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M40 Junction 10 TN11

Vissim Forecast Modelling

Highways England

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Executive Summary

AECOM was commissioned by Highways England to carry out traffic impact analyses of a set of proposed mitigations at Junction 10 of the M40. This traffic impact analysis assesses the benefits of each of the proposed schemes on the overall junction performance using 2026, 2031 and 2036 flows, including Heyford Park development flows.

The proposed schemes were combined in 5 different scenarios to assess which combination provides better results for the overall junction operation.

The schemes provide additional capacity at the key junctions are listed below:

- **Baynard's Green roundabout;**
- **Padbury Junction; and**
- **Ardley Roundabout**

Different combinations of schemes were tested in the modelled scenarios.

An initial assessment was previously undertaken using 2026 flows to reduce the number of proposed scenarios to be analysed further for all flow scenarios. As a result of the initial analysis, Scenario 2 was discarded due to the low benefits observed from the modelling results.

Further analysis has been undertaken for the selected scenarios using 2031 and 2036 flows. The 2031 VISSIM demand has been developed from the strategic model outputs to include the wider reassignment and rerouting impact caused by the development and the proposed interventions.

Table 1. M40 J10 – Modelling parameters

Name	Scheme	2026	2031	2036
Reference Case	-	✓	✓	✓
Do minimum		✓	✓	✓
Do Something 1	(1) Baynard's Green Roundabout	✓	✓	✓
Do Something 2	(2) Padbury Roundabout	✓		
Do Something 3	(1+2) Baynard's Green & Padbury Roundabouts	✓	✓	✓
Do Something 4	(1+2+3) Baynard's Green & Padbury & Ardley Roundabouts	✓	✓	✓
Do Something 5	(1+3) Baynard's Green & Ardley Roundabouts	✓	✓	✓

A general overview of the modelling results has been summarised below. The rerouting effects observed in the model results have been analysed in Section 4.

Do Something 1

The mitigation at Baynard's Green roundabout results in:

- ✓ a reduction of queues on all approaches to the junction and a significant reduction in latent demand (vehicles unable to enter the network) in the model;
- × the increase in flow through Baynard's Green leads to an increase in journey times along the A43 between Baynard's Green and Ardley roundabout;

- × the additional demand southbound on Ardley roundabout create queues that back up onto Cherwell junction in the AM peak affecting the southbound flows along the A43.

Do Something 2 (2026 Only)

The mitigation at Padbury junction results in:

- ✓ the elimination of queuing on the M40 southbound off-slip;
- × an increase in flow from the M40 southbound off-slip which results in longer journey times and queues along the A43;
- × the additional demand southbound on Ardley roundabout create queues that extend back to Padbury and Baynard's Green junctions in the AM peak, reducing the capacity and increasing in latent demand on the approaches to Baynard's Green roundabout.

Do Something 3

The combination of the mitigation schemes at Baynard's Green and Padbury junctions result in:

- ✓ a reduction of queues on all approaches to Baynard's Green junction and a significant reduction in latent demand in the model;
- ✓ the elimination of queuing on the M40 southbound off-slip;
- × the increase in flows across Baynard's Green and the southbound off-slip results in longer journey times and queues along the A43;
- × the additional demand on the southbound approach to Ardley roundabout results in queues backing up on to Cherwell junction, affecting the southbound movements along the A43.

Do Something 4

The combination of the mitigation schemes at all three junctions result in:

- ✓ a reduction of queues on all approaches to Baynard's Green and the elimination of latent demand in the model;
- ✓ the elimination of queuing on the M40 southbound off-slip;
- ✓ a reduction in southbound queues on the A43 approaching Ardley roundabout, which no longer back up to Cherwell junction;
- ✓ a reduction in journey times southbound along the A43 as the access to the southbound on-slip is unaffected by queues from Ardley junction;
- ✓ A significant impact on wider reassignment and routing changes has been observed.

Do something 5

The combination of the mitigation schemes at Baynard's Green and Ardley junctions result in:

- ✓ a reduction of queues on all approaches to Baynard's Green and the elimination of latent demand in the model;
- ✓ a reduction in southbound queues on the A43 approaching Ardley roundabout, which no longer affects Cherwell junction;
- ✓ a reduction in journey times southbound along the A43 as the access to the southbound on-slip is unaffected by queues from Ardley junction; and
- \- a slight reduction in queues on the southbound off-slip compared to Do Minimum in AM, due to the better operation of the A43.

Introduction

02

Introduction

AECOM has been commissioned by Highways England to carry out a traffic impact analysis of a set of proposed mitigations at Junction 10 of the M40. The purpose of which is to assess the benefits of each of the schemes on the overall junction performance.

This report details the purpose of the models, the changes made to the base model to produce the option tests and sets out the methodology adopted. This document also details the changes in measured key journey times, changes in queues, and key network performance indicators between the different scenarios.

Background

This background section provides a simple chronological record of the discussions and development of the M40 Junction 10 Study, as well as a summary of the improvement options proposed and tested to date:

- In 2011 A-One+ undertook the Congestion Scoping Study, which resulted in the implementation of the recently delivered M40 Junction 10 pinch point scheme (PPS).
- In December 2013, AECOM's M40 Junction 10 Stage 1 Study Report detailed the strategic development sites, trip generation and forecast the traffic impact on the A43 and M40 Junction 10 up to the future year 2031.
- On 3rd April 2014, a meeting was held between Highways England (HE), Oxfordshire County Council (OCC), South Northamptonshire District Council (SNDC) and Cherwell District Council (CDC) to review the developments and growth forecast up to 2031. At this meeting several additional and updated documents were cited for review. Whilst the M40 Junction 10 PPS was going to be delivered, the local planning authorities were concerned about the ability of the M40 Junction 10 PPS to cater for economic growth aspirations, indicating 2020-2025 as the period within which the network is considered to reach an unacceptable level of operation and proposing therefore to investigate further potential improvement options.
- On 23rd July 2014, a meeting was held between HE, OCC and CDC to discuss initial modelling results and potential cumulative impacts of proposed growth on the SRN. In addition, it was agreed to carry out modelling assessment at M40 J9 using HE's M40 J9 LinSig model.
- In October 2014, AECOM's M40 Junction 10 Stage 2 Study Report included a review of growth up to 2031 contained in AECOM's M40 Junction 10 Stage 1 Study Report. In addition, it identified the following four improvement options:
  - Option 1: Pinch Point Widening;
  - Option 2: Dumbbell Roundabout with the removal of Padbury roundabout;
  - Option 3: Dumbbell Roundabout retaining Padbury roundabout;
  - Option 4: Two Bridge roundabout.
- In March 2015, AECOM's Technical Note 4 (TN4) identified Option 4 as offering the best performance; it was decided that this should be assessed further.
- In April 2015, AECOM's Technical Note 5 (TN5) submitted AECOM's Two Bridge roundabout improvement scheme and tested outputs up to 2031. A43 Baynards Green roundabout was recognised as a constraint for the network operation, causing extensive queues along the A43 and potentially constraining the traffic at M40 Junction 10. Conclusions of TN5 were that further testing was needed to be undertaken to determine when the M40 Junction 10 PPS would fail and how to address queues on the A43 taking into consideration the interaction with A43 Baynards Green roundabout acting as a bottleneck holding back traffic on the A43 into M40 Junction 10.
- In November 2015, AECOM's Technical Note 6 (TN6) identified the 2021-2026 time period as the tipping point of the M40 Junction 10 PPS. In addition, AECOM's Two Bridge roundabout improvement scheme was tested for 2026, assuming that the A43 Baynards Green roundabout constraint had been removed (i.e. roundabout removal assuming expressway implementation on the A43) so that queues were released onto the A43

Padbury junction. In this instance, the A43 westbound approach resulted in severe queue issues that needed to be addressed. Thus, AECOM recognised that the improvement scheme needed to be reviewed in order to achieve optimum operation at all M40 Junction 10 approaches.

- In March 2016, AECOM's Technical Note 7 (TN7) reviewed AECOM's Two Bridge Roundabout option and it was clear that this scheme would not be capable of preventing the high level of queue formation at the A43 southbound approach. Therefore, AECOM undertook an iteration exercise to design an improvement scheme that can accommodate future growth up to 2031 that secures optimal operation on both the M40 mainline and the A43 approach to M40 Junction 10. This scheme included signal control at Ardley, Cherwell and Padbury junctions using MOVA control. In addition, the proposed scheme would require a lane drop at the M40 mainline in the southbound direction between the off-and on-slip and a DMRB (TD 22/06) Merge Lane Layout Type G with a two-lane gain after the on-slip. Finally, AECOM carried out an indicative gap analysis of the proposed scheme which showed a low level of completion of the tasks required for the Project Control Framework Stage 0 in order to initiate a project.
- In October 2016, AECOM re-validated HE's M40 Junction 10 VISSIM Model using traffic survey data collected in March 2016. The purpose of this model revalidation was to understand the performance of the junction with the PPS improvements implemented.
- On 14th November 2016, AECOM and HE carried out a workshop to identify potential risks associated with the M40 Junction 10 proposed highway scheme.
- Following discussions with Highways England's Transport Planning Group (TPG) – formerly known as Traffic Appraisal Modelling and Economics (TAME) – it was deemed that although the 2016 re-validated model provided suitable levels of validation under both DMRB and WebTAG standards, in order to ensure that a robust tool is available for undertaking a Value for Money (VfM) assessment, tighter levels of validation were required at the M40 Southbound off-slip approach. Therefore, in August 2017, AECOM completed a revalidation of Highways England's M40 Junction 10 VISSIM base model.
- In September 2017, AECOM was commissioned by HE to undertake further assessments of the potential impacts of HS2 construction traffic at M40 Junction 10 up to a 2018 future year, using the 2017 re-validated Vissim model and to analyse several mitigation schemes.
- In January 2019, AECOM produced a 2031 forecast year assessment using the 2017 re-validated Vissim model. These models were used to assess the capacity of a series of proposed mitigation schemes to accommodate future year flows.
- Further to this modelling exercise, Oxfordshire County Council (OCC) showed interest in using this Vissim model to assess the impact of the expected traffic growth and proposed mitigations.

Structure of the note

It is recommended that this Technical Note is read in conjunction with AECOM's M40 Junction 10 TN9 and TN10 to understand all issues around the junction better.

The structure of this note is detailed as follows:

- Section 03: Presents the modelling approach;
- Section 04: Details the assumptions and methodology for the development of the demand matrices;
- Section 05: Summarises the outputs obtained and provides a discussion of the findings; and
- Section 06: Provides a summary of work undertaken and conclusions.

Modelling Approach

03

Overview

M40 Junction 10, commonly known as Cherwell Valley Interchange, is located north-west of Bicester. Whilst the junction is within the boundary of Oxfordshire County Council, it is managed by Highways England's Area 7 Spatial Planning & Economic Development (SPED) team. However, M40 Junction 10 is part of DBFO (area) 30 – M40 [J1-15] Denham to Warwick and the DBFO company is UK Highways M40 Ltd.

Initially designed as a standard two-roundabout dumbbell junction, the current extent of the junction includes:

- A43 Cherwell junction;
- A43 / B430 Ardley Roundabout; and
- A43 Padbury Junction.

M40 Junction 10 is a critical point of the SRN, being one of the waypoints on the main freight route to the north-east. It is widely used for movements between the M40 and the A43 and suffers from high congestion, particularly on A43 approaches.

Modelling approach

The junction has been modelled using VISSIM, an industry standard micro-simulation modelling software package, using Dynamic Traffic Assignment.

As highlighted in the previous section, in August 2017 AECOM revised and refined the latest M40 Junction 10 model validated in October 2016 focusing on validation enhancements, particularly for the PM peak. The model produced in 2017 also provides tighter validation levels on the M40 southbound off-slip to Junction 10, and it is deemed to provide a better platform for future year testing than the 2016 model.

Based on the above, it has been agreed to undertake the re-assessment of the impact of the proposed developments' traffic upon M40 Junction 10 using the M40 Junction 10 VISSIM model re-validated by AECOM in 2017.

The model includes the following junctions/roundabouts:

- A43 Cherwell junction
- A43 / B4100 Baynards Green;
- A43 / B430 Ardley Roundabout; and
- A43 Padbury Junction.

The extents of the model are shown in Figure 1.

A more detailed breakdown of the re-validated model, including model and matrix development, can be found in the M40 Junction 10 Local Model Validation Report (EMS 107.LMVR).

The assessment of the proposed mitigations was carried out by analysing of the impact of the different interventions and the cumulative impact of different combinations of interventions, as shown in Table 3.

It was agreed that, in order to narrow down the number of scenarios to be modelled, the 2026 "Do Minimum" demand would be assigned to all the 2026 mitigation scenarios, which will inform the selection of a preferred combination of schemes. The 2026 results reported in the Technical Note do not therefore reflect any rerouting effects caused by the schemes in the wider network; the results are a static picture of the operation of the proposed schemes.

The 2031 scenarios were developed subsequently to assess the impact of the mitigations with demand assumptions that consider the reassignment/ rerouting resulting from each mitigation, informed by the strategic models.

The 2036 scenarios were developed by adding the estimated growth from NTEM to the 2031 demand.

Figure 1. Modelled VISSIM Network - Source: OpenStreetMap (and) contributors, CC-BY-SA

Modelling parameters

Modelling parameters have been kept consistent with those in the base model. These are shown in Table 2.

Table 2. M40 J10 – Modelling parameters

	Modelling Parameters	
Evaluation Periods	AM Peak	0745-0845
	PM Peak	1630-1730
Additional Periods	AM Build-Up	0645-0745
	AM Cool-Down	0845-0915
	PM Build-Up	1530-1630
	PM Cool-Down	1730-1800

	Modelling Parameters
Vehicle Types	Light Vehicles, LVs
	Heavy Vehicles, HVs
VISSIM Version	5.40.06
PC MOVA Version	PC MOVA 7

Modelled scenarios

Table 3 below shows demand assumptions and coded schemes for each of the developed scenarios:

Table 3. Modelling Scenarios – Summary

Name	Flows	Scheme
Reference Case	2026 - Reference Case 2026 2031 - Reference Case 2031 2036 - Reference Case 2031 + Tempro	-
Do minimum	2026 - Do Minimum 2026 2031 - Do Minimum 2031 2036 - Do Minimum 2031 + Tempro	
Do Something 1	2026 - Do Minimum 2026 2031 - Do Something 1 2031 2036 - Do Something 1 2031 + Tempro	(1) Baynard's Green Roundabout
Do Something 2	Do Minimum 2026	(2) Padbury Roundabout
Do Something 3	2026 - Do Minimum 2026 2031 - Do Something 1 2031 2036 - Do Something 1 2031 + Tempro	(1+2) Baynard's Green & Padbury Roundabouts
Do Something 4	2026 - Do Minimum 2026 2031 - Do Something 2 2031 2036 - Do Something 2 2031 + Tempro	(1+2+3) Baynard's Green & Padbury & Ardley Roundabouts
Do Something 5	2026 - Do Minimum 2026 2031 - Do Something 1 2031 2036 - Do Something 1 2031 + Tempro	(1+3) Baynard's Green & Ardley Roundabouts

Modelled schemes

Figure 2 to Figure 3 below show the three schemes modelled in scenarios Do Something 1 to Do Something 5, either individually or in combination.

The mitigation for **Baynard's Green roundabout (1)**, shown in Figure 2, consists of the addition of an extra flare on each of the approaches, the addition of a circulatory lane inside the roundabout, the signalisation of all arms and an increase in the size of the circulatory to increase storage capacity.

The mitigation at **Padbury Junction (2)**, shown in Figure 3, consists of the signalisation of the southbound approach on the A43 and the M40 southbound off-slip and the addition of an extra lane on the roundabout between these two approaches.

The mitigation at **Ardley Roundabout (3)**, shown in Figure 4, consists of the signalisation of all approaches to the junction plus the addition of a lane inside the circulatory.

It should be noted that the signal operation has been modelled using PCMOVA (an add-on to Vissim, which explicitly replicates MOVA operation) – this is consistent with the forecast modelling previously undertaken in 2017.

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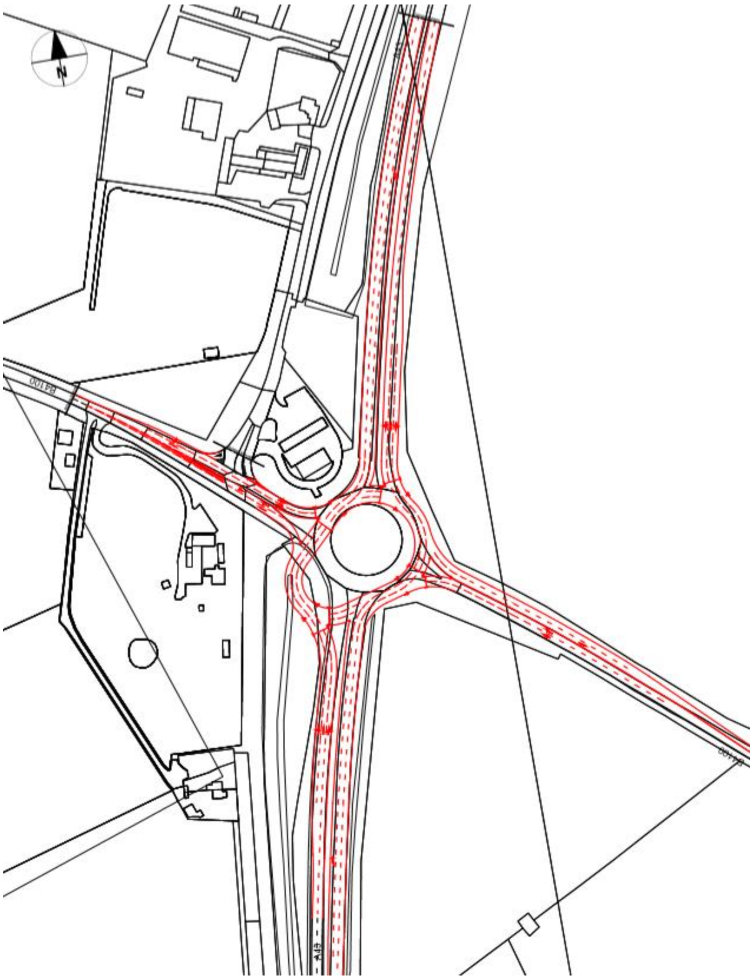

Figure 2. Baynard's Green Roundabout (1).

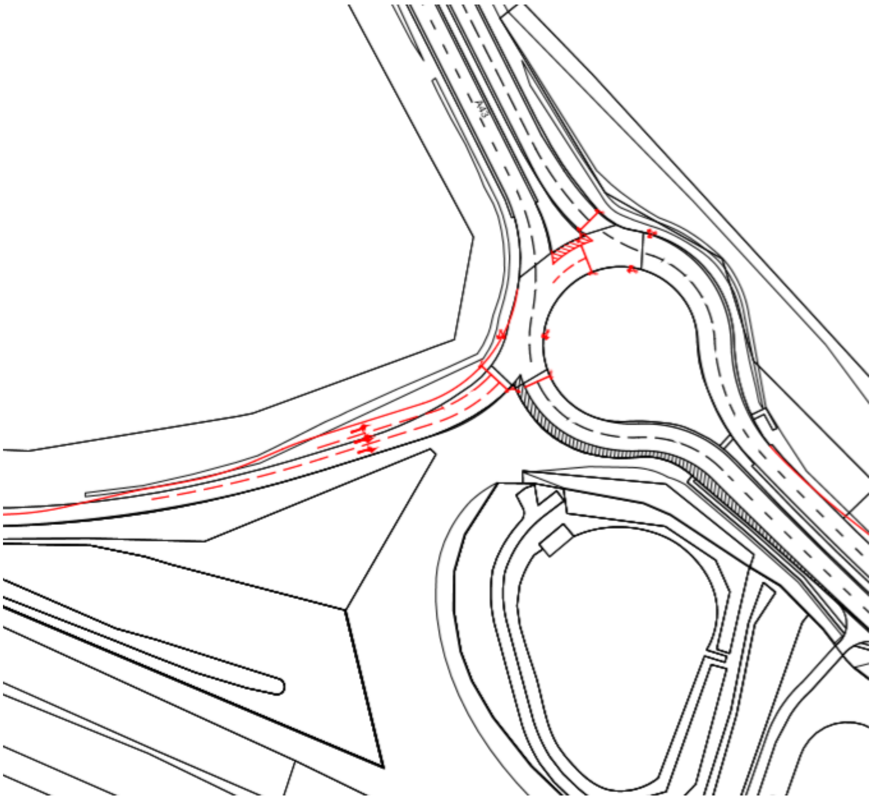

Figure 3. Padbury junction (2).

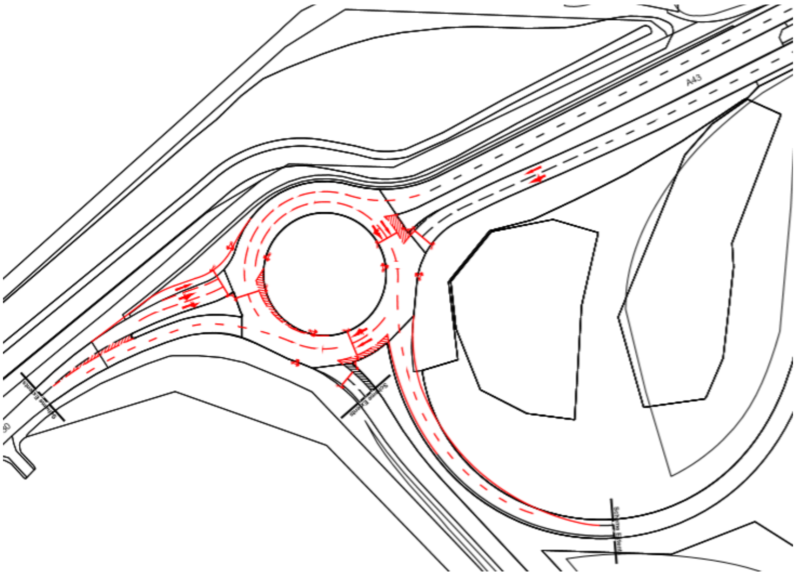

Figure 4. Ardley roundabout (3).

Demand development

Assumptions

2026

In 2026, two sets of demand matrices have been assigned in these models, as shown in Table 3 (page 16), i.e. Reference Case 2026 and Do Minimum 2026.

- The **Reference Case demand** contains the base flows plus the expected growth from 2016 to 2026 without development trips; whilst
- the **Do Minimum demand** consists of the base flows plus the expected growth from 2016 to 2026 with Heyford Park development trips.

It should be noted that the only additional trips included in the Do Minimum demand are associated with the Heyford Park development; all other growth is included in the Reference Case demand.

The absolute growth from 2016 to 2026 in both sets of demand has been calculated based on Highways England's Regional Traffic Model (RTM), as detailed in the section below. The 2026 demand was assigned onto the existing network, i.e. none of the proposed schemes has been coded in the strategic models to calculate the demand flows.

2031

In 2031, four sets of demand matrices have been assigned for 2031, as shown in Table 3 (page 16), i.e. Reference Case 2031, 2031 Do Minimum, 2031 Do Something 1 and 2031 Do Something 2.

- The **Reference Case demand** contains the base flows plus the expected growth to 2031 without development traffic; whilst
- the **Do Minimum demand** consists of the base flows plus the expected growth to 2031 with Heyford Park development flows.
- The **Do Something 1 demand** includes the estimated traffic growth to 2031, the Heyford Park development, and the wider reassignment and rerouting effects caused by the proposed schemes at Baynard's Green roundabout and Padbury junction.
- The **Do Something 2 demand** includes the estimated traffic growth to 2031, the Heyford Park development, and the wider reassignment and rerouting effects caused by the proposed schemes at Baynard's Green roundabout, Padbury junction and Ardley Roundabout.

2036

The 2036 demand has been developed by applying NTEM growth to the 2031 trip ends extracted from the strategic model. It should be noted that the demand differences caused by the proposed schemes in 2031 have a larger effect in 2036 as the same growth factor has been applied to all the demand scenarios, causing a more considerable increase in the Do Something scenarios.

The additional increase in demand is reflected in the results and should be considered in the analysis of the proposed scheme operation.

Matrix development

The demand growth from the strategic model scenarios has been calculated by adding the trip end growth from the RTM strategic model to the validated Vissim base demand matrices, which have then been furnessed. This methodology was agreed with OCC and HE as the best approach to develop the forecast Vissim matrices and minimise any possible turning count discrepancies between the RTM and Vissim.

The example below shows how trip end growth from the strategic model has been calculated:

Reference Case growth = Reference Case 2026 flows – Base 2016 flows

Do Minimum growth = Do Minimum 2026 flows – Base 2016 flows

Since the RTM peak hour matrices represent one-hour flows and the Vissim matrices are divided into 15 minutes periods, the RTM growth has been divided into 15-minute slots based on the flow profile extracted from the base Vissim matrices, as shown in Figure 5.

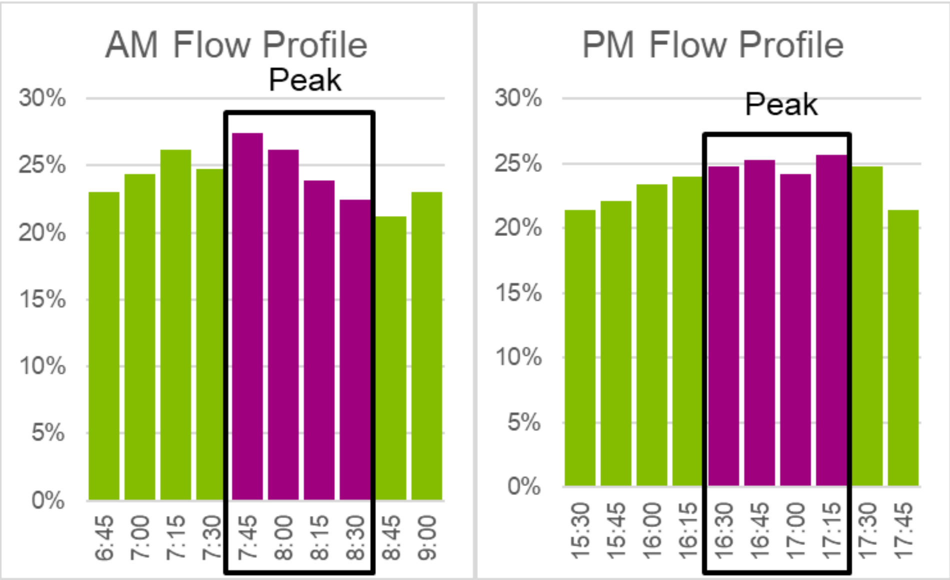

Figure 5. Flow profiles[1].

The absolute growth extracted from the strategic model and the absolute growth assigned to the Vissim model during the peak hour has been checked to ensure it is identical.

Demand growth checks

The demand assumed for the Vissim models in the peak hours has been checked against TEMPro growth factors for the area – this comparison can be found in Table 4.

The adopted growth in the Vissim model exceeds the growth estimated using TEMPro, which is considered robust.

[1] Refer to *M40 Junction 10 Local Model Validation Report (EMS 107.LMVR)* for further details on the definition of the peak time periods.

Table 4. Comparison of TEMPro growth factors and growth adopted in the Vissim matrices.

	Growth from Vissim matrices		TEMPro
	2026 RC - 2016 Base	2026 DM - 2016 Base	2016 - 2026
AM	1.1987	1.2136	1.1383
PM	1.2086	1.2117	1.1369
	Growth from Vissim matrices		TEMPro
	2031 RC - 2016 Base	2031 DM - 2016 Base	2016 - 2031
AM	1.2681	1.2732	1.1724
PM	1.2907	1.3032	1.1777

For details on the calculation of the adopted TEMPro factors, refer to Appendix B.

Comparison of growth

The demand used as an input for the Vissim models has been compared to the hourly demand in the strategic models for the same peak hours. The total vehicles included in the matrices is shown in Table 5.

As is shown, the difference between the strategic model demand and the Vissim models is consistent through the scenarios, which indicates that absolute growth is consistent through the forecast scenarios.

Table 5. Total vehicles in Vissim and strategic modelling peak hours.

		2016 Base	2026 RC	2026 DM	2031 RC	2031 DM	2031 S1	2031 S2
Strategic models Matrices	AM	10456	12702	12876	13431	13531	13562	13580
	PM	11484	14014	14051	15004	15145	15049	15097
Vissim Matrices	AM	10332	12578	12752	13306	13408	13437	13456
	PM	11611	14141	14178	15131	15272	15175	15225

Model convergence

The approach used to validate the base models has been consistently followed in the forecast scenarios.

Whilst the models have been run using Dynamic Traffic Assignment (DTA), there is no route choice between O-D pairs; the model convergence, therefore, has no impact on the final traffic assignment. The models have nonetheless been converged according to DMRB and TfL's criteria (TfL has developed specific guidance for Vissim models):

- (1). 95% of all path traffic volumes change by less than 5% for at least four consecutive iterations;
- (2). 95% of the travel times on all paths change by less than 20% for at least four consecutive iterations; and
- (3). The percentage change in user costs or time spent within the network (V) should be less than 1% for four consecutive iterations.

After achieving convergence, models have been multi-run for results using 10 different random seeds, starting with random seed 1 and ending at random seed 10, with a random seed increment of 1.

Results presented in the following sections show average measurements, as derived from 10 model runs undertaken for each of the AM and PM peaks.

Model adjustments

The models have been optimised in crucial areas, such as Cherwell roundabout, to realistically model changes in vehicle behaviour resulting from the additional demand and layout changes. However, to provide a like for like comparison, the same parameters have been coded in all the models.

The optimisation changes applied to the models are listed below:

- The lane changes operation at Cherwell roundabout; and
- A route closure has been added to stop vehicles leaving the M40 southbound going through the junction, only to join the M40 again.

Modelling Results

04

2026 - Modelling results

Journey times

A journey time route has been defined and broken down by section (see Figure 6) to assess the impacts of the different mitigation schemes near Junction 10 of the M40. The route was defined separately for southbound and northbound directions.

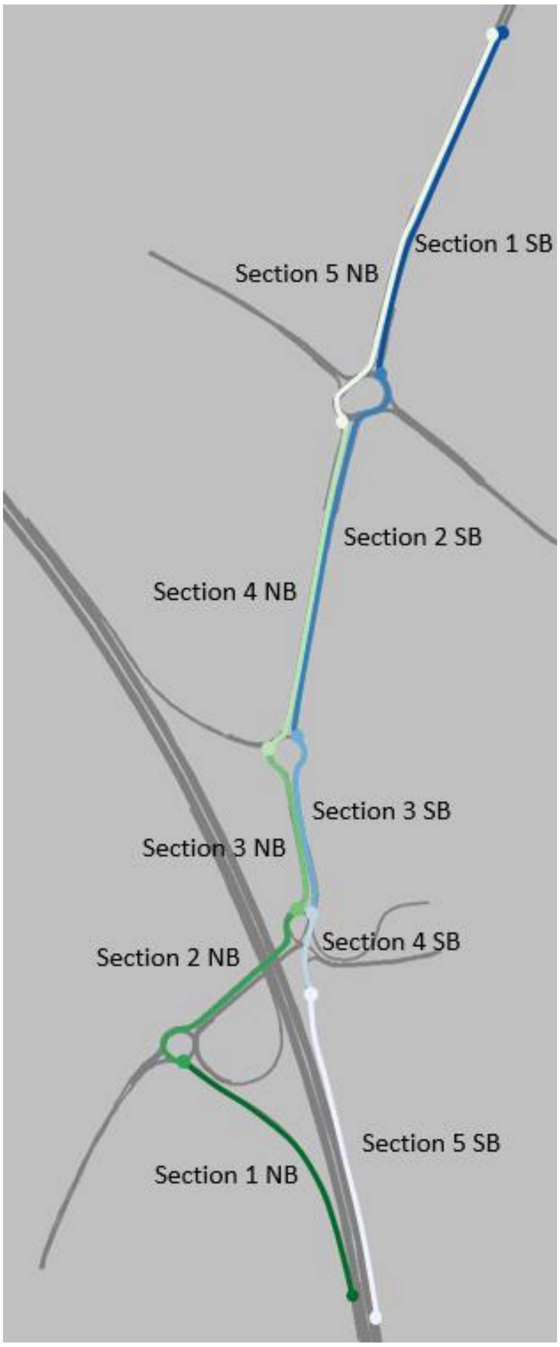

Figure 6. Locations of journey time route sections.

AM Peak

Figure 7 and Figure 8 show the journey time results northbound and southbound across the AM peak hour model.

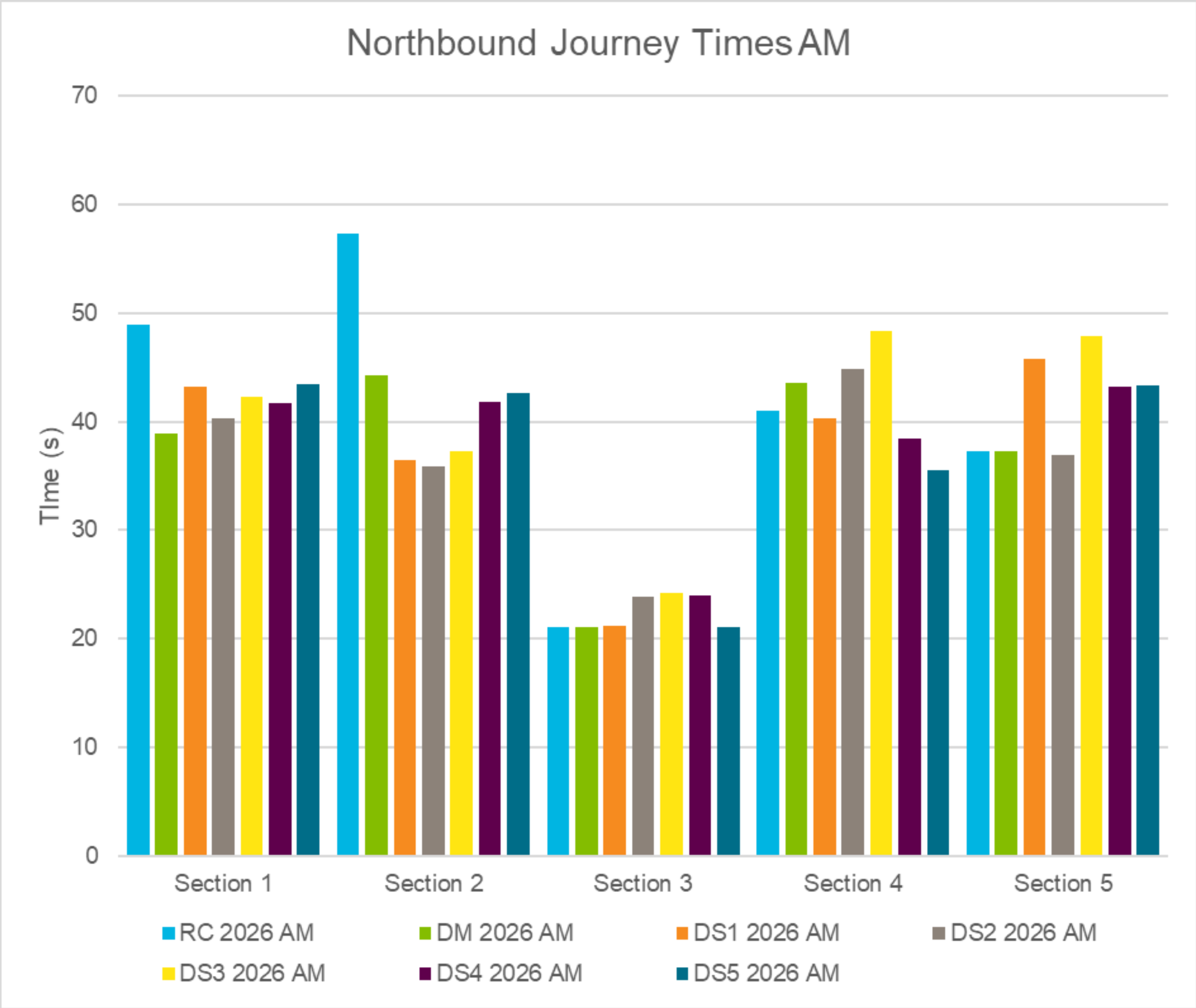

Figure 7. Northbound journey times by section - AM peak.

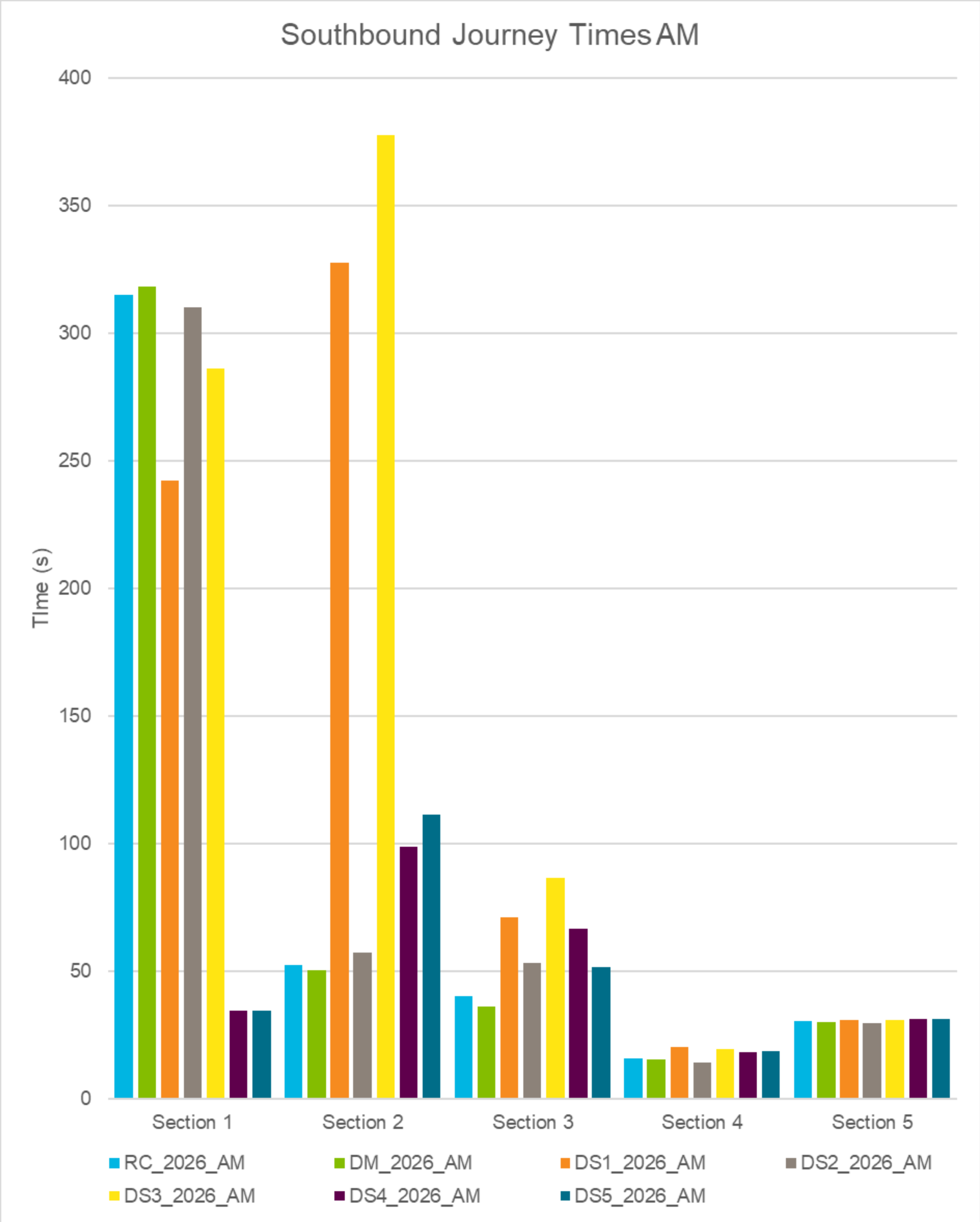

Figure 8. Southbound journey times by section – AM peak.

Do Minimum

There is a slight journey time reduction on the northbound sections 1 and 2 in the Do Minimum scenario compared to the Reference Case. This journey time reduction is potentially caused by a minor flow reduction, facilitating access to the junction from the northbound off-slip and causing improvements on the first two journey times sections. This flow reduction is likely to be caused by wider rerouting and an increase of the latent demand with more vehicles queuing out of the network

Due to the additional demand on the southbound movements at the Cherwell roundabout, the main north-south movement is given more green time in the Do Minimum scenario, resulting in a reduction in journey time northbound along the second section of the route.

The rest of the northbound route does not present significant differences between Reference Case and Do Minimum.

The southbound route presents no significant differences between the Reference Case and Do Minimum scenarios.

Do Something 1

The improvements at the Baynard's Green roundabout result in higher flows being released southbound through this junction onto the A43; this leads to queues building up at downstream junctions. The increased southbound throughput of the junction significantly impacts the southbound journey time towards Baynard's Green roundabout. The journey time reduces by 70 seconds on Section 1 but on Sections 2 and 3 southbound journey times increase by approximately 30 seconds. The scheme therefore results in the southbound bottleneck to be displaced to the downstream junctions, particularly the Ardley roundabout.

As with the Do Minimum scenario, the increased southbound demand at Cherwell Roundabout results in an increase in green time allocation for the main north-south movements, which causes an 8 second reduction in journey times on Section 2 northbound.

The last northbound section is slightly slower in Do Something 1 due to increased flow across Baynard's Green Roundabout.

Do Something 2

There are no significant differences in journey times along the A43 compared to the Do Minimum scenario.

Do Something 3

The combination of the mitigation schemes at Baynard's Green roundabout and Padbury junction result in a slight increase in the northbound journey time on the last section of the A43 compared to Do Minimum caused by the additional traffic from the M40 southbound off-slip routing north along the A43.

In the southbound direction, the additional throughput from the southbound off-slip and the signalisation of Padbury result in a journey time increase in the second section of the southbound route compared to Do Minimum, as the signals at Padbury result in additional queues extending back from Padbury roundabout. However, the improvements at Baynard's Green provide a better operation in the north, improving the journey times in the first section.

Due to the additional demand released from Baynard's Green and Padbury junctions, the A43 southbound demand arriving in Ardley roundabout creates a queue that reaches back to Cherwell Junction, affecting the discharge from the A43 into the M1 southbound on-slip.

As it was described in Scenario 1, this combination of mitigation schemes effectively shifts the bottleneck from Baynard's Green roundabout and Padbury junction onto the downstream junctions.

Do Something 4

The combination of the mitigations at Baynard's Green, Padbury and Ardley roundabouts increases the A43 southbound flows through Baynard's Green and Padbury junction and reduces the queues southbound on the A43 approaching Ardley junction (refer to queue results).

Without the mitigation at Ardley junction, the southbound queue reached back to Cherwell Junction, affecting the southbound discharge onto the southbound on-slip. Once the mitigation in Ardley is included, the southbound flows at Cherwell junction are unaffected by the queues from Ardley roundabout, improving the southbound journey times along the A43, compared to Do Minimum.

Do Something 5

The mitigation of Ardley roundabout reduces the southbound queues approaching Ardley roundabout, resulting in an increase in southbound flows through Cherwell junction. The additional flows through Cherwell junction create a reduction in southbound journey times, providing additional gaps at Padbury junction that result in a minor queue reduction along the M1 Southbound off-slip.

PM Peak

Figure 9 and Figure 10 show the journey time results northbound and southbound across the model for the PM peak.

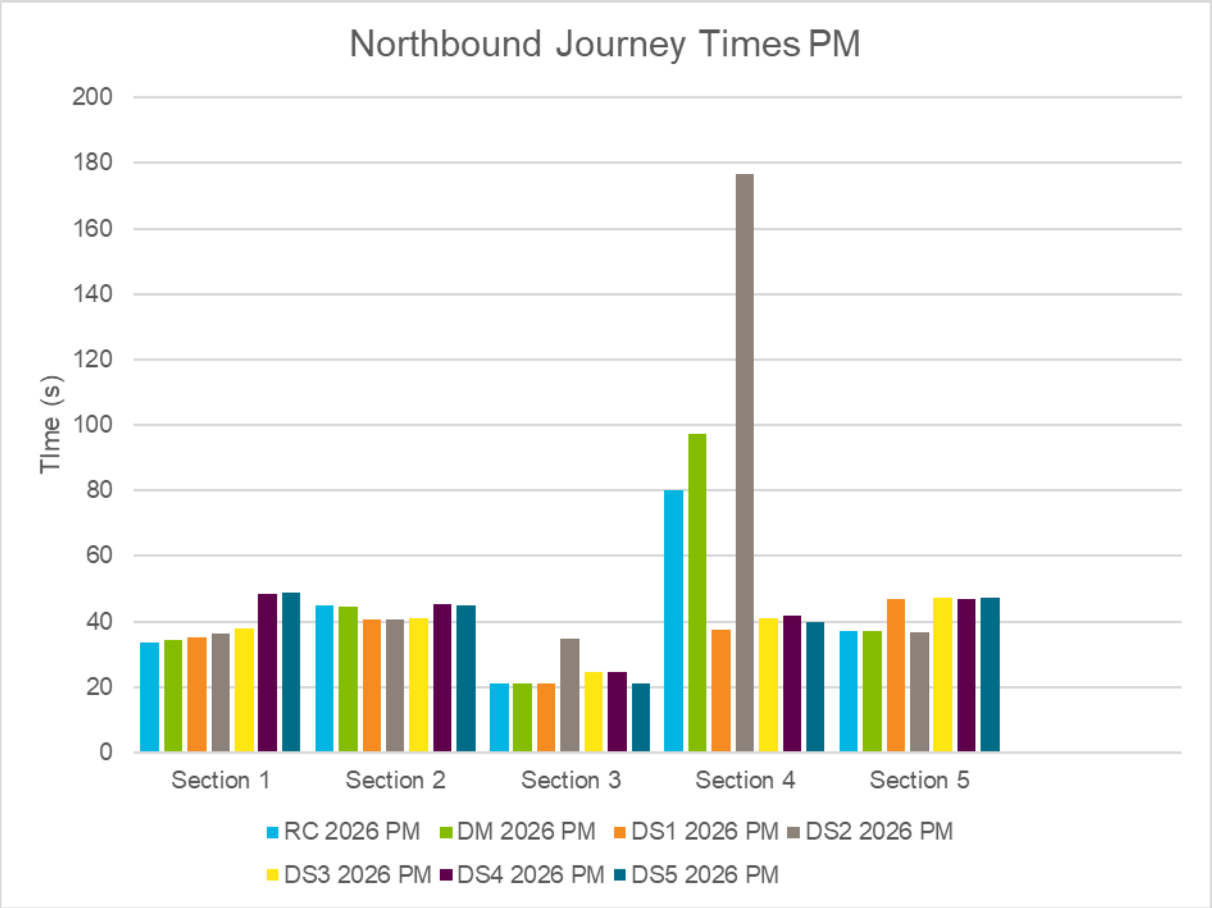

Figure 9. Northbound journey times by section - PM peak.

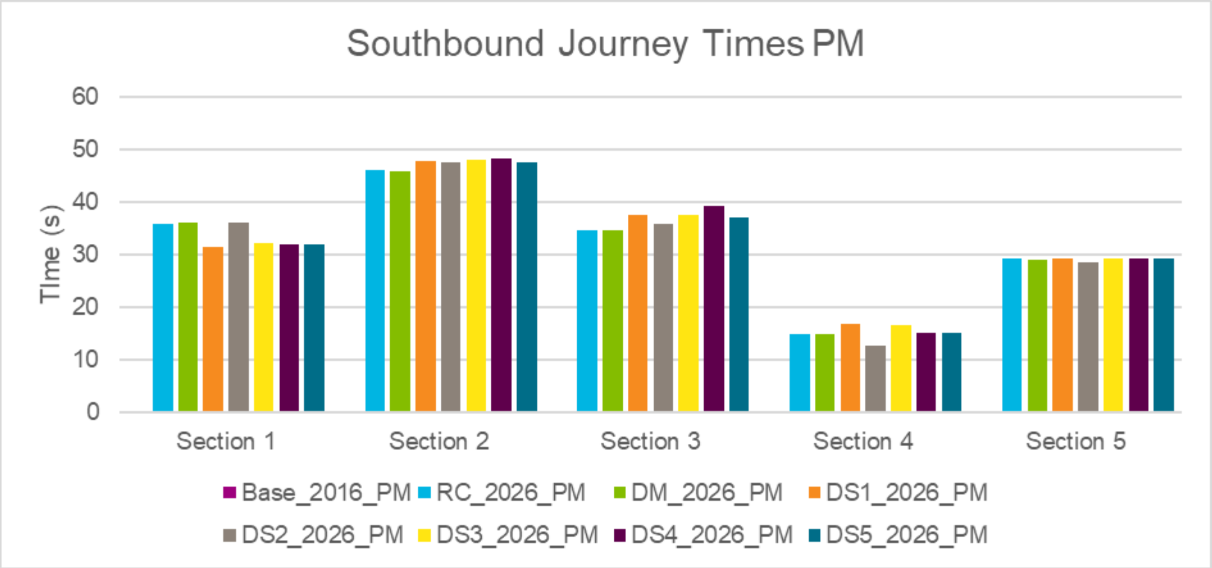

Figure 10. Southbound journey times by section - PM peak.

Do minimum

The only significant difference in journey time results between the Reference Case and Do Minimum scenarios is on the northbound approach to Baynard's Green Roundabout, where there is a minor increase in journey times caused by the additional northbound demand in the Do Minimum matrices.

Do Something 1

The main difference between Do Something 1 and Do Minimum is a journey time reduction on Section 4 of the northbound journey time route approaching Baynard's Green roundabout caused by the mitigation at this junction.

Do Something 2

The main impact of the mitigation of Padbury junction in the PM peak is also the northbound journey time route to access Baynard's Green roundabout (Northbound - Section 4), where the journey times increase along this section due to additional traffic from the M40 southbound off-slip that is able to access the A43 due to the mitigation of Padbury junction.

Do Something 3

The additional capacity and journey time improvements created by the intervention at Baynard's Green roundabout offset the impact of the additional traffic released by the mitigation at Padbury junction, accommodating the additional demand on the A43 northbound without any significant increase in delay.

Do Something 4

The additional capacity and journey time improvements created by the intervention at Baynard's Green roundabout offset the impact of the additional traffic released by the mitigation at Padbury junction, accommodating the additional demand on the A43 northbound without any significant increase in delay.

Contrary to the impact observed in the AM peak, the lower demand on the A43 southbound reduces the benefit caused by the mitigation at Ardley roundabout.

Do Something 5

The only significant difference between Do Something 1 and Do Minimum is a journey time reduction in section 4 on the northbound journey time route approaching Baynard's Green roundabout caused by the mitigation at this junction.

Queues

AM Peak

Figure 12 shows the AM queue results for selected markers. The complete set of results can be found in Appendix E. Figure 11 shows the location of the queue counters in the models. These queue results represent the length of the queue from the queue counter to the back of the queue, spread across all lanes i.e. if the queue backs up onto different approaches or lanes, the queue counter records the maximum queue length.

It should be noted that the queue results represent the average queue across the peak hour.

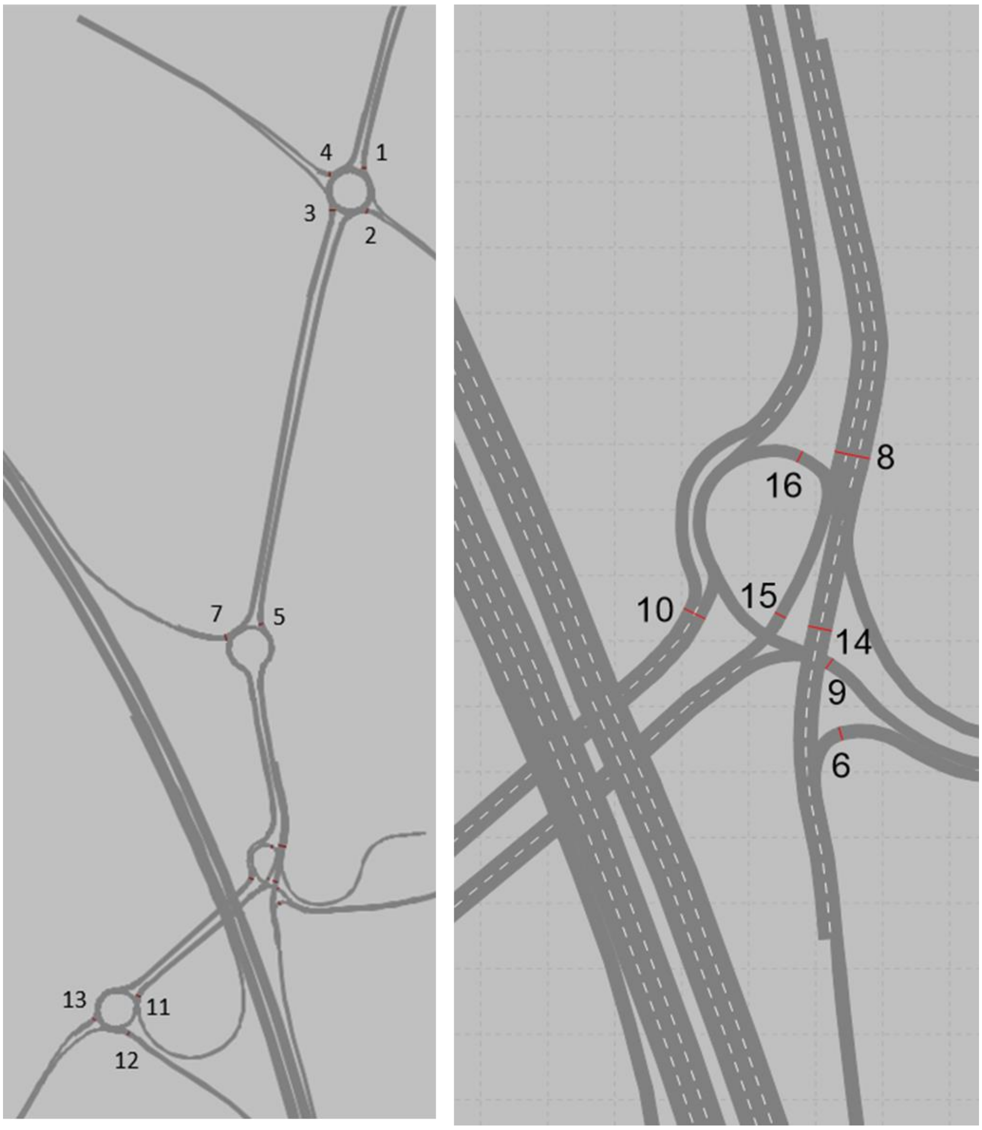

Figure 11. Location of queue counters in the model.

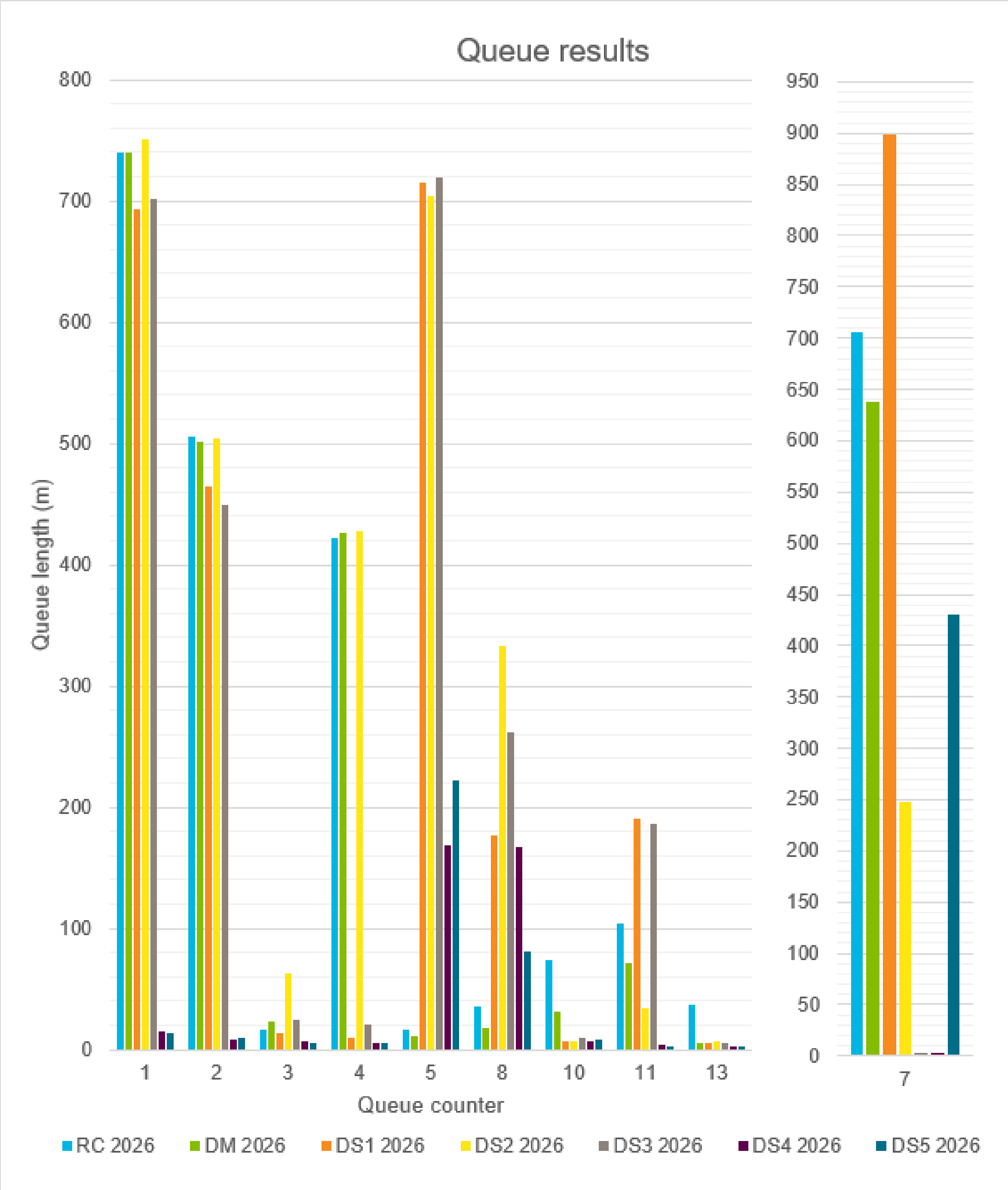

Figure 12. AM queue results for selected markers.

Do Minimum

There are no significant differences in queue results between Reference Case and Do Minimum for any of the queue counters except 7, 10, and 11.

There is a queue reduction on the southbound off-slip (counter 7) due to a slight reduction in northbound movements across Padbury junction, which facilitates the discharge from the off-slip into the junction.

For queue counter 10, there is also a reduction in queues in line with the northbound journey time results shown for this section due to the increased green time for the north-south movements at Cherwell junction.

There is a slight reduction in demand accessing Ardley from the A43 in the Do Minimum Scenario, which results in a decrease in queues at this approach (queue counter 11).

Do something 1

The implementation of the mitigation at Baynard's Green roundabout results in the following changes in queuing:

- ✓ on the southbound approach (queue counter 1), despite the mitigation achieving a higher discharge from this arm, the queues from the downstream junction still extend along the entire length of the link; there is a reduction in latent demand from the zone loading onto this link (refer to latent demand results)
- ✓ on the westbound approach (counter 2), there is a reduction in queues caused by the junction improvement, compared to the Do Minimum scenario where the queue extends for the whole length of the link. This results in a reduction in latent demand in the zones loading in this link.
- ✓ queues on the eastbound approach (counter 4) are significantly reduced compared to Do Something scenario (with the corresponding reduction in latent demand on this link) to only 10 meters in Do Something 1; and
- ✓ there is no difference in queues on the northbound approach to this junction.

On the southbound approach to Cherwell junction (queue counter 8), the additional southbound traffic along the A43 results in an increase in queues on the A43 southbound approach to Cherwell. The northbound approach to this junction (queue counter 10) also experiences a reduction in queues caused by the increased green time for the north-south movements.

The only significant change at the Ardley roundabout is an increase in queues on the southbound approach caused by the flow increase from the A43 southbound.

Do Something 2

The most significant impacts in queue results of the scenario Do Something 2 are:

- ✓ The most significant impact of the mitigation of Padbury junction is the significant reduction in queues on the M40 southbound off-slip (counter 7), eliminating this queue's impact on the M40 mainline. It should be noted that the length of the off-slip is 550 meters from the main carriageway to the stop line, while the estimated queue in Do Something 2 scenario is just under 250 meters.

On the other hand, the increase in flow from the southbound off-slip and signalisation at Padbury, increases the queues on the southbound approach to Cherwell junction. These queues reach back to Padbury roundabout and Baynard's Green roundabout increasing the queues from the eastbound and westbound approaches to Baynard's Green roundabout.

Do Something 3

The most significant impacts in queue results of the scenario Do Something 3 are:

- ✓ A significant queues reduction on the eastbound approach to Baynard's Green roundabout compared to Do Minimum; and
- ✓ A further 250 meters reduction to an almost non-existent queue on the southbound off-slip compared to Do Minimum.

These results are in line with those for journey times, the reduction in queues on the southbound off-slip reflects its higher throughput onto the A43, which shows increased saturation levels.

Do Something 4

The main impact of Ardley roundabout's mitigation combined with Baynard's Green and Padbury junctions is a reduction in queues on the southbound approach to Ardley junction to virtually 0m. Without the queues from Ardley roundabout backing up onto Cherwell junction, the southbound queues along the A43 are significantly reduced:

- ✓ Queues on all approaches to Baynard's Green roundabout virtually disappear (counters 1 to 4); and
- ✓ Queues on the southbound approach to Cherwell junction (counter 8) are also significantly reduced.

Do Something 5

The comparison between Do Minimum and Do Something 5 is the reduction of queues approaching Ardley roundabout (queue counter 11) results in an unobstructed southbound flow at Cherwell junction and a generalised reduction of southbound queues along the A43:

- ✓ Queues on all approaches to Baynard's Green roundabout virtually disappear;
- ✓ Queues on the southbound approach to Cherwell junction (counter 8) are reduced; and
- ✓ Queues on the M40 southbound off-slip are reduced and contained within the storage capacity of the slip road.

PM Peak

Figure 13 shows the queue results for the PM peak.

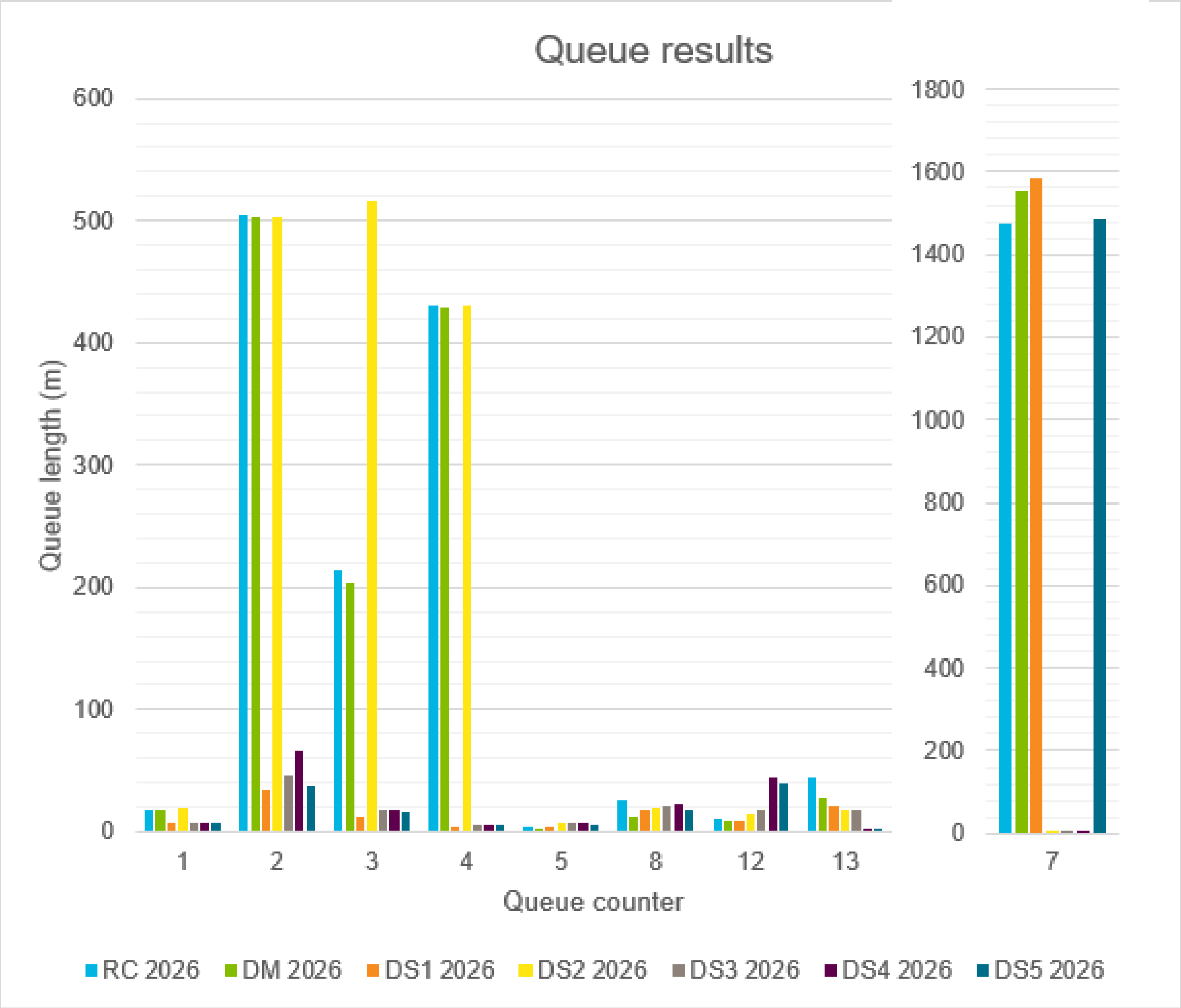

Figure 13. PM queue results for selected markers.

Do Minimum

There are no significant differences in queues between Reference Case and Do Minimum except an increase of the queues on the A40 southbound off-slip (counter 7).

Do something 1

The mitigation at Baynard's Green roundabout results in a significant reduction in queues in all the approaches to this junction due to its better operation and additional capacity provided by the proposed mitigation.

Due to the additional flows along the A43, fewer gaps are available for the M40 southbound off-slip flows, increasing the queues on the southbound off-slip (counter 7).

Do Something 2

The most significant impact of the mitigation at Padbury junction is a significant reduction of queues on the M40 southbound off-slip, removing the impact on the M40 mainline.

The additional traffic accessing the A43 from the southbound off-slip results in an increase in queues on the northbound approach to Baynard's Green roundabout (counter 3)

Do Something 3

The combination of mitigation schemes at Baynard's Green and Padbury junctions' results in the removal of the queues on the M40 off-slip (counter 7), the virtual elimination of the queues created by the additional demand released from the M40 off-slip on the northbound approach to Baynard's Green roundabout (counter 3), and the significant reduction of queues at Baynard's Green junction.

Do Something 4

There are no significant differences in queuing between Scenarios 3 and 4 in the PM peak.

Do Something 5

The mitigation at Baynard's Green roundabout results in a significant reduction in queues in all the approaches to this junction due to its better operation and additional capacity provided by the proposed mitigation.

The changes in the flow patterns caused by the mitigation at Ardley roundabout offset the queue increase observed in Do Something 1.

Network Performance

Latent demand

Figure 14 shows the latent demand results for AM and PM.

Most of the latent demand in the models is located on the approaches to Baynard's Green roundabout; its mitigation in the AM in the Do Something 1 scenario achieves a reduction, but the increase in traffic from the southbound off-slip in scenarios Do Something 3 to 4 leads to the over-saturation of Baynard's Green roundabout.

In PM, the mitigation of Baynard's Green reduces the latent demand observed on the approaches to this junction.

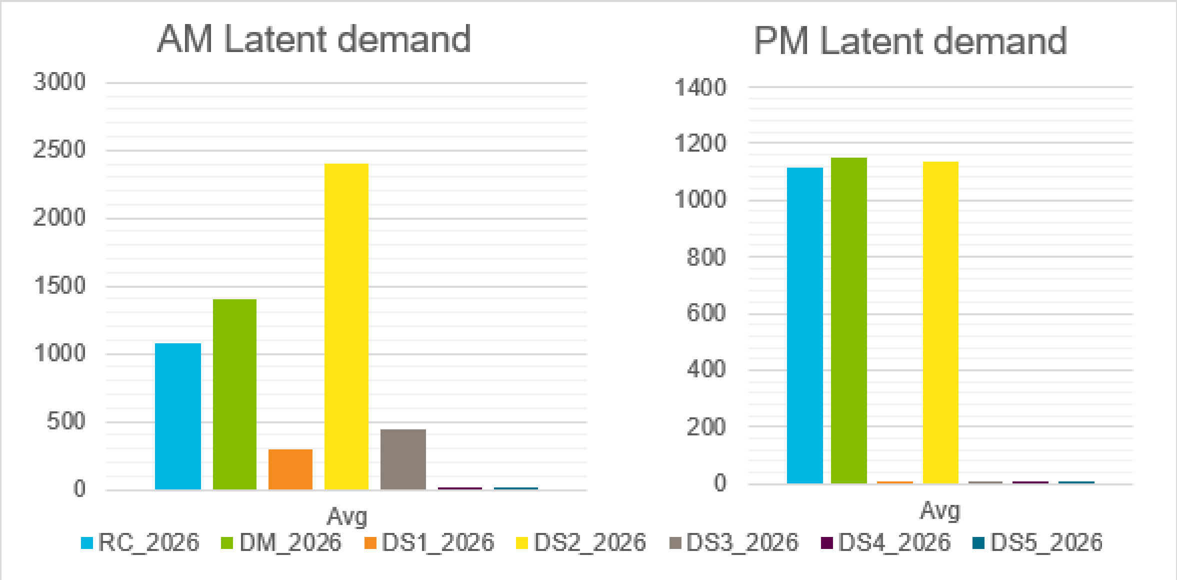

Figure 14. Latent demand results.

Total Delay

Figure 15 shows the total recorded delay for all vehicles that have entered the network at the end of the evaluation period, plus the latent delay[2]. The overall delay results provide a general view of the impact caused by the Heyford Park Development and the overall improvement provided by each scenario.

Scenario 1 achieves a 30% and 65% reduction in delays in the AM and PM peak respectively, mainly in the form of latent delay on the approaches to Baynard's Green roundabout.

Scenario 2 fails to reduce the overall delays; the delay experienced by vehicles queuing on the M40 southbound off-slip in the Reference Case and Do Minimum scenarios now occurs along the A43 for those same vehicles, and increase the latent delay on the approaches to Baynard's Green roundabout.

Scenario 3 results in a 30% reduction of overall delays in the AM peak, as the reduction in queues on the southbound off-slip is countered by an increase in congestion of the A43 southbound; and an 85% decrease in the PM peak as congestion along the A43 gets reduced significantly in this scenario.

Scenario 4 results in additional reductions in delays: 85% in both AM and PM compared to Reference Case, as the improvements at Ardley junction improves the southbound movements along the A43.

Scenario 5 experiences an 80% reduction in delays in the AM peak compared to Reference Case, mainly attributed to the elimination of latent delay on the approaches to Baynard's Green roundabout. In the PM peak, the reduction is 65% compared to Reference Case due to a reduction in latent demand on Baynard's Green roundabout approaches.

DRAFT

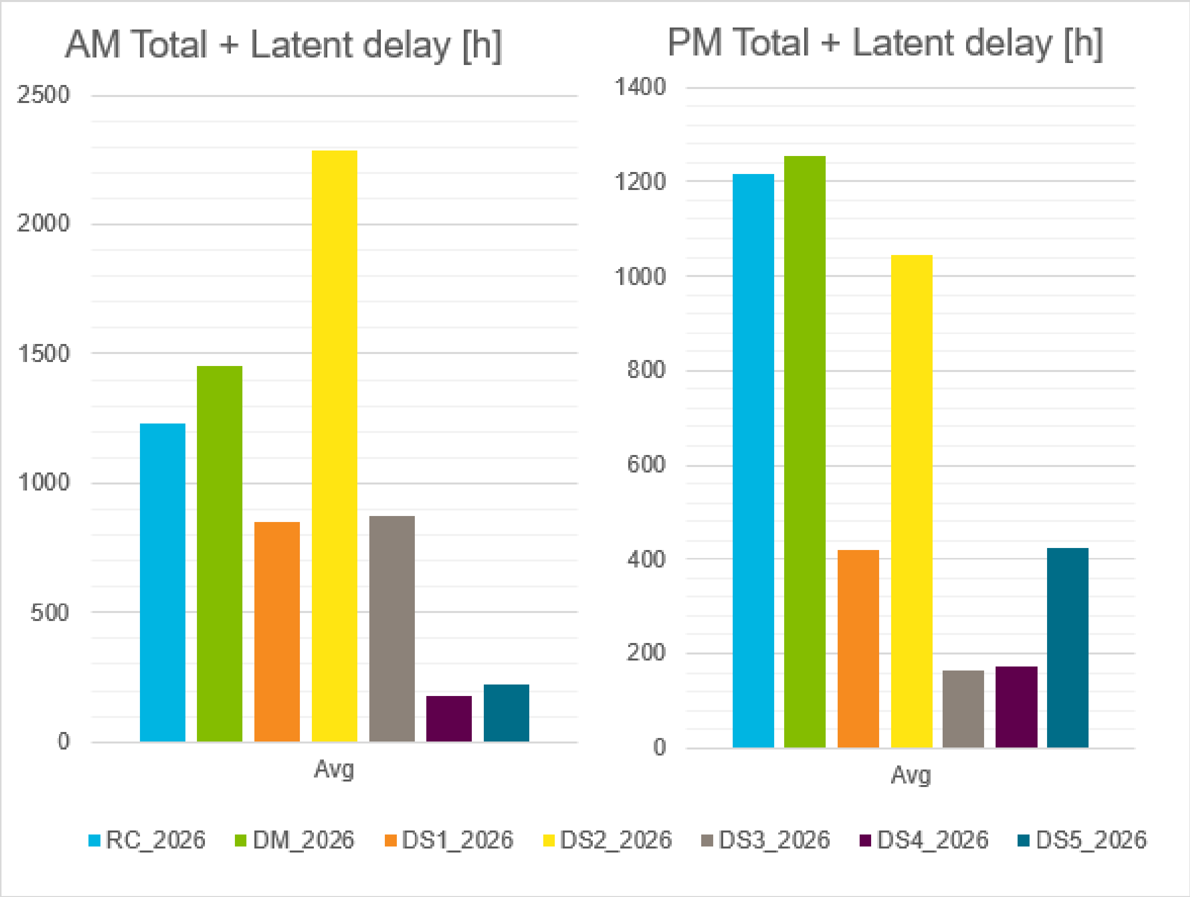

Figure 15. Addition of total recorded delay and latent delay[2].

[2] Latent delay is defined as the overall time waited by vehicles between their specified start time and the actual time when they are loaded in the network, or the end of the evaluation period – Vissim 5.40 – User Manual.

2031 - Modelling results

Journey times

In Figure 16, one route was defined by section to assess the impacts in journey time at junction 10 of the M40. The route was defined separately for southbound and northbound directions. The 2031 flow volumes across the journey time routes have also been provided to clarify the impact of the wider reassignment included in the 2031 scenarios.

AM Peak

Figure 17 and Figure 18Figure 8 show the journey time results northbound and southbound across the AM peak model.

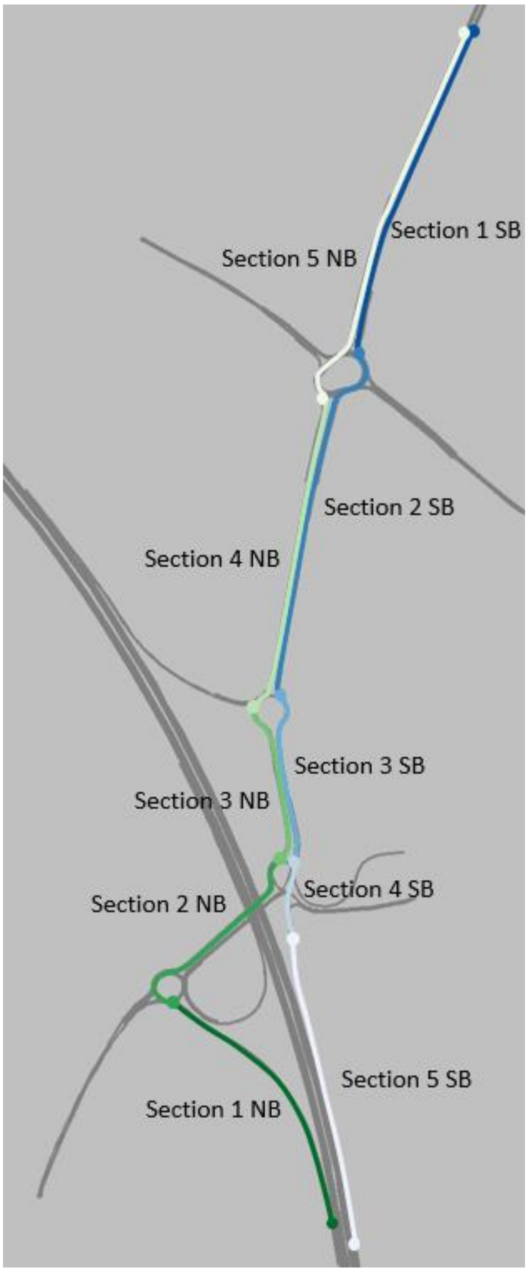

Figure 16. Locations of journey time route sections.

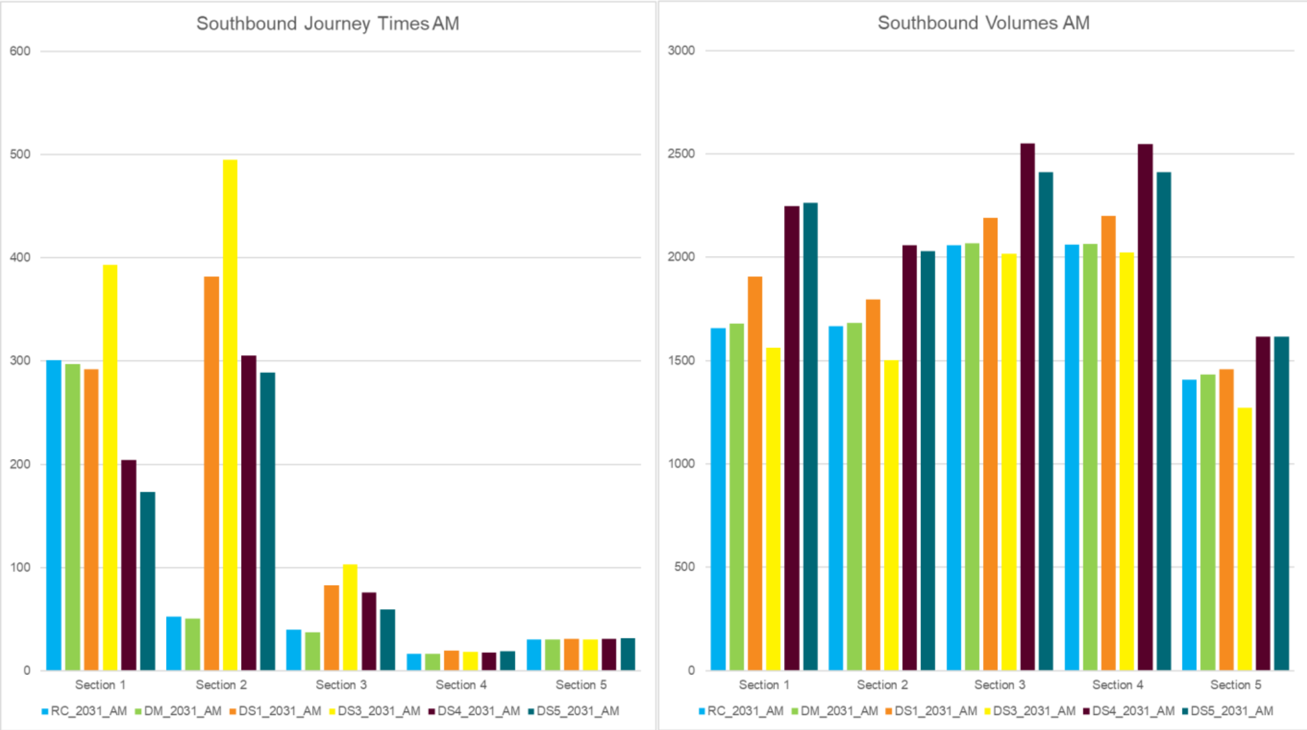

Figure 17. Southbound journey times by section – 2031 AM peak.

Figure 18. Northbound journey times by section - 2031 AM peak.

Do Minimum

The journey time difference in Section 2 Northbound is considered negligible, and it is believed to be caused by the model variability and the difference in northbound flows between Reference Case and Do Minimum. The journey time results show a small difference in this section.

The rest of the northbound route does not present significant differences between Reference Case and Do Minimum.

The southbound route presents no significant differences between the Reference Case and Do Minimum scenarios.

Do Something 1

The improvements at Baynard's Green roundabout result in more significant southbound flows through this junction onto the A43 increasing the queues built up from downstream junctions (Padbury). The increased southbound throughput of the Baynard's Green junction does not significantly impact the southbound journey time to access Baynard's Green roundabout (section 1). However, in sections 2 and 3 southbound, the journey time results show a significant increase due to the additional flow released from Baynard's Green. The proposed scheme effectively mitigates the existing bottleneck at Baynard's Green, but without any additional intervention, the scheme shifts the capacity constraints for the southbound movements onto the downstream junctions.

As with the Do Minimum scenario, the increased southbound demand at Cherwell Roundabout results in an increase in green time allocation for the main north-south movements, which causes minor journey time reductions on Section 2 northbound.

The last northbound section is slightly slower in Do Something 1 due to increased flow across Baynard's Green Roundabout.

Do Something 3

There is an increase in the journey times on Sections 1 and 2 caused by the signalisation at Padbury and the additional demand from M40 southbound off-slip for the southbound movements. The proposed signalisation creates the gaps required for the vehicles from the M40 southbound off-slip causing additional delay to the vehicles on the A43.

The additional demand on the A43 southbound released from Baynard's Green and the M40 off-slip cannot be accommodated at Ardley roundabout, creating a southbound queue that extends back to the Cherwell junction and reduces the capacity and southbound discharge at the junction. The reduced discharge at Cherwell junction increases the southbound queue between the Padbury and Cherwell junctions, which extend north of Baynard's Green.

As described in the 2026 scenarios, this combination of mitigation schemes effectively shifts the bottleneck from the Baynard's Green roundabout and Padbury junction onto the downstream junctions, particularly the Ardley roundabout.

For the northbound movements along the A43, the combination of the mitigation schemes at Baynard's Green roundabout and Padbury junction result in a slight increase in journey times caused by the additional traffic from the southbound off-slip routing north along the A43.

Do Something 4

The mitigation at Ardley roundabout combined with the proposed interventions in Baynard's Green and Padbury junctions creates a significant queue reduction on the approach from the A43 (refer to queue results).

Once the mitigation in Ardley is implemented, the southbound flow at the Cherwell junction is unaffected by the queues from Ardley roundabout. The mitigation at Ardley produces a significant increase in the southbound flows, while the journey times along the A43 southbound are also significantly shorter in most of the sections.

The journey time results in Section 2 are significantly higher when compared to the Do Minimum and Reference Case scenarios due to the higher demand and the signalisation of Padbury junction.

Do Something 5

Similarly to the observations made regarding the 2026 models, the reduction in queues approaching Ardley roundabout result in increased southbound discharge through Cherwell junction and a general reduction of southbound journey times. Due to the priority-controlled operation at Padbury, the vehicles from Baynard's Green get most of the benefit caused by the proposed interventions, which also creates a change in the flow patterns on the A43 southbound reducing the demand on Ardley roundabout.

PM Peak

Figure 19 and Figure 20 show the journey time results northbound and southbound across the PM peak model.

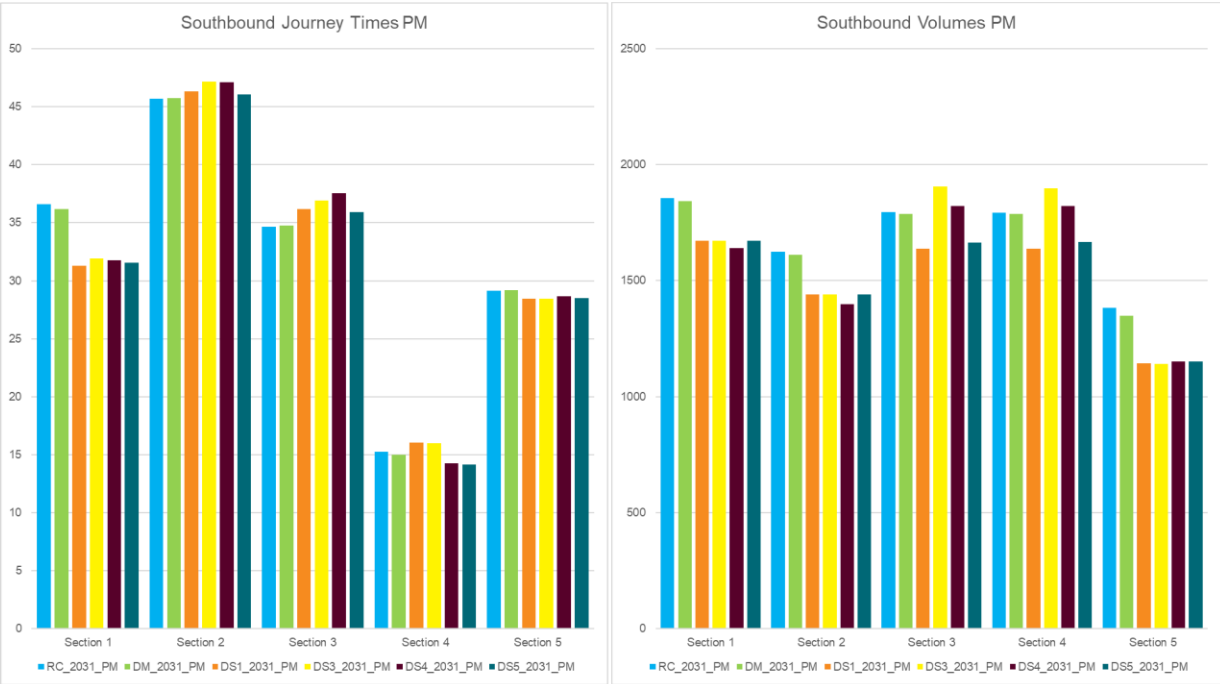

Figure 19. Southbound journey times by section - PM peak.

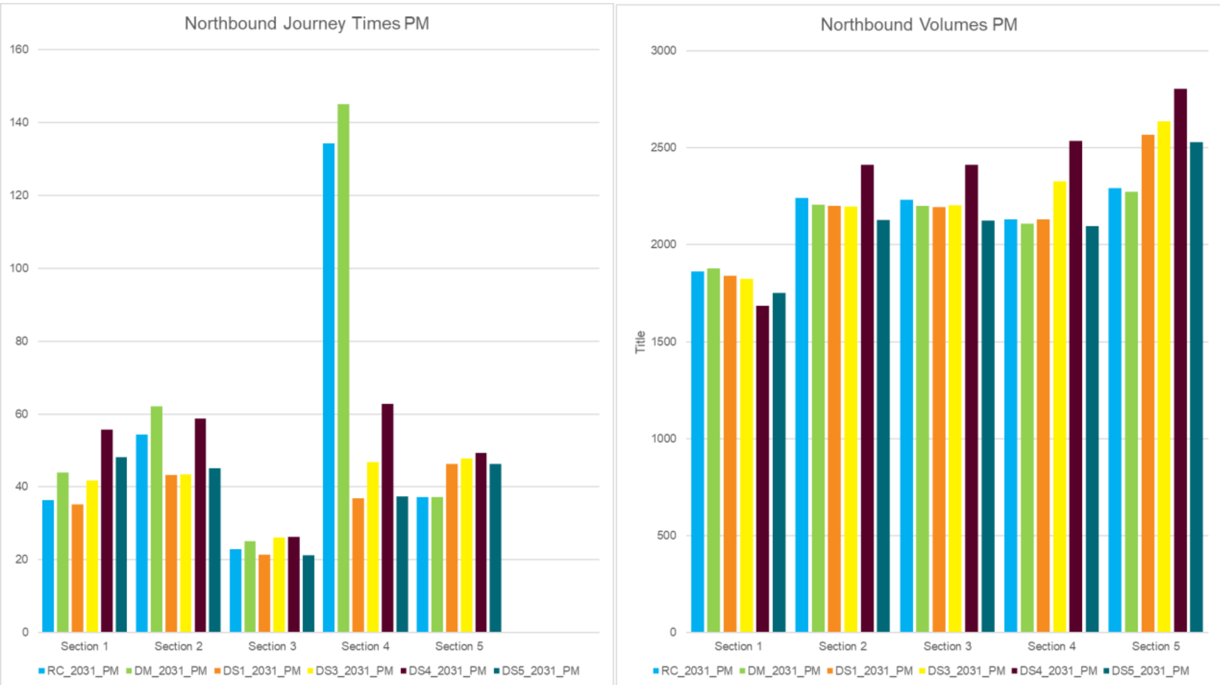

Figure 20. Northbound journey times by section – PM peak.

Do minimum

The only significant difference in the journey time results between the Reference Case and Do Minimum scenarios is in the northbound direction, mainly in the approach to Baynard's Green Roundabout, where there is an increase in journey times caused by the additional northbound demand of the Do Minimum matrices.

Do Something 1

The only significant difference caused by the proposed interventions in the Do Something 1 scenario is the journey time reduction at Baynard's Green roundabout for northbound (Section 4) and southbound (Section 1) approaches.

Do Something 3

The mitigation at Baynard's Green roundabout offsets the impact that the mitigation of Padbury junction had on the northbound journey times, allowing the extra vehicles coming from the M40 off slip (see volumes at Section 4)

Do Something 4

The additional capacity and journey time improvements created by the intervention at Baynard's Green roundabout offsets the impact of the additional traffic released by the mitigation at Padbury junction, accommodating the additional demand on the A43 northbound without any significant increase in delay.

Contrary to the impact observed in the AM peak, the lower demand on the A43 southbound reduces the benefit caused by the mitigation at Ardley roundabout.

Do Something 5

The only significant difference between Do Something 1 and Do Minimum is a journey time reduction on section 4 of the northbound journey time route approaching Baynard's Green roundabout caused by the mitigation at this junction.

Queues

AM Peak

Figure 22 shows the AM queue results for selected markers. The complete set of queue preliminary results can be found in Appendix F. Figure 21 shows the location of the queue counters in the models. These queue results represent the length of the queue from the queue counter to the back of the queue, spread across all lanes i.e. if the queue extends on different approaches or lanes, the queue counter records the maximum queue length.

It should be noted that the queue results represent the average queue across the peak hour.

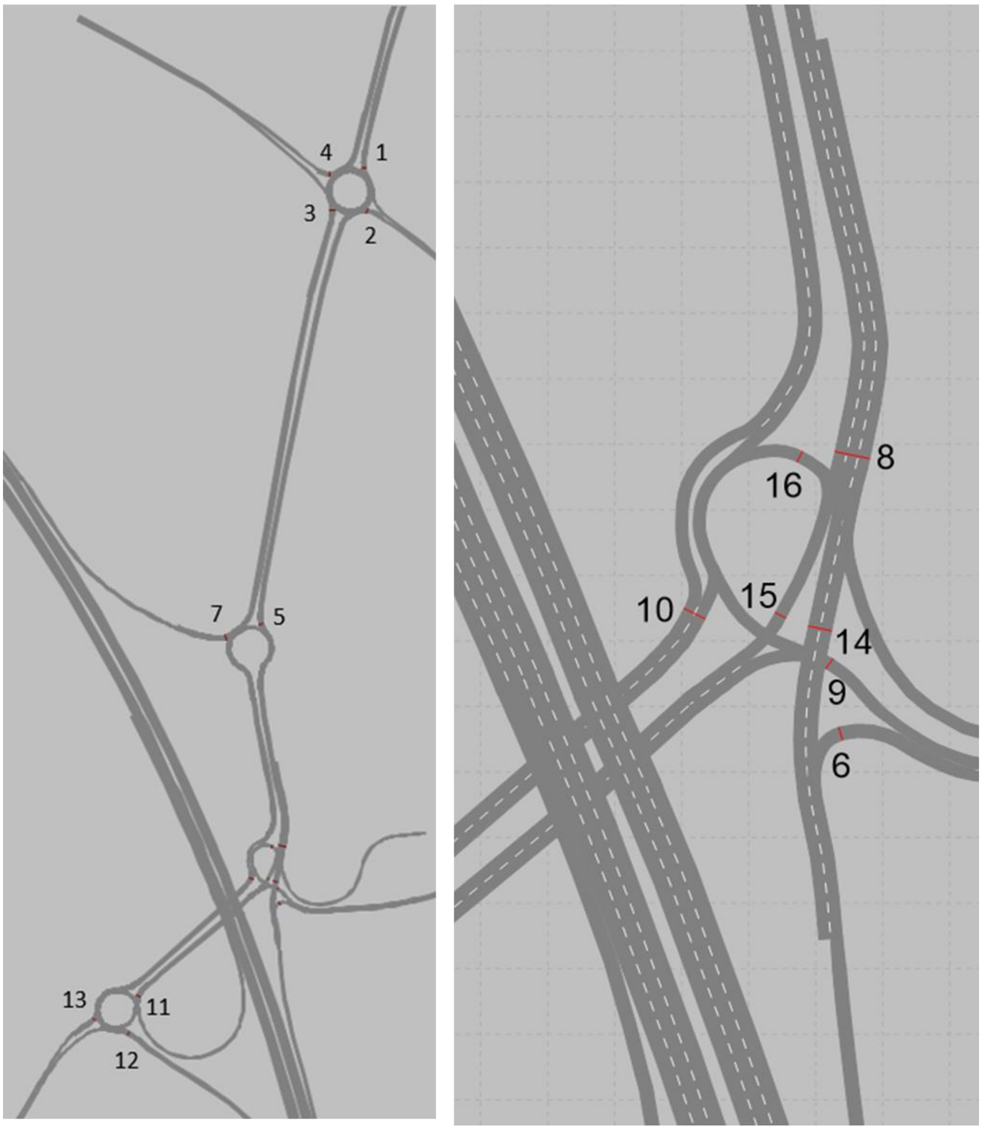

Figure 21. Location of queue counters in the model

Table 6. Queuing Storage per input link

Queue Counter No.	Approach		Modelled Link Length (m)
1	A43 North	Baynard's Green Roundabout	775
2	B4100 East		525
4	B4100 West		425
9	Services (Ahead)	Cherwell Junction	250
6	Services (Left)		250
13	B430 West	Ardley Roundabout	250

The queues extending past the link storage capacity stated in Table 6 are not included in the queue results as they are treated as latent demand in the model.

Table 7. Queuing Storage per internal link

Queue Counter No.	Approach		Modelled Link Length (m)
3	A43 South	Baynard's Green Roundabout	620
5	A43 North	Padbury Roundabout	620
7	M40		525
8	A43 North	Cherwell Junction	275
10	A43 South		250
11	A43 North	Ardley Roundabout	250
12	M40		550

The queues extending close/ past the link storage capacity stated in Table 7 may affect the operation of upstream junctions/ links.

The detailed queue preliminary results for 2031 can be found in Appendix F.

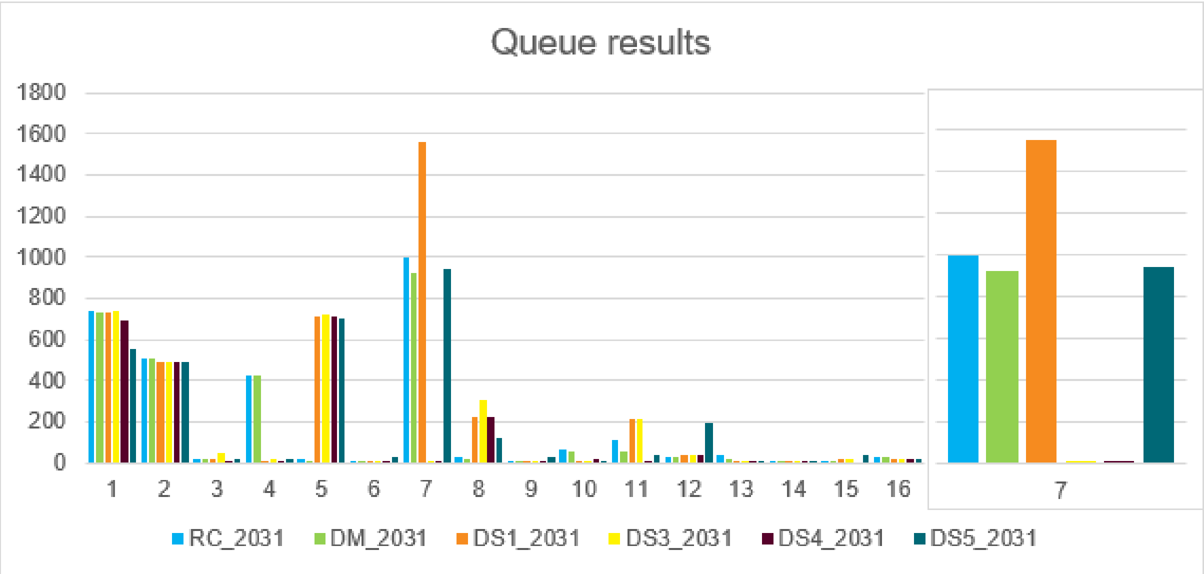

Figure 22. AM queue results for selected markers

PM Peak

Figure 23 below presents the queue results for the PM peak.

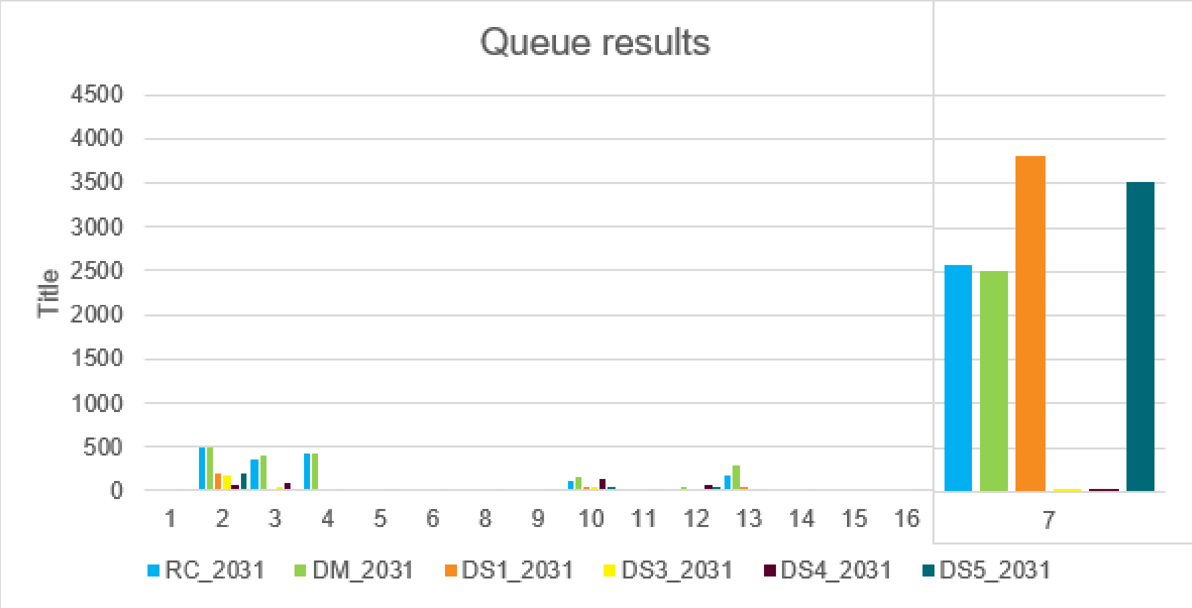

Figure 23. PM queue results for selected markers

Network Performance

Latent demand

Figure 24 shows the latent demand results for AM and PM.

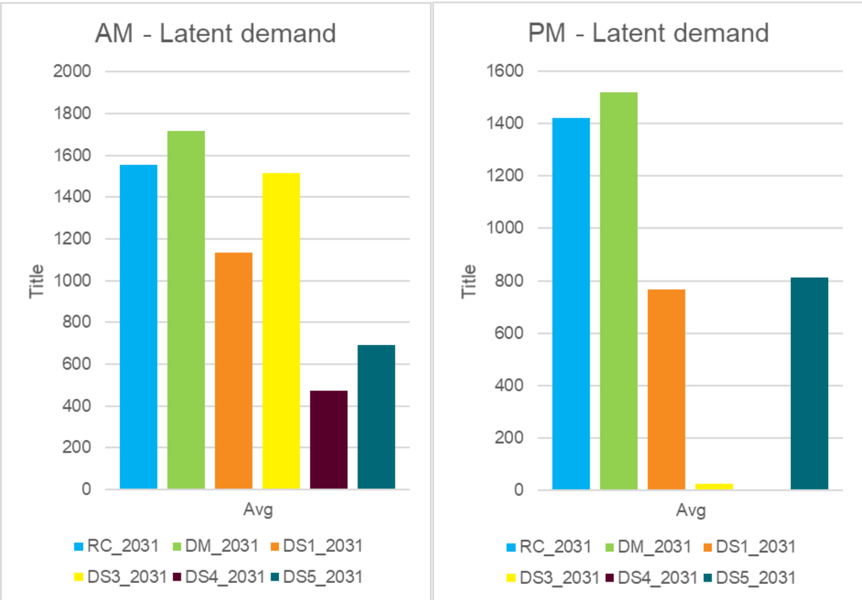

Figure 24. Latent demand results

Total Delay

Figure 25 shows the total recorded delay for all vehicles at the end of the evaluation period, including latent delay[2].

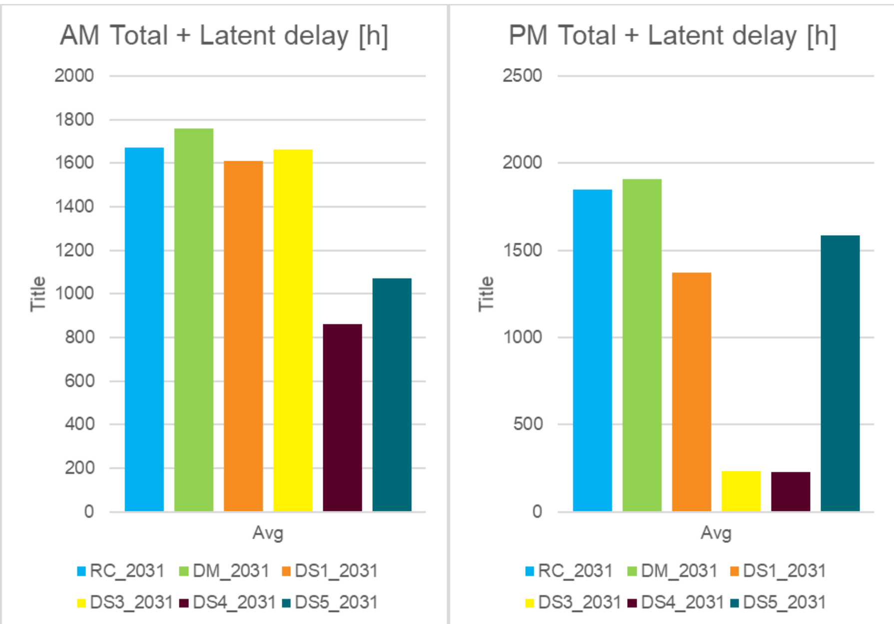

Figure 25. Addition of total recorded delay and latent delay[3]

The detailed network performance results for 2031 can be found in Appendix I. Reference network performance results from the 2026 version of the model can be found in Appendix H.

[3] Latent delay is defined as the overall time waited by vehicles between their specified start time and the actual time when they are loaded in the network, or the end of the evaluation period – Vissim 5.40 – User Manual.

2036 - Modelling results

The 2036 results are not considered to provide a reliable basis to assess the network operation due to the high level of congestion and constant gridlocks observed in the models.

The 2036 results show that only Do Something 4 can cope with the expected growth in 2036, but some queuing problems are seen on the M40 northbound off-slip.

It should be noted that the 2036 demand does not include any wider reassignment effects in the area caused by the additional growth from 2031 to 2036, which may result in a worst-case scenario for the model area.

Journey times and queue results have been provided in Appendix D and Appendix G.

Network Performance

Latent demand

Figure 26 shows the latent demand preliminary results for AM and PM.

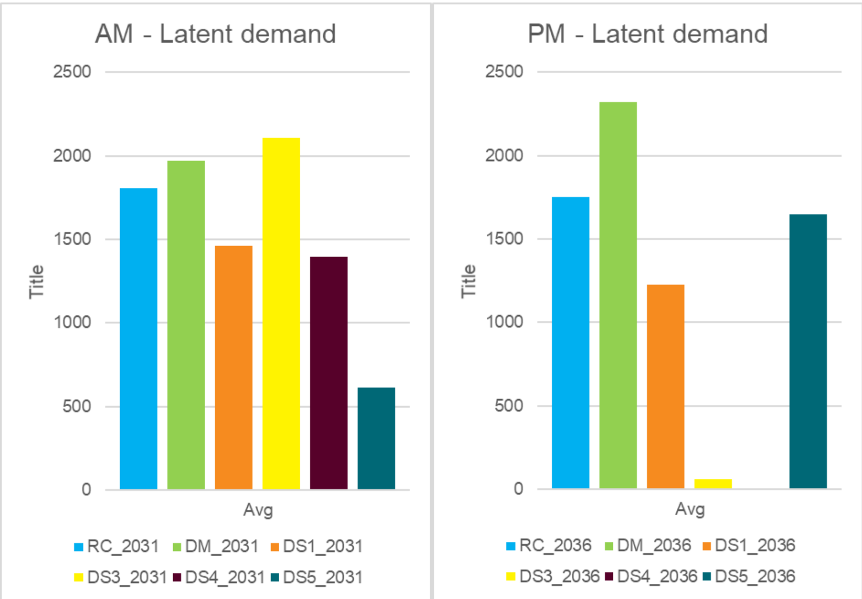

Figure 26. Latent demand results

The latent demand results in Figure 26 show a significant increase in latent demand in Scenario 3. The increase in latent demand is caused by the additional southbound flows in 2036 and the limited capacity at Ardley roundabout. Without the proposed improvements at Ardley roundabout, the junction cannot accommodate the predicted demand in 2036, causing an increase in the southbound queue that reaches the A43.

The lower delay observed in Do Something 5 is caused by the difference in the demand included in that scenario.

Total Delay

Figure 27 shows the total recorded delay for all vehicles at the end of the evaluation period, including latent delay[2].

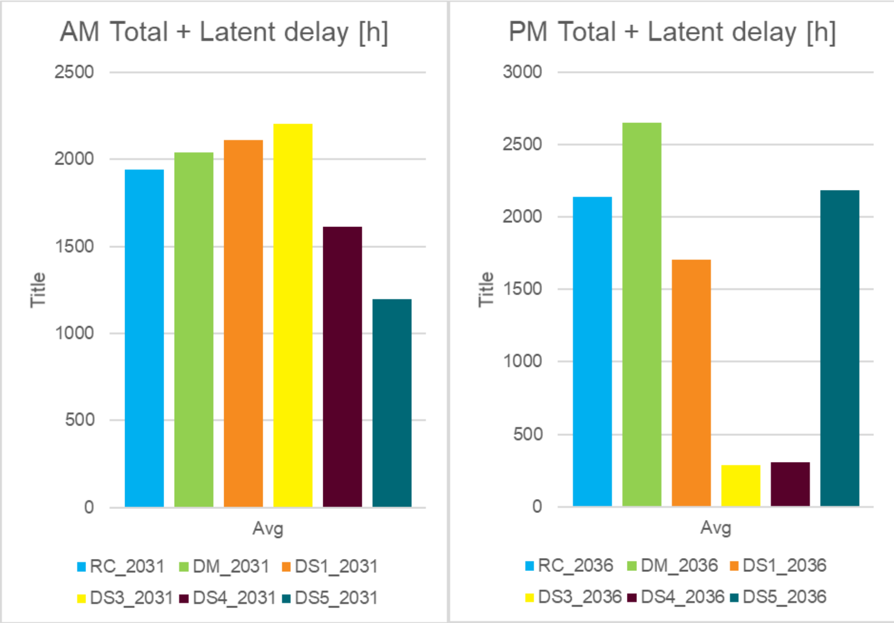

Figure 27. Addition of total recorded delay and latent delay[4]

The detailed network performance preliminary results for 2036 can be found in Appendix J.

[4] Latent delay is defined as the overall time waited by vehicles between their specified start time and the actual time when they are loaded in the network, or the end of the evaluation period – Vissim 5.40 – User Manual.

Summary & Conclusions

05

Summary

The results and conclusion summarised below have been based on 2031 and 2026 flows. The 2036 results are not considered to provide a reliable basis to assess the network operation due to the high level of congestion and constant gridlocks observed in the models.

It should be noted that the 2036 results show that only Do Something 4 can cope with the expected growth in 2036, but some queuing problems are seen on the M40 northbound off-slip.

The results for each scenario can be summarised as follows:

Do Something 1

The mitigation at Baynard's Green roundabout results in:

- ✓ a reduction of queues on all approaches to the junction and a significant reduction of the latent demand in the model;
- × an increase in flow through Baynard's Green leading to an increase in journey times along the A43 between Baynard's Green and Ardley roundabout; and
- × the additional demand southbound on Ardley roundabout creates queues that back up onto Cherwell junction in the AM peak: these queues affect the southbound flows along the A43.

Do Something 2

The mitigation at Padbury junction results in:

- ✓ the elimination of queuing on the M40 southbound off-slip;
- × the increase in flow from the M40 southbound off-slip results in longer journey times and queues along the A43;
- × the additional demand southbound on Ardley roundabout creates queues that extend back to Padbury and Baynard's Green junctions in the AM peak, reducing the capacity and increasing the latent demand on the approaches to Baynard's Green roundabout.

Do Something 3

The combination of the mitigation schemes at Baynard's Green and Padbury junctions results in:

- ✓ a reduction of queues on all approaches to Baynard's Green junction and a significant reduction of the latent demand in the model;
- ✓ the elimination of queuing on the M40 southbound off-slip;
- × the increase in flows across Baynard's Green and the southbound off-slip results in longer journey times and queues along the A43;
- × the additional demand on the southbound approach to Ardley roundabout results in queues backing up to Cherwell junction, affecting the southbound movements along the A43.

Do Something 4

The combination of the mitigation schemes at all three junctions result in:

- ✓ a reduction of queues on all approaches to Baynard's Green and the elimination of the latent demand in the model;
- ✓ the elimination of queuing on the M40 southbound off-slip;
- ✓ a reduction in southbound queues on the A43 approaching Ardley roundabout, which no longer backs up to Cherwell junction;

- ✓ a reduction in journey times southbound along the A43 as the access to the southbound on-slip is unaffected by queues from Ardley junction.

Do something 5

The combination of the mitigation schemes at Baynard's Green and Ardley junctions result in:

- ✓ a reduction of queues on all approaches to Baynard's Green and the elimination of the latent demand in the model;
- ✓ a reduction in southbound queues on the A43 approaching Ardley roundabout, which no longer affects Cherwell junction;
- ✓ a reduction in journey times southbound along the A43 as the access to the southbound on-slip is unaffected by queues from Ardley junction; and
- a slight reduction in queues on the southbound off-slip compared to Do Minimum in AM, due to the better operation of the A43.

Appendices

06

Appendix A – O-D Matrices

A.1 Reference Case AM

* time interval in hours [hh.mm]:
6.45 7.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	66	17	274	146	2	6
67	0	0	0	0	41	32
7	6	0	38	12	5	3
113	0	13	12	2	475	5
39	6	17	14	0	69	1
10	34	39	841	41	5	1
11	59	0	25	2	0	0

* time interval in hours [hh.mm]:
7.00 7.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	72	7	246	155	11	8
85	0	0	0	11	30	46
5	1	0	34	19	14	5
147	1	42	3	6	564	11
48	9	2	12	0	84	7
5	46	41	786	43	4	2
8	60	0	19	8	1	0

* time interval in hours [hh.mm]:
7.15 7.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	85	13	230	156	9	16
80	0	0	3	7	35	51
8	4	0	39	12	21	1
176	1	43	10	7	606	8
51	0	4	20	0	102	4
13	47	24	813	63	1	6
29	73	0	38	5	0	0

* time interval in hours [hh.mm]:
7.30 7.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7

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0	41	9	171	108	7	9
77	0	0	2	10	28	64
10	4	0	44	14	21	0
168	1	52	9	18	641	8
48	2	2	10	0	119	8
11	53	38	722	60	4	3
22	79	1	50	10	0	1

* time interval in hours [hh.mm]:
7.45 8.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	79	10	241	118	16	9
103	0	0	5	3	29	66
16	1	0	43	10	36	0
189	1	34	11	17	710	13
56	8	4	17	0	102	4
10	42	42	791	64	3	1
24	71	0	51	4	0	1

* time interval in hours [hh.mm]:
8.00 8.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	55	13	246	98	14	13
74	0	5	3	2	54	72
11	0	0	54	14	22	1
211	1	26	9	15	670	9
59	2	10	12	0	98	6
20	38	43	648	88	6	3
29	109	0	43	3	1	1

* time interval in hours [hh.mm]:
8.15 8.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	58	16	217	109	21	13
53	0	2	0	6	31	63
6	0	0	42	14	28	0
174	1	34	8	4	562	10
48	6	5	12	0	89	4
10	50	35	729	62	1	4
24	68	0	33	7	0	3

* time interval in hours [hh.mm]:
8.30 8.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7

0	57	15	198	102	14	6
49	0	4	0	3	29	68
11	1	0	44	12	23	0
175	1	43	2	7	560	17
49	6	13	7	0	62	12
10	31	28	629	60	4	2
15	87	1	31	5	0	0

* time interval in hours [hh.mm]:
8.45 9.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	51	13	202	90	22	10
40	2	5	5	9	19	46
12	0	0	50	9	35	0
146	0	38	1	16	474	11
29	0	9	2	0	63	6
11	34	34	696	46	1	2
21	72	0	28	2	0	0

* time interval in hours [hh.mm]:
9.00 9.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	66	17	274	146	2	6
67	0	0	0	0	41	32
7	6	0	38	12	5	3
113	0	13	12	2	475	5
39	6	17	14	0	69	1
10	34	39	841	41	5	1
11	59	0	25	2	0	0

A.2 Reference Case PM

* time interval in hours [hh.mm]:
15.30 15.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	47	15	193	55	19	6
94	0	0	4	0	33	80
15	0	0	59	7	27	0
250	1	47	12	12	887	16
31	1	2	5	0	33	4
9	15	38	604	31	4	5
18	64	1	15	6	1	0

* time interval in hours [hh.mm]:
15.45 16.00
* Scaling factor:
1
* number of zones:
7

* zones:

1	2	3	4	5	6	7
0	45	30	196	61	21	2
85	0	12	2	6	33	76
21	3	0	53	2	43	0
272	0	23	4	17	856	19
51	1	0	2	0	31	3
9	14	34	674	27	0	2
19	81	0	21	2	0	0

* time interval in hours [hh.mm]:
16.00 16.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	52	11	232	50	13	10
107	0	4	2	6	36	65
14	0	0	54	7	38	0
264	1	48	8	12	881	11
68	1	7	6	0	55	1
7	16	51	709	40	0	3
20	90	0	21	4	0	0

* time interval in hours [hh.mm]:
16.15 16.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	44	27	189	65	15	7
117	0	6	0	3	42	82
23	0	0	54	5	32	0
263	0	43	14	6	932	7
101	5	2	2	0	40	5
13	28	31	739	33	1	3
23	87	0	13	4	0	2

* time interval in hours [hh.mm]:
16.30 16.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
1	76	15	202	57	22	9
124	0	11	3	0	41	85
26	1	0	43	4	33	4
299	0	28	16	14	933	7
89	1	2	2	0	56	4
11	22	41	746	31	5	5
16	88	0	28	5	0	1

* time interval in hours [hh.mm]:
16.45 17.00
* Scaling factor:
1
* number of zones:
7

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* zones:

1	2	3	4	5	6	7
0	81	15	243	45	22	9
143	0	4	4	3	25	103
21	0	0	47	0	32	0
311	0	44	16	9	973	7
86	1	3	7	0	52	4
24	34	29	686	61	2	2
19	82	0	16	7	0	2

* time interval in hours [hh.mm]:
17.00 17.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	85	29	224	61	23	6
147	0	5	0	5	35	78
23	0	0	44	4	16	1
302	0	29	18	18	878	16
107	1	6	2	0	38	2
24	18	37	677	36	1	7
17	90	2	10	2	0	5

* time interval in hours [hh.mm]:
17.15 17.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
1	76	20	238	55	17	9
133	0	2	2	2	50	105
15	1	0	37	3	41	3
324	1	41	17	18	955	13
100	2	3	2	0	53	1
6	25	28	709	64	4	7
21	102	0	11	8	0	2

* time interval in hours [hh.mm]:
17.30 17.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	69	14	205	55	17	11
110	0	0	0	10	48	91
38	0	0	46	9	23	0
312	0	34	16	19	912	14
97	1	4	2	0	53	5
9	23	43	723	32	0	4
21	96	0	18	12	1	2

* time interval in hours [hh.mm]:
17.45 18.00
* Scaling factor:
1
* number of zones:
7

* zones:

1	2	3	4	5	6	7
0	47	15	193	55	19	6
94	0	0	4	0	33	80
15	0	0	59	7	27	0
250	1	47	12	12	887	16
31	1	2	5	0	33	4
9	15	38	604	31	4	5
18	64	1	15	6	1	0

A.3 Do Minimum AM

* time interval in hours [hh.mm]:
6.45 7.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	77	18	293	142	2	7
70	0	0	0	0	42	37
7	6	0	38	11	5	3
120	0	14	12	2	483	6
37	6	15	13	0	63	1
10	36	38	837	37	5	1
11	62	0	24	2	0	0

* time interval in hours [hh.mm]:
7.00 7.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	84	7	265	152	12	9
89	0	0	0	11	31	51
5	1	0	35	18	14	5
155	1	43	4	6	572	12
46	10	2	11	0	76	7
5	49	40	782	39	4	2
8	63	0	18	7	1	0

* time interval in hours [hh.mm]:
7.15 7.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	98	13	249	154	9	18
84	0	0	3	7	35	57
8	5	0	40	12	20	1
185	1	44	11	6	615	9
49	0	4	19	0	94	4
13	50	24	811	57	1	7
28	76	0	38	5	0	0

* time interval in hours [hh.mm]:
7.30 7.45
* Scaling factor:

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1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	49	10	191	108	8	10
80	0	0	2	9	28	70
11	5	0	45	13	21	0
175	1	53	9	17	650	9
46	2	2	9	0	110	8
11	57	37	720	53	4	3
21	84	1	49	9	0	1

* time interval in hours [hh.mm]:
7.45 8.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	92	11	261	115	17	11
107	0	0	5	3	29	72
16	1	0	44	9	36	0
198	1	34	12	16	719	15
53	8	3	16	0	93	4
10	45	41	789	58	2	1
23	75	0	50	4	0	1

* time interval in hours [hh.mm]:
8.00 8.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	65	14	265	97	15	14
77	0	5	3	2	55	78
11	0	0	55	13	22	1
221	1	26	10	15	678	10
56	2	10	11	0	91	6
20	41	43	646	81	6	3
28	115	0	41	3	1	1

* time interval in hours [hh.mm]:
8.15 8.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	69	16	234	108	22	15
56	0	2	0	5	32	68
6	0	0	44	13	28	0
182	1	34	9	3	569	11
45	6	5	12	0	82	4
10	53	34	727	56	1	4
24	71	0	32	7	0	3

* time interval in hours [hh.mm]:
8.30 8.45
* Scaling factor:

1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	67	16	214	100	14	6
51	0	4	0	3	29	74
11	1	0	45	11	23	0
183	1	44	2	7	566	18
46	6	11	7	0	56	12
11	34	27	627	55	4	2
15	91	1	30	5	0	0

* time interval in hours [hh.mm]:
8.45 9.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	60	14	218	88	22	12
42	2	5	6	8	20	51
12	0	0	51	8	34	0
154	0	39	1	15	480	12
27	0	8	2	0	56	6
11	37	33	694	41	1	2
20	76	0	27	2	0	0

* time interval in hours [hh.mm]:
9.00 9.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	77	18	293	142	2	7
70	0	0	0	0	42	37
7	6	0	38	11	5	3
120	0	14	12	2	483	6
37	6	15	13	0	63	1
10	36	38	837	37	5	1
11	62	0	24	2	0	0

A.4 Do Minimum PM

* time interval in hours [hh.mm]:
15.30 15.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	45	15	194	54	19	7
93	0	0	4	0	32	80
15	0	0	59	7	27	0
251	1	47	12	12	890	16
32	1	2	5	0	35	4
10	14	38	603	30	4	5
19	66	1	16	6	2	0

* time interval in hours [hh.mm]:
15.45 16.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	43	31	197	60	22	2
84	0	12	2	6	32	77
22	3	0	53	2	44	0
273	0	23	4	17	860	20
54	1	0	2	0	33	3
9	14	34	672	27	0	2
20	83	0	23	2	0	0

* time interval in hours [hh.mm]:
16.00 16.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	50	11	232	49	13	10
106	0	4	2	6	36	66
14	0	0	54	7	39	0
265	1	48	8	12	885	11
70	1	7	6	0	57	1
7	16	51	707	39	0	3
21	92	0	22	4	0	0

* time interval in hours [hh.mm]:
16.15 16.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	43	27	189	63	15	7
115	0	6	0	3	42	83
23	0	0	53	5	32	0
263	0	43	14	5	937	7
104	5	2	2	0	41	5
14	27	31	738	32	1	3
25	89	0	14	4	0	2

* time interval in hours [hh.mm]:
16.30 16.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
1	74	15	202	56	23	9
123	0	11	3	0	41	86
27	1	0	43	4	33	4
300	0	28	16	14	937	7
92	1	2	2	0	58	4
12	21	41	744	31	5	5
18	90	0	29	5	0	1

* time interval in hours [hh.mm]:
16.45 17.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	79	15	243	44	22	9
142	0	4	4	3	24	103
21	0	0	47	0	33	0
312	0	44	16	9	977	7
89	1	3	7	0	54	5
24	33	29	684	60	3	2
20	84	0	17	7	0	2

* time interval in hours [hh.mm]:
17.00 17.15
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	83	29	225	60	23	6
146	0	5	0	5	35	79
24	0	0	44	4	16	1
302	0	29	18	17	882	16
110	1	7	2	0	39	3
25	17	37	676	35	1	7
18	93	2	11	2	0	5

* time interval in hours [hh.mm]:
17.15 17.30
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
1	73	20	238	54	17	9
132	0	2	2	2	50	105
15	1	0	37	3	41	3
324	1	40	17	17	960	13
104	2	3	2	0	55	2
6	24	28	708	63	4	7
22	105	0	11	8	0	2

* time interval in hours [hh.mm]:
17.30 17.45
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	67	14	206	54	17	11
110	0	0	0	10	48	91
38	0	0	46	9	23	0
313	0	34	15	19	917	14
100	1	4	2	0	55	6
9	22	44	721	31	0	4
22	98	0	19	13	2	2

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* time interval in hours [hh.mm]:
17.45 18.00
* Scaling factor:
1
* number of zones:
7
* zones:

1	2	3	4	5	6	7
0	45	15	194	54	19	7
93	0	0	4	0	32	80
15	0	0	59	7	27	0
251	1	47	12	12	890	16
32	1	2	5	0	35	4
10	14	38	603	30	4	5
19	66	1	16	6	2	0

Appendix B – TEMPro growth factors

To extract growth factors, TEMPRO v7.2 has been interrogated for the origin and destination trip ends.

The most updated National Transport Model (NTM) Dataset AF15 has been used in order to extract separate growth predictions for the following relevant areas within the M40 Junction 10 network:

- Northampton;
- Milton Keynes;
- Oxford;
- West Oxfordshire;
- Cherwell; and
- South Northamptonshire.

A weighted average of the districts listed above has been applied to ascertain the final growth factors that have then been used to compare with the growth from the strategic model. Individual weights for each zone have been extracted, based on the distance to the M40 Junction 10 and the number of household and jobs for each district.

These weights are tabulated below in Table 8.

Table 8. NTEM Areas – 2016-2018 Weights

NTEM Area	Weight (%)
Northampton	9%
Milton Keynes	3%
Oxford	19%
West Oxfordshire	9%
Cherwell	52%
South Northamptonshire	7%

By applying these weights together with the individual growth factor for each of the areas considered, final growth factors are derived. These are shown below in Table 9.

Table 9. TEMPRO growth factors – 2016-2018

Peak Period	NTEM Factors
AM Peak	1.1383
PM Peak	1.1369

Areas covered by TEMPRO zones mentioned above are shown in Figure 28.

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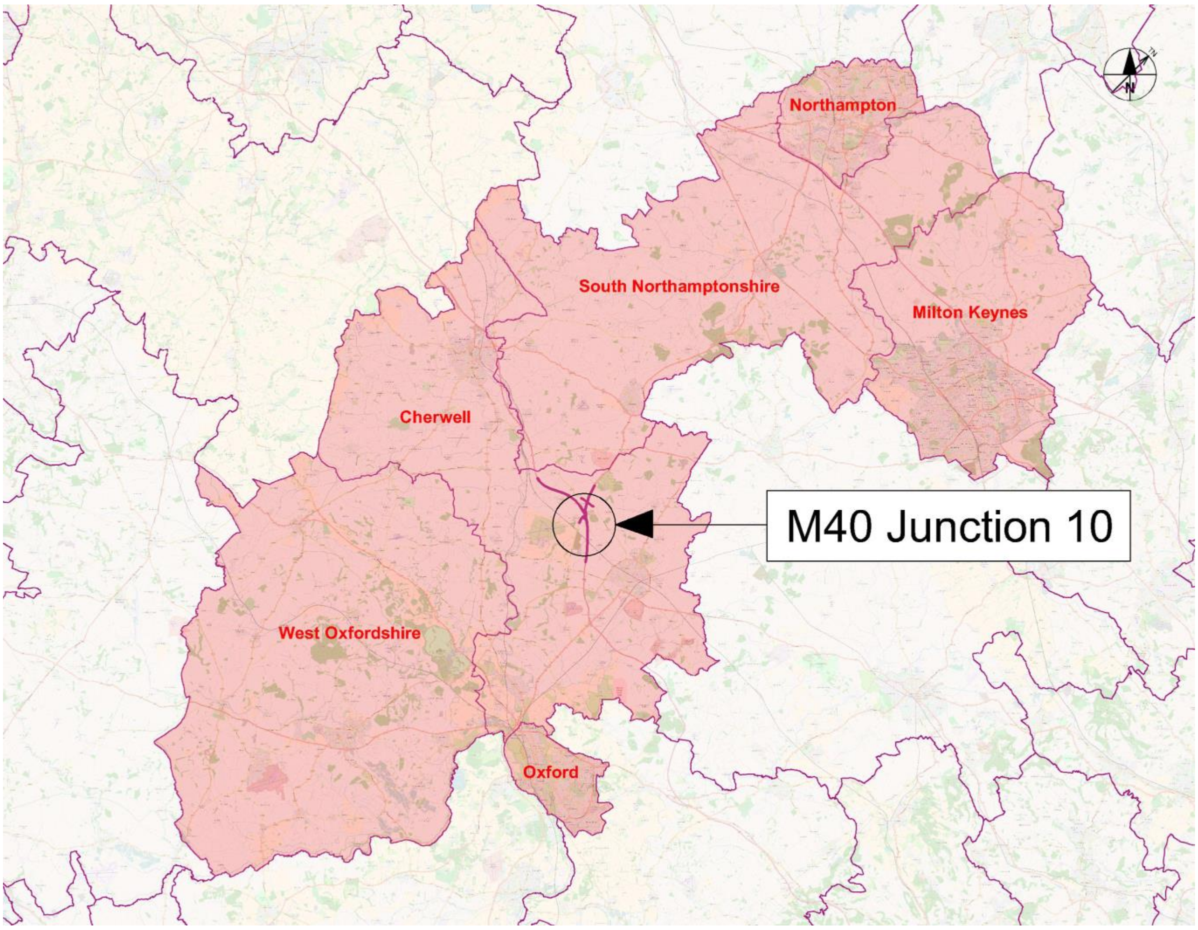


Figure 28. M40 Junction 10 – Relevant TEMPRO Zones

Appendix C – 2031 Complete Journey Time & Volume Results

Table 10. Journey Times & Volumes 2031 – AM

	RC_2031_AM		DM_2031_AM		DS1_2031_AM		DS3_2031_AM		DS4_2031_AM		DS5_2031_AM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 NB	43.6	1261	45.07	1362	50.36	1330	50.33	1327	49.92	1337	48.82	1232
Section 2 NB	53.95	1605	48.76	1644	36.88	1608	38.52	1605	43.95	1617	44.1	1515
Section 3 NB	21.13	1369	21.15	1398	21.24	1372	24.73	1365	24.55	1382	21.04	1289
Section 4 NB	42.93	1594	41.89	1626	42.73	1611	51.64	1676	41.66	1699	43.05	1556
Section 5 NB	37.35	1631	37.2	1661	45.53	1602	49.53	1593	43.71	1640	46.97	1495

	RC_2031_AM		DM_2031_AM		DS1_2031_AM		DS3_2031_AM		DS4_2031_AM		DS5_2031_AM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 SB	300.98	1658	296.83	1678	292.06	1907	393.28	1561	204.21	2246	173.25	2263
Section 2 SB	52.26	1666	50.56	1681	381.84	1795	495.04	1503	305.39	2059	288.97	2031
Section 3 SB	39.61	2058	37.07	2068	83.1	2190	102.89	2018	76.05	2549	59.66	2410
Section 4 SB	16.32	2062	16.26	2063	19.81	2201	18.31	2024	17.74	2546	18.96	2412
Section 5 SB	30.63	1406	30.46	1433	30.86	1457	30.27	1271	31.2	1614	31.58	1614

Table 11. Journey Times & Volumes 2031 – PM

	RC_2031_PM		DM_2031_PM		DS1_2031_PM		DS3_2031_PM		DS4_2031_PM		DS5_2031_PM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 NB	36.38	1861	43.91	1878	35.27	1840	41.81	1823	55.75	1685	48.07	1752
Section 2 NB	54.34	2241	62.05	2207	43.2	2201	43.48	2198	58.78	2413	45.16	2126
Section 3 NB	22.84	2231	25.03	2199	21.35	2195	26.14	2204	26.35	2413	21.18	2123
Section 4 NB	134.25	2130	144.96	2109	36.8	2129	46.72	2326	62.72	2535	37.39	2095
Section 5 NB	37.18	2293	37.17	2273	46.3	2567	47.83	2635	49.33	2803	46.35	2528

	RC_2031_PM		DM_2031_PM		DS1_2031_PM		DS3_2031_PM		DS4_2031_PM		DS5_2031_PM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 SB	36.59	1854	36.16	1841	31.28	1671	31.92	1672	31.74	1640	31.54	1671
Section 2 SB	45.7	1625	45.75	1612	46.33	1441	47.16	1441	47.13	1399	46.08	1440
Section 3 SB	34.66	1795	34.77	1787	36.2	1639	36.92	1905	37.56	1821	35.94	1663
Section 4 SB	15.25	1793	14.98	1786	16.02	1639	15.97	1898	14.26	1821	14.14	1667
Section 5 SB	29.15	1383	29.19	1348	28.43	1143	28.45	1142	28.67	1151	28.51	1151

Appendix D – 2036 Complete Journey Time & Volume Results

Table 12. Journey Times & Volumes 2036 – AM

	RC_2036_AM		DM_2036_AM		DS1_2036_AM		DS3_2036_AM		DS4_2036_AM		DS5_2036_AM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 NB	58.9	1300	50.11	1408	50.39	1316	55.54	1308	50.44	1398	52.74	1387
Section 2 NB	65.31	1034	57.37	1123	39.22	1085	45.77	1074	45.34	1101	44.86	1094
Section 3 NB	21.11	1417	21.11	1458	21.33	1425	44.72	1409	25.06	1440	21.18	1433
Section 4 NB	42.71	1423	43.45	1455	45.43	1428	153.37	1401	42.97	1440	43.16	1438
Section 5 NB	37.3	1359	37.24	1373	46.63	1348	68.32	1341	44.14	1377	44.95	1354

	RC_2036_AM		DM_2036_AM		DS1_2036_AM		DS3_2036_AM		DS4_2036_AM		DS5_2036_AM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 SB	296.52	1685	289.77	1710	314.06	1842	486.91	1355	226.27	2179	193.63	2427
Section 2 SB	51.88	1407	50.67	1415	400.65	1496	586.87	1094	318.48	1728	271.59	1950
Section 3 SB	40.55	1694	37.28	1690	89.02	1778	113.76	1353	78.60	1988	59.71	2194
Section 4 SB	16.59	1072	16.57	1091	19.49	1088	18.25	814	18.03	1244	19.21	1369
Section 5 SB	30.64	1431	30.74	1457	30.65	1430	30.13	1155	31.22	1594	31.74	1713

Table 13. Journey Times & Volumes 2036 – PM

	RC_2036_PM		DM_2036_PM		DS1_2036_PM		DS3_2036_PM		DS4_2036_PM		DS5_2036_PM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 NB	39.82	1919	105.42	1837	35.7	1831	45.25	1811	107.25	1680	50.77	1746
Section 2 NB	62.82	1569	95.68	1481	44.42	1548	47.45	1537	69.29	1370	46.17	1423
Section 3 NB	21.51	2053	89.26	1820	21.34	2083	26.19	2080	28.23	2242	21.15	1966
Section 4 NB	83.05	2068	238.12	1815	38.13	2078	47.64	2079	71.28	2214	37.13	1968
Section 5 NB	37.07	1985	37.77	1765	47.21	2018	48.37	2083	50.41	2196	46.43	1920

	RC_2036_PM		DM_2036_PM		DS1_2036_PM		DS3_2036_PM		DS4_2036_PM		DS5_2036_PM	
	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)	Time (s)	Volume (vehs)
Section 1 SB	35.88	1931	35.43	1736	31.69	1739	32.09	1739	31.92	1706	31.54	1739
Section 2 SB	44.67	1516	45.7	1227	46.36	1229	47.64	1229	47.58	1184	46.08	1228
Section 3 SB	34.02	1678	33.58	1423	36.97	1487	38.34	1487	38.5	1446	35.94	1489
Section 4 SB	15.54	1118	14.08	869	16.28	874	16.36	871	14.42	873	14.14	873
Section 5 SB	29.4	1436	28.57	1171	28.56	1180	28.79	1181	28.77	1190	28.51	1176

Appendix E – 2026 Complete Queue Results

Figure 29. Queue Results 2026 – AM

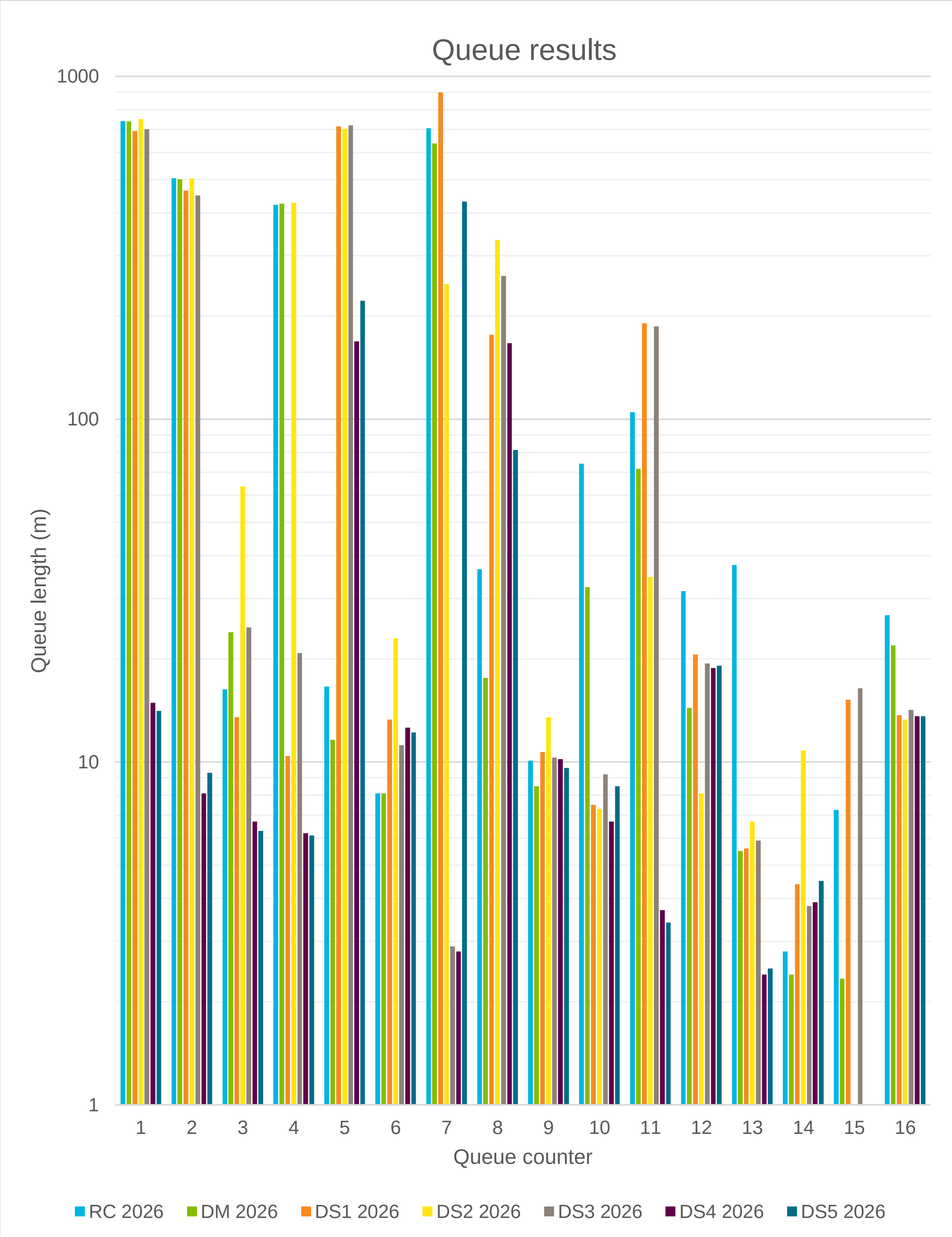
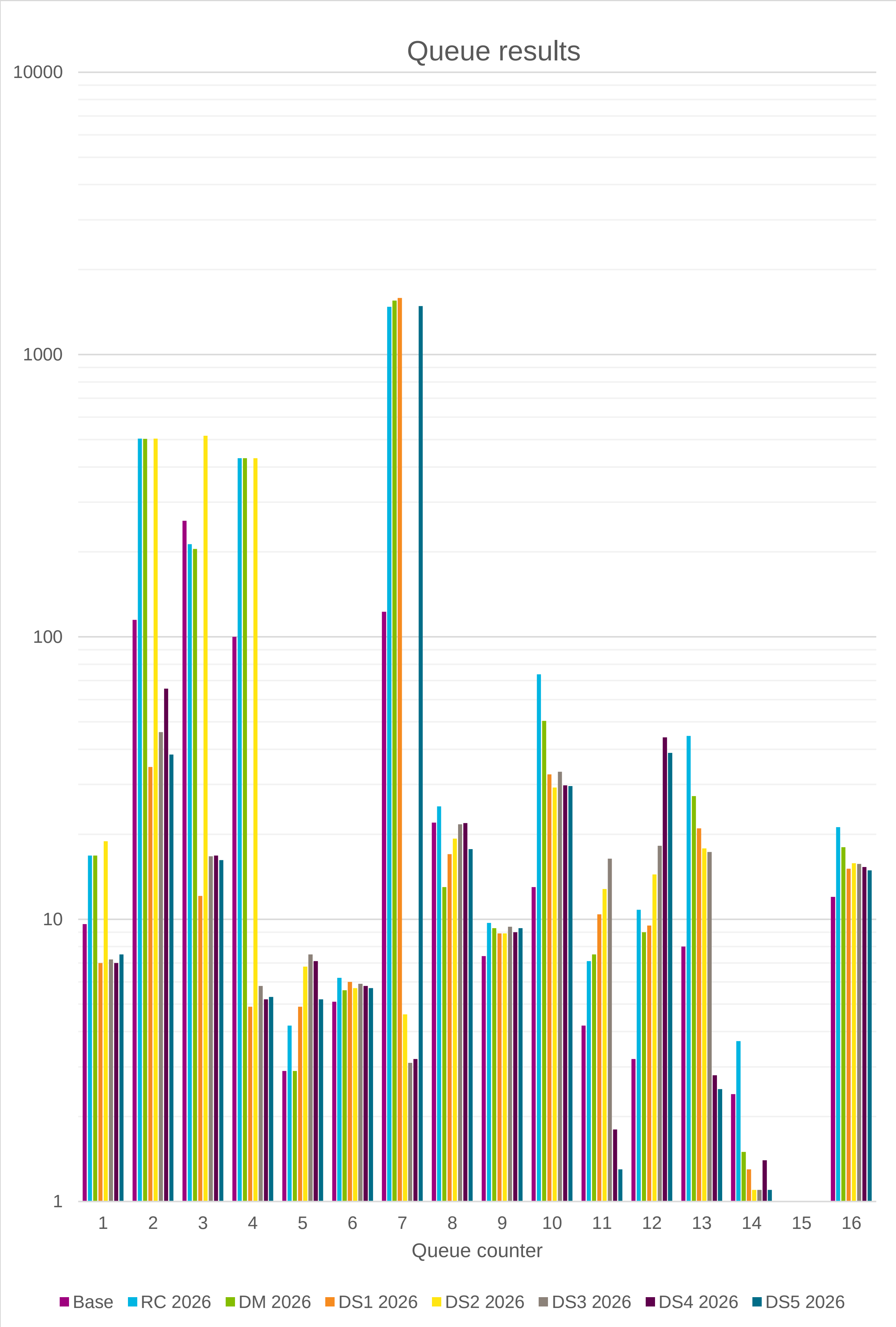


Figure 30. Queue Results 2026 – PM



Appendix F – 2031 Complete Queue Results

Figure 31. Queue Results 2031 – AM

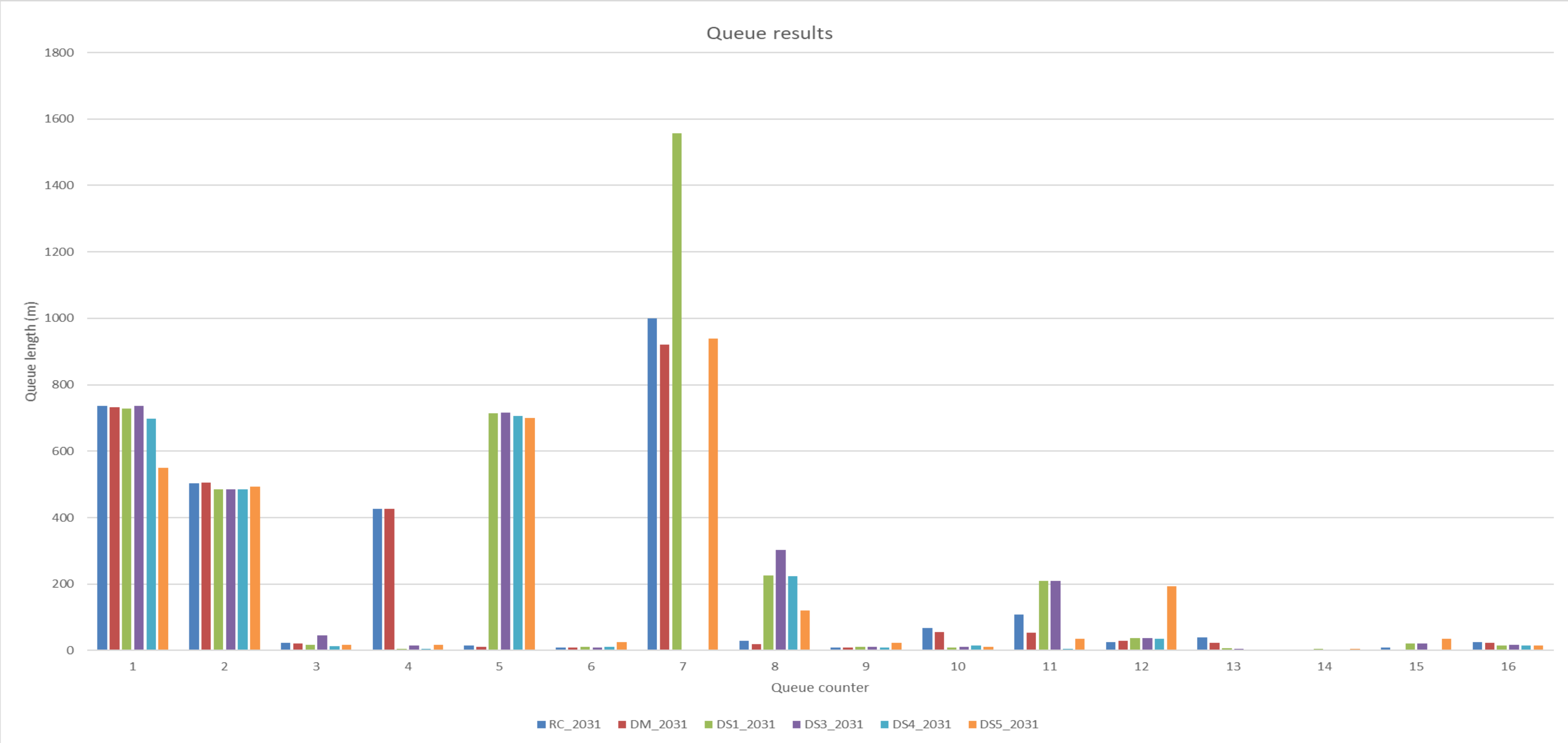
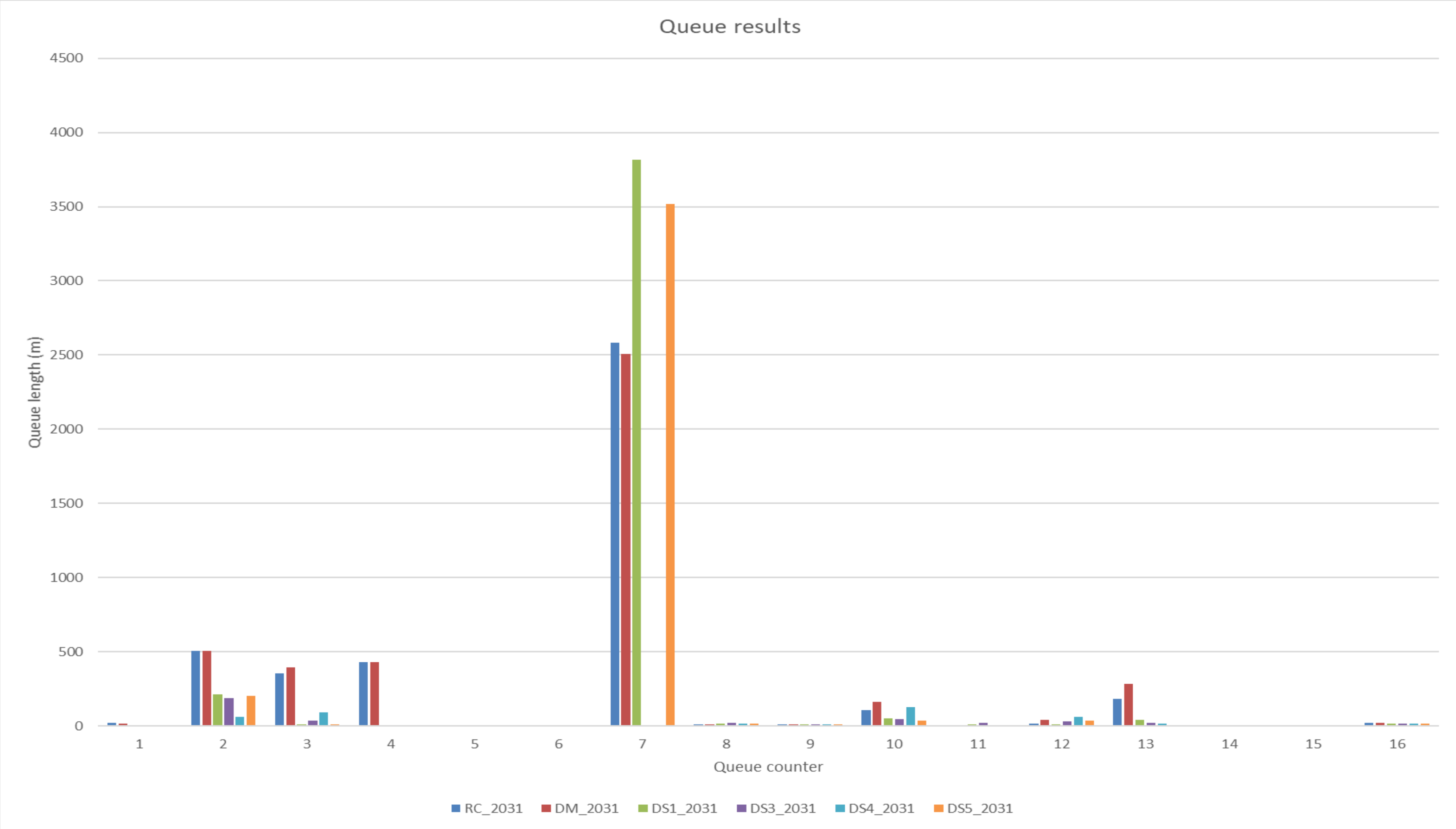


Figure 32. Queue Results 2031 – PM



Appendix G – 2036 Complete Queue Results

Figure 33. Queue Results 2036 – AM

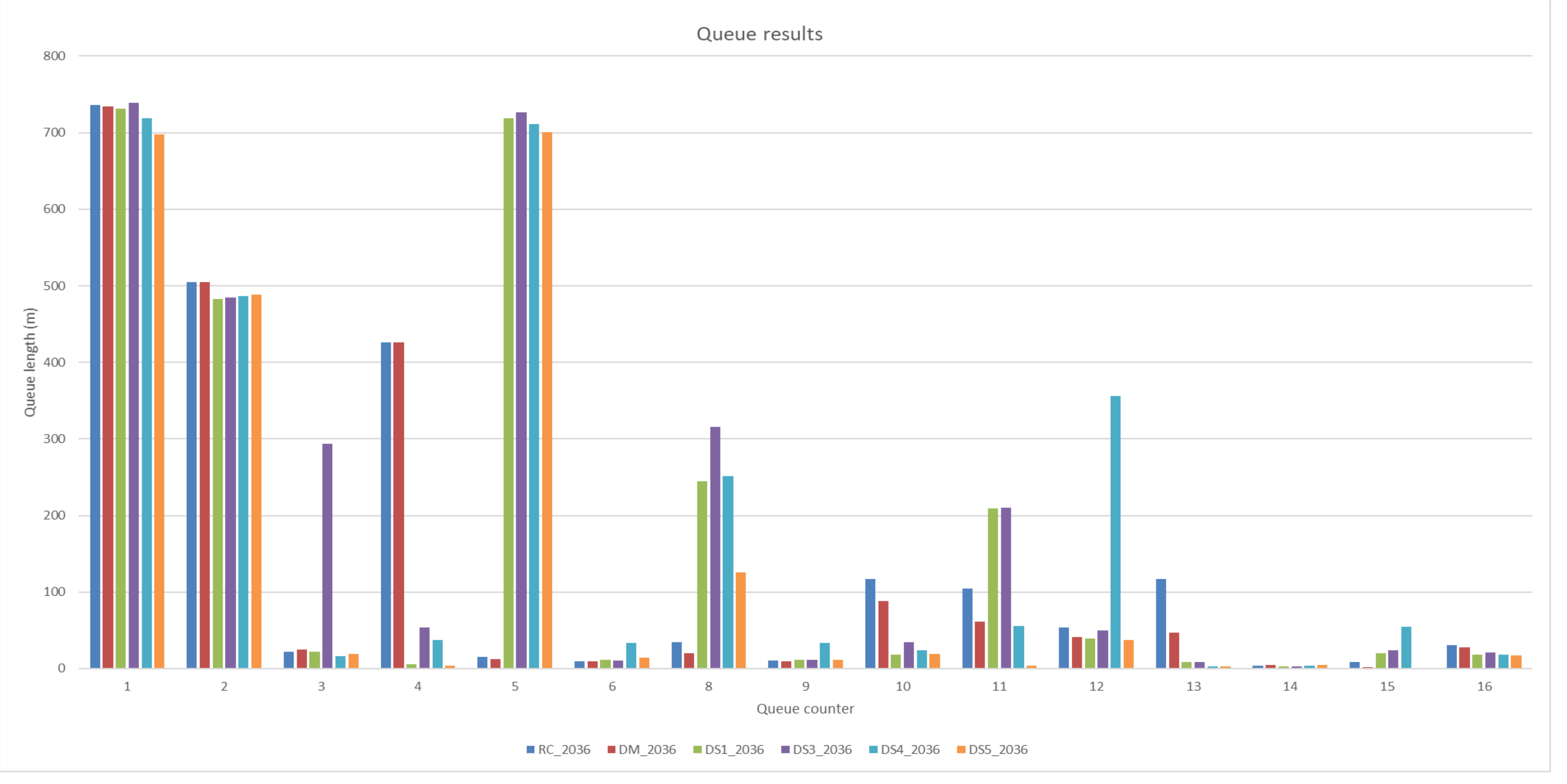
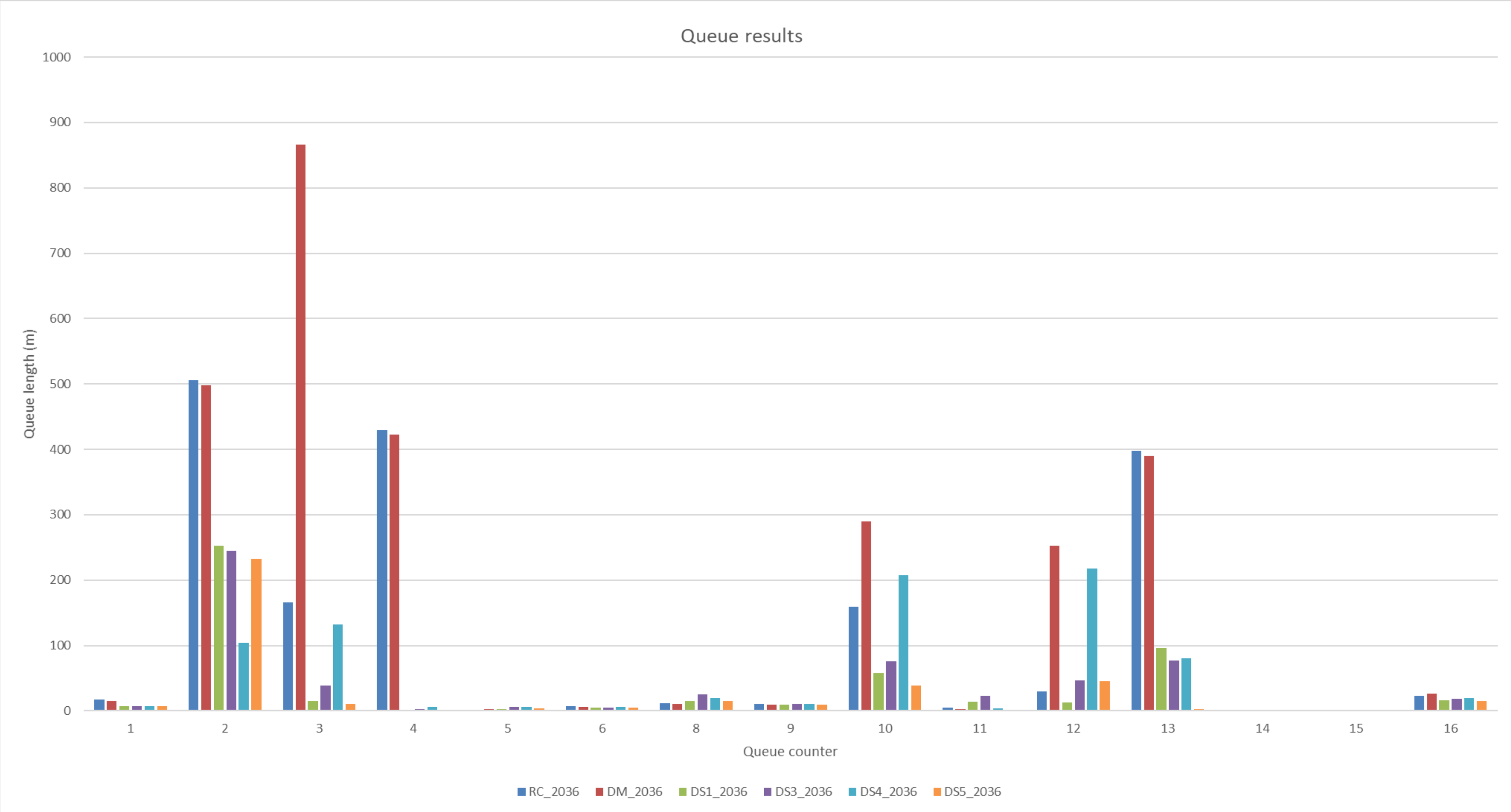


Figure 34. Queue Results 2036 – PM



Appendix H – 2026 Complete Network Performance Results

Table 14. Network Performance Preliminary Results 2026 – AM

Latent demand											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2026	1104	1008	1086	1054	1091	1046	1129	1044	1060	1070	1069
DM_2026	1384	1410	1423	1415	1427	1351	1402	1384	1422	1381	1400
DS1_2026	272	339	358	135	308	398	327	149	326	355	297
DS2_2026	2431	2267	2545	2508	2337	2313	2392	2339	2424	2424	2398
DS3_2026	217	408	429	528	326	620	440	489	529	464	445
DS4_2026	0	0	0	0	1	0	0	0	0	0	1
DS5_2026	0	0	0	0	1	0	0	0	0	0	1

Latent delay time [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2026	792	739	807	788	809	772	834	764	787	812	790
DM_2026	1020	1040	1045	1063	1055	1015	1030	1031	1060	1048	1041
DS1_2026	163	240	195	102	202	257	254	195	244	244	210
DS2_2026	1729	1472	1764	1659	1577	1521	1608	1565	1615	1606	1612
DS3_2026	157	333	269	323	214	378	268	365	354	329	299
DS4_2026	0	0	0	0	0	0	0	0	0	0	0
DS5_2026	0	0	0	0	0	0	0	0	0	0	0

AM Total + Latent delay [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2026	1212	1224	1222	1245	1275	1220	1265	1229	1195	1269	1236
DM_2026	1418	1459	1452	1491	1478	1447	1453	1436	1470	1453	1456
DS1_2026	790	914	837	691	869	910	870	864	873	877	850
DS2_2026	2518	2167	2424	2342	2212	2186	2278	2218	2267	2284	2290
DS3_2026	687	909	834	899	776	990	837	955	929	897	871
DS4_2026	189	192	149	193	164	196	208	160	155	203	181
DS5_2026	219	207	249	216	217	240	222	207	203	247	223

Table 15. Network Performance Preliminary Results 2026 – PM

Latent demand											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2026	1111	1100	1127	1089	1080	1125	1140	1132	1131	1114	1115
DM_2026	1126	1134	1124	1187	1116	1152	1140	1183	1123	1183	1147
DS1_2026	0	2	0	0	0	0	0	0	0	0	2
DS2_2026	1105	1128	1118	1160	1129	1142	1129	1123	1136	1167	1134
DS3_2026	0	2	0	0	0	0	0	0	0	0	2
DS4_2026	0	2	0	0	0	0	0	0	0	0	2
DS5_2026	0	2	0	0	0	0	0	0	0	0	2

Latent delay time [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2026	711	690	715	689	696	701	724	738	715	715	709
DM_2026	727	729	706	751	707	735	713	752	726	758	730
DS1_2026	0	0	0	0	0	0	0	0	0	0	0
DS2_2026	700	712	713	725	715	715	714	727	741	730	719
DS3_2026	0	0	0	0	0	0	0	0	0	0	0
DS4_2026	0	0	1	0	0	0	0	0	0	0	0
DS5_2026	0	0	0	0	0	0	0	0	0	0	0

PM Total + Latent delay [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2026	1206	1102	1217	1204	1231	1229	1260	1280	1272	1167	1217
DM_2026	1276	1272	1268	1254	1182	1265	1256	1258	1268	1259	1256
DS1_2026	458	395	384	422	397	429	394	406	452	458	419
DS2_2026	1034	1045	1077	1052	1052	1043	1013	1065	1057	1007	1045
DS3_2026	165	160	169	163	169	162	166	165	164	162	164
DS4_2026	172	163	177	168	187	169	172	167	167	186	173
DS5_2026	458	399	419	409	364	414	483	426	451	408	423

Appendix I – 2031 Complete Network Performance Results

Table 16. Network Performance Preliminary Results 2031 – AM

Latent demand											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	1537	1558	1513	1558	1556	1551	1589	1534	1569	1564	1553
DM_2031	1669	1747	1743	1720	1707	1742	1690	1718	1714	1698	1715
DS1_2031	1006	1118	1138	1157	1237	1129	1120	1083	1069	1293	1135
DS3_2031	1549	1484	1531	1688	1489	1619	1254	1517	1497	0	1514
DS4_2031	486	479	572	586	489	379	343	502	413	468	472
DS5_2031	411	415	471	415	536	2953	438	376	477	444	694

Latent delay time [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	1129	1179	1127	1190	1177	1175	1186	1143	1176	1202	1168
DM_2031	1257	1304	1307	1299	1281	1301	1281	1302	1278	1279	1289
DS1_2031	650	772	797	809	815	818	815	775	736	917	790
DS3_2031	1001	1036	1073	1138	1032	1126	837	973	960	0	1019
DS4_2031	308	360	435	422	321	298	232	347	306	361	339
DS5_2031	235	295	327	294	358	854	333	309	324	295	362

AM Total + Latent delay [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	1611	1676	1632	1738	1689	1678	1694	1635	1644	1709	1671
DM_2031	1753	1758	1801	1759	1759	1776	1721	1763	1747	1770	1761
DS1_2031	1438	1583	1700	1594	1609	1672	1652	1603	1536	1724	1611
DS3_2031	1650	1677	1736	1774	1671	1761	1463	1619	1612	0	1662
DS4_2031	832	886	961	943	842	803	752	876	812	885	859
DS5_2031	806	876	906	869	966	2592	900	963	932	885	1069

Table 17. Network Performance Preliminary Results 2031 – PM

Latent demand											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	1394	1501	1414	1428	1510	1366	1350	1366	1454	1441	1422
DM_2031	1620	1544	1499	1486	1450	1453	1472	1582	1600	1497	1520
DS1_2031	945	714	732	910	796	718	869	802	558	639	768
DS3_2031	26	20	58	14	6	31	17	21	0	37	26
DS4_2031	0	5	0	0	1	0	1	0	0	4	3
DS5_2031	968	704	1056	646	746	937	857	705	557	942	812

Latent delay time [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	892	935	921	950	933	870	890	885	935	940	915
DM_2031	987	995	962	991	939	917	961	994	1004	977	973
DS1_2031	187	128	124	150	143	144	152	132	83	121	136
DS3_2031	8	2	21	2	2	9	1	1	1	12	6
DS4_2031	0	0	0	0	1	1	0	0	0	0	0
DS5_2031	322	240	247	89	155	279	239	187	79	177	201

PM Total + Latent delay [h]											
Model	1	2	3	4	5	6	7	8	9	10	Avg
RC_2031	1918	1979	1706	1795	1673	1939	1876	1855	1872	1886	1850
DM_2031	2072	1940	1816	1886	1961	1938	1921	1923	1804	1820	1908
DS1_2031	1504	1347	1345	1401	1374	1378	1406	1359	1258	1338	1371
DS3_2031	263	221	258	226	233	241	221	221	201	241	233
DS4_2031	205	221	244	246	257	227	232	235	207	231	230
DS5_2031	1703	1600	1771	1429	1524	1659	1647	1535	1385	1595	1585

Appendix J – 2036 Complete Network Performance Results

Table 18. Network Performance Preliminary Results 2036 – AM

Latent demand											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	1838	1808	1779	1757	1819	1769	1841	1827	1776	1821	1804
DM_2031	1967	1970	1952	1988	1977	1950	1989	1978	1931	1988	1969
DS1_2031	1512	1139	1568	1300	1701	1425	1461	1569	1399	1541	1462
DS3_2031	2185	2234	1841	1994	2228	2233	1995	2135	2116	2114	2108
DS4_2031	842	931	6514	968	761	785	708	805	787	829	1393
DS5_2031	649	551	761	658	725	401	523	609	605	666	615

Latent delay time [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	1372	1348	1342	1336	1384	1354	1401	1373	1349	1378	1364
DM_2031	1492	1506	1488	1512	1516	1486	1500	1490	1450	1504	1494
DS1_2031	1104	892	1063	1063	1232	1076	1033	1163	1042	1113	1078
DS3_2031	1481	1471	1373	1418	1466	1509	1268	1450	1452	1458	1435
DS4_2031	645	667	2794	717	579	560	487	586	600	619	825
DS5_2031	471	421	562	414	561	353	355	470	507	561	468

AM Total + Latent delay [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	1974	1881	1911	1912	1989	1973	1939	1916	1940	1966	1940
DM_2031	2038	2036	1999	2039	2052	2095	2027	2034	2001	2066	2039
DS1_2031	2199	1917	2043	2144	2245	2171	2051	2155	2091	2122	2114
DS3_2031	2305	2304	2193	2085	2281	2364	1943	2203	2143	2204	2202
DS4_2031	1187	1218	5803	1254	1120	1104	1028	1132	1136	1166	1615
DS5_2031	1208	1122	1327	1163	1266	1114	1088	1145	1258	1297	1199

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Table 19. Network Performance Preliminary Results 2036 – PM

Latent demand											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	1720	1865	1818	1752	1842	1605	1695	1680	1797	1746	1752
DM_2031	2426	2368	2027	2425	2527	2318	2526	2006	2238	2337	2320
DS1_2031	1244	1268	1370	1048	1183	871	1228	1341	1257	1438	1225
DS3_2031	82	26	64	54	9	100	67	90	56	39	59
DS4_2031	0	3	0	0	1	13	0	0	0	2	5
DS5_2031	1877	1787	1635	1426	1646	1851	1558	1577	1236	1863	1646

Latent delay time [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	1072	1086	1084	1117	1180	1057	1105	1027	1083	1097	1091
DM_2031	987	947	808	957	1017	930	992	787	906	912	924
DS1_2031	316	309	365	231	290	180	288	341	284	389	299
DS3_2031	15	6	22	17	6	20	14	19	12	13	15
DS4_2031	2	1	0	1	1	5	8	0	2	1	2
DS5_2031	781	796	686	453	595	785	582	778	408	734	660

PM Total + Latent delay [h]											
Model	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg**
RC_2031	2114	2217	2213	2067	2029	2159	2092	2169	2267	2059	2139
DM_2031	2767	2676	2503	2683	2806	2631	2818	2419	2570	2613	2649
DS1_2031	1714	1718	1831	1564	1675	1481	1715	1794	1711	1870	1707
DS3_2031	288	271	298	277	280	289	295	291	281	299	287
DS4_2031	329	260	260	320	288	289	383	351	305	288	307
DS5_2031	2371	2278	2233	1953	2155	2328	2142	2221	1807	2368	2186

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