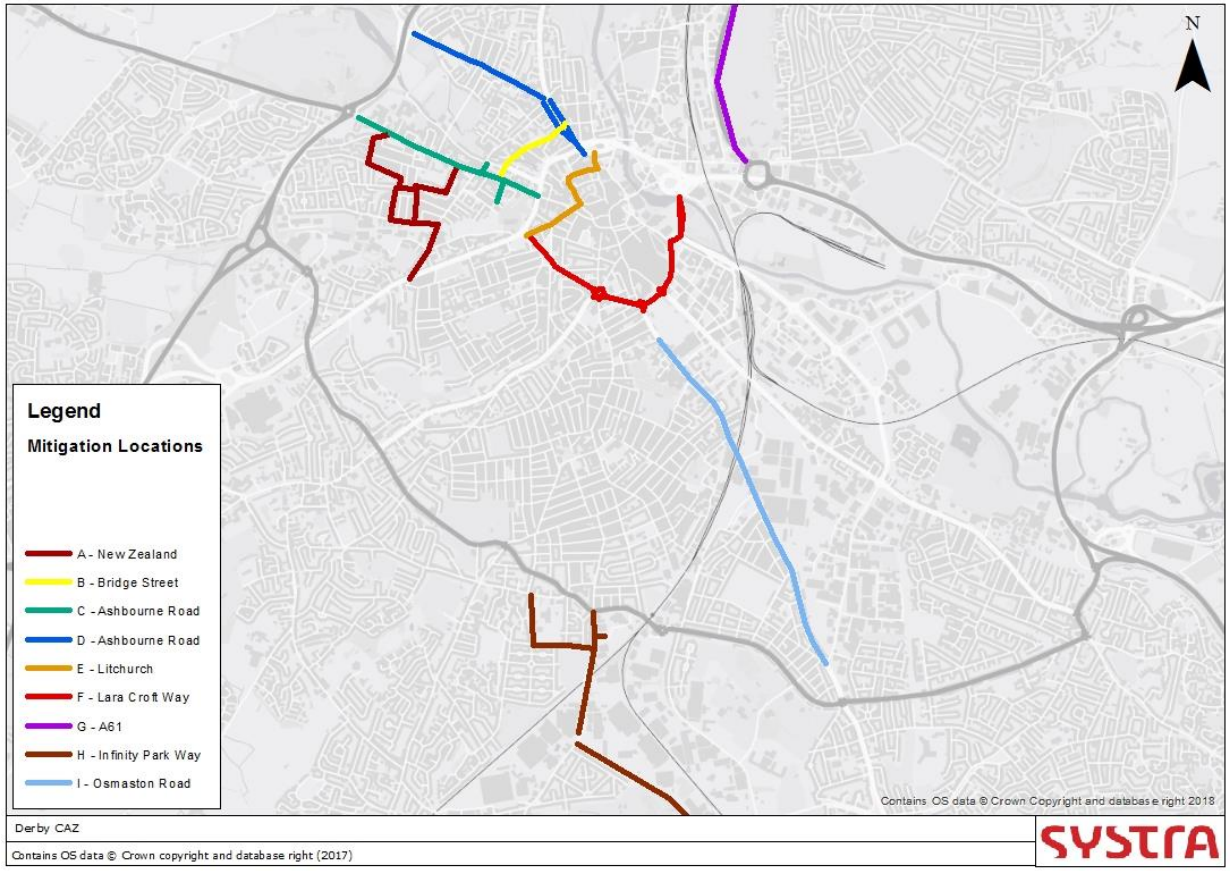
Location

- The table below details key locations requiring possible potential mitigation, based on the analysis of Option 3.0.

- These are the areas that it is suggested that the following elements of the study focus on.

Mitigation Locations				
Key	Type	Location	Direction	Description of the Issue
A	Area	New Zealand	Both	Address Rat running between Uttoxeter New Road and Ashbourne lane.
B	Road	Bridge Street	Both	Address Rat running between Friar Gate and Kedleston Road
C	Road	Kedleston Road	Both	Look for further changes in traffic flows
D	Road	Ashbourne Road	Both	Address predicted increases in traffic flows
E	Area	Litchurch	Northbound	Address Rat running between Curzon Street and Kedleston Road, via the City centre
F	Road	Lara Croft Way	Both	Improvements between Uttoxeter New Road and East gate, to further encourage use of the Eastern extent of the Inner Ring Road.
G	Road	A61	Both	Address re-assignment onto the A61.
H	Road	Infinity Park Way	Both	Address re-assignment to Infinity Park Way.
I	Road	Osmaston Road	Both	Address/encourage re-assignment to Osmaston Road.

Mitigation
Location



Mitigation
Options to be considered

Mitigation Resolution Options					
Key	Type	Location	Direction	Potential Options	
A	Area	New Zealand	Both	1	20 Mph zone within the observed area of rat-running.
				2	One Way/ Severed roads to prevent through movements between Uttoxeter Old Road and Ashbourne Road.
				3	Provide an improved through route to encourage movements away from Stafford Street.
B	Road	Bridge Street	Both	1	20 Mph zone within the observed area of rat-running.
				2	One Way/ Severed roads to prevent through movements between Kedleston and Ashbourne Road.
C	Road	Kedleston Road	Both	1	Bus priority around King Street gyratory.
				2	Prioritise signals along the route to max capacity.
D	Road	Ashbourne Road	Both	1	Max out Bus priority.
				2	Prioritise side roads at signals in order to restrict capacity as a through route.
E	Area	Litchurch	Northbound	1	Restricted/Banned access to Cheapside from Curzon Street would minimise through traffic in the city centre.
F	Road	Lara Croft Way	Both	1	Improve the priority of Ring Road Traffic to encourage circulation. Improve capacity.
G	Road	A61	Both	1	Improvements to the Pentagon Island (current DCC scheme)
H	Road	Infinity Park Way	Both	1	Unlikely to be an issue once the SDGZ is fully developed. However, traffic management on Willmore Road and Sinfin Lane in the form of speed restrictions could minimise through traffic.
I	Road	Osmaston Road	Both	1	Maximise capacity of the A6, signalisation of Shardlow Road RA or speed increases.

Appendix 3: Derby– Option 2.5 Extension and Mitigation – Highway and ENEVAL

Introduction

- Derby City Council (DCC) has commissioned SYSTRA to produce a series of incremental options, with the aim of testing traffic management schemes that reduce the level of NOX emissions on Stafford Street.
- To this extent, Option 2.5 was selected as the preferred option.
- Following this selection, further mitigation was undertaken to address adverse effects resultant reassignments have on the surrounding area. Such alterations are geared towards minimising wider impacts whilst maintaining a NOX reduction of at least 42% on Stafford Street.
- The aim of this presentation is to introduce, test and evaluate these mitigation proposals.

Overview of Strategies Tested

Mitigation Resolution Options					
Key	Type	Location	Potential Options		Time Periods
A	Area	New Zealand	1	20 Mph Limit introduced along rat-running route.	AM, IP, PM
			2	Banned Turns into New Zealand form Uttoxeter Old Road.	AM, IP, PM
			3	Altered Signals to prioritise Uttoxeter Old Road Over Ashbourne Road (Westbound)	AM, IP, PM
B	Road	Bridge Street	2	Signals altered to prioritise Kedleston Road.	AM, PM
C	Road	Kedleston Road	1	Signals altered to prioritise Kedleston Road.	AM, PM
D	Road	Ashbourne Road	1	Altered Signals to prioritise Uttoxeter Old Road Over Ashbourne Road (Westbound)	AM (IP and PM Limited)
F	Road	Lara Croft Way	1	Signal prioritisation provided for trips circumnavigating the Southern extent of the Inner Ring Road. .	AM
H	Road	Infinity Park Way	1	Prioritise trips passing along the Outer Ring Road, altering signals at the junction with Victory Road and at the Spider Bridge.	AM, IP, PM
I	Road	Osmaston Road	1	Prioritise trips passing along the Outer Ring Road, altering signals at the junction with Victory Road and at the Spider Bridge.	AM, IP, PM

New Zealand (A) & Ashbourne Road (D)

New Zealand

Introduction

- Due to the close proximity of certain mitigation proposals, it was pertinent to run tests in conjunction with adjacent areas as opposed to on an individual basis. This test therefore encompasses locations A & D New Zealand and Ashbourne Road respectively.

New Zealand

- New Zealand refers to the residential area bracketed by Ashbourne Road to the North, Kingsway to the West and Slack Lane to the South. Restrictions on Stafford Street movements in Option 2.5 has resulted in the occurrence of re-route-ing through this area, most prominent within the AM peak.

- A two-part solution has been implemented to resolve this. This combines the following:
  - Speeds along identified links with undesirable re-routing have been reduced to 20mph. This better reflects the real situation in the area, where slower speeds are usual because of the nature of the area with parked cars along both sides of relatively narrow roads. Effectively this makes the model more representative of the area and reflective of the desirability of the routes but most likely does not translate to a required change on the ground.
  - Northbound Left hand turns from Uttoxeter Old Road to both Etwall Street and Stepping Lane, have been banned.

Enhancements of Uttoxeter Old Road/Ashbourne Road

Introduction

Ashbourne Road

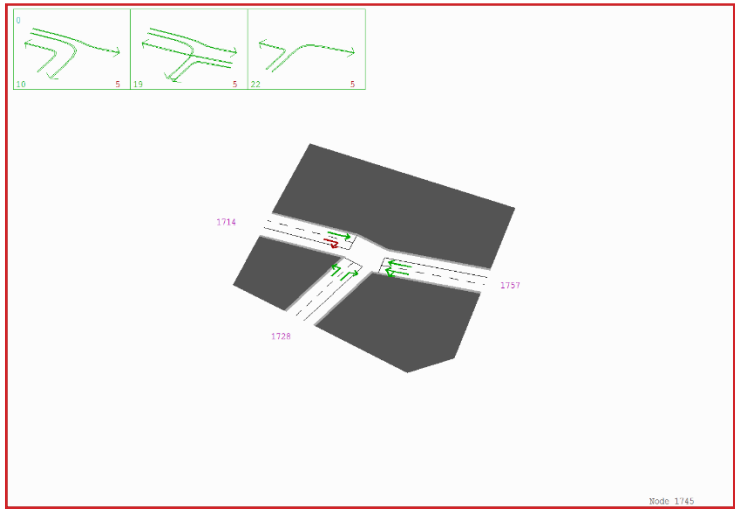
- Alterations to Stafford Street result in Uttoxeter Old Road emerging as an alternative route to the Inner Ring Road.

- As such, alterations seek to legitimise this route giving priority to turns traveling left out of Uttoxeter new road, at the expense of trips traveling Westbound on Ashbourne Road. The aim of this was to increase the attractiveness of Uttoxeter Old Road and further reduce traffic flow along Stafford Street.

- The signal stages/times at the junction between Uttoxeter Old Road and Ashbourne Road where altered to include a new stage 1 as shown in the adjacent figure.

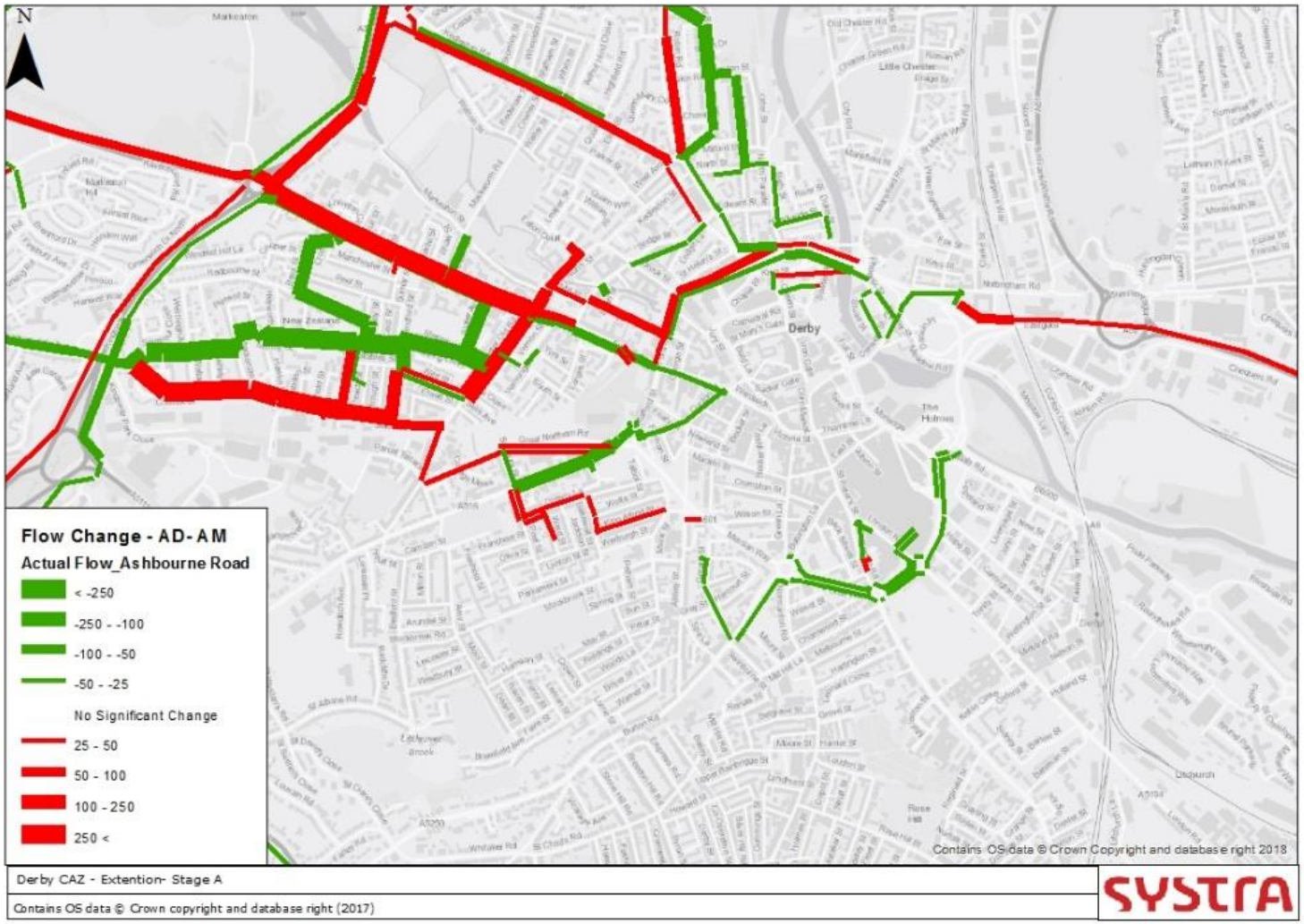
- Time allocated to the newly created stage 1 provides turns to and from Uttoxeter Old Road with an additional ten seconds of green time. This has been subtracted from stage two.

- As an additional stage has been added to the AM peak, alterations were also required within the IP and PM periods. However, as there is minimum demand within IP and PM periods, a minimum green time of 5 seconds has been assigned. Hence minimising the effect of the alteration



New Zealand & Ashbourne Road

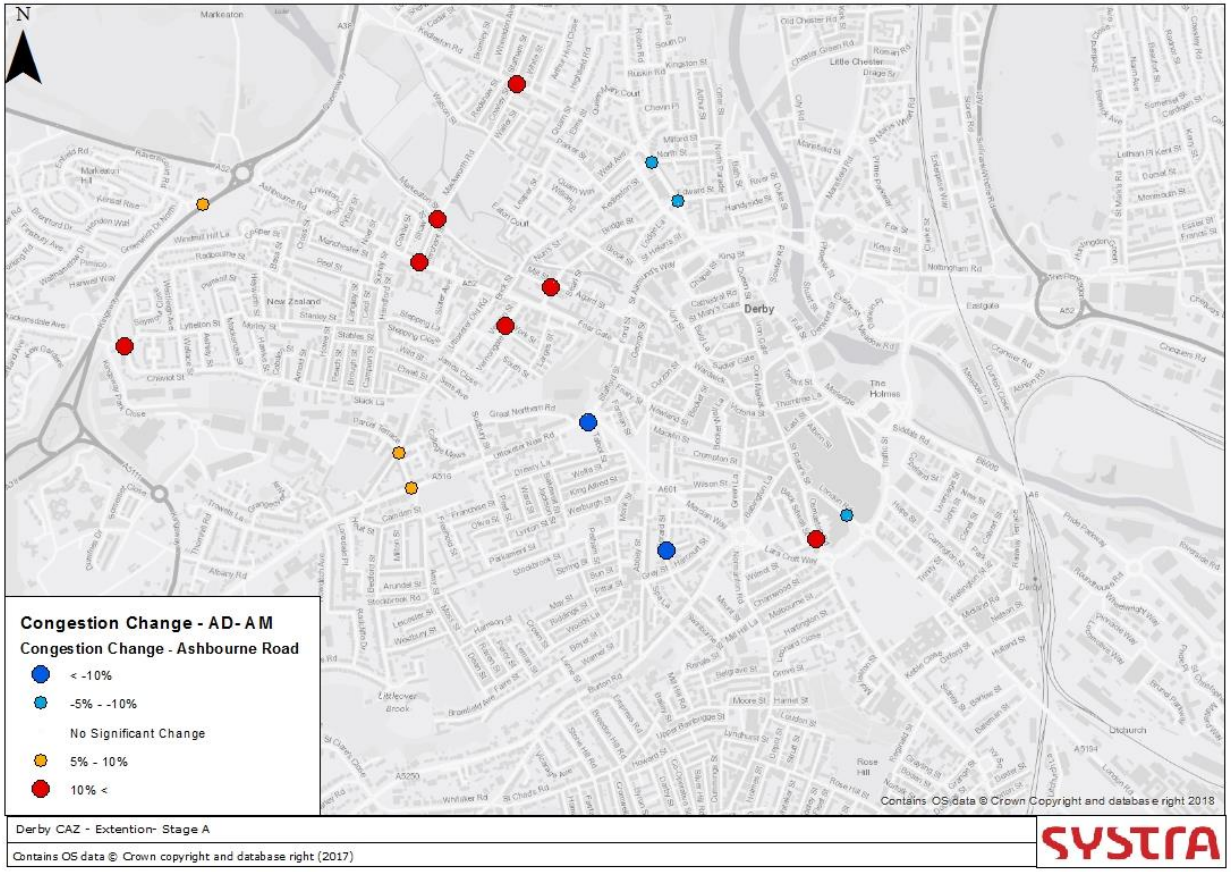
Flow Change - AM



SYSTRA

New Zealand & Ashbourne Road

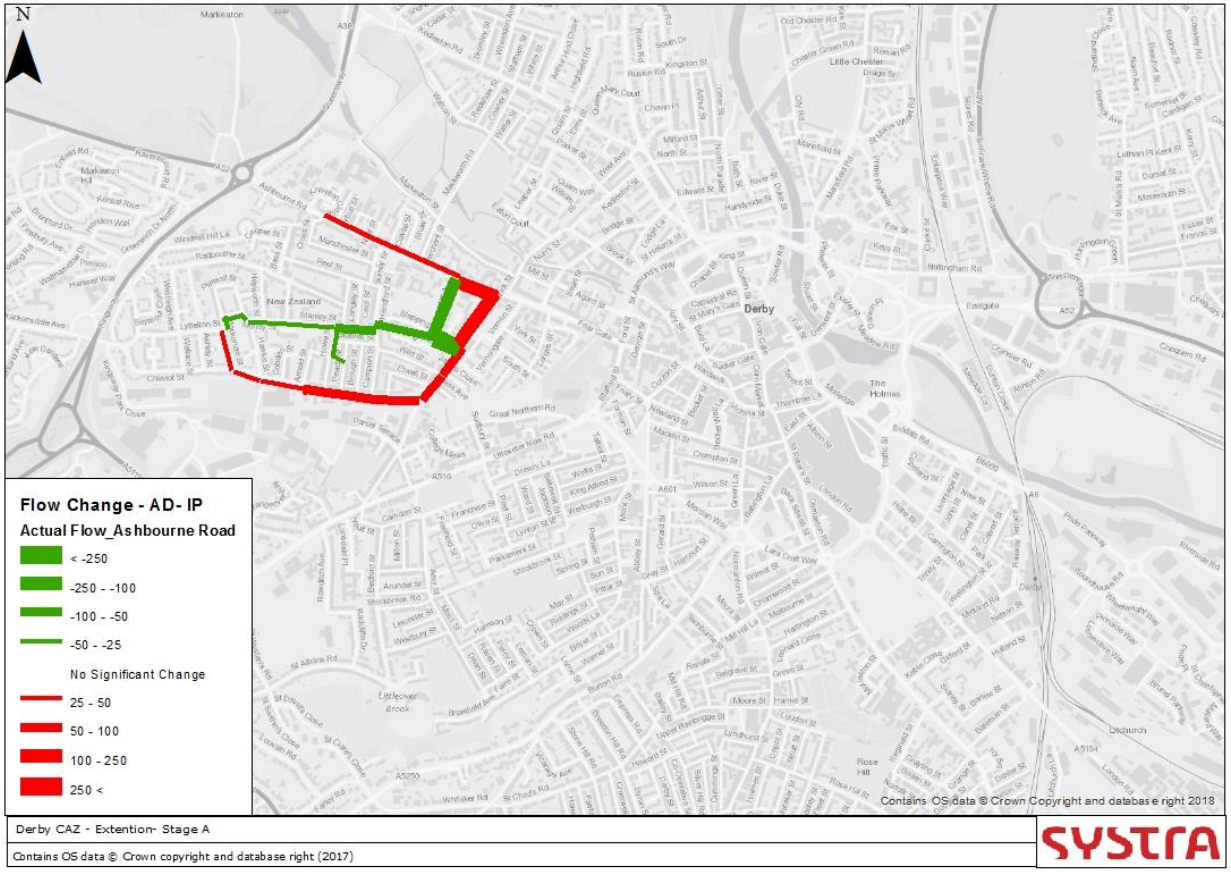
Congestion Change - AM



SYSTRA

New Zealand & Ashbourne Road

Flow Change - IP



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SYSTRA

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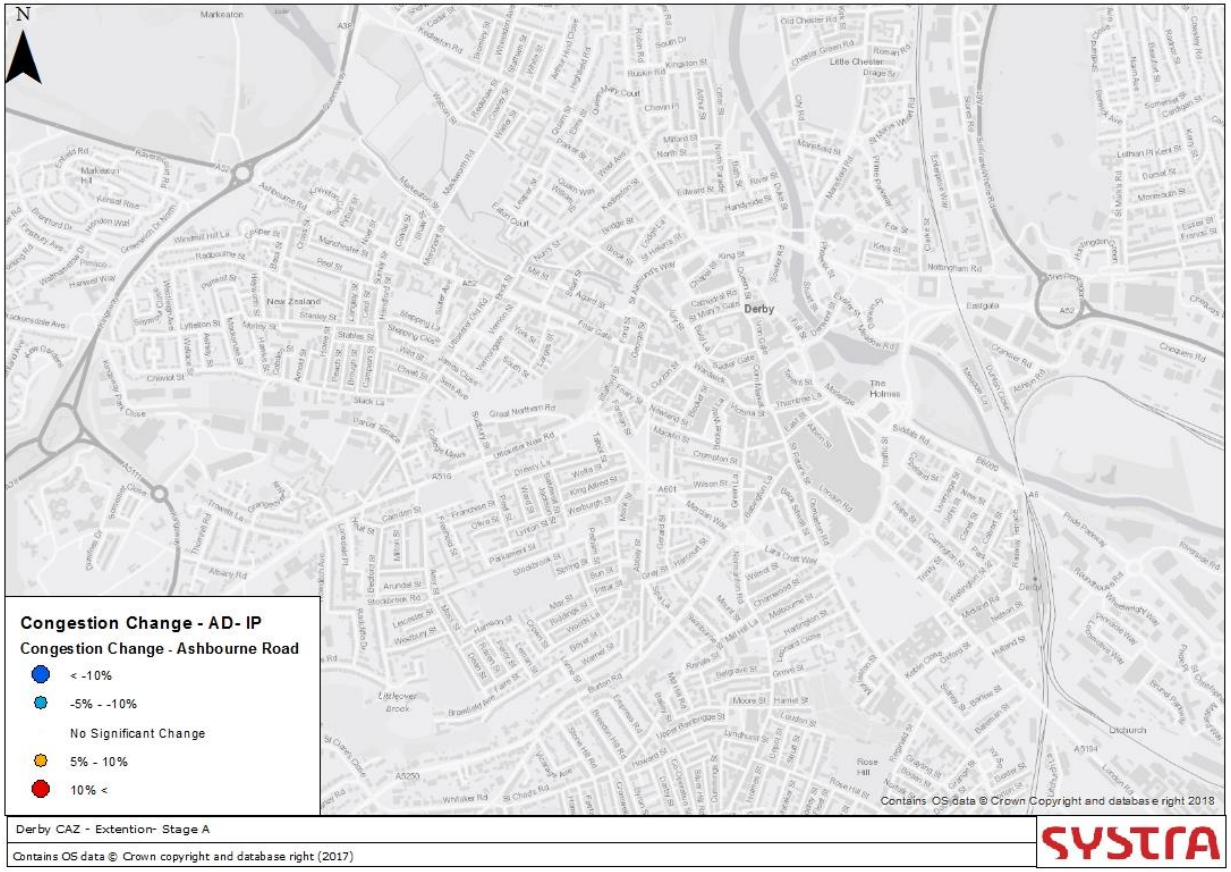
New Zealand & Ashbourne Road

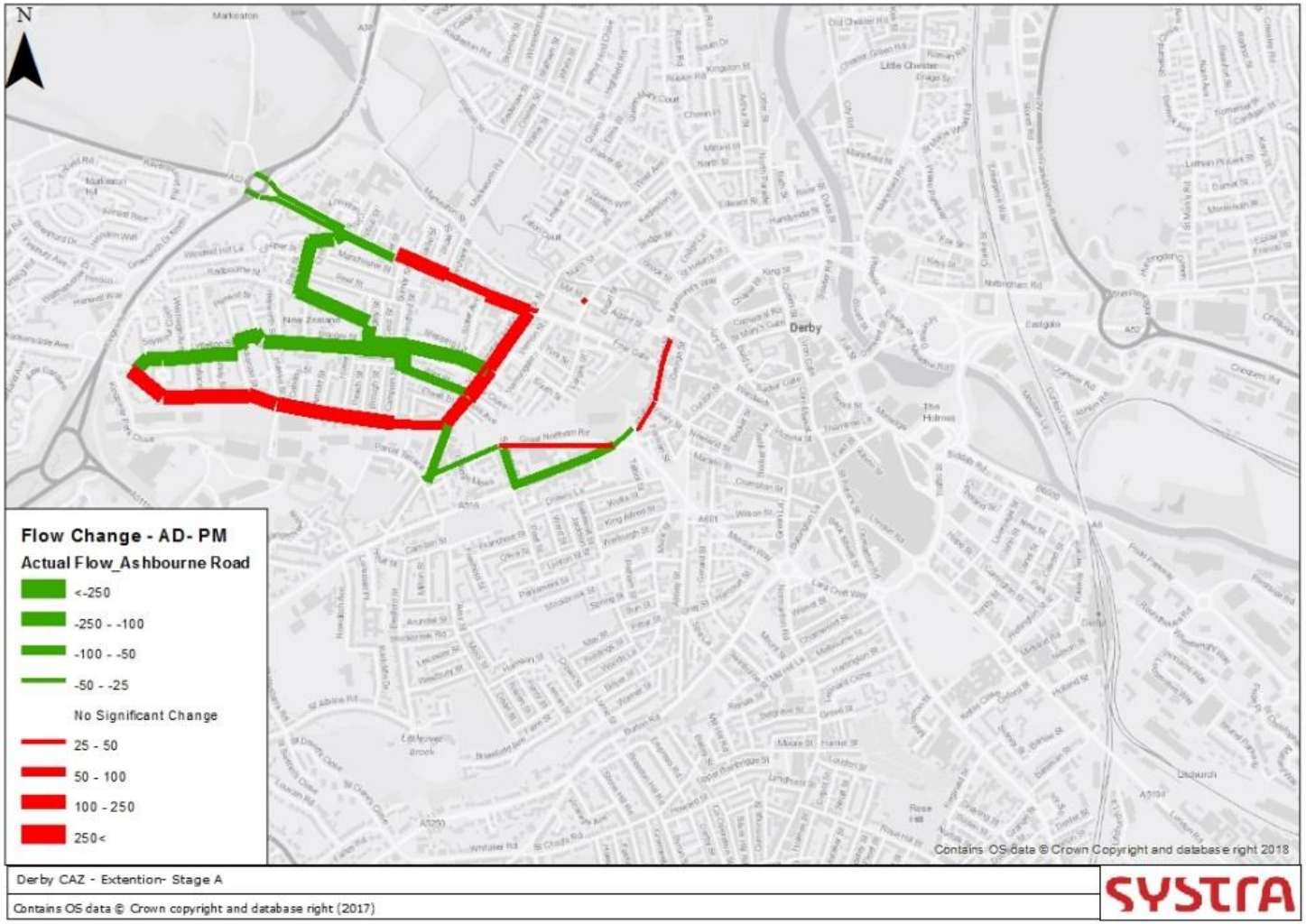
Congestion Change - IP



SYSTRA

New Zealand & Ashbourne Road

Flow Change - PM



Derby CAZ - Extention- Stage A

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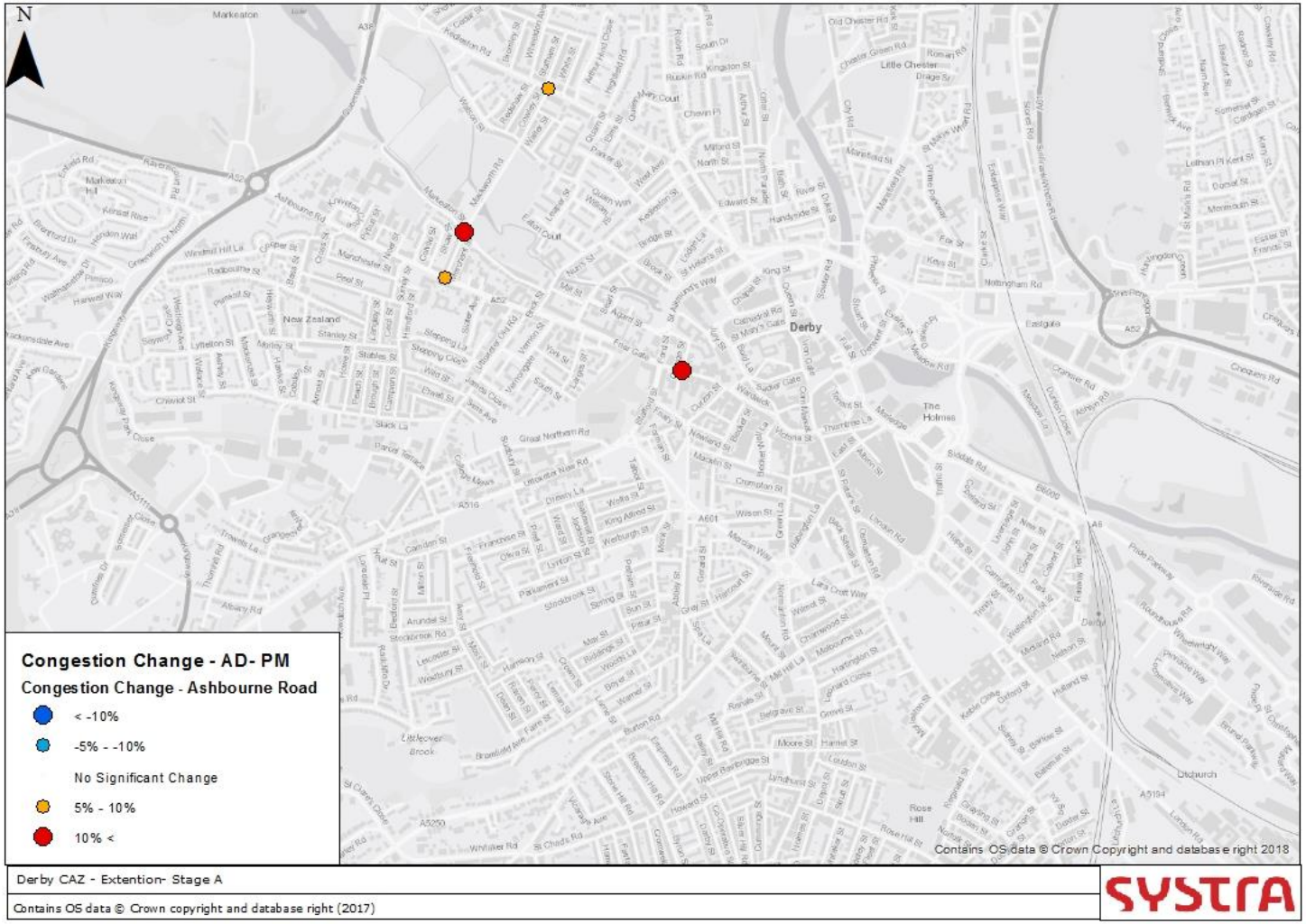
SYSTRA

New Zealand & Ashbourne Road

Congestion Change - PM



SYSTRA

New Zealand & Ashbourne Road

Summary

- Within the AM Flow Change plots, the legitimisation of Uttoxeter Old Road acts to draw a substantial number of trips onto the route.
- However, it has no significant impact on flows along Stafford Street and therefore will have minimal direct impact on the Air Quality issues along this route.
- The use of Uttoxeter Old Road is likely to be further legitimised via alterations to Lara Croft Way, also applied solely to the AM Peak.
- Regarding undesirable re-routing in residential areas in the AM, IP and PM periods, we see that the banning of turns into New Zealand, coupled with speed restrictions within the residential block, act to significantly reduce the number of trips utilising the route. Instead these trips now utilise the legitimised Uttoxeter Old Road route, alongside a shift onto Slack Lane.

Bridge Street (B) & Kedleston Road (C)

Bridge Street (B) & Kedleston Road (C)

Introduction

- Due to the shared solution available for locations Bridge Street (B) and Kedelston Road (C) these have been combined.

Bridge Street

- Bridge Street connects Ashbourne Road with Kedleston Road. Under the traffic management scenario 2.5 Bridge Street incurs an increase in flow due to the reduced green time available at the Friar Gate/ Ford Street junction. This reduction places increased pressure on Bridge Street as an alternative route between these two roads.

- As a residential route, mitigation efforts seek to stem this increase. To this extent, it is deemed that alterations to signal priority at the Bridge Street/ A6 Junction, reducing green time on Bridge Street, acts to achieve this goal whilst simultaneously increasing the viability of Kedleston Road.

Bridge Street (B) & Kedleston Road (C)

Introduction

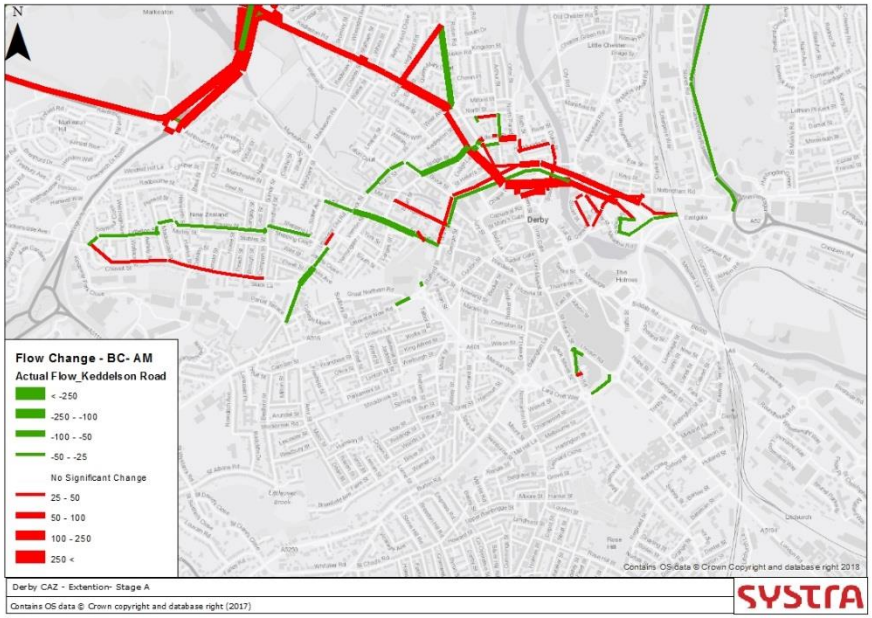
Kedleston Road

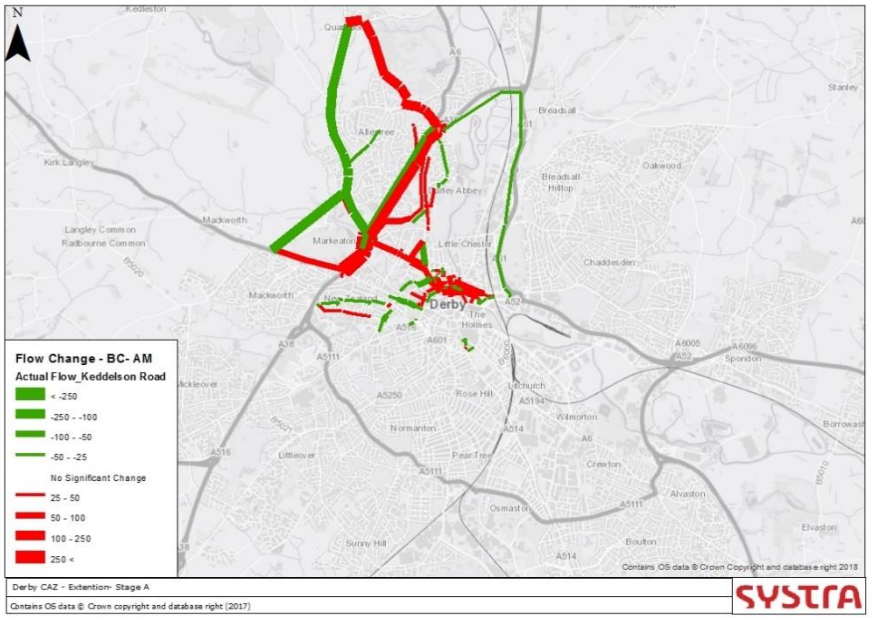
- In order to accommodate trips dissuaded from utilising Stafford Street/Friar Gate, attempts have been made to increase the attractiveness of Kedleston Road.

- This was achieved via an alteration to signal priorities at key locations along its length. These changes include:
  - Bridge Street/A6: Three seconds were removed from Stage 1 and 3 and six seconds added to Stage 2, giving priority to trips utilising the A6 to travel outbound from the city. This measure was applied to the AM and PM peaks only.
  - A6/Duffield Road: Three seconds were removed from Stage 1 and added to Stage 2, limiting the green time available for access to Duffield Road, but increasing green time from Kedleston Road. This measure was applied to the AM and PM peaks only.
  - A38 Slip/Kedleston Road: Ten seconds removed from Stage 1 and added to Stage 2, increasing the green time available for trips from the A38. This measure was applied to the AM peak only.
  - A38 Slip/ Kedleston Road: Three seconds moved from Stage 1 to Stage 2, increasing the green time available for trips from the A38. Applied to the PM peak only.

Bridge Street (B) & Kedleston Road (C)

Flow Change - AM

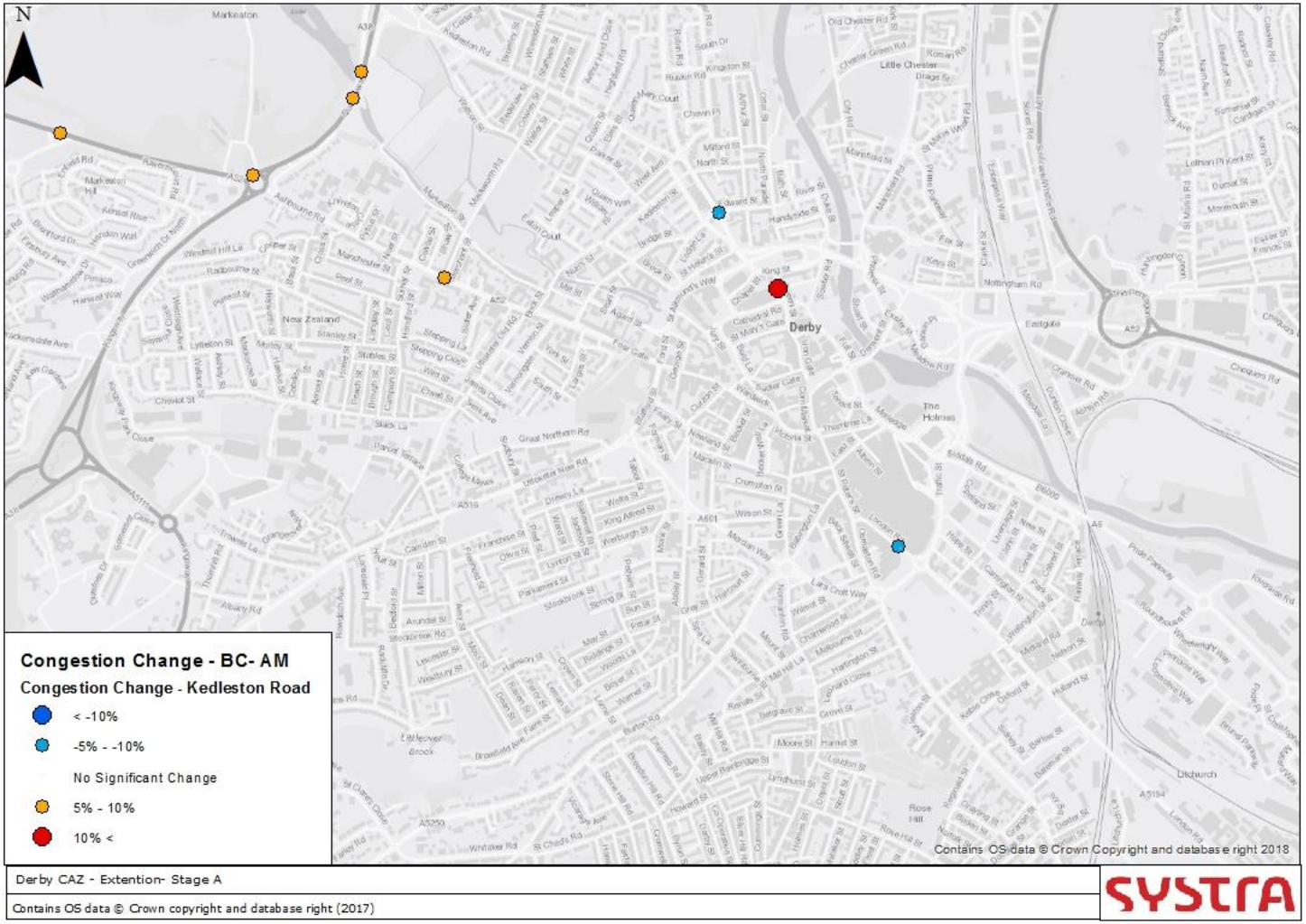




SYSTRA

Bridge Street (B) & Kedleston Road (C)

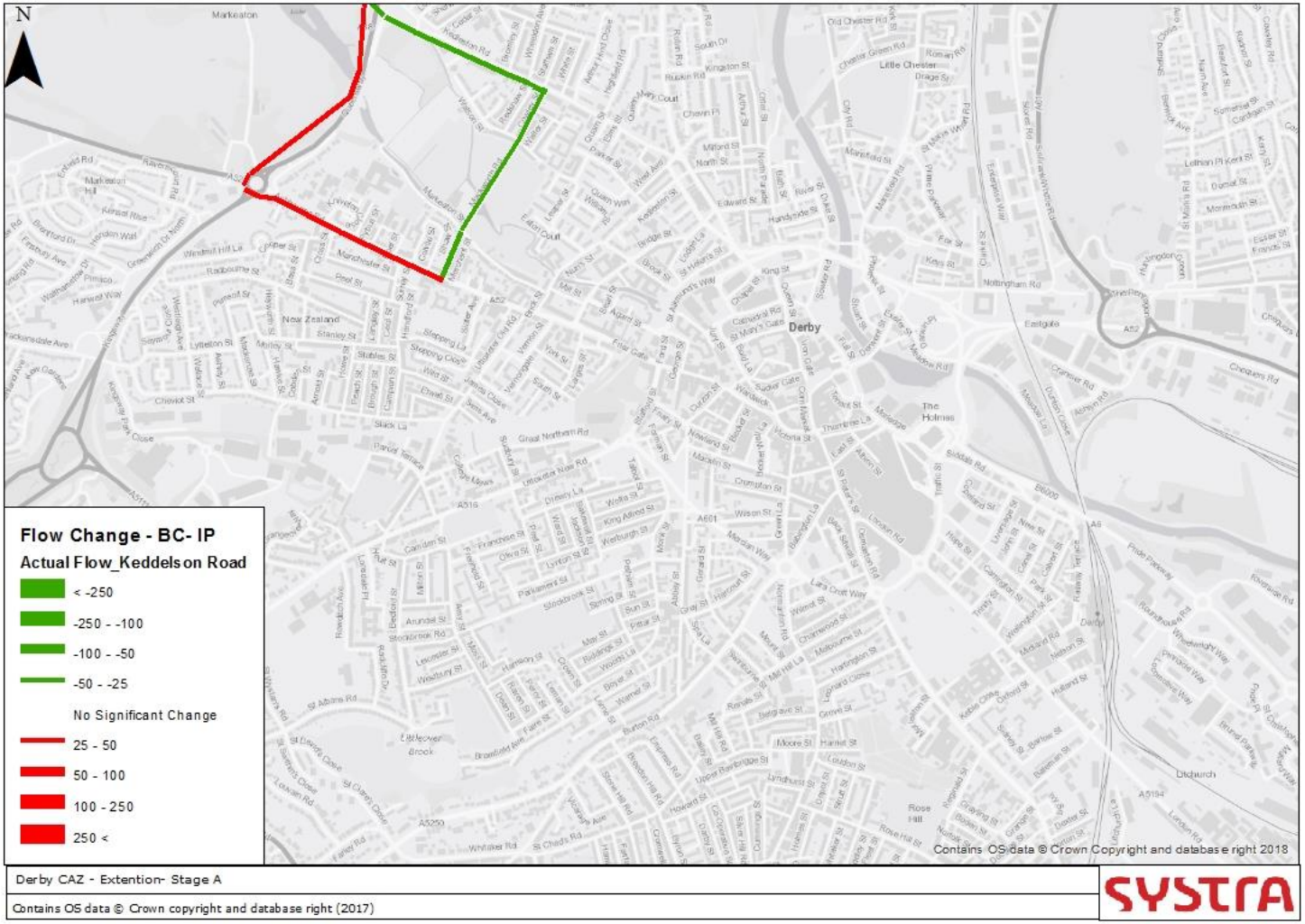
Congestion Change - AM



SYSTRA

Bridge Street (B) & Kedleston Road (C)

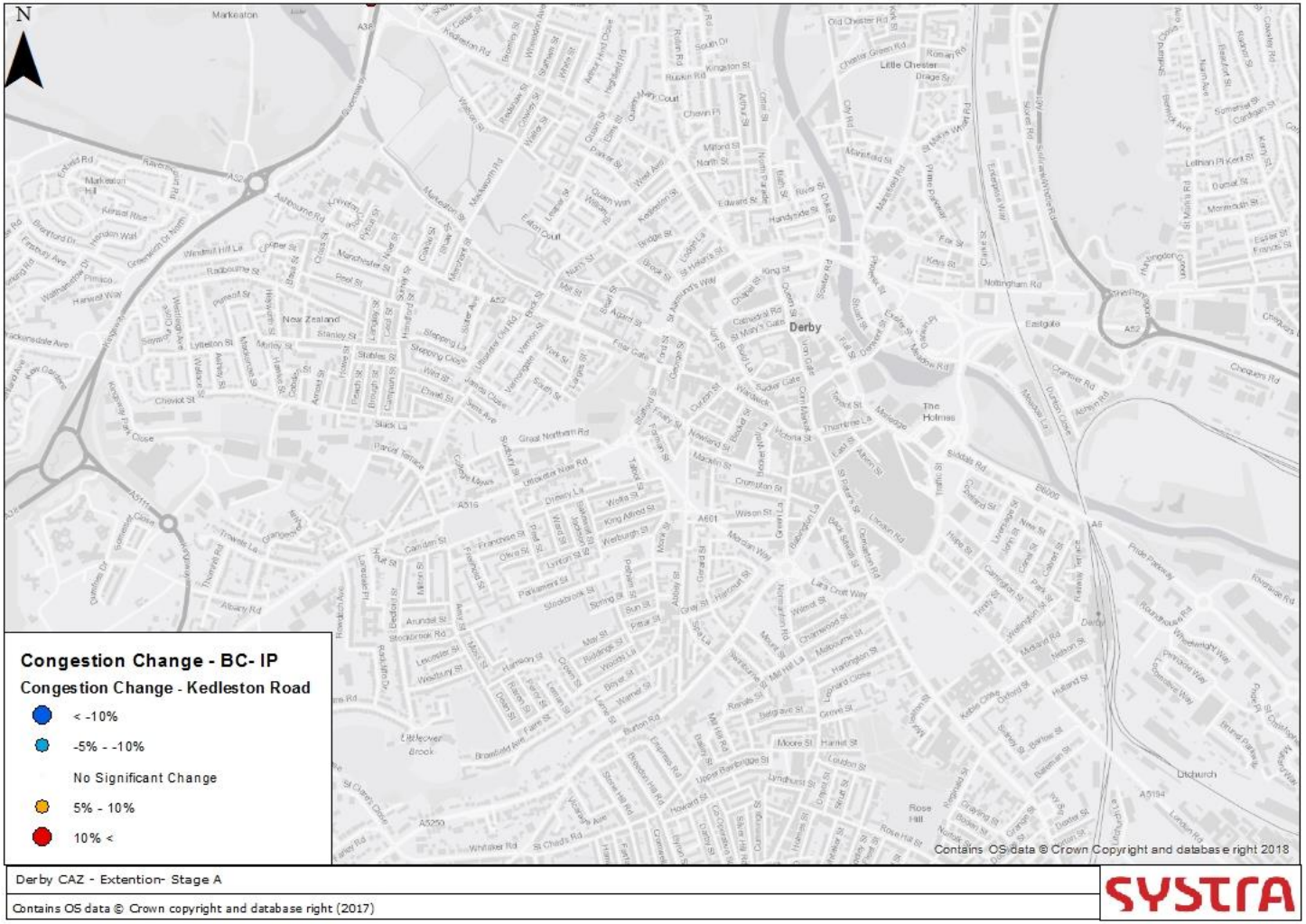
Flow Change - IP



SYSTRA

Kedleston Road

Congestion Change - IP



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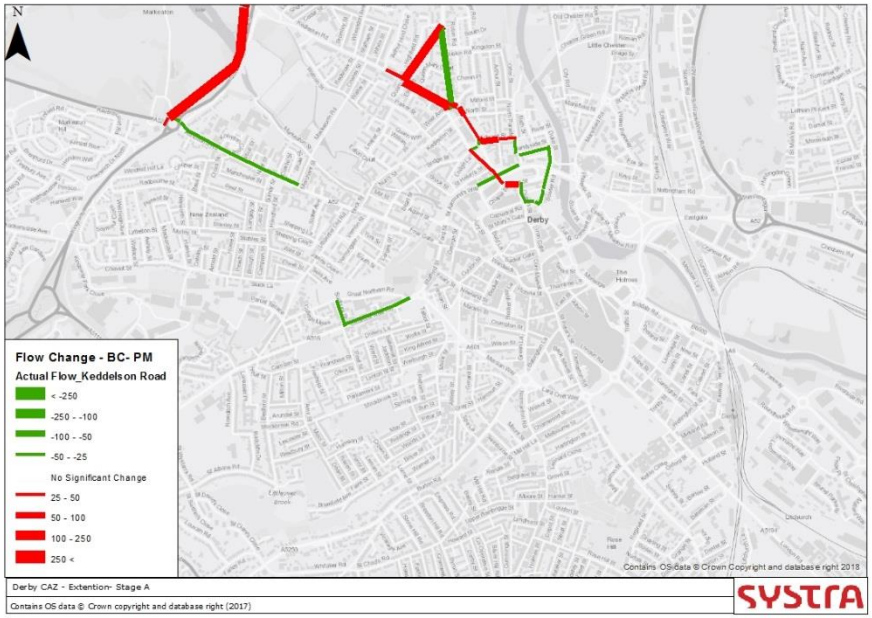
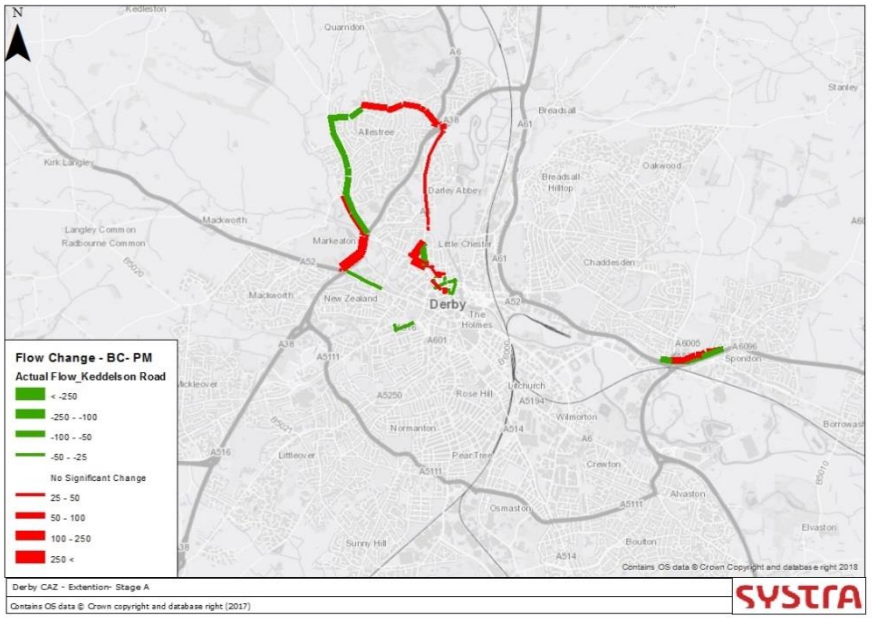
Bridge Street (B) & Kedleston Road (C)

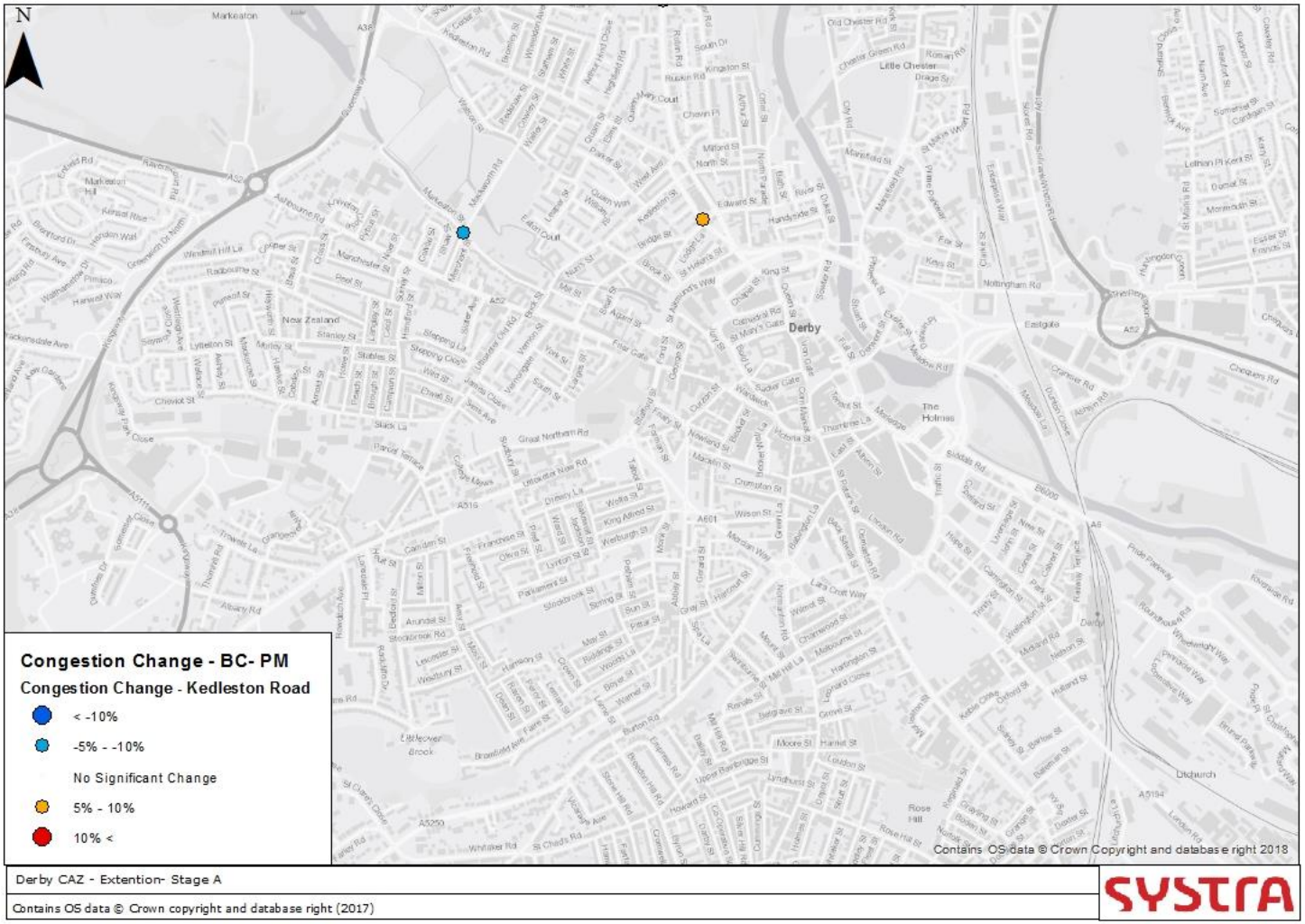
Flow Change - PM





Bridge Street (B) & Kedleston Road (C)

Congestion Change - PM



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SYSTRA

SYSTRA

Bridge Street (B) & Kedleston Road (C)

Summary

- Within the AM peak, the prioritisation of Kedleston Road acts to substantially increase the number of trips utilising the route, alongside reducing the number of trips using Bridge Street. This acts to reinforce the formation of an alternative route between the A38 and the A52.

- However, it has no significant impact on flows along Stafford Street and therefore will have minimal direct impact on the Air Quality issues along this route.

- Currently however, without alterations to Ashbourne Road, there is little to encourage a shift onto this reinforced route. This is be addressed later when the two schemes, Kedleston and Ashbourne, are combined.

- Regarding the negative effects of the prioritisations, there are two key issues. Firstly, due to the interaction between Duffield Road and Kedleston Road, the prioritisation of turns from the A38, right onto Kedleston Road leads to a Zonal (Quarndon) route shift onto Duffield Road. Though less prominent in the AM peak, this is clearly apparent in the IP and PM periods. With the shift leading to net decrease in trips along Kedleston Road, as well as rat running through Darley.

- Additionally, though trips from the south are being dissuaded, those that do pass through Stafford Street are presented with no legitimate means of accessing Kedleston Road/ Duffield Road. This leads to rat running both through the city centre and along the afore-mentioned Darley Route

Lara Croft Way (F)

Lara Croft Way (F)

Introduction

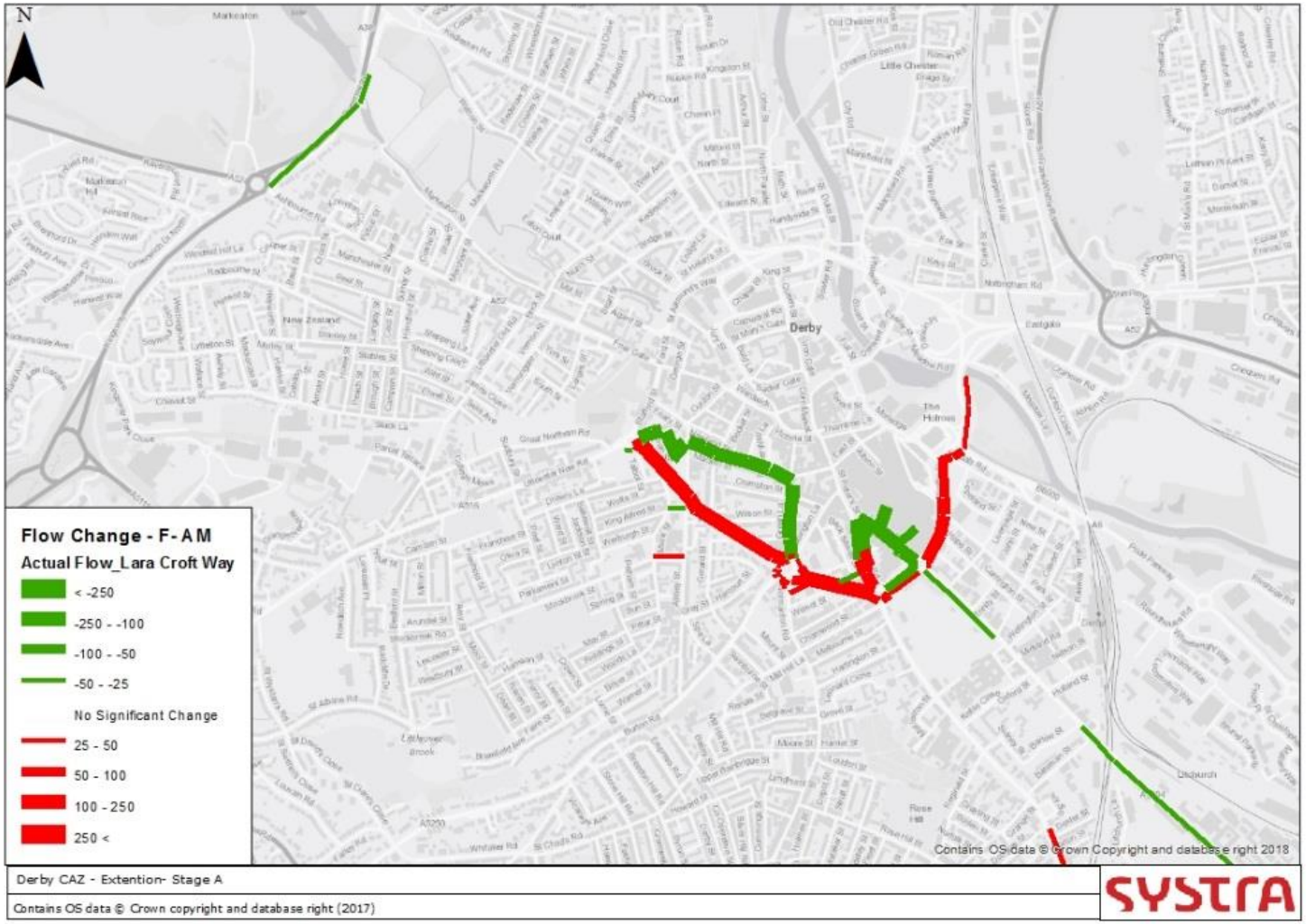
- Within the AM period, a majority of trips utilising Stafford Street do so in order to move between Uttoxeter New Road and the A52. In order to encourage these trips to utilise the Southern extent of the Inner Ring Road, as opposed to the Northern, attempts have been made to increase flows along Lara Croft Way.

- Alterations in this area focuses on increasing the priority of trips circumnavigating the Inner ring road at the Burton Road, Osmaston Road and Derby Road roundabouts. Collectively entitled Lara Croft Way.

- Priority has been changed as follows:
  - Burton Road Roundabout: 6 Seconds added
  - Osmaston Road Roundabout: 6 seconds added
  - Derby Road Roundabout: 6 Seconds added

Lara Croft Way (F)

Flow Change - AM



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SYSTRA

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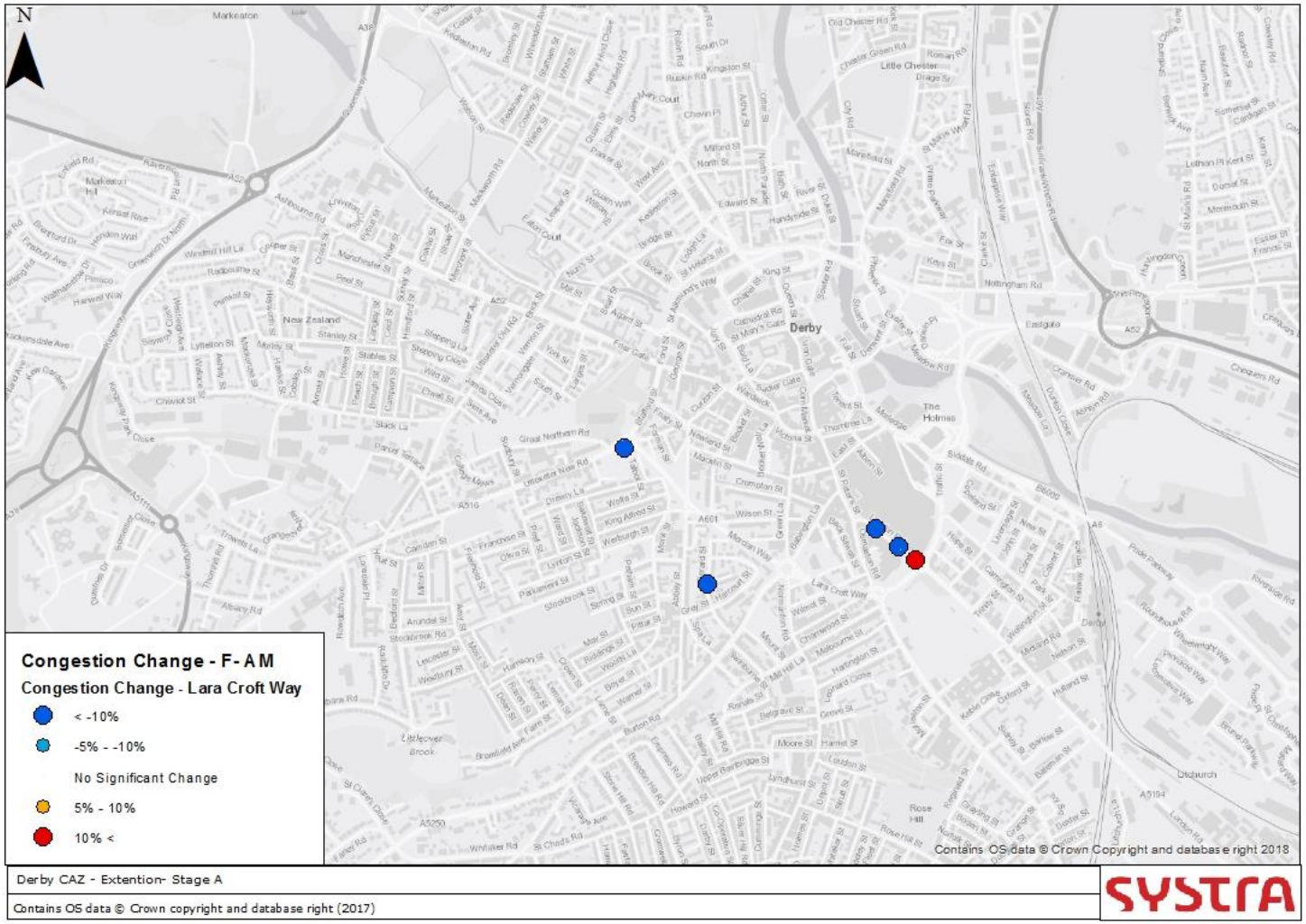
Lara Croft Way (F)

Congestion Change - AM



SYSTRA

Lara Croft Way (F)

Summary

- The prioritisation of signals within the AM peak, leads to a highly localised increase in the number of trips, using the Southern extent of the Inner Ring Road.

- However, it has no significant impact on flows along Stafford Street and therefore will have minimal direct impact on the Air Quality issues along this route.

South Derby - Infinity Park Way (H) & Osmaston Road (I)

South Derby

Introduction

- Locations H and I both pertain to the increase in traffic along both Infinity Park Way and Osmaston Road as a result of the implementation of the Stafford Street traffic management measures. Mitigation aims to reduce the utilisation of these routes and instead divert trips onto the Inner Ring Road via the A6.

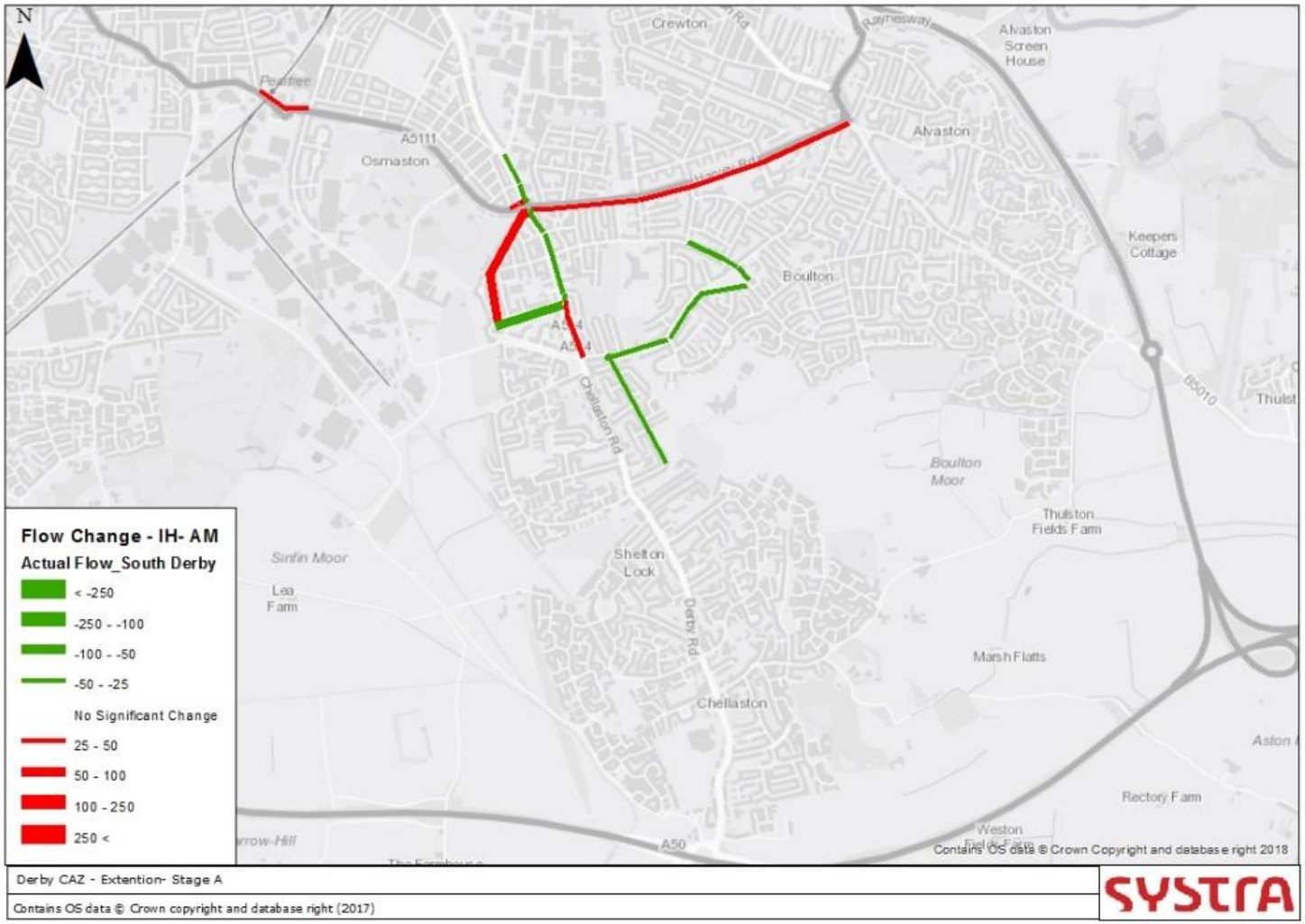
- To this extent, the solution is a shared one. Decreasing travel time along the Outer Ring Road via the alteration of the signals at the Spider Bridge and Victory Road Junctions, prioritising East-West Ring Road movements at the expense of the minor routes (North/ South).

- In all peaks, 6 Seconds were subtracted from North/ South arms off both junctions and transferred to East/ West arms.

- The only exception was the northbound arm of the Victory Road junction, which was already set at a minimum value.

South Derby

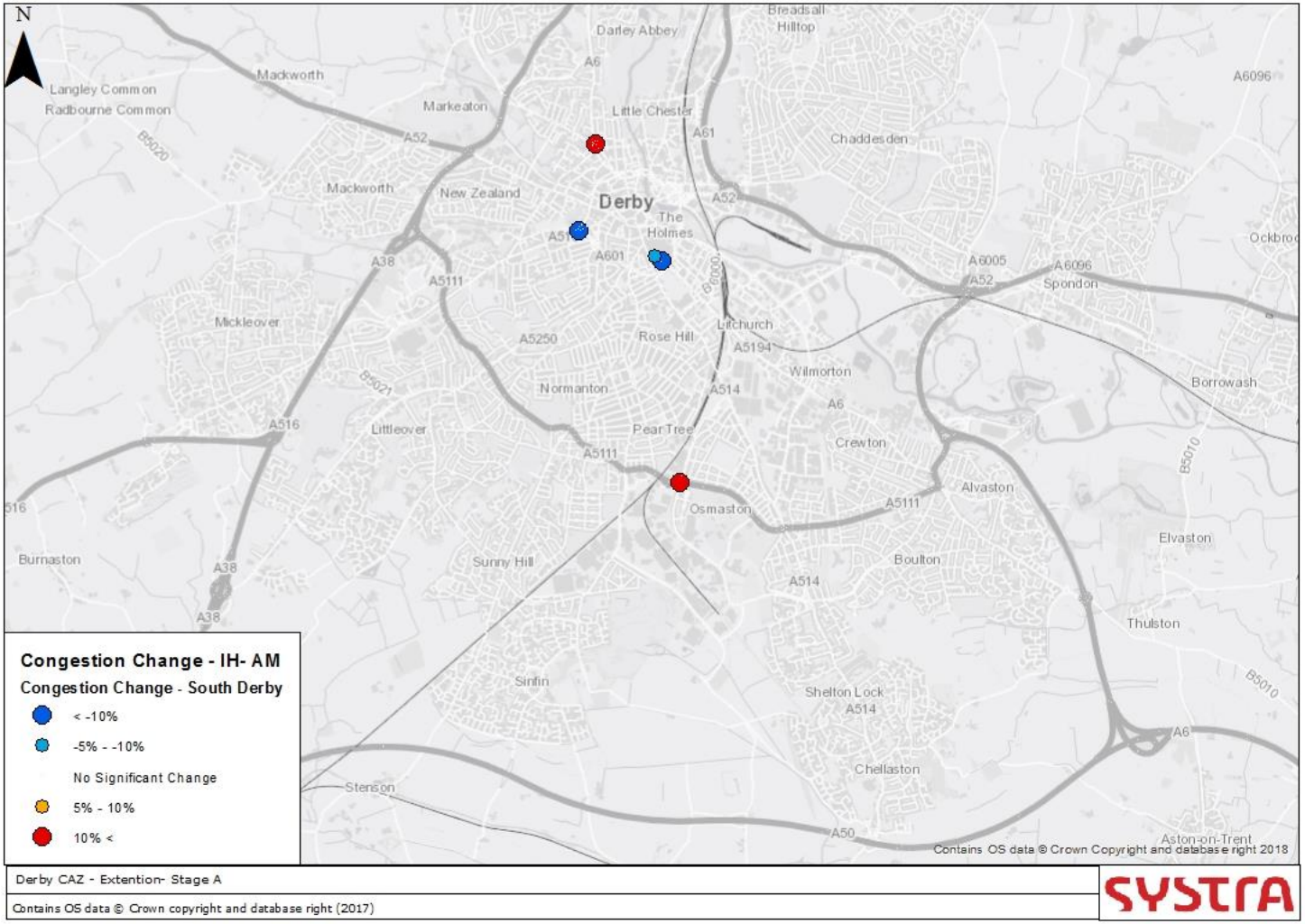
Flow Change - AM



SYSTRA

South Derby

Congestion Change - AM



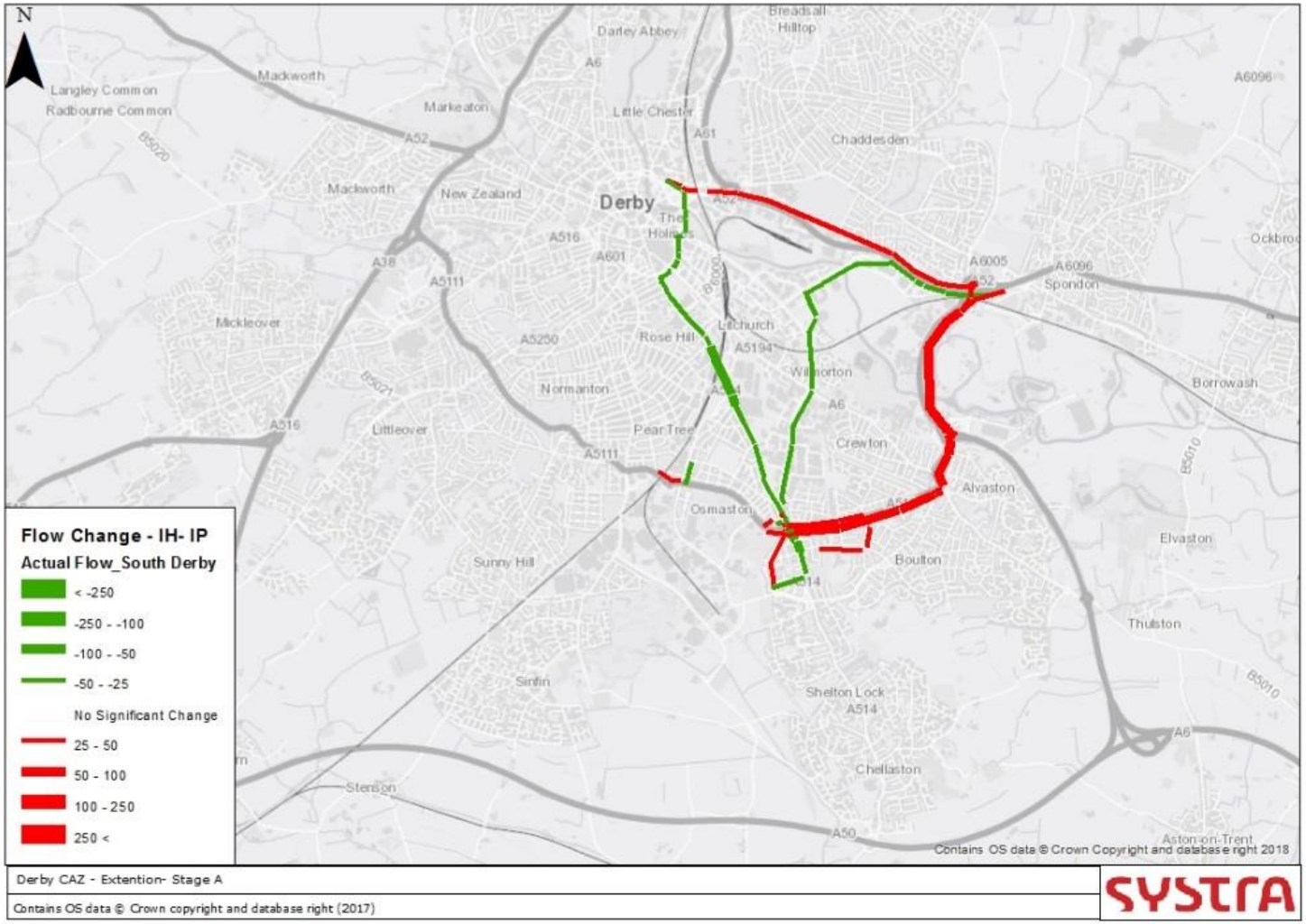
Derby CAZ - Extention- Stage A

SYSTRA

SYSTRA

South Derby

Flow Change - IP



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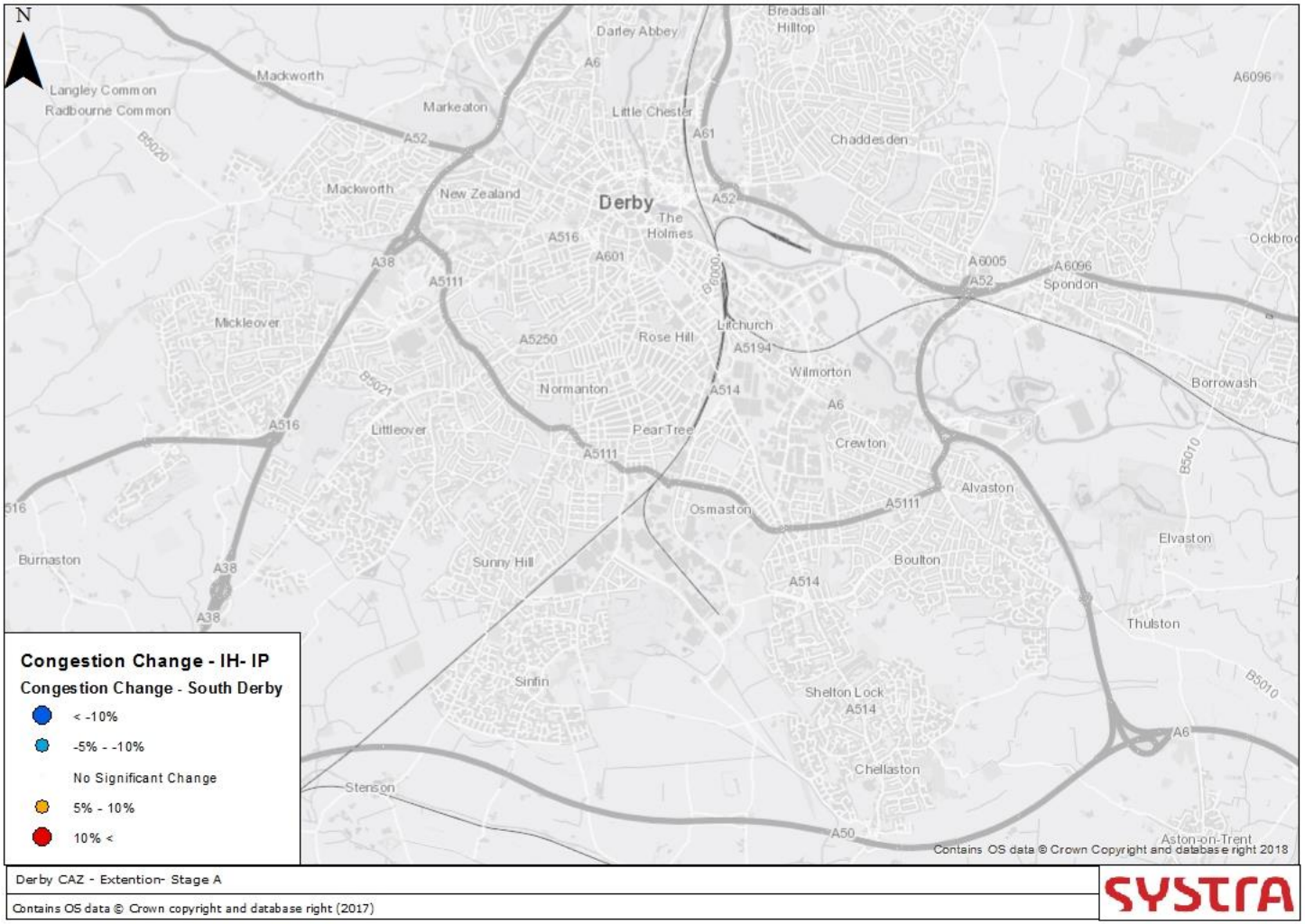
South Derby

Congestion Change - IP



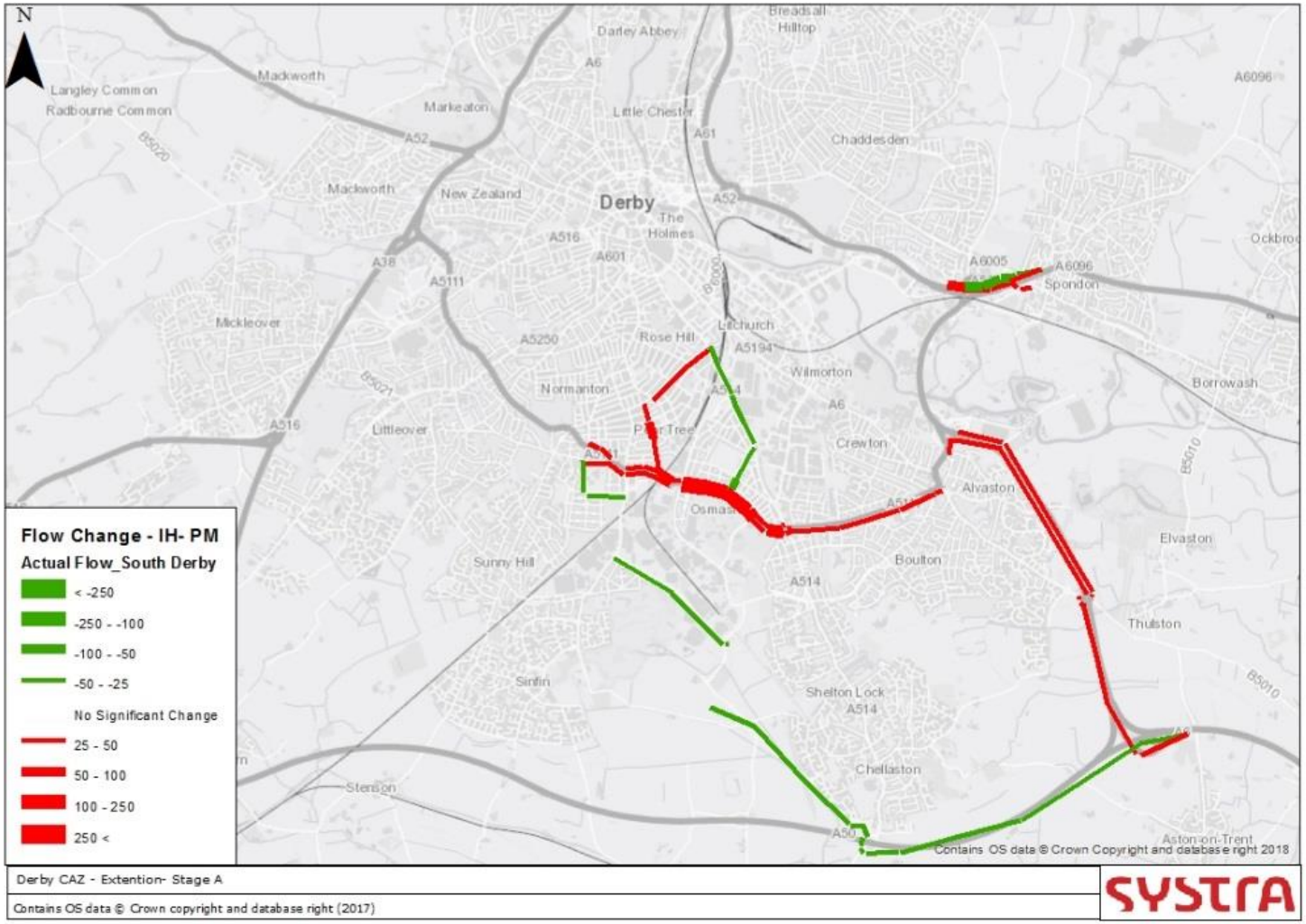
Derby CAZ - Extention- Stage A

SYSTRA

SYSTRA

South Derby

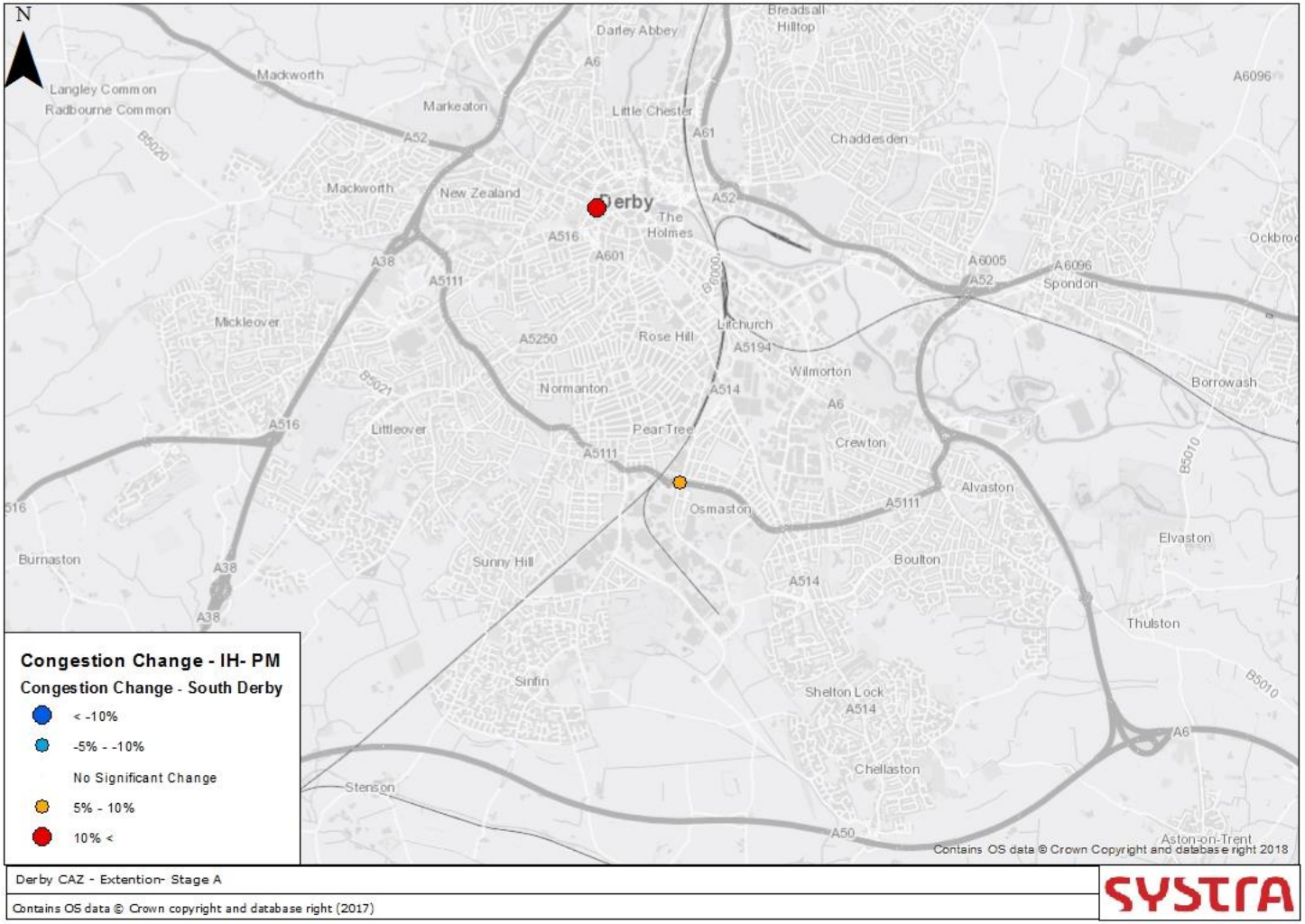
Flow Change - PM



Derby CAZ - Extention- Stage A

South Derby

Congestion Change - PM



Derby CAZ - Extention- Stage A

SYSTRA

SYSTRA

South Derby

Summary

- The prioritisation of signals for Ring Road traffic movements results in the desired reductions in traffic along Infinity Park Way and Osmaston Road.

- However, it has no significant impact on flows along Stafford Street and therefore will have minimal direct impact on the Air Quality issues along this route.

Combined Test

Combined

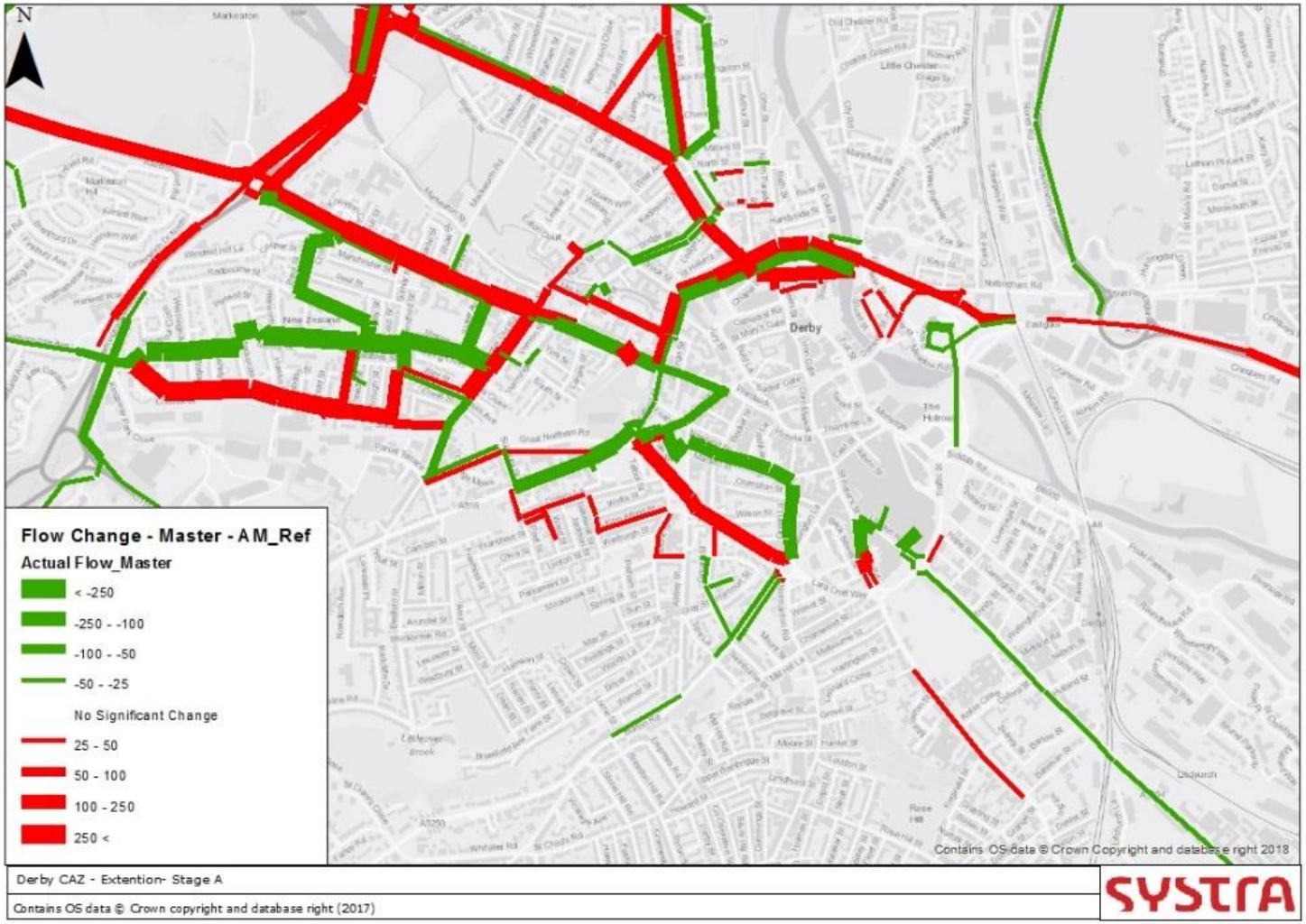
Introduction

In order to access the combined effects of the mitigation proposals, each strategy has been combined.

Mitigation Resolution Options					
Key	Type	Location	Potential Options		Time Periods
A	Area	New Zealand	1	20 Mph Limit introduced along residential areas of undesirable re-routing.	AM, IP, PM
			2	Banned Turns into New Zealand form Uttoxeter Old Road.	AM, IP, PM
			3	Altered Signals to prioritise Uttoxeter Old Road Over Ashbourne Road (Westbound)	AM, IP, PM
B	Road	Bridge Street	2	Signals altered to prioritise Kedleston Road.	AM, PM
C	Road	Kedleston Road	1	Signals altered to prioritise Kedleston Road.	AM, PM
D	Road	Ashbourne Road	1	Altered Signals to prioritise Uttoxeter Old Road Over Ashbourne Road (Westbound)	AM (IP and PM Limited)
F	Road	Lara Croft Way	1	Signal prioritisation provided for trips circumnavigating the Southern extent of the Inner Ring Road. .	AM
H	Road	Infinity Park Way	1	Prioritise trips passing along the Outer Ring Road, altering signals at the junction with Victory Road and at the Spider Bridge.	AM, IP, PM
I	Road	Osmaston Road	1	Prioritise trips passing along the Outer Ring Road, altering signals at the junction with Victory Road and at the Spider Bridge.	AM, IP, PM

Combined (vs 2.5)

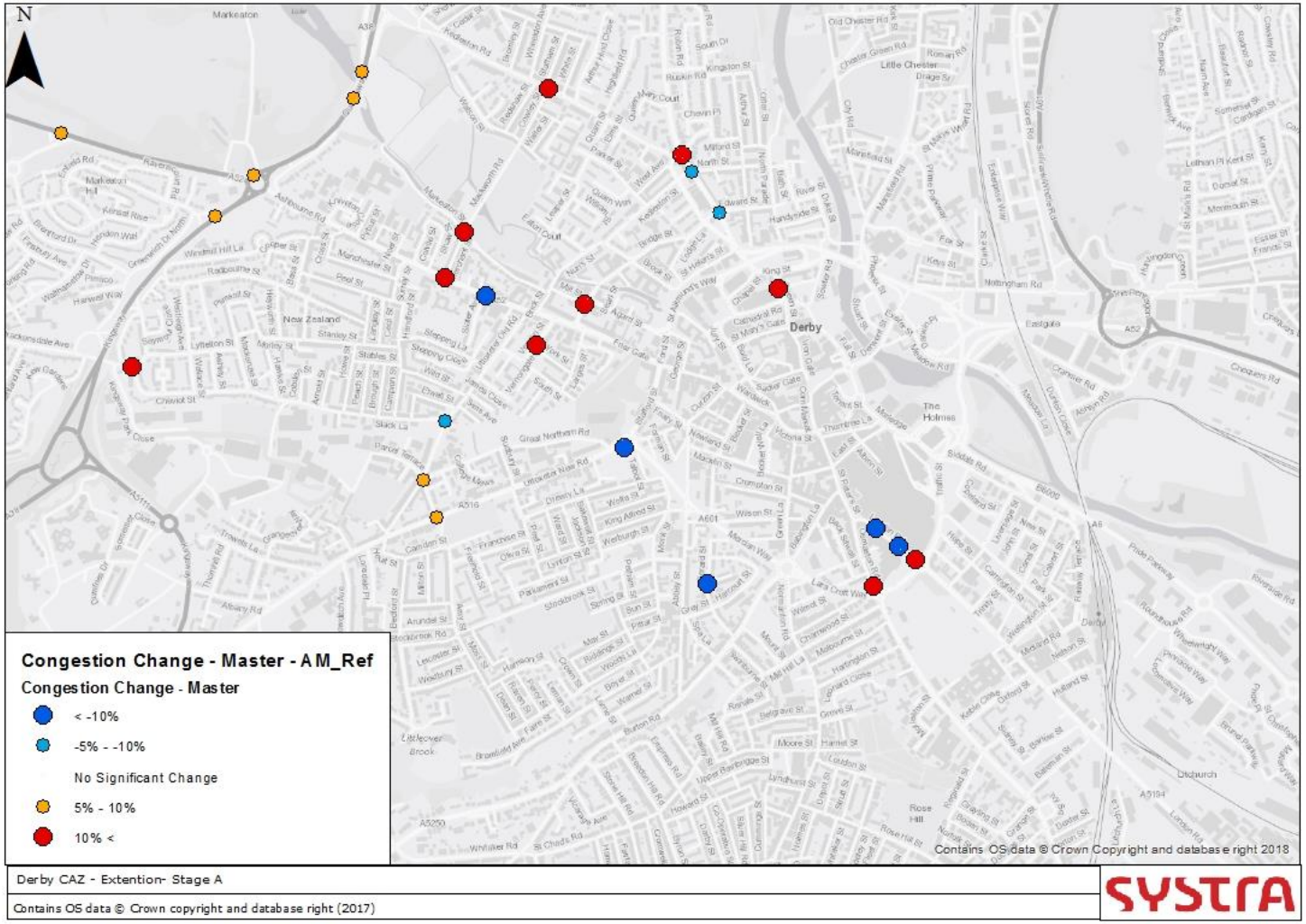
Flow Change - AM



SYSTRA

Combined (vs 2.5)

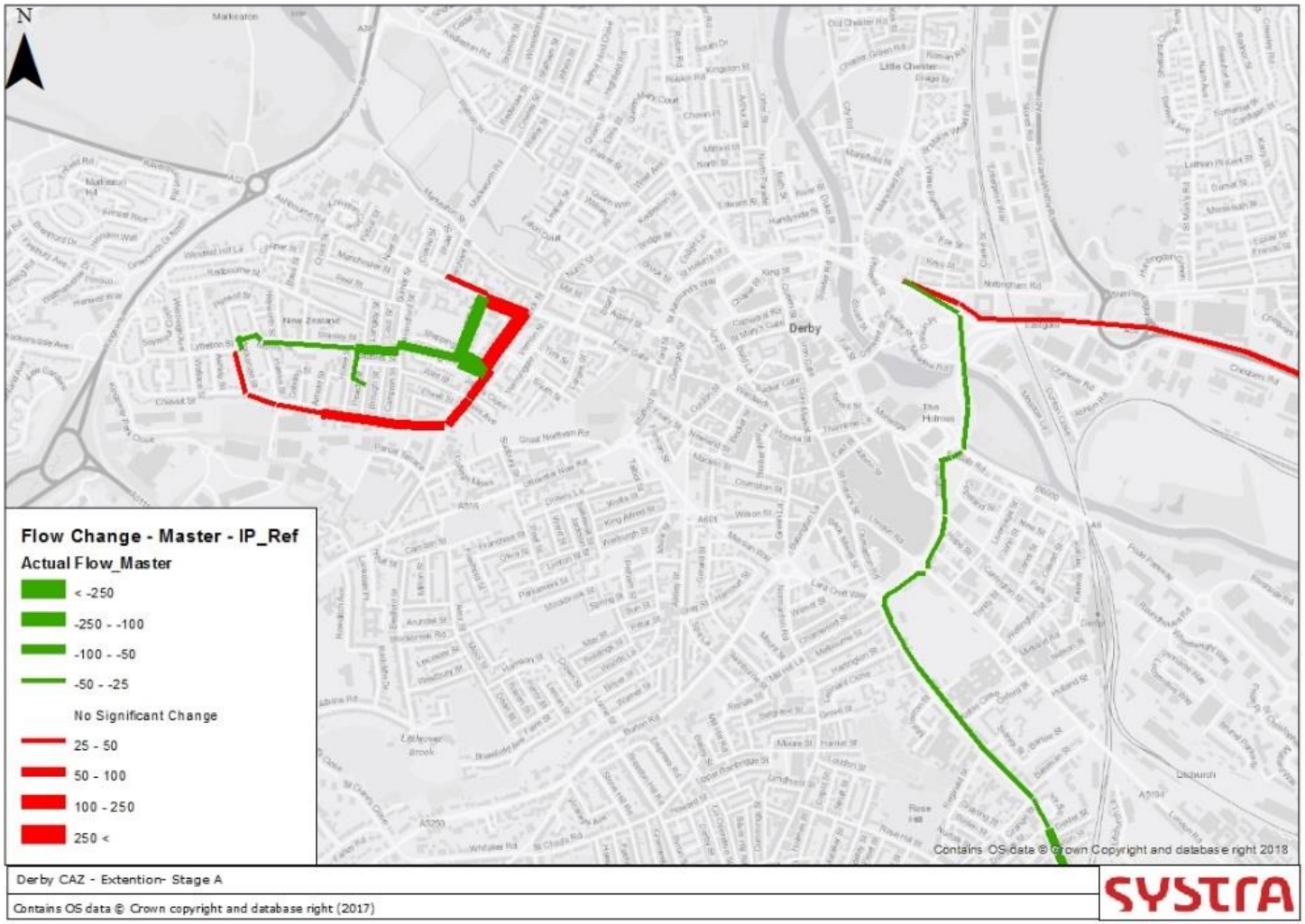
Congestion Change - AM



SYSTRA

Combined (vs 2.5)

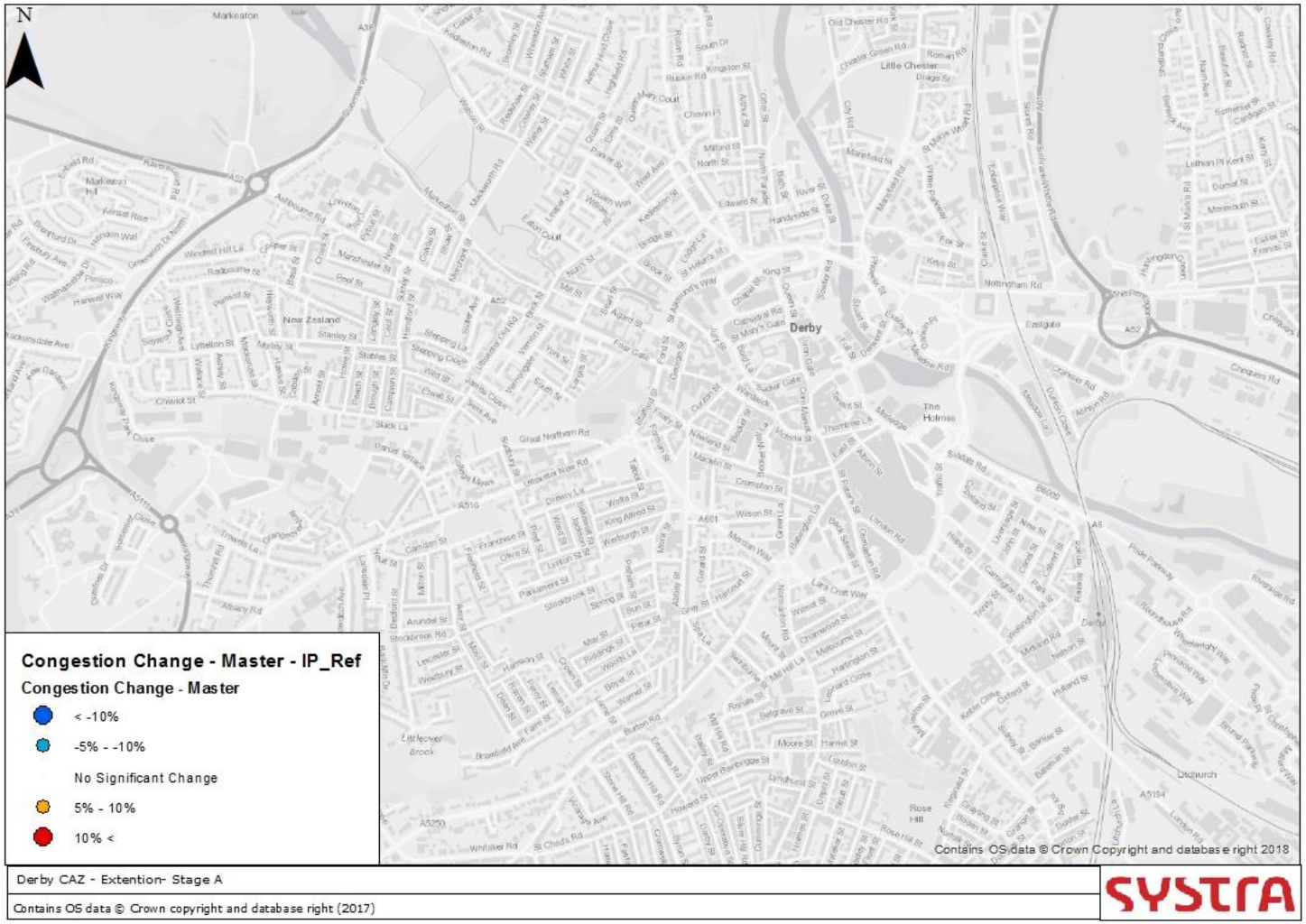
Flow Change - IP



SYSTRA

Combined (vs 2.5)

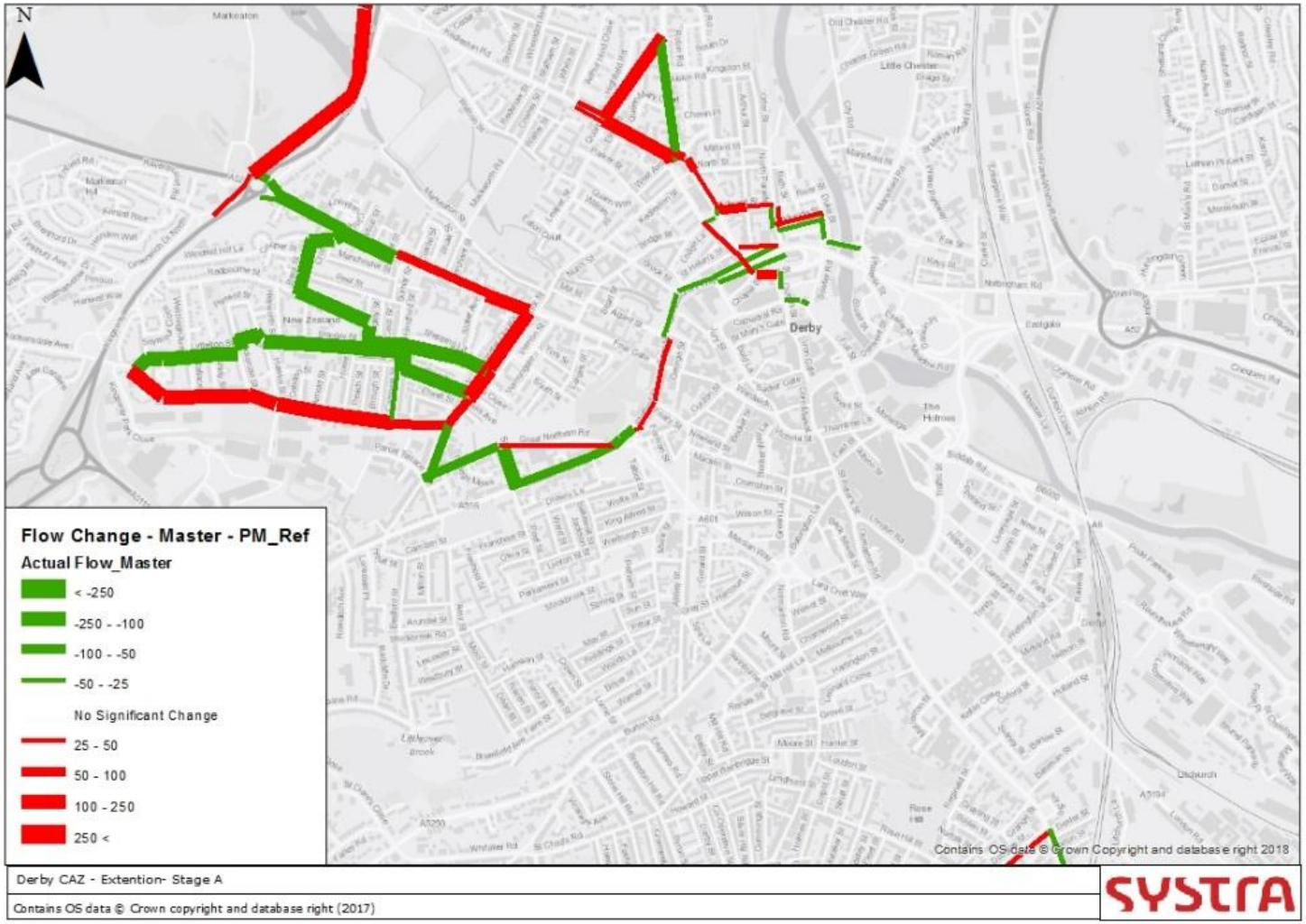
Congestion Change - IP



SYSTRA

Combined (vs 2.5)

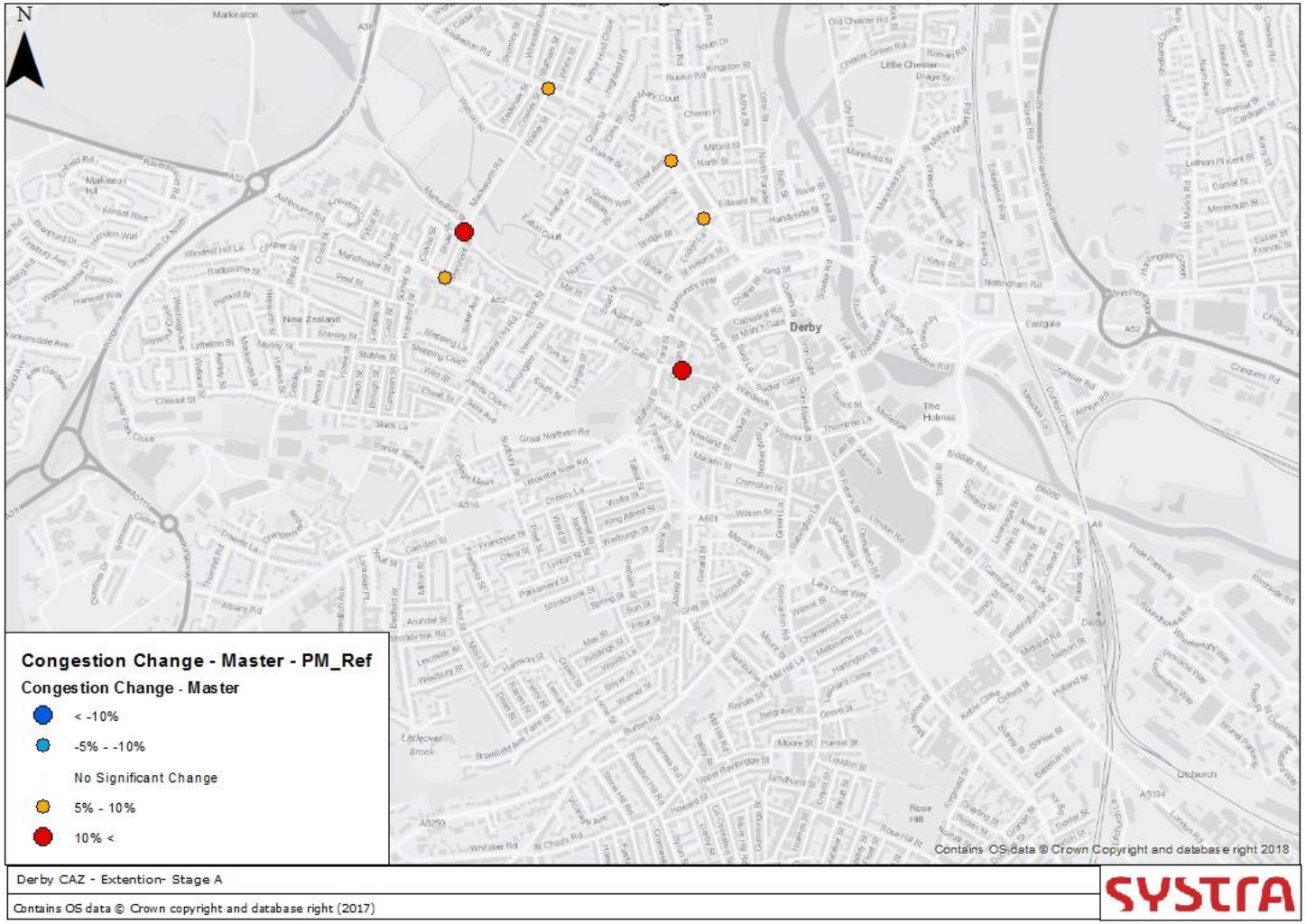
Flow Change - PM



SYSTRA

Combined (vs 2.5)

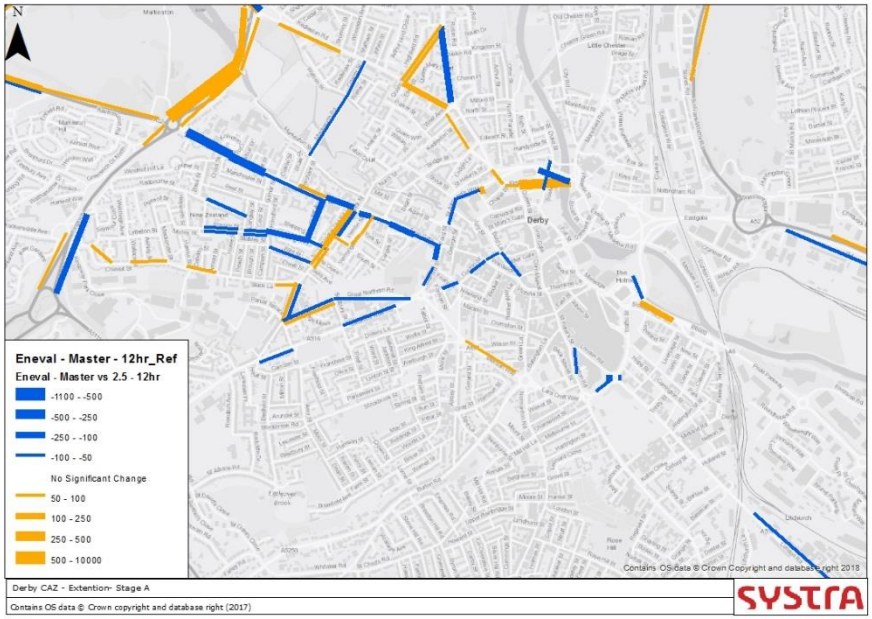
Congestion Change - PM

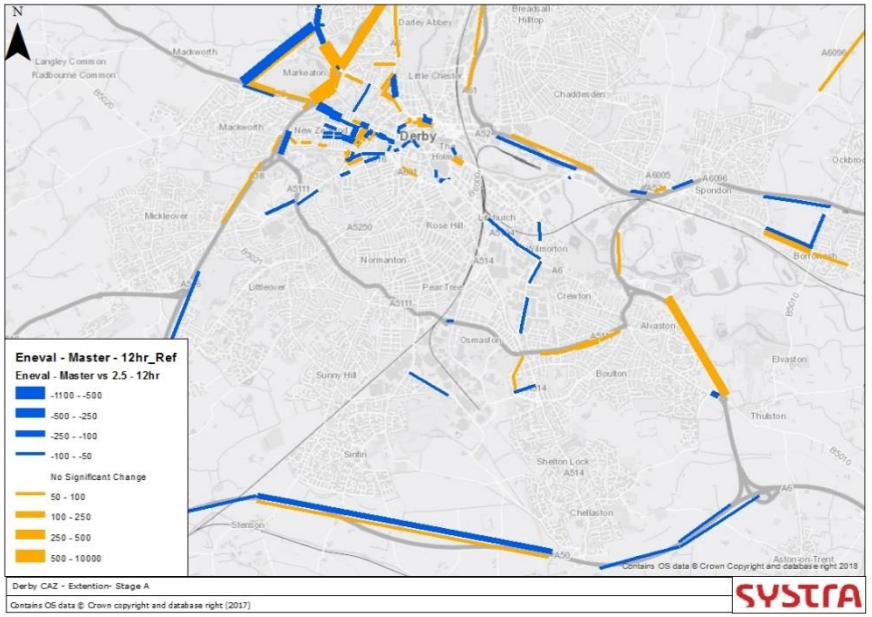


SYSTRA

Combined (vs 2.5)

Eneval



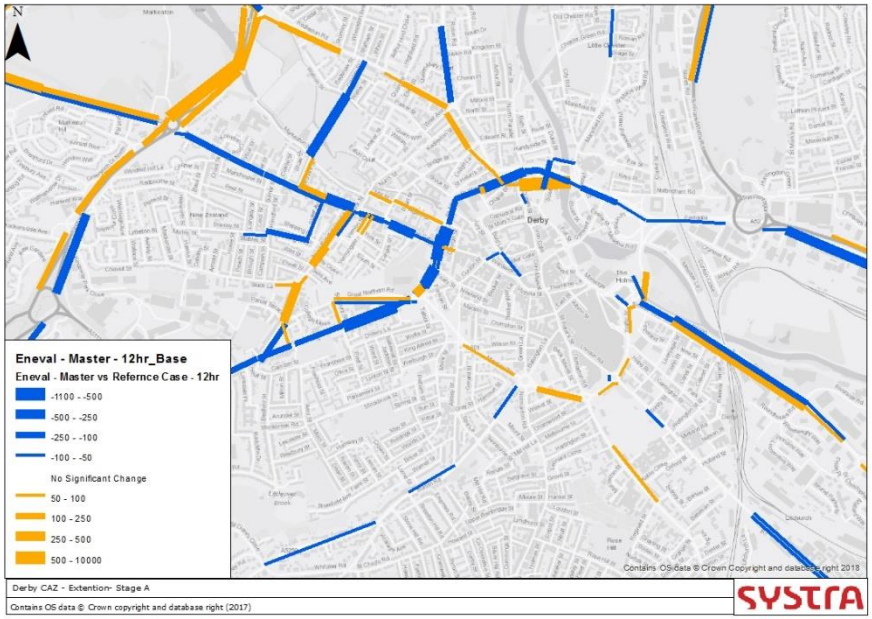


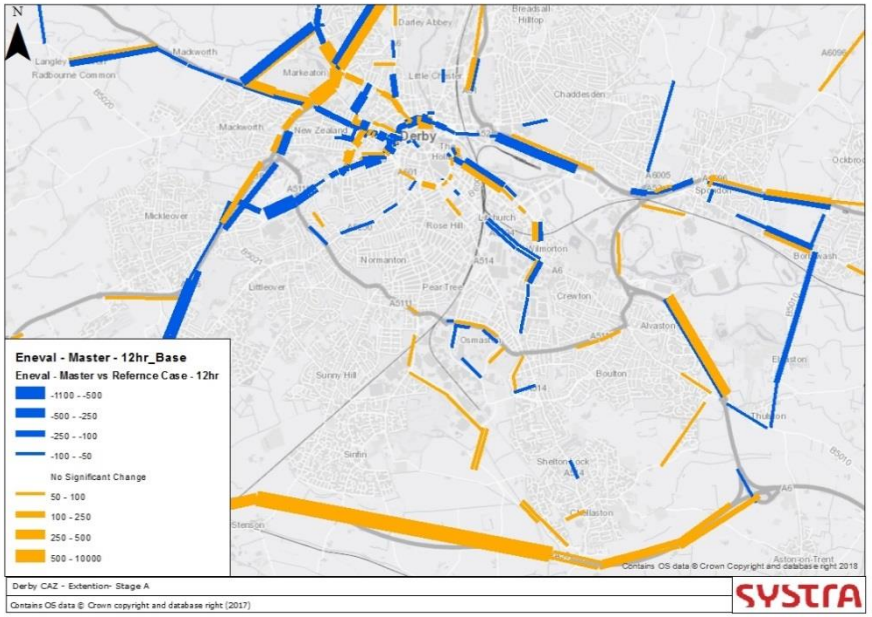
Stage Alteration				
Op 2.5	NOX		Diff	% Diff
	2.5	2.5 With Mitigation		
NB	340	238	-102	-30%
SB	191	177	-14	-7%
Total	531	415	-116	-22%

SYSTRA

Combined (vs Ref)

Eneval





Stage Alteration				
Op 2.5	NOX		Diff	% Diff
	Ref	2.5 With Mitigation		
NB	571	238	-333	-58%
SB	324	177	-147	-45%
Total	895	415	-480	-54%

SYSTRA

Master

Eneval Summary

- Eneval results depict a notable benefit resulting from the implemented all the Combined alterations, bringing NOX emissions below the -42% stipulated by JAQU.

- This further reduction stems from Ashbourne Road becoming less attractive through the legitimisation of Uttoxeter Old Road and the alteration made to Kedleston Road. The possibility of exceedance levels seen elsewhere (regarding emission levels), was the subject of further investigation in the air quality model, as set out in AQ3.