

SDC Site Allocations Plan Housing Assessment

Bidford-on-Avon Capacity Assessment

VM215331.TN003

Introduction

1. This Technical Note has been produced by Vectos Microsim (VM) in response to a request from Stratford District Council (SDC), and Warwickshire County Council (WCC) to identify the impact associated with the delivery of a range of potential residential sites identified in SDC's Site Allocations Plan (SAP).
2. Testing is required to understand what the implications are of delivering the SAP sites on the transport network. The delivery of the SAP sites may be necessary to bridge any shortfall in the allocated housing delivery rates within the Stratford District, post adoption of the Core Strategy. As such, this assessment considers the cumulative effect of these sites alongside assumptions pertaining to the developments identified within the existing Core Strategy that are not yet permitted.
3. This Note documents the approach followed, development and model scenario assumptions and outputs identified therefrom.

Background

4. VM has previously undertaken a detailed assessment of the SDC Reserve Sites which, subject to the completions rate, may come forward in addition to the Core Strategy allocation. Modelling work and associated reporting was completed for an assessment of the implications of delivering a range of the Reserve Sites within both Stratford upon Avon and Southam.¹ This study work identified the quantum and locations of Reserve Site development that could be delivered, and the associated network mitigation, above that which was identified through the previous Core Strategy work that would be required to maintain an acceptable level of network operation.
5. This updated assessment is now required to consider the cumulative effect of the SAP housing sites being proposed by SDC in the Bidford-on-Avon area, whereby such additional developments are assessed on top of the Core Strategy allocations. The assessment follows the same format as the previous Reserve Sites testing, with the intention being to identify the cumulative impact on the relevant model networks of delivering these sites alongside existing development proposals.

Objectives

6. Through discussions between WCC and SDC, VM has identified the core objective of assessing the SAP sites within the Bidford-on-Avon model (BoA), and to provide commentary on the network operation once the SAP allocation has been included, as well as to identify any additional highway measures which may be required.

¹ VM185174.TN004.SDC_Reserve Sites_Southam Assessment, April 2019

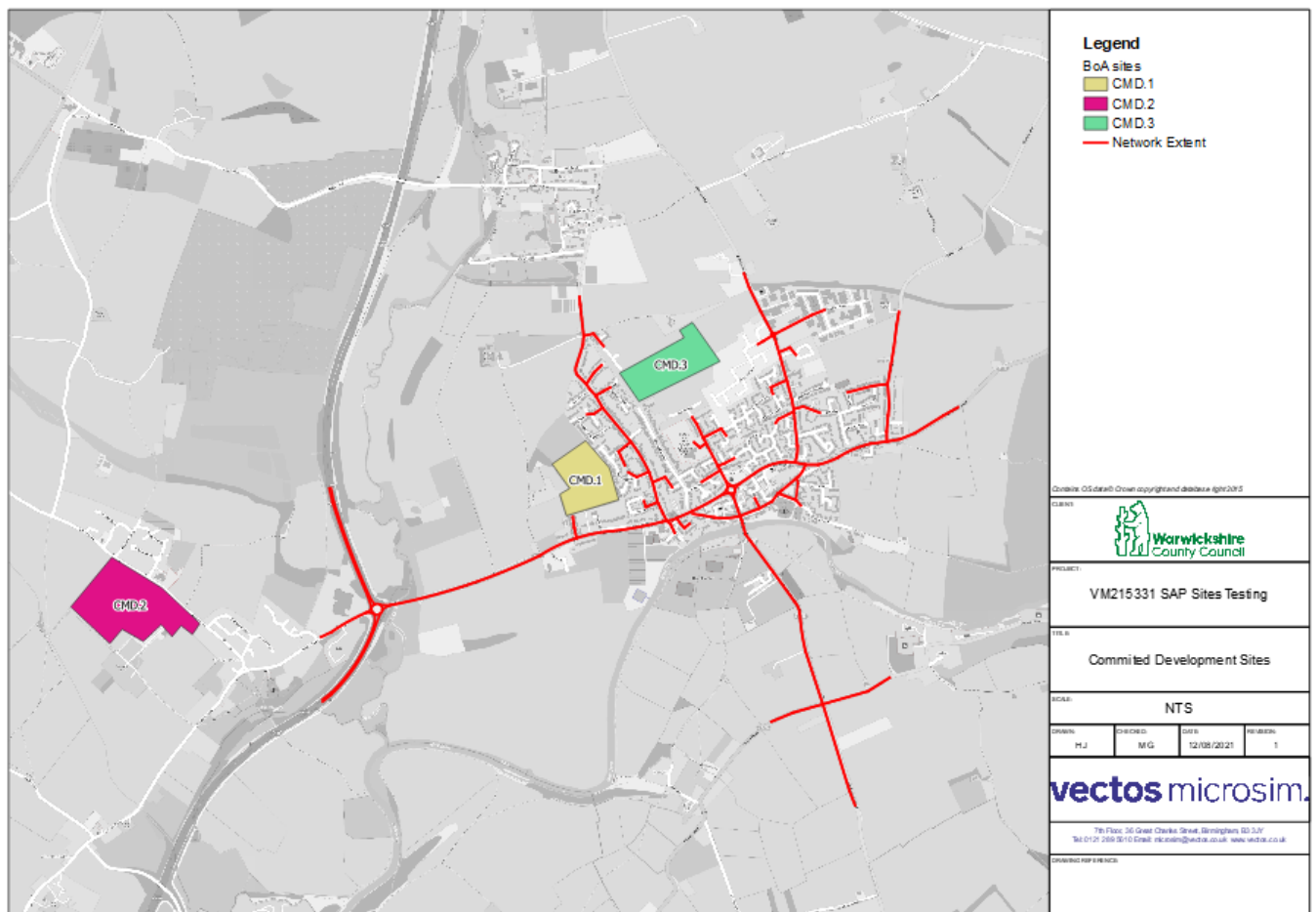
2031 Reference Case Update

7. The initial stage of the assessment required an update to the 2031 BoA Reference Case model to account for committed developments sites identified by WCC. SDC's housing trajectory informed the quantum of development expected to be delivered between 2019 and 2031 in the Bidford-on-Avon modelled area. The following table and figure details the three developments identified. Two sites lie within the model extent, Salford Road and Land at Waterloo Road and the Salford Priors development is located just outside the modelled area. All sites identified are residential development sites.

Table 1 Bidford-on-Avon Committed Development Sites 2019 to 2031

Ref	Site	Dwellings	Zone	Zone Type
CMD.1	18 Salford Road, Bidford-on-Avon, B50 4EN	48	8	Existing
CMD.2	Land off School Road, Salford Priors	68	103	Existing
CMD.3	Land At Waterloo Road	152	60	New

Figure 1 2031 Committed Development Sites



8. Further details regarding access strategy, trip generation and the trip distribution is provided below.

Committed Development Sites

18 Salford Road

9. The committed development included at Salford Road was already under construction prior to the development of the Bidford-on-Avon 2019 Base model. As a result the site is represented by an existing zone, zone 8 and the model includes the priority junction site access. The housing trajectory informed the remaining quantum of development expected to be delivered between 2019 and 2031 as an additional 48 dwellings.
10. A review of documents pertaining to the Salford Road development were interrogated via the SDC Planning Portal, however no details regarding a site specific trip generation could be found. In the absence of any available trip generation data the following proxy trip rates have been used for The Salford Road development. These trip rates are based on an ATC survey of observed weekday trip rates (48 dwellings) for Old School Mead, Bidford-upon-Avon.

Table 2 Salford Road Trip Rates

Hour	In	Out	Total
0700 to 0800	0.056	0.296	0.352
0800 to 0900	0.183	0.521	0.704
0900 to 1000	0.141	0.169	0.31
1600 to 1700	0.31	0.169	0.479
1700 to 1800	0.479	0.099	0.578
1800 to 1900	0.254	0.183	0.437

11. As partial build out of the site was accounted for within the 2019 Base model, the trips for this site have been distributed using the existing distribution from Zone 8 using the lights matrix within the 2019 Base model.

Land off School Road, Salford Priors

12. The committed development Land off School Road lies on the periphery of the model extent. The existing model zone 103 represents vehicular movements to/from Salford Priors via Station Road and this zone has been used to include this committed development site. The housing trajectory informed the remaining quantum of development expected to be delivered between 2019 and 2031 as an additional 103 dwellings.
13. Trip Generation details were extracted for the Land off School road committed development via the transport assessment.

Table 3 Land off School Road, Salford Priors Trip Rates

Hour	In	Out	Total
0700 to 0800	0.056	0.296	0.352
0800 to 0900	0.183	0.521	0.704
0900 to 1000	0.141	0.169	0.31
1600 to 1700	0.31	0.169	0.479
1700 to 1800	0.479	0.099	0.578
1800 to 1900	0.254	0.183	0.437

14. The distribution has been informed by the distribution outlined within the Land off School Road, Salford Priors transport assessment undertaken by BWB. The distribution indicated that 88% of the total trip generation is likely to interact with the Bidford-on-Avon model extent and this has been accounted for with reduction of 11.7% of the total trip generation for the site.

Land at Waterloo Road

15. The committed development Land at Waterloo Road sits to the north of a fairly new development at Chestnut Way which was already under construction prior to the development of the Bidford-on-Avon 2019 Base model. A new zone, Zone 60, has been included within the Reference Model to accommodate the Land at Waterloo Road development. The housing trajectory informed the remaining quantum of development expected to be delivered between 2019 and 2031 as an additional 152 dwellings.
16. A review of documents pertaining to the Land at Waterloo Road development were interrogated via the SDC Planning Portal, however no details regarding a site specific trip generation could be found. In the absence of any available trip generation data the following proxy trip rates have been used for The Salford Road development. These trip rates are based on an ATC survey of observed weekday trip rates (48 dwellings) for Old School Mead, Bidford-upon-Avon.

Table 4 Salford Road Trip Rates

Hour	In	Out	Total
0700 to 0800	0.056	0.296	0.352
0800 to 0900	0.183	0.521	0.704
0900 to 1000	0.141	0.169	0.31
1600 to 1700	0.31	0.169	0.479
1700 to 1800	0.479	0.099	0.578
1800 to 1900	0.254	0.183	0.437

17. As the site lies within close proximity to the development at Chestnut Way which was accounted for within the 2019 Base model via Zone 17, the trips for Land at Waterloo Road site have been distributed using the existing distribution from Zone 17 using the lights matrix within the 2019 Base model.

Committed Development Matrix Level

18. The trip generation and distributions described above have been used to build a demand matrix for each modelled hour that reflects the committed development trip levels and trip patterns. The committed development demands have been assigned to Matrix level 3.

Model Forecasting

19. In order that the model can be deemed suitable for use as a tool for assessing development impacts within the area, it is necessary that, in addition to the committed development trips, an element of background growth is included.

20. The process by which the Paramics model has been forecast is in line with the methodology outlined within the Warwickshire County Council Modelling protocol.

21. To generate the demand matrices for the future year scenarios TEMPro factors were obtained, using TEMPro version 7.2b, and then used to uplift the 2019 Base model demands.

22. The resulting growth factors were then applied to the Base year demands, with the NTM adjusted factors focussing on External to External trips only i.e. trip between the strategic External zones. Since the known committed developments were included within the model area no further growth of internal trips has been assumed.

23. All zones considered to be External in nature are listed below:

- 101,102,103,104,105,106,107,108,109 and 110

24. The growth factors taken from a TEMPro are summarised below:

Table 5 – TEMPro NTM Adjusted Growth Factors

Period	Period	Origin
2019-2031	AM	1.0759
2019-2031	PM	1.0777

Matrix Levels

25. The growth elements described above have been used to develop a new set of demand matrices for each modelled hour that reflects the background growth and committed development trips.

26. These matrices has been included in each of the forecast year reference models using the following matrix levels:

- Matrix Level 1 – Base 2019 Lights
- Matrix Level 2 – Base 2019 Heavies + HGV Background Growth
- Matrix Level 3 – Committed Developments
- Matrix Level 4 – Lights Background Growth

Demands Summary

27. The total growth included in each forecast scenario is summarised in the Tables below:

Table 2 – 2031 Reference Demands

	AM Period			PM Period		
	07:00-08:00	08:00-09:00	09:00-10:00	16:00-17:00	17:00-18:00	18:00-19:00
2019 Lights	3,296	3,661	2,755	3,540	3,867	3,094
2019 Heavies	203	151	250	153	94	114
2019 TOTAL	3,499	3,812	3,005	3,693	3,961	3,208
Base Lights	3296	3661	2755	3540	3867	3094
Base HGV + Growth	218	163	269	165	101	123
Committed Development	88	201	102	137	168	168
Background Growth Lights	162	77	107	138	133	72
2031 Total	3,765	4,102	3,234	3,980	4,269	3,458
2031 Growth	7.59%	7.59%	7.59%	7.77%	7.77%	7.77%

Model Performance

28. On completion of the future year scenario, analysis was undertaken to assess the overall level of stability to ensure that the model could be considered fit for future use. The outcome of this assessment, based on 10 runs per time period, is summarised below.

Model Stability

- 29. The stability focusses on the number of vehicles present on the network at a certain point in time and is based on successful runs only.
- 30. A successful run has been deemed as such if the number of vehicles on the network is shown to increase from the start of the period, reach a peak level, and then fall as the period nears its end. This has been supported by visual observations of the models to ensure that in cases where this pattern is not present, that it is indeed a result of an unrealistic locking up of the network.
- 31. The results presented within the following table and figures show the stability of the 2031 forecast models.

Table 7 – 2031 Model Stability

	AM	PM
Runs	10	10
Successful Runs	10	10
Success Rate	100%	100%
Peak (veh): Max	215	219
Peak (veh): Ave Max	206	207
End of Period (veh): Max	125	133
End of Period (veh): Ave	56	58

Figure 1 – 2031 AM Model Performance

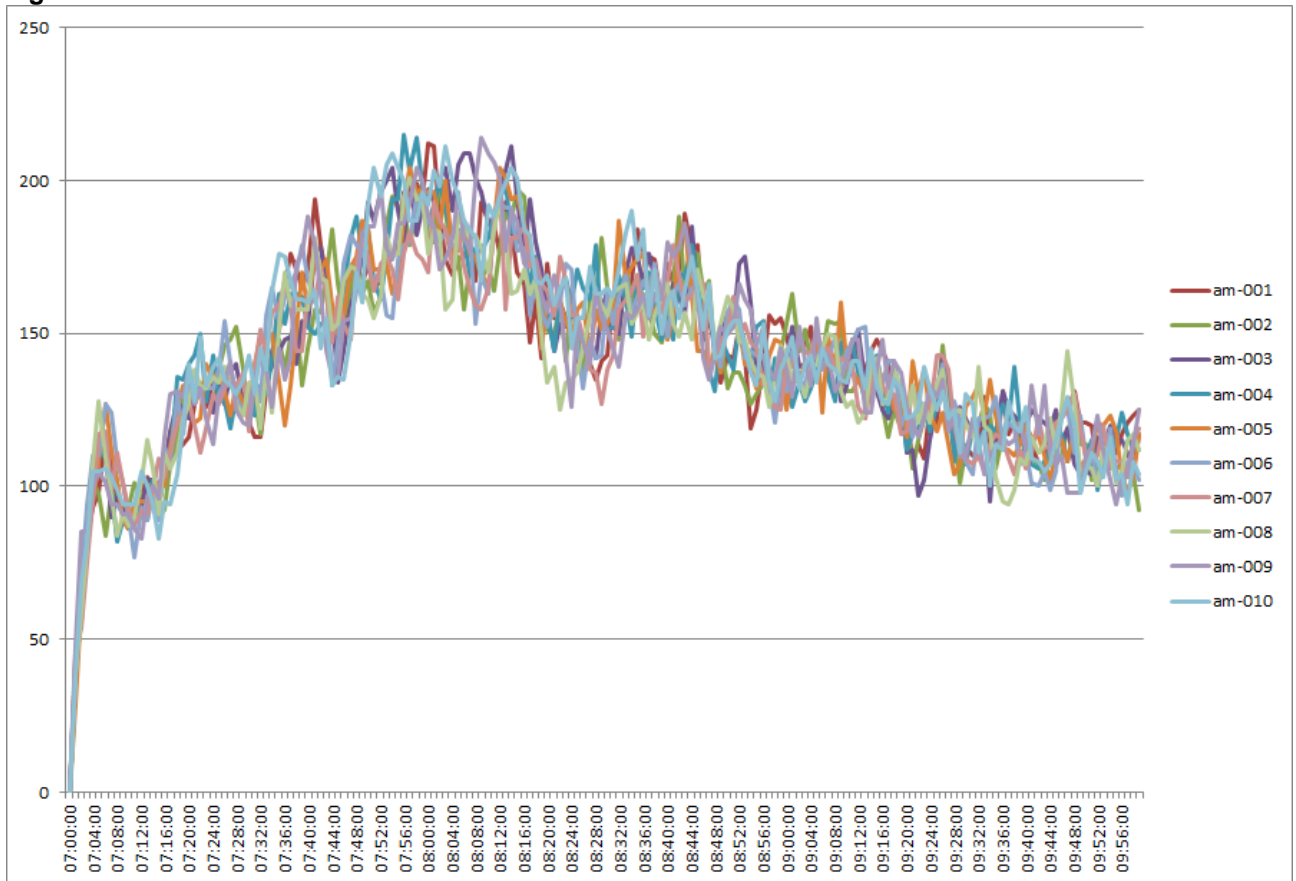
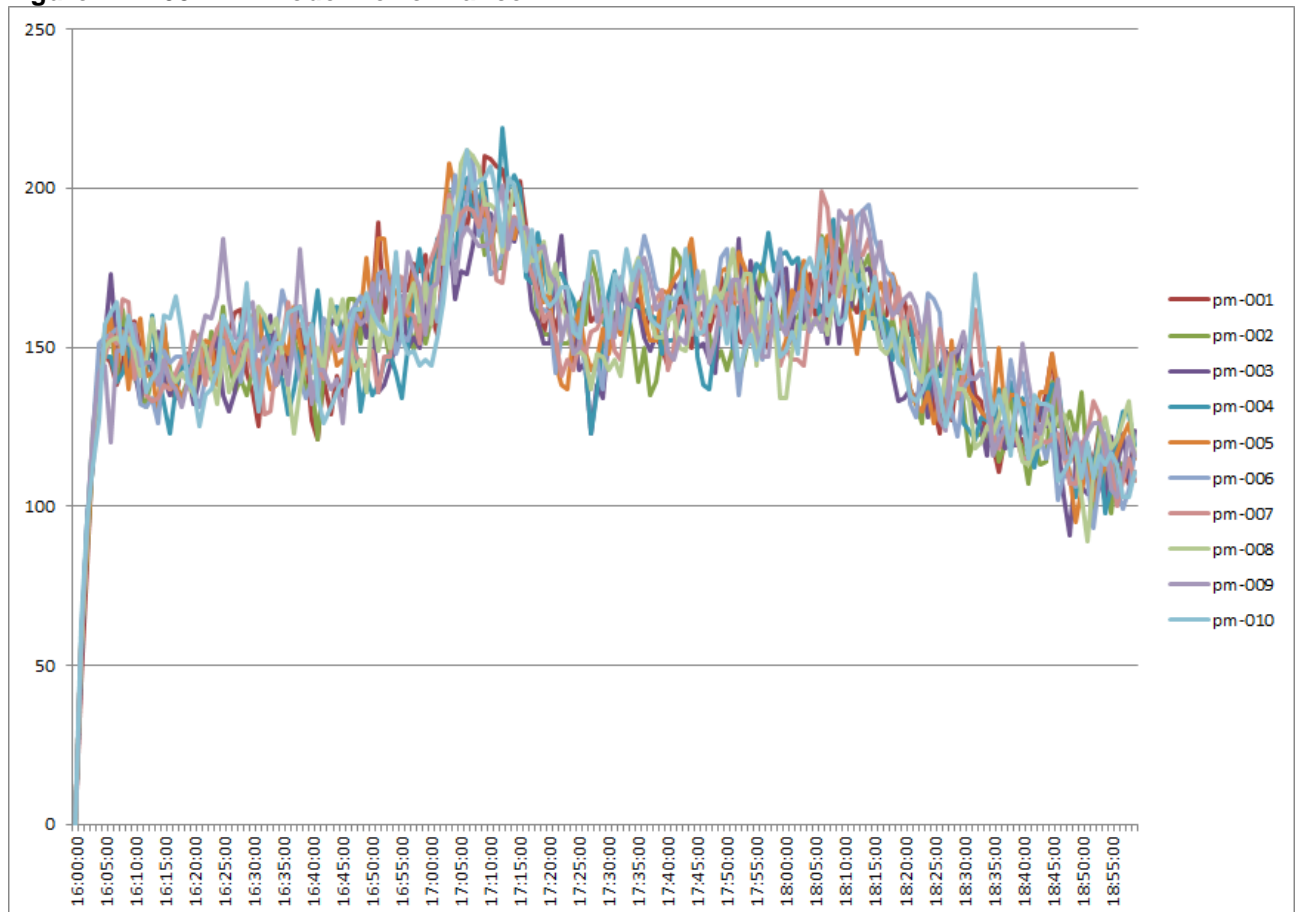


Figure 2 – 2031 PM Model Performance



- 32. The model stability was recorded at 100% successful in the AM and PM periods. These models are therefore considered to be stable and provide a suitable tool in which future year assessments can be undertaken.

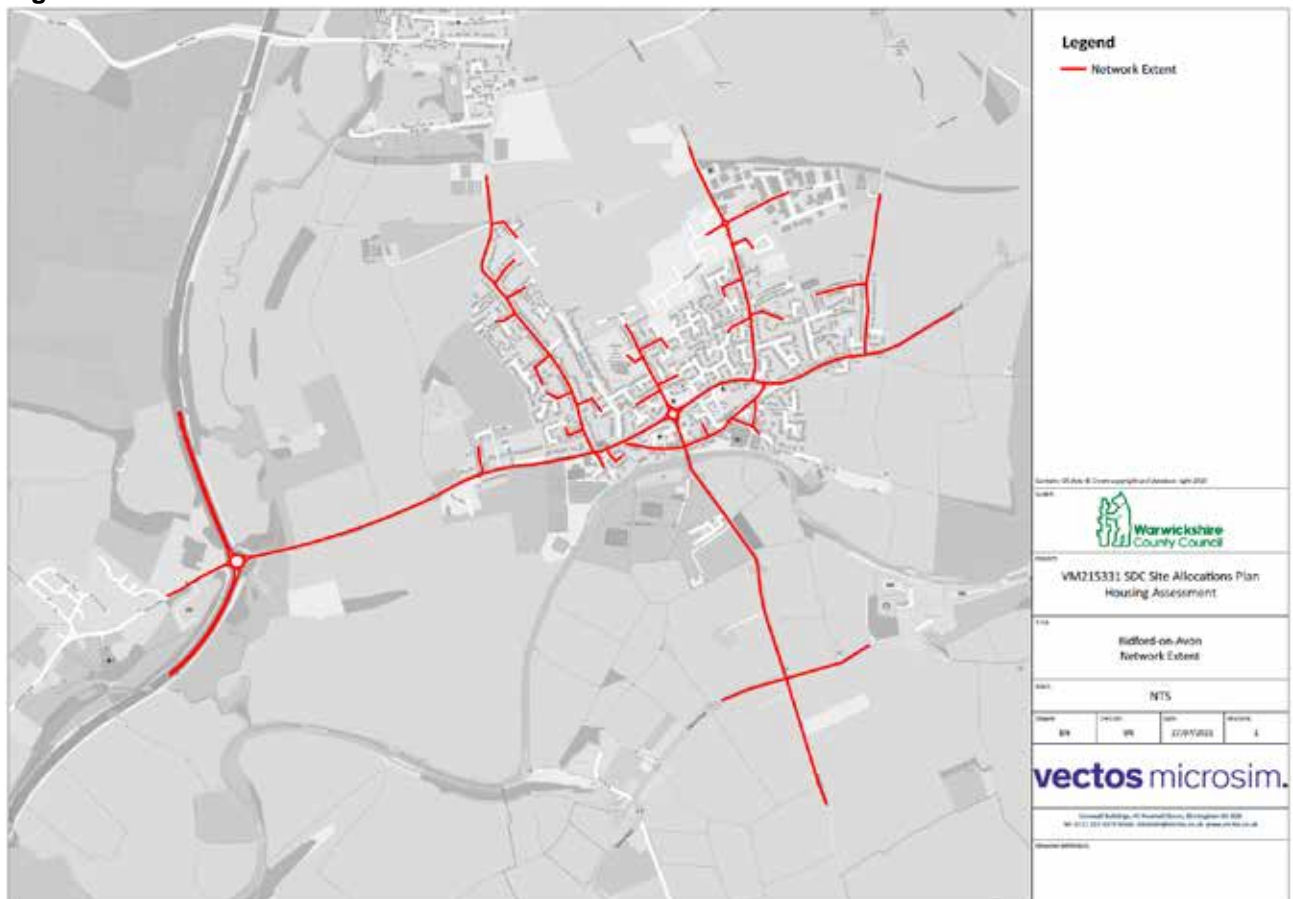
Reference Case Forecasting Conclusion

- 33. The resulting Reference Case models are up to date in terms of both committed developments and Forecast Growth and provide a suitably stable base to assess SAP development impact.

2031 SAP Assessment

34. Following the update of the 2031 Reference Case model, the first stage of the assessment centres on the assignment of trips predicted to be generated by the SAP sites into the 2031 Bidford-on-Avon Reference case network. The trips will be assigned based upon a trip generation and distribution agreed with WCC, and a review of the resultant network conditions will then be undertaken in light of the inclusion of these sites, with a focus on the impact that the SAP sites will elicit on the network.
35. The second stage of the assessment will establish what additional mitigation measures will be required to ensure the network will continue to operate satisfactorily when all sites are included.
36. This assessment focusses on the impacts of delivering the identified SAP sites that lie within Bidford-on-Avon area in addition to the 2031 Reference Case Demands. Accordingly, the 2031 Reference Case model has been utilised. The extent of this model network is demonstrated within **Figure 3**.

Figure 3 Bidford-on-Avon Network Extent



SAP Site Inclusions

37. The SAP sites within and close to Bidford-on-Avon have been explicitly modelled, and are detailed in **Table 8** and **Figure 4**.

Figure 4 SAP Site Locations

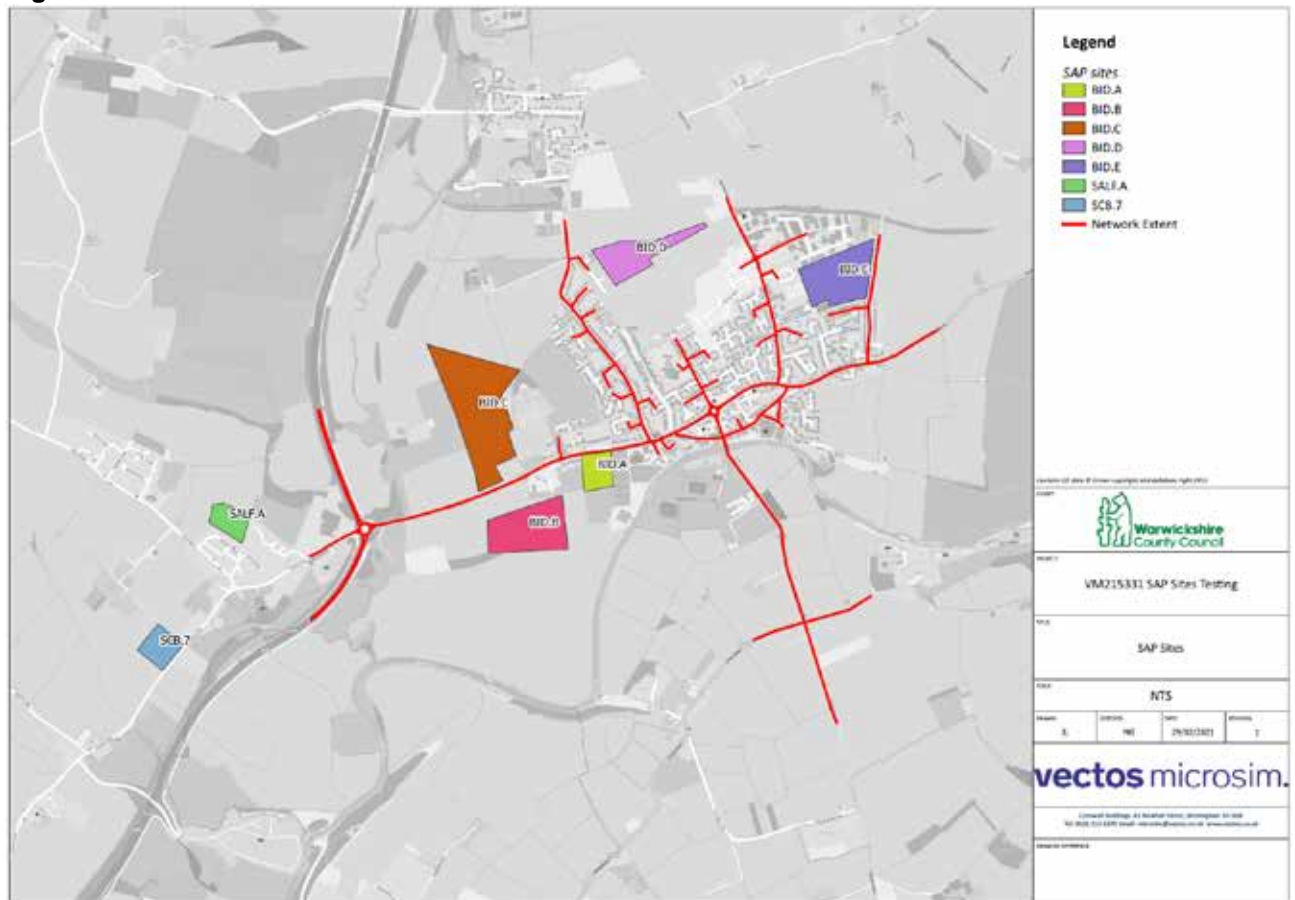


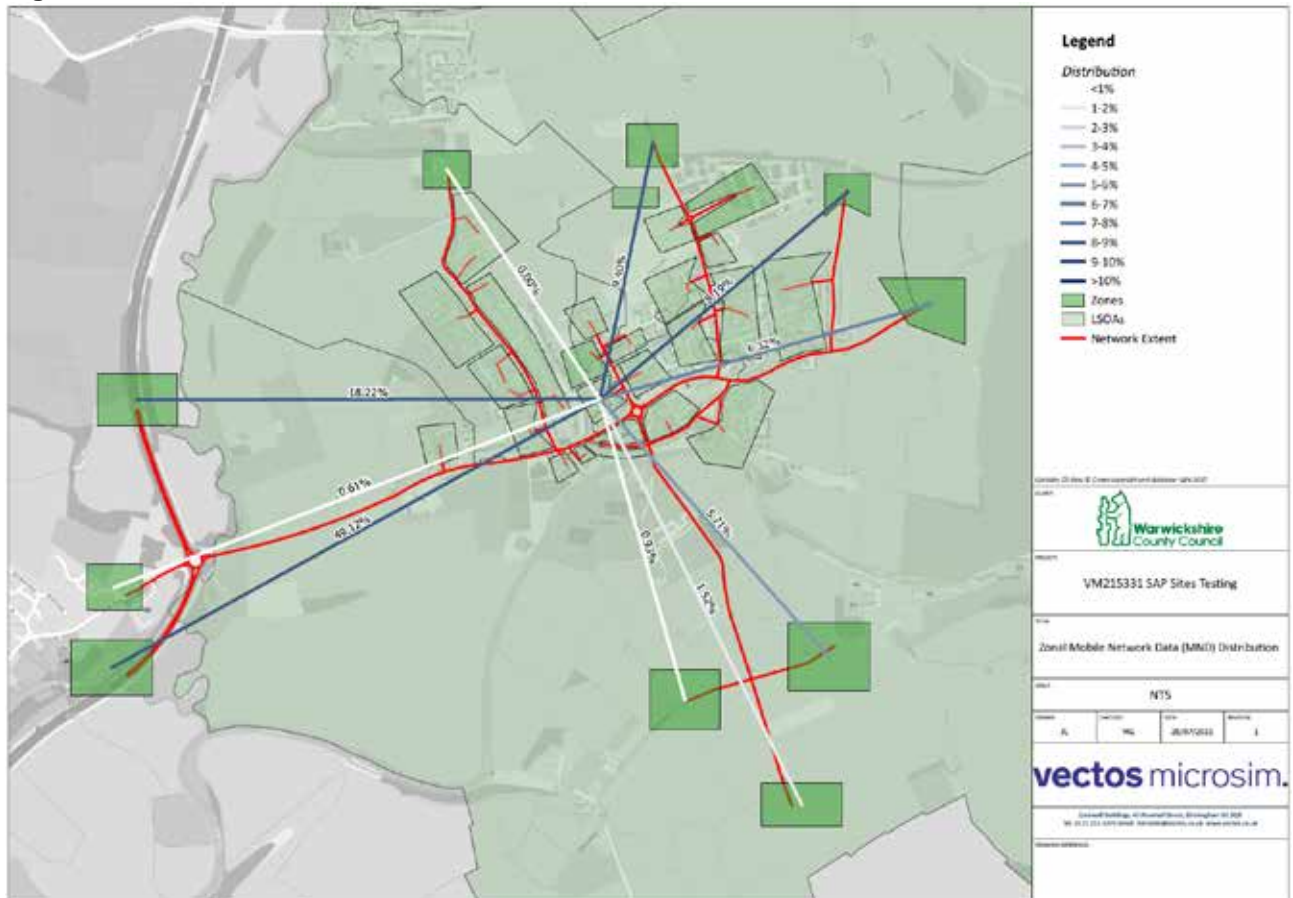
Table 8 Bidford-on-Avon SAP Sites Included within Modelling

SAP Ref	SAP Site	Dwellings Assumed	Trip Rates Assigned
BID.A	South of Salford Road (east), Bidford-on-Avon	25	Bidford-on-Avon Residential Trip Rates
BID.B	South of Salford Road (west), Bidford-on-Avon	60	Bidford-on-Avon Residential Trip Rates
BID.C	North of Salford Road, Bidford-on-Avon	120	Bidford-on-Avon Residential Trip Rates
BID.D	East of Victoria Road, Bidford-on-Avon	120	Bidford-on-Avon Residential Trip Rates
BID.E	West of Grafton Lane, Bidford-on-Avon	150	Bidford-on-Avon Residential Trip Rates
SALF.A	North of Bomford Way, Salford Priors	25	Bidford-on-Avon Residential Trip Rates
SCB.7	West of Evesham Road, Salford Priors	25	Bidford-on-Avon Residential Trip Rates

38. WCC have advised that the appropriate trip rate to assign to all of the Bidford-on-Avon SAP sites should be based on ATC survey of observed weekday trip rates (48 dwellings) Old School Mead, Bidford-upon-Avon.

- 39. Each of the sites have been coded into the updated 2031 Reference model, with access arrangements included to ensure that all traffic leaving each site accesses the wider highway network.
- 40. The trips generated have been distributed using the WCC mobile network database (MND). The MND has been interrogated, with a distribution being derived from a combination of the three LSOA (Lower Super Output Area) that cover the Bidford-on-Avon area, Stratford-on-Avon 012b, 012c and 012d. **Figure 5** shows the generic zonal distribution applied to each of the SAP sites. Within the plot all zones which represent an origin or destination within the model network are highlighted.

Figure 5 SAP MND Distribution



- 41. Distribution for the Salford Priors sites was adjusted to account for the site residing outside of the modelled network. The distribution was informed from the committed development Land off School Road, Salford Priors assumption outlined within the Transport Assessment, of which 88% of trips are shown to interact with the Bidford-on-Avon modelled network.
- 42. Following the derivation of the demands, in the first instance no mode shift assumptions were applied as initial indications suggested there to be minimal impacts and therefore the full allocation of the SAP sites was retained. This provided a robust set of demands for the SAP assessment.
- 43. No assumptions have been applied to account for the potential shift in background traffic in response to the delivery of enhancements to existing and provision of new sustainable transport

services/measures. As a result, when assessed in the context of overall demands assigned within the model, these adjustments affect less than 1% of the assigned demand totals within the model.

44. The cumulative hourly trip generation for the SAP Site demands is summarised in **Table 9**.

Table 9 SAP Sites Net Trip Generation

Hour	Total Trips	
0700-0800	175	809
0800-0900	415	
0900-1000	219	
1600-1700	284	1006
1700-1800	350	
1800-1900	372	

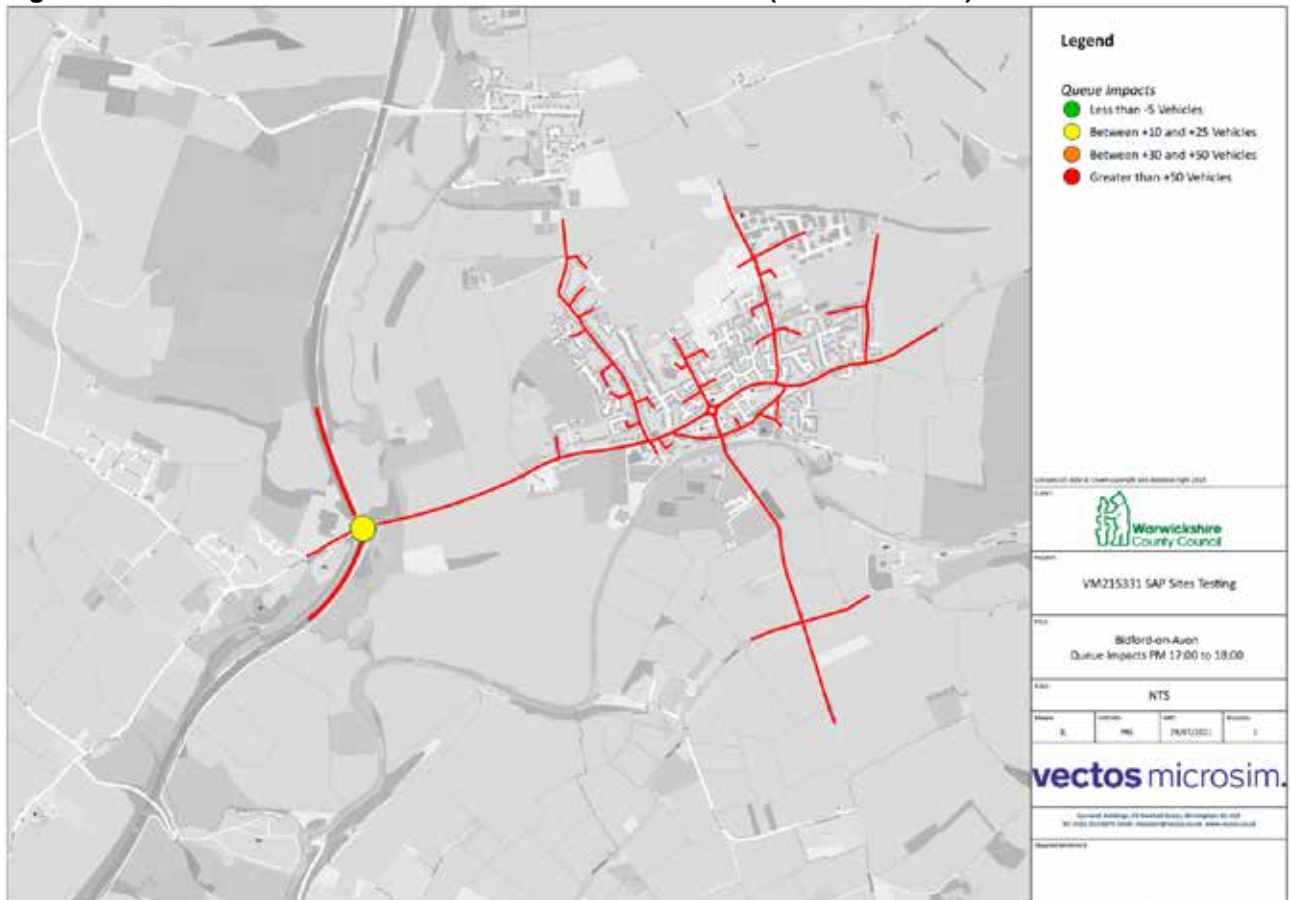
Model Results Analysis

45. Based upon the above details, for this stage of the assessment, the following model scenarios have been created and reported upon:
- 2019 Bidford-on-Avon Base
 - 2031 Bidford-on-Avon Reference
 - 2031 Bidford-on-Avon Reference + SAP Sites
46. By assessing the three scenarios outlined above, it will be possible to ascertain the direct impact likely to occur as a result of delivering the SAP sites.
47. A visual review revealed that congestion across the model did not appear to significantly worsen by the inclusion of the SAP sites.
48. The review of the impact focuses on the AM and PM peak hours (08:00 – 09:00, 17:00 – 18:00) as they cover the period of the biggest impact on the model.

Queue Length Analysis

49. In order to quantify the impact of including the SAP sites within the model, initially an analysis of the average maximum queue differences between the 2031 Core Strategy scenario and the 2031 Core Strategy + SAP Sites scenario has been undertaken.
50. To visualise the areas of impact, the queue length difference was classified within these plots as follows:
- **Queue Reduction** (a reduction in queue lengths of greater than 5 vehicles)
 - **Moderate Increase** (an increase in queue lengths of between 10 and 25 vehicles)
 - **Significant Increase** (an increase in queue lengths of between 30 and 50 vehicles)
 - **Very Significant Increase** (an increase in queue length of over 50 vehicles)
51. The classifications detailed above are consistent with the approach adopted during the previous Core Strategy and subsequent Reserve Sites assessment stages. In line with the visual observations there were no notable queue impacts reported within the AM Peak hour when assessing the queues. The queue comparison results for the PM peak hour are shown within the following **Figure 6**.

Figure 6 - 2031 Reference vs 2031 Reference + SAP Sites (PM Peak Hour)



52. The queue analysis presented within **Figure 6** demonstrates the impact of including the SAP sites within the 2031 Reference scenario, during the PM peak hour. The results indicate that there is only likely to be one area of impact, which occurs at the A46 /B439 Salford Road junction, specifically on the A46 southbound approach to the junction. Queues are shown to increase from 7 to 19 vehicles.

Link Flow Analysis

53. Further to the queue length analysis presented above, and following discussions with SDC, it has been determined that a further measure of network impacts should be considered, in the form of analysing the predicted increase in traffic flows leaving the Bidford model extent in the direction of Stratford upon Avon.
54. This has been presented within the following flow difference plots, which not only demonstrates the change in traffic flows to/from Stratford upon Avon, but also general changes in traffic flows across the network as a result of including the SAP Sites.

Figure 7 Flow Difference Plot – AM Peak Hour – Reference Case vs Reference + SAP Sites



- 55. **Figure 7** provides a flow difference plot for the AM peak hour, which presents the changes in traffic flows across the network as a result of adding the SAP Sites to the model.
- 56. The flow difference plot clearly demonstrates that the areas where flow increases are highest are focused on the B439, between Bidford village centre and the A46, and on Grafton Lane (the access route to the the West of Grafton Road SAP Site).
- 57. The flows presented demonstrate a very small increase in traffic predicted to route on the B439 towards Stratford, during the AM period, with an additional 17 vehicles travelling towards Stratford and 7 vehicles travelling into Bidford from Stratford.

Figure 8 Flow Difference Plot – PM Peak Hour – Reference Case vs Reference + SAP Sites



- 58. **Figure 8** provides a flow difference plot for the PM peak hour, again presenting the changes in traffic flows across the network as a result of adding the SAP Sites to the model.
- 59. As per the AM flows, the flow difference plot clearly demonstrates the areas where any flow increases are focused. This again is most notable on the B439 between the A46 and Bidford village centre, with the highest flows being traffic travelling from the A46 towards Bidford. Again there are also notable increases in flows on Grafton Lane (the access route to the West of Grafton Road SAP Site).
- 60. The flows presented demonstrate a very small increase in traffic predicted to route on the B439 to/from the Stratford direction, during the PM period, with only 13 additional vehicles travelling from Stratford towards Bidford, and only 7 additional vehicles making this journey in reverse.

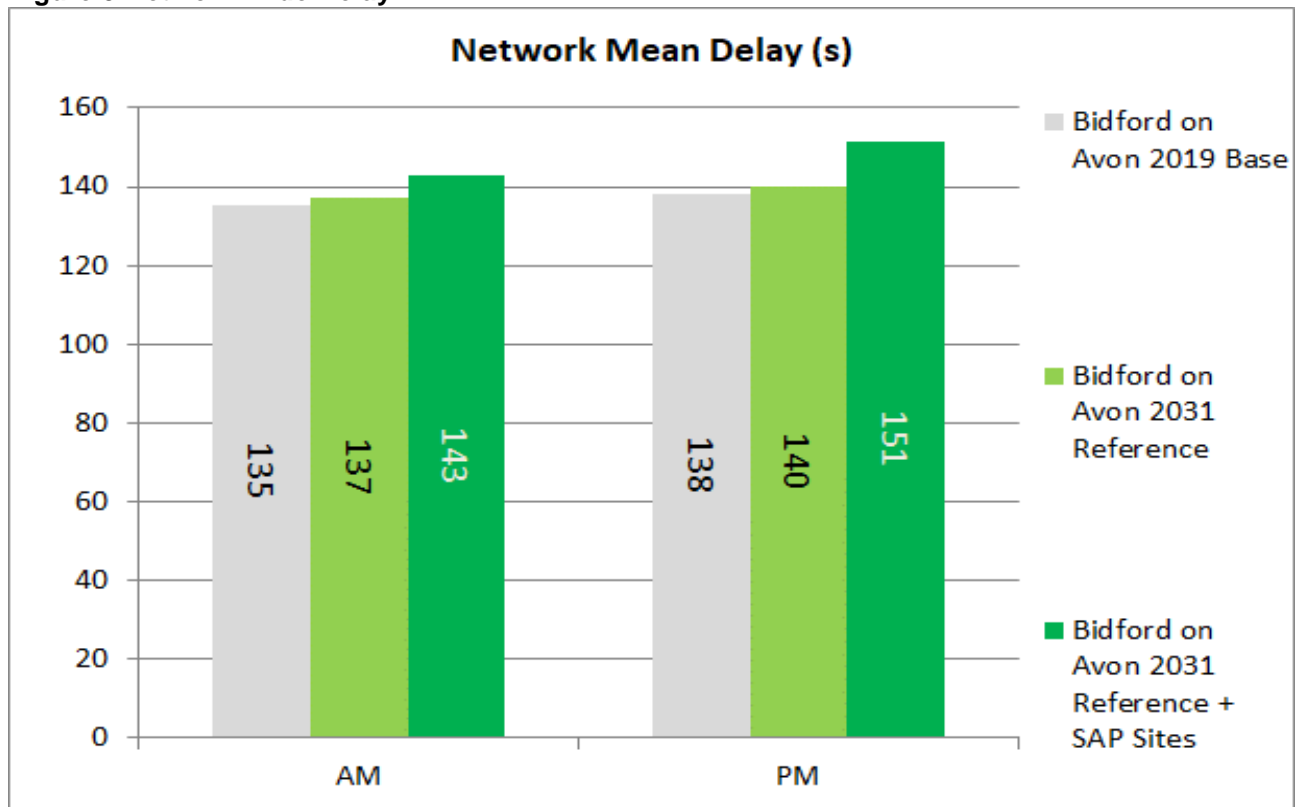
Model Results Summary

- 61. Following the assessment of the SAP sites on junction queuing, it was considered that there was no requirement to mitigate the minimal impacts reported at the A46 /B439 Salford Road junction within the PM peak hour. Therefore the headline statistics have been extracted and presented for comparison from the following models:
- 62. The assessment in this section covers the following scenarios:
 - 2019 Bidford-on-Avon Base

- 2031 Bidford-on-Avon Reference
- 2031 Bidford-on-Avon Reference + SAP Sites

63. The strategic level analysis of the impact of including the SAP Sites brings is outlined through the network wide delay results, which are presented in **Figure 7**.
64. The network wide delay records the average journey time of every single vehicle in the model network, and therefore allows a comparison of the strategic level impacts in terms of additional delay incurred in each SAP scenario relative to the Core Strategy conditions.

Figure 9 Network Wide Delay



65. The results presented in **Figure 7** show that the average journey time in the AM increases slightly upon inclusion of the SAP sites, by 6 seconds compared to the 2031 Reference scenario.
66. In the PM, the inclusion of the SAP sites increases the average journey time by 11 seconds compared to the 2031 Reference scenario.
67. The mean delay results indicate that the inclusion of the SAP sites would have minimal impact on overall network wide conditions within Bidford-on-Avon when compared against both Baseline and 2031 Reference Case conditions.

Summary and Conclusions

Summary

68. This Technical Note has been produced by Vectos Microsim (VM) in response to a request from Stratford District Council (SDC), and Warwickshire County Council (WCC) to identify the impact associated with the delivery of a range of potential residential sites identified in SDC's Site Allocations Plan (SAP).
69. The testing is required to understand what the implications are of delivering such sites, which may be necessary to bridge any shortfall in the allocated housing delivery rates within the Stratford District, post adoption of the Core Strategy.
70. The primary objective of this Note is to assess at a final point the impacts on the Bidford-on-Avon model network associated with the delivery of the potential SAP Sites identified by SDC.
71. The initial analysis has focused on the impact of the inclusion of the full build out of the potential SAP Sites in the 2031 Reference scenario. This stage outlined that no further mitigation would be required on the network to accommodate the SAP sites.
72. Queue length analysis indicated that there was a moderate increase of 12 vehicles in queue length on at the A46 /B439 Salford Road junction in the PM peak hour. Although this moderate impact has been flagged it was not considered to require mitigation.