Model Development Report

North Somerset Local Plan

North Somerset Council

October 2025

Delivering a better world

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
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1. Introduction and Background

Introduction

1.1 AECOM has been commissioned by North Somerset Council (NSC, or 'the Council') to provide transport planning consultancy services in relation to their emerging Local Plan for 2041. As part of this, strategic transport modelling has been undertaken to be used as evidence for developing and appraising the transport impacts of the Local Plan.

1.2 This report outlines the approach and creation of a modelling platform to assess the proposed strategy, which includes a highway model with a public transport GIS-based model and variable demand modelling element.

1.3 The proposed approach for the modelling has been detailed in the Appraisal Specification Report (ASR) (Feb 2021) which has been developed in line with Department for Transport's Transport Appraisal Guidance (TAG). The ASR is shown in Appendix A. This has been agreed with the Client and has been reviewed by National Highways (NH). Comments provided by NH on the ASR have been addressed through the model development. These comments are outlined in section 3.

1.4 This report is written as an appendix to the North Somerset Local Plan Transport Assessment (NSLP Reg 19 2041 TA). It explains how the results of the modelling presented in the TA were created.

1.5 The initial version of this report was published in March 2022, followed by a second version in August 2024, which reflected the previous modelling works of the North Somerset Local Plan. This updated report has been revised based on the latest Local Plan modelling, which includes the following updates:

- Local Plan period has been updated from 2039 to 2041.
- The base highway model has been amended to include the most recent TAG values as well as some minor edits to incorporate the local plan development sites.
- The Local Plan allocations have been updated, and this report covers all of the modelling for the updated Local Plan.

Background and objectives of study

1.6 North Somerset is a unitary authority in the South-West of England, bordered by Bristol, and Bath and North East Somerset (B&NES) to the east, and Sedgemoor and Mendip to the south. According to ONS data (2019), around 215,000 people live in and 86,000 people work in the region. The largest settlement is Weston-super-Mare, with other larger settlements including Clevedon, Portishead and Nailsea. North Somerset also houses Bristol Airport, which attracted more than 9 million passengers in 2019. Figure 1-1 shows the extent of the North Somerset area.

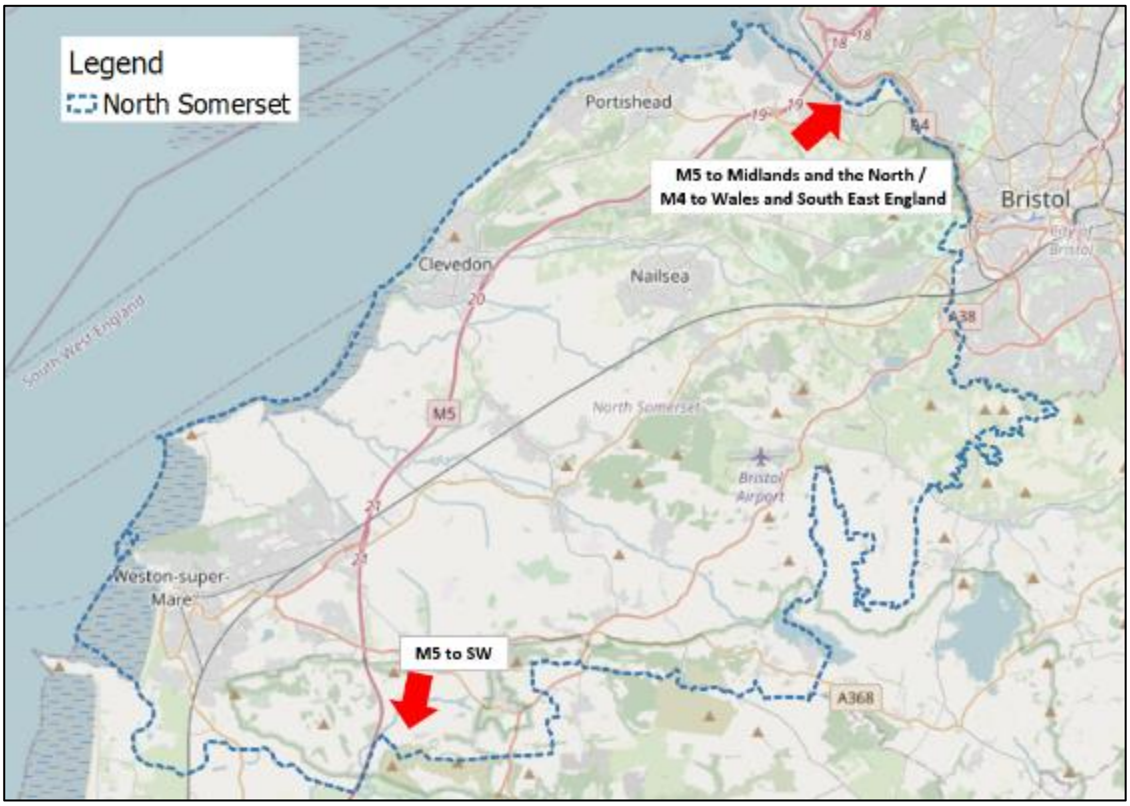


Figure 1-1: Map of North Somerset region

1.7 North Somerset Council is currently developing their Local Plan for the period up until 2041. This Local Plan outlines the strategic and detailed policies to guide development proposals across the county. This Plan will also detail the spatial strategy for developments across North Somerset.

1.8 This report outlines the development of a base transport model and the forecast modelling which have assessed the proposed Local Plan spatial strategies, and mitigation options. This modelling suite includes the use of the highway model, as well as a GIS-based Public Transport (PT) model using TRACC which will be used together within a Variable Demand Model (VDM).

1.9 The transport model is one part of the appraisal process but is instrumental in highlighting additional network pressures. It also provides information on targeted PT and highway investment to release capacity and bring social, environmental, and economic benefits to North Somerset. In addition, North Somerset has an ambition to be carbon neutral by 2030 which means that delivering sustainable transport is an important factor of the Local Plan. Therefore, the modelling needs to include assessment of the impact of the Local Plan on other sustainable modes, and opportunities for sustainable transport to accommodate additional travel demand generated by growth.

1.10 The transport modelling informs, and has been used iteratively with, the development of sustainable transport mitigation. This aimed to accommodate growth in as sustainable manner as far as possible, with the potential for targeted capacity improvements considered and applied to the transport modelling.

2. Modelling Approach

2.1 The methodology for assessing the Local Plan growth options for North Somerset was guided based on the strengths and weaknesses of the data/models already available. It was also guided by the various potential software/techniques required to produce a suitable transport model. This allowed a flexible and robust approach to modelling multiple modes.

2.2 To create a modelling platform that is robust in assessing the proposed Local Plan strategic allocations, three models have been created:

- A SATURN highway model, using the North Somerset Strategic Model (NSSM) as a starting point
- A TRACC based public transport model to provide public transport generalised costs to estimate the impact of potential mitigation measures.
- A DIADEM variable demand model which estimates the impact of the new demand and subsequent mitigation strategy on travel patterns and trip making, especially the choice between highway and PT modes of transport.

2.3 The modelling platform (PT supply model, highway assignment model and variable demand model) work together to estimate the impact of the differing traffic patterns associated with development scenarios and indicate the impact on mode shift and highway flows and congestion. The modelling tool also allows testing of the impact of potential mitigation measures (both highway and PT interventions) on mode shift, highway flows and congestion under different development scenarios.

2.4 An overall summary of the key elements of the modelling methodology can be seen in Figure 2-1.

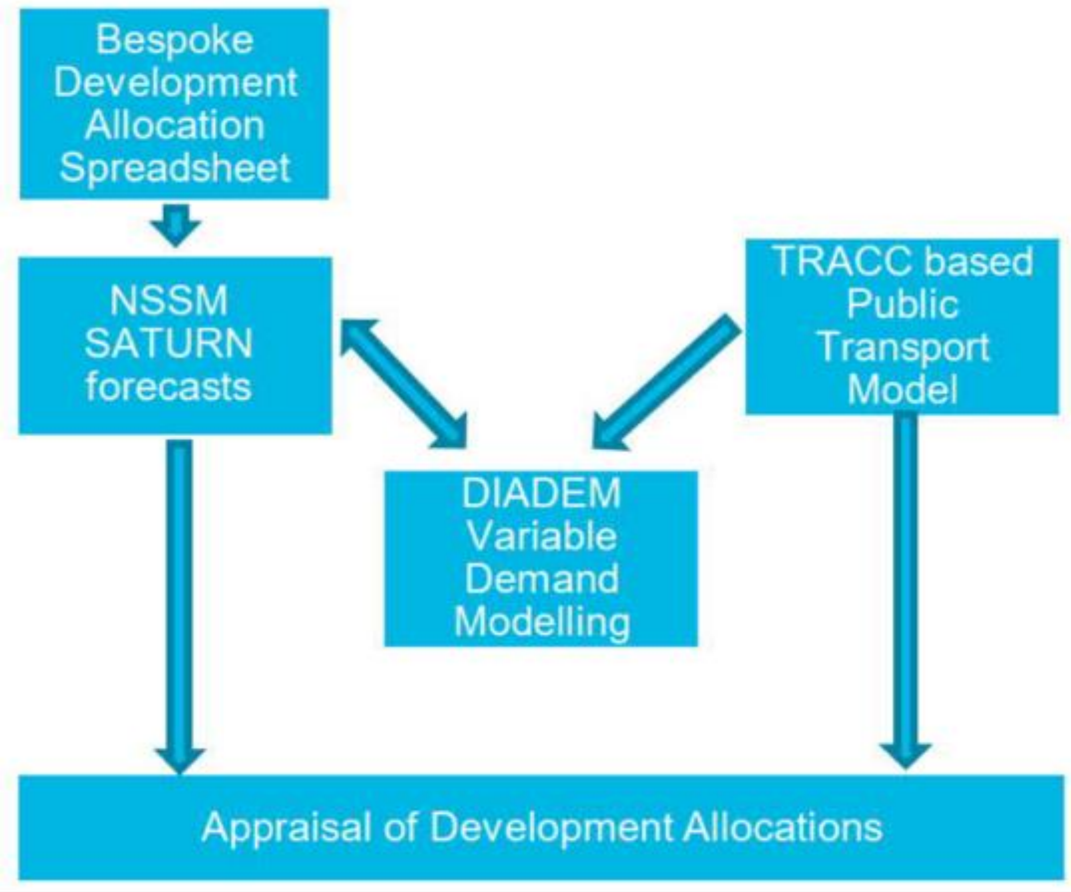


Figure 2-1: Transport Modelling Key Elements

3. Base Model Development

Highway Model

Outline of Planned Network Changes

3.1 For the highway assessment, three enhanced versions of the TAG-compliant NSSM have been developed and utilised. The original NSSM model, received from WSP, had relatively good strategic network and zonal coverage of the North Somerset area and was calibrated well along most of the key routes. Calibration of the existing model is outlined in the NSSM Local Model Validation Report, September 2020 (LMVR). This report is attached in Appendix B.

3.2 Three successive enhancements have been made to the NSSM base model, each incorporating updates to the network and generalised cost parameters. These are detailed below:

- Version 1 (v1): Expanded network coverage and updated model speeds, with generalised costs revised using the May 2021 TAG Databook.
- Version 2 (v2): Network modifications at Tickenham and M5 junctions, alongside updated generalised costs based on the May 2023 TAG Databook.
- Version 3 (v3): Further update of generalised costs using the May 2025 TAG Databook.

3.3 The base model year is 2018 and the enhanced version of the model retains the same base year.

3.4 To understand if this model was suitable for using for this study, a review was undertaken, and targeted enhancements of the model were identified. As, at the time of the review, the preferred Spatial Strategy was yet to be confirmed, the review of NSSM was based on the key strategic routes and locations within the model, and the overall network and zonal disaggregation across the region.

3.5 To summarise the changes to the base model that have been undertaken (and are further explained in this section) are shown in Figure 3-1.

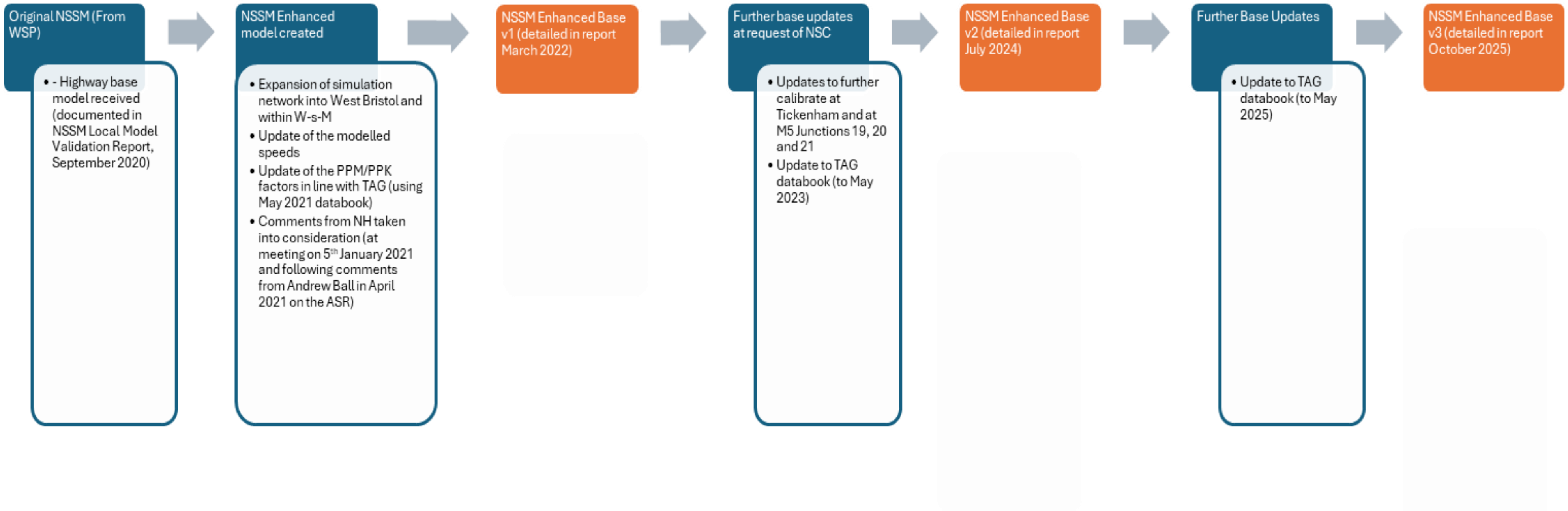


Figure 3-1: Base updates from NSSM/NSLP modelling

3.6 Following the meeting with NH on the 5th January 2021, comments on the ASR were outlined in an email to the project team on the 13th April 2021 from National Highways (NH). These have been addressed through the development of the model, which is described in the following sections.

Model Choice

3.7 As outlined in the ASR, there are two models covering the North Somerset area: the wider NSSM with a separate model covering the Weston-super-Mare area in more detail than the NSSM. NH favoured the use of one model, with the enhancement of the NSSM to cover more detail in the Weston-super-Mare area. This recommendation has been taken forward.

Route Choice between Bristol and North Somerset

3.8 As part of the changes outlined for the network on the Bristol and North Somerset boundary, additional junctions on the edge of Bristol were chosen to be converted from buffer to more detailed simulation to provide a more realistic response to congestion in this area, especially in the peak periods. NH has recommended that care should be given to ensure route choice remains realistic, especially comparing the M5 to potential competing routes to the north of North Somerset. As the model was enhanced, route choices between Bristol and North Somerset have been reviewed and no issues have been identified.

Trip Rates

3.9 NH recommended that trip rates for each site are agreed with themselves.

3.10 NH agreed on the modelling approach that trip rates are developed on a site-by-site basis as location of the proposed allocation will strongly influence the mode share characteristic the proposed allocation site, thereby impact on the number of vehicle movements generated by the site.

3.11 There was also a recommendation that any consideration of internalisation at sites will need to take into account the mode share proportion of the internal trips. That is, particularly for medium and larger potential allocations where internalisation can have a material impact on the number of external trips generated, the trip length aspect of mode share needs to be considered. This is because the majority of walk and cycle trips are shorter in length, and therefore a relatively high proportion of these will be contained within the allocation area. Conversely, the proportion of ‘external to the allocation’ trips that are by car and public transport will be higher, and when considering the ability for these trips to be undertaken by sustainable modes, it would not be realistic to assume that significant proportions could be transferred to walk and cycle modes. It is expected that the Bus Service Improvement Plan (BSIP) will create realistic opportunities to reduce car trips and has been considered as part of this stage of modelling.

Queuing at Motorway Slips

3.12 NH raised a question about model behaviour on the M5 southbound in North Somerset. The issue occurs north of M5 J21, in the southbound direction, where traffic slows, seemingly in anticipation of the approaching slip road. However, the exact cause of the problem has not been identified. It is understood that SATURN may not be as robust in monitoring queue length, however, the outputs from SATURN may be a good indicator. Paragraph 3.60 of this report compares the operation of J21 with the original NSSM and shows that the volume vs capacity ratios around the junction are similar to the original NSSM.

3.13 Following these enhancements, the NSSM Enhanced model was checked against observed flows and journey times to ensure the model still conforms to TAG calibration and validation guidance.

NSSM Enhanced Base v1

3.14 Following the review, four enhancements have been undertaken, as agreed with the Client and National Highways to develop an **NSSM Enhanced Base v1** model. The enhancements set out were outlined in the ASR and presented to NSC and National Highways (NH) at a meeting on 5th January 2021 and agreed. These are:

- An expansion of the modelled simulation network into South West Bristol.
- An expansion of network within Weston-super-Mare.

- An update of the modelled speeds within the model area.
- An update of the generalised cost parameters in line with latest TAG (at time).

Expansion of the modelled network into South West Bristol

3.15 The review concluded that there was a need to improve model route choice between Bristol and North Somerset, therefore it was decided to extend the simulation area further into the Bristol area to encompass additional key junctions.

3.16 There are several key routes between Bristol and North Somerset which can become very congested within the peak hours and, as many of the routes are parallel to each other, route choice can be sensitive. To help represent delay and congestion more accurately within the model, the following key junctions were represented in more detail (converted from buffer (peripheral) into more detailed simulation coding):

- Parson Street Gyratory (A).
- Junctions around the Cumberland Basin (B, C, D).
- Hartcliffe roundabout (on Hengrove Way) (E).

3.17 These are shown in Figure 3-2.

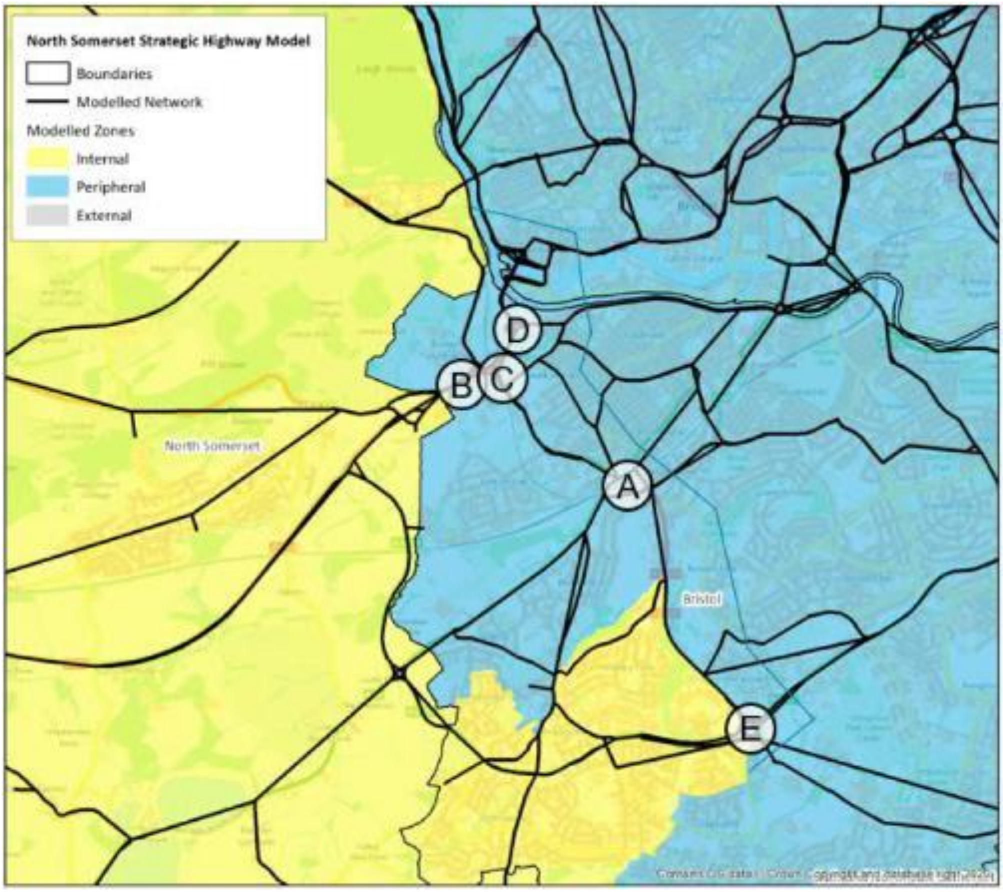


Figure 3-2: Locations for extending simulation network into South West Bristol

Expansion of the Weston-super-Mare Network

3.18 As outlined in the ASR, the majority of the road network within the centre of Weston-super-Mare (W-s-M) is coded as less detailed buffer, network. This means that the model calculations are simplified and there is no calculation of junction delay. The NSSM LMVR states that there is a separate model of Weston-super-Mare (the Weston Town Model (WTM)) which could be used alongside the NSSM to provide more detailed modelling. However, following a review, it was decided that the WTM is too old and would need extensive updating to be used for this study. Therefore, it was decided that to ensure the model is accurately representing delay in the centre of W-s-M, the representation of the network should be improved by converting buffer coding into simulation.

3.19 Signals in the newly formed simulation area were coded using the signal information received from NSC. The data were analysed and appropriately applied to the stages.

3.20 Figure 3-3 outlines the area of the Weston-super-Mare network that has been converted into simulation. The main junctions, and corresponding links between the junctions, that were converted are shown by letters. These are;

- A: A370/Broadway roundabout.
- B: A370/Winterstoke Road roundabout.
- C: Winterstoke Road/Broadway mini roundabout.
- D: A370/B440/A3033 roundabout.

Figure 3-3: Locations for extending simulation network into Weston-super-Mare

Update of Modelled Speeds

3.21 The review highlighted that in some parts of the calibration of the original base model, speeds had been fixed to ensure that the base model reflected observed levels of congestion. This includes routes where there is significant congestion in the peak periods. However, fixing speeds means that any changes in flow on the link will not change the speed, meaning that in forecast years the speeds would remain the same as in the base year, which is not realistic. Therefore, the following updates were carried out to update these fixed speeds in the model:

- All the low-speed roads in model were reviewed as described in the ASR (<=32 kph or 20 mph) and speeds were updated where necessary with the road speed limit.
- Speed Flow Curves were added to all the major roads and critical areas – A-roads and slip roads to motorway, W-s-M and South Bristol.
- For the area to the south of Bristol (bounded by the Harbourside to the north, A4 Bath Road to the east, and A4174 to the south) fixed speeds have been replaced with speed flow curves based on the speed limits on the ground. This is detailed in Figure 3-4.

Update to Value of Time (VoT) and Vehicle Operating Cost (VOC)

3.22 In line with TAG, the Pence per Minute (PPM) and Pence per Kilometre (PPK) values have been updated using the values from the May 2021 TAG Databook.

Figure 3-4: SATURN network of links which have been converted from fixed to variable speed

NSSM Enhanced Base v2

Link Flow Calibration Improvements

3.23 Following the previous issue of the report (v2, March 2022) some further base changes have been made based on the discussions with NSC in the following locations to improve link flow calibration:

- B3130 Tickenham.
- M5 J19/J20/J21 junction approaches.

3.24 To do this, some select links were undertaken on the approaches and very minor changes to the demand were applied to uplift/decrease modelled flows to observed counts to be closer or within TAG criteria. The distribution of trips remained the same.

Update to Value of Time (VoT) and Vehicle Operating Cost (VOC)

3.25 In line with TAG, the Pence per Minute (PPM) and Pence per Kilometre (PPK) values have been updated using the values from the May 2023 TAG Databook

Addition of Local Development Zones

3.26 There has been an addition of 29 new zones which account for the various forecast developments in North Somerset including Local Plan sites. These zones have also been included in the Base Scenario, though no trips go to or from these zones. They have been included in order to ensure consistency between base and forecast matrices in the Variable Demand Model (VDM).

NSSM Enhanced Base v3

Update to Value of Time (VoT) and Vehicle Operating Cost (VOC)

3.27 In line with TAG, the Pence per Minute (PPM) and Pence per Kilometre (PPK) values have been updated using the values from the May 2025 TAG Databook.

3.28 It should be noted that, as outlined in TAG Unit M3.1, the HGV values for PPM have been factored by 2 in accordance with guidance below:

"The value of time given in TAG unit A1.3 for HGVs relates to the driver's time and does not take account of the influence of owners on the routeing of these vehicles. On these grounds, it may be considered to be more appropriate to use a value of time around twice the TAG unit A1.3 values".

3.29 Table 3-1shows a comparison between the PPM and PPK factors between the Original NSSM and the factors from the May 2025 Databook which have been used in the enhanced version of the model.

Table 3-1: PPM and PPK Values: Original NSSM vs updated May 2025 Databook

		AM Peak	AM Peak	Inter peak	Inter peak	PM Peak	PM Peak
		ppm	ppk	ppm	ppk	ppm	ppk
Original NSSM 2018 Base Model	Car Commute	20.67	6.09	21.01	6.09	20.74	6.09
	Car Employer's Business	30.82	12.50	31.59	12.50	31.27	12.50
	Car Other	14.26	6.09	15.19	6.09	14.93	6.09
	LGV	21.79	14.11	21.79	14.11	21.79	14.11
	HGV	22.12	36.83	22.12	36.83	22.12	36.83
Updated Model: using May 2025 Databook	Car Commute	20.80	6.74	21.14	6.74	20.87	6.74
	Car Employer's Business	31.02	13.08	31.78	13.08	31.46	13.08
	Car Other	14.35	6.74	15.29	6.74	15.03	6.74
	LGV	23.06	14.12	23.06	14.12	23.06	14.12
	HGV	48.18	52.48	48.18	52.48	48.18	52.48
Difference	Car Commute	***0.13***	***0.65***	***0.13***	***0.65***	***0.13***	***0.65***
	Car Employer's Business	***0.2***	***0.58***	***0.19***	***0.58***	***0.19***	***0.58***
	Car Other	***0.09***	***0.65***	***0.1***	***0.65***	***0.1***	***0.65***
	LGV	***1.27***	***0.01***	***1.27***	***0.01***	***1.27***	***0.01***
	HGV	***26.06***	***15.65***	***26.06***	***15.65***	***26.06***	***15.65***

Note: *ppm: pence per minute, ppk: pence per kilometre*

Addition of Local Development Zones

3.30 There has been an addition of a further 17 zones which account for the various additional forecast developments in North Somerset including Local Plan sites. These zones have also been included in the Base Scenario, though no trips go to or from these zones. They have been included in order to run the Variable Demand Model (VDM).

Calibration and Validation of the NSSM Enhanced Base model

3.31 As outlined in the ASR, as part of the NSSM enhanced base model v3 update, the model has been enhanced but not recalibrated or revalidated. However, to ensure that the model has not been negatively impacted by these changes to the existing NSSM, checks have been undertaken to make sure that the model still calibrates in line with TAG. The base model used for Local Plan modelling will be referred to as the NSSM enhanced model, with the latest version designated as NSSM enhanced base model v3.

3.32 Significance has been given to calibration in areas where the Local Plan allocations are likely to be located as well as on main routes across the network.

Model Statistics

3.33 TAG Unit M3-1 provides guidance on the most appropriate assignment convergence measures and the values considered acceptable for use in a Base Model. Table 3-2 presents the convergence criteria for the NSSM enhanced base model.

Table 3-2: Measures of assignment convergence and Base Year acceptable values

Measure of convergence	TAG Unit M3-1
Proximity (Delta and %GAP)	Less than 0.1%, or at least stable with convergence fully documented and all other criteria met.
Stability (Percentage of links with a flow change <1%)	Four consecutive iterations greater than 98%

3.34 The model has been assigned using SATURN version 11.5.05N for the AM, IP and PM peak models.

3.35 Table 3-3 sets out the assignment convergence statistics for the NSSM enhanced model compared to the original base model. The table shows the results for the last four iterations of each assigned peak.

Table 3-3: Convergence Statistics: Base Model

	Original NSSM Model			Enhanced NSSM model		
Time period	Assignment Loop*	%Flows	%GAP	Assignment Loop*	%Flows	%GAP
AM	17	98.5	0.00096	15	98.4	0.045
	18	98.9	0.00066	16	98.4	0.039
	19	99	0.0012	17	98.6	0.044
	20	99	0.00065	18	98.9	0.040
IP	9	98.4	0.00004	20	98.4	0.010
	10	98.8	0.00003	21	98.3	0.0091
	11	99.5	0.00002	22	98.6	0.015
	12	99.3	0.00003	23	98.5	0.0093
PM	16	98.3	0.0015	21	98.4	0.024
	17	98.7	0.0014	22	98.3	0.019
	18	98.9	0.002	23	98.9	0.019
	19	98.7	0.0014	24	98.9	0.018

* Last four iterations presented, as per the convergence stopping requirement

3.36 As we have increased the simulation area of the base model to areas on the edge of Bristol and Weston-super-Mare, it is expected that the convergence results might differ between the two models. The accompanying table demonstrates that the enhanced model achieves convergence in fewer loops during the AM Peak, indicating improved stability. While the Interpeak (IP) and PM Peak models require slightly more loops to converge compared to the original NSSM, they still meet the TAG convergence criteria, confirming the robustness of the enhanced model for forecasting purposes. Table 3-4 to Table 3-6 shows model statistics taken from both the original NSSM and enhanced NSSM model by model peak. The table shows an increase in travel time and distance for the enhanced model, which is due to increasing the simulation area and changes to the network in the enhanced model. This has, in turn, reduced the average speed across the network which is likely to be attributed to the conversion of more congested areas of the network, especially in South West Bristol, to simulation.

Table 3-4: Base Model Statistics: Original NSSM vs enhanced NSSM – AM Peak

	Original Base		Enhanced NSSM	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	10,512	66,237	12,826	69,000
Travel distance (pcu kms)	667,396	4,241,956	720,693	4,266,547
Average Speed (kph)	63.5	64.0	56.2	61.8

Table 3-5: Base Model Statistics: Original NSSM vs enhanced NSSM – Interpeak

	Original Base		Enhanced NSSM	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	8,050	52,244	9,335	52,140
Travel distance (pcu kms)	574,229	3,884,169	613,007	3,883,710
Average Speed (kph)	71.3	74.3	65.7	74.5

Table 3-6: Base Model Statistics: Original NSSM vs enhanced NSSM – PM Peak

	Original Base		Enhanced NSSM	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	10,853	64,981	13,096	67,380
Travel distance (pcu kms)	676,086	4,096,456	722,988	4,087,010
Average Speed (kph)	62.3	63.0	55.2	60.7

Link Validation: Link Counts

3.37 The validation criteria and guidelines for link flows and turning movements as defined in TAG are defined in Table 3-7.

Table 3-7: Link Flow and Turning Movement Validation Criteria and Guidelines

Criteria	Description of Criteria	Guideline
1	Individual flows within 100 veh/h of counts for flows less than 700 veh/h	> 85% of cases
1	Individual flows within 15% of counts for flows from 700 to 2,700 veh/h	> 85% of cases
1	Individual flows within 400 veh/h of counts for flows more than 2,700 veh/h	> 85% of cases
2	GEH < 5 for individual flows	> 85% of cases

3.38 The model shows good correlation with observed flows across the majority of the validation links. The AM, IP and PM models have overall pass rates of 88%, 86% and 91% respectively, and therefore pass the TAG criteria of 85% of links passing within the simulation area.

3.39 Table 3-8 provides a summary of the proportion of links that are passing in each peak. Figure 3-5 to Figure 3-7 show the link validation within the enhanced NSSM. A full results summary can be seen in Appendix C.

Table 3-8: Link Count Validation summary: Original NSSM vs Enhanced NSSM

Time Period	Criteria		Original NSSM		Enhanced NSSM	
		No. of Counts	No. Passing	% Passing	No. Passing	% Passing
AM	Flow < 700	121	103	85%	107	88%
	700 < Flow < 2700	39	29	74%	32	82%
	Flow > 2700	8	7	88%	8	100%
	All Flows	168	139	83%	147	88%
	GEH < 5	168	129	77%	132	79%
	Overall Pass (GEH or Flow)	168	143	85%	149	89%
IP	Flow < 700	113	98	87%	98	87%
	700 < Flow < 2700	24	20	83%	20	83%
	Flow > 2700	8	6	75%	6	75%
	All Flows	145	124	86%	124	86%
	GEH < 5	145	108	74%	108	74%
	Overall Pass (GEH or Flow)	145	125	86%	125	86%
PM	Flow < 700	119	106	89%	111	93%
	700 < Flow < 2700	38	31	82%	32	84%
	Flow > 2700	11	9	82%	10	91%
	All Flows	168	146	87%	153	91%
	GEH < 5	168	137	82%	144	86%
	Overall Pass (GEH or Flow)	168	148	88%	154	92%

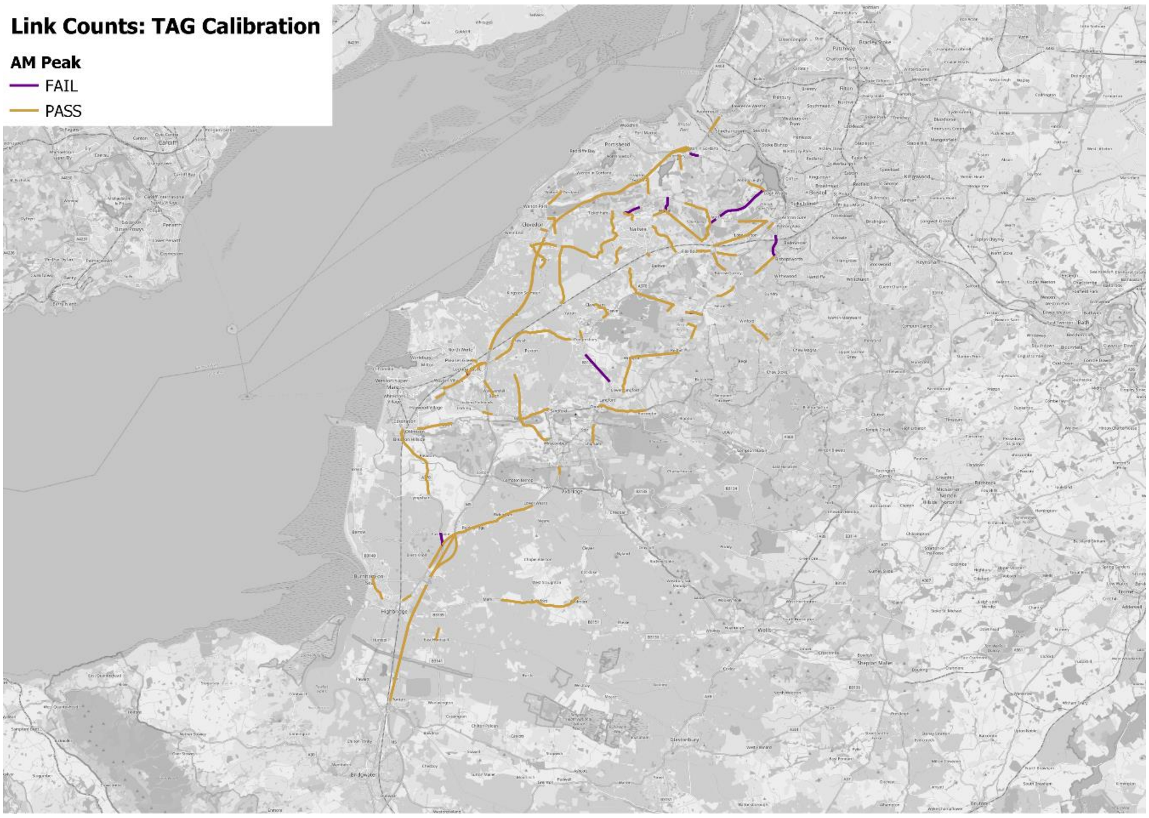


Figure 3-5: Enhanced NSSM: Link validation counts in AM peak

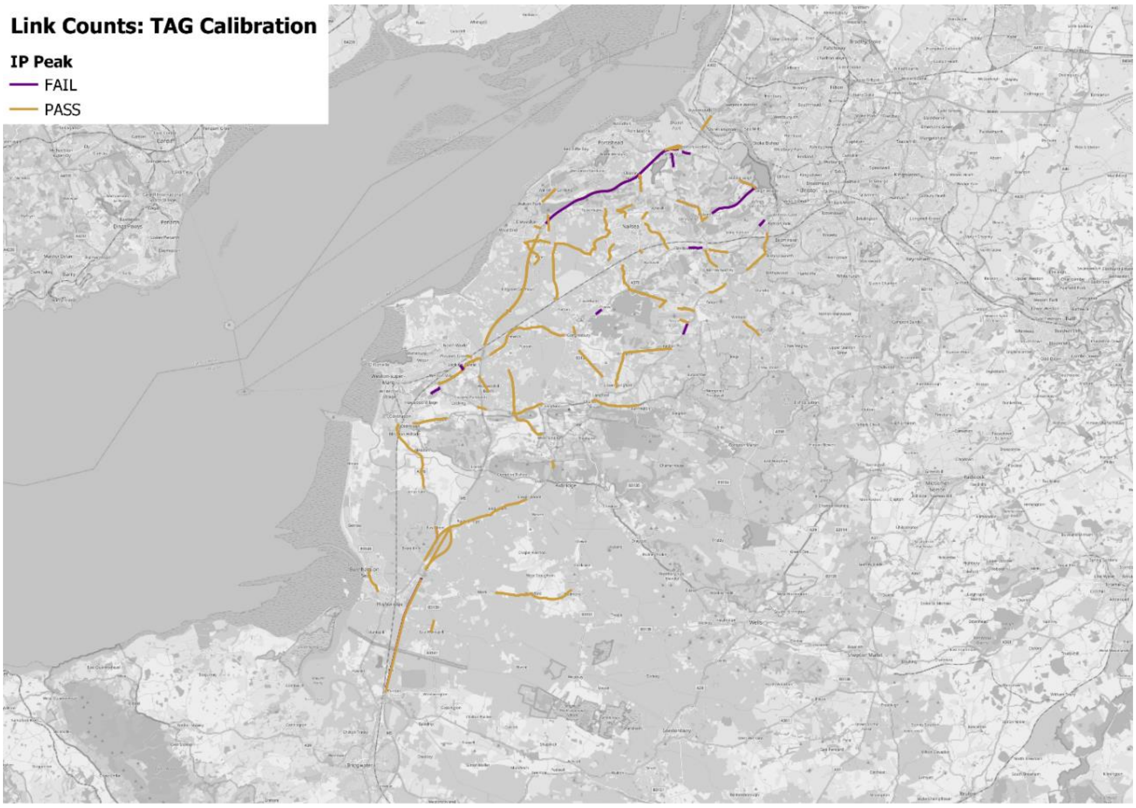


Figure 3-6: Enhanced NSSM: Link validation counts in Interpeak

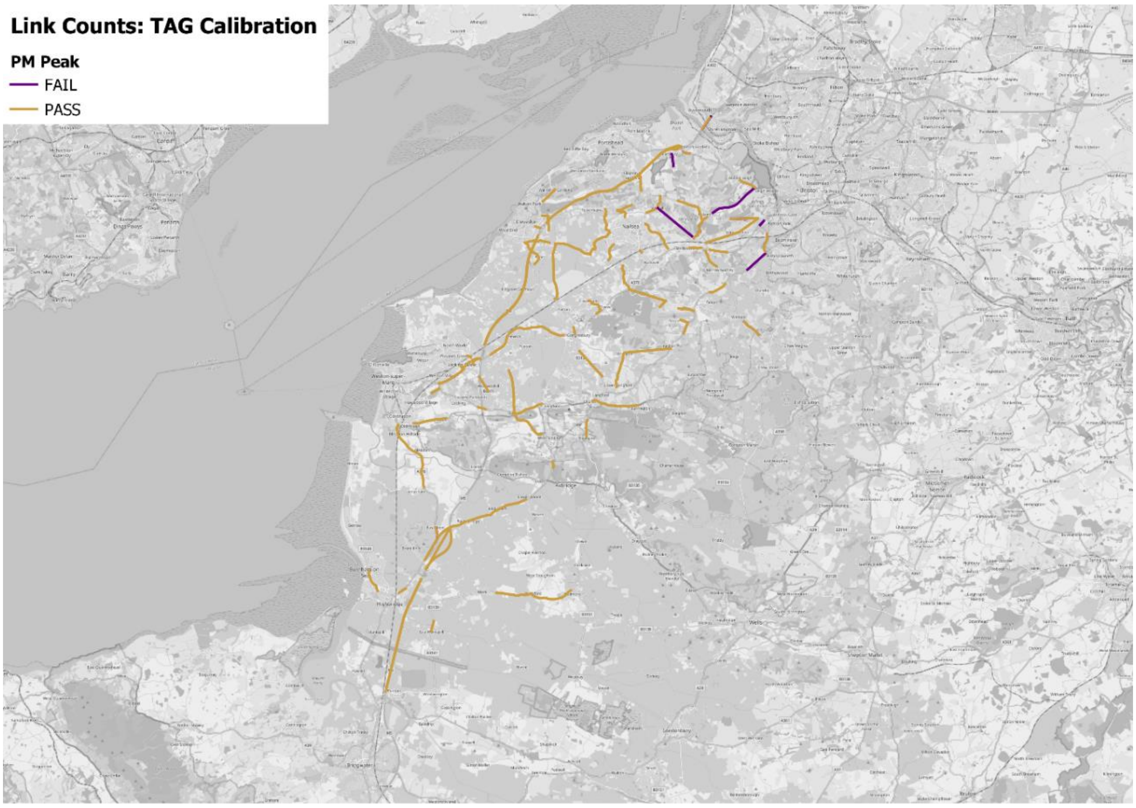


Figure 3-7: Enhanced NSSM: Link validation counts in PM Peak

3.40 The results show that there has been a slight change in calibration of the model as a result of the updates. However, over 85% of links pass in each peak, and the changes have been necessary to improve the overall accuracy of the model and suitability to address changes in traffic flows in future years. Comparing the calibration of the original NSSM and the enhanced version of the model, a few conclusions have been drawn:

- In the AM Peak, calibration has improved on links closer to Bristol such as A370 Long Ashton Bypass (WB) compared with the original NSSM. In addition, B3130 Tickenham Road (EB), A369 west of B3129 Beggarbush Lane Leigh Woods (EB & WB) have improved calibration in the new enhanced model.
- In the Interpeak, there has been no significant difference in calibration between the old NSSM and the Enhanced NSSM models.
- In the PM Peak, calibration has improved on links such as Nailsea Wall (EB), A369 west of B3129 Beggarbush Lane Leigh Woods (EB) as well as the B3128 Tickenham Hill west of Towerhouse Lane (WB). Of the links that do fail, the majority of these are close to passing the criteria, such as Beggar Bush Lane (WB).

3.41 On the M5, there is a 100% pass rate in the AM Peak, 80% in the Interpeak and 90% in the PM Peak.

3.42 In the Interpeak, the M5 southbound between J19 and J20 fails with a GEH of 11.5, where the M5 northbound between J22 and J23 fails with a GEH of 7.9. However, compared with the original base, the change in flow is slight for each location, therefore there is a negligible change from the original NSSM.

3.43 In the PM Peak, the M5 southbound, the count on Avonmouth Bridge north of junction 19 fails with the modelled flow higher than the observed count with a GEH of 8.2. However, it has improved from the original NSSM model, from a GEH of 12.5.

Link Validation: Screenlines

3.44 Table 3-9 outlines the TAG criteria for screenline validation.

Table 3-9: Screenline Flow Validation Criterion and Guideline

Description of Criteria	Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines (i.e. 95%)

3.45 As outlined in the NSSM LMVR (in Appendix B), all the screenline flows were assessed with validation criteria of 10% flow difference and GEH, as some of the screenlines have a relatively low total observed flow and this makes the 5% TAG criterion difficult to meet in some cases (i.e. where a 5% threshold relates to a very small number of trips). The screenlines used in the original NSSM work are shown below in Figure 3-8.

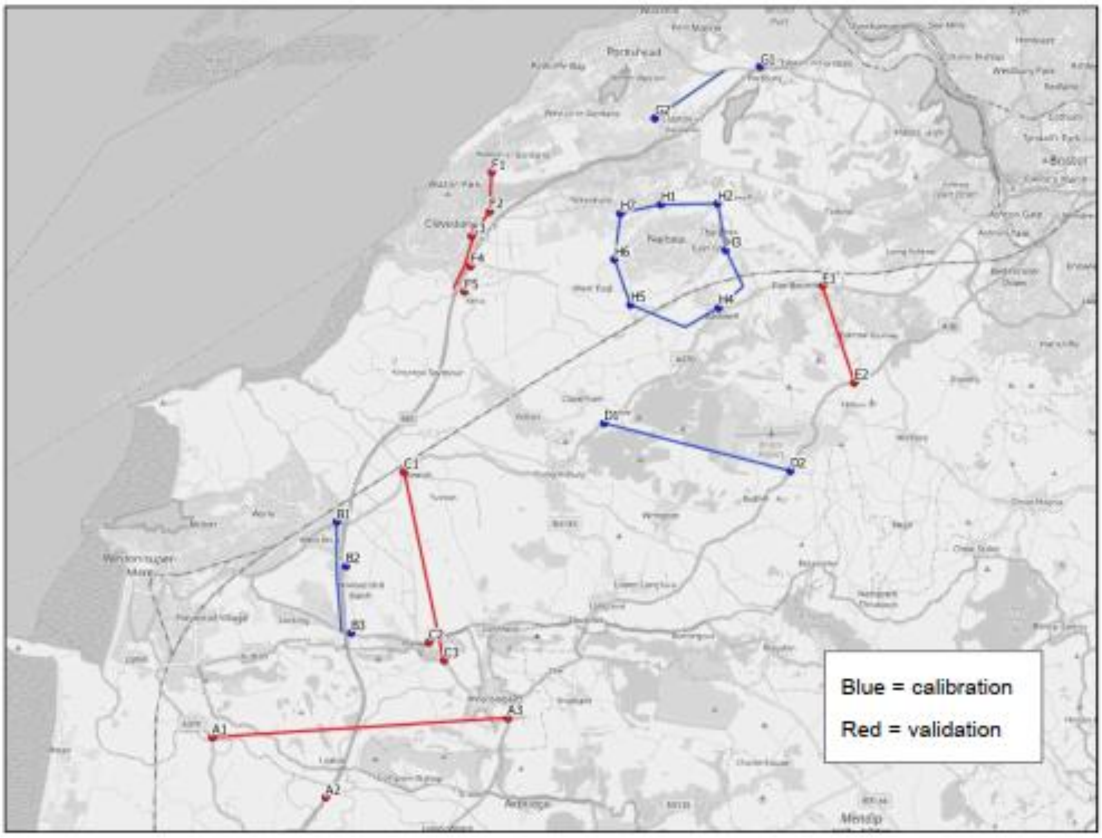


Figure 3-8: Screenlines used in NSSM (taken from NSSM LMVR)

3.46 Details on the screenlines are shown in Table 3-10.

3.47 Summary results for each peak are shown below in Table 3-11, Table 3-12, and Table 3-13. Full results comparing the results from the Original NSSM can be seen in Appendix D.

Table 3-10: Screenline Descriptions

Screenline	Cal/Val	Description
A	**Validation**	South of Weston-super-Mare, running from the A370, M5 and A38
B	**Calibration**	At Weston-super-Mare, running parallel to the M5 on the west side, between the A370, Wolvershill Road and A371.
C	**Validation**	At Weston-super-Mare, running parallel to the M5 on the east side, through Banwell and Hewish
D	**Calibration**	Between A370 and A38 to the south of Bristol Airport
E	**Validation**	Between the A370 and A38 near Barrow Gurney
F	**Validation**	At Clevedon, running parallel to the M5
G	**Calibration**	At Portishead, running parallel to the M5
H	**Calibration**	Cordon around Nailsea and Backwell

Table 3-11: Screenline Validation results for Enhanced NSSM: AM Peak

Screenline	Cal / Val	Dir	Obs	Mod	% Diff	<5%	<10%	GEH	GEH <5
A	Val	NB	4,073	4,172	+2.4%	Pass	Pass	1.5	Pass
		SB	3,684	3,830	+4.0%	Pass	Pass	2.4	Pass
B	Cal	EB	3,474	3,456	-1.0%	Pass	Pass	0.3	Pass
		WB	2,922	2,887	-1.0%	Pass	Pass	0.6	Pass
C	Val	EB	1,171	1,172	+0.1%	Pass	Pass	0.0	Pass
		WB	1,292	1,291	-0.1%	Pass	Pass	0.0	Pass
D	Cal	NB	1,420	1,456	+2.6%	Pass	Pass	1.0	Pass
		SB	1,001	982	-2.0%	Pass	Pass	0.6	Pass
E	Val	EB	1,631	1,688	+3.5%	Pass	Pass	1.4	Pass
		WB	1,194	1,350	+13.1%	Fail	Fail	4.4	Pass
F	Val	EB	3,228	3,460	+7.2%	Fail	Pass	4.0	Pass
		WB	3,364	3,463	+2.9%	Pass	Pass	1.7	Pass
G	Cal	NB	1,360	1,468	+7.9%	Fail	Pass	2.9	Pass
		SB	1,770	1,845	+4.2%	Pass	Pass	1.8	Pass
H	Cal	In	1,470	1,514	+3.0%	Pass	Pass	1.1	Pass
		Out	1,722	1,705	-1.0%	Pass	Pass	0.4	Pass
				Pass Rate of all Screenlines		**81%**	**94%**		**100%**
				Pass Rate in Original NSSM		**94%**	**94%**		**94%**

3.48 The table shows that in the AM Peak, all screenlines pass in terms of GEH in the enhanced version of the NSSM. Looking further at the flow difference criteria, three screenlines fail within the 5% flow criteria. Screenline E (WB) fails in both versions of the model, however, the enhanced NSSM has improved calibration on this screenline.

3.49 Screenline F (EB) has failed the flow percentage difference criterion in the enhanced model; however, it is only just outside the 5% criteria, at 7.2%. On this screenline, of the five counts, only one fails the flow criteria (B3133 Ettlingen Way). Screenline G (NB) has failed the flow percentage difference criterion in the enhanced model. On this screenline there are only two counts, and both counts pass.

Table 3-12: Screenline Validation results for Enhanced NSSM: Interpeak

Screenline	Cal / Val	Dir	Obs	Mod	% Diff	<5%	<10%	GEH	GEH <5
A	Val	NB	3,830	3,885	+1.4%	Pass	Pass	0.9	Pass
		SB	3,476	3,272	-5.9%	Fail	Pass	3.5	Pass
B	Cal	EB	2,211	2,201	0.0%	Pass	Pass	0.2	Pass
		WB	2,375	2,336	-2.0%	Pass	Pass	0.8	Pass
C	Val	EB	975	1,087	+11.5%	Fail	Fail	3.5	Pass
		WB	1,044	1,079	+3.3%	Pass	Pass	1.1	Pass
D	Cal	NB	962	999	+3.8%	Pass	Pass	1.2	Pass
		SB	963	980	+2.0%	Pass	Pass	0.5	Pass
E	Val	EB	1,131	1,223	+8.2%	Fail	Pass	2.7	Pass
		WB	1,197	1,319	+10.2%	Fail	Fail	3.5	Pass
F	Val	EB	2,052	2,223	+8.3%	Fail	Pass	3.7	Pass
		WB	1,988	2,199	+10.6%	Fail	Fail	4.6	Pass
G	Cal	NB	1,039	1,113	+7.1%	Fail	Pass	2.3	Pass
		SB	1,011	1,051	+4.0%	Pass	Pass	1.3	Pass
H	Cal	In	1,223	1,195	-2.3%	Pass	Pass	0.8	Pass
		Out	1,194	1,163	-2.6%	Pass	Pass	0.9	Pass
				Pass Rate of all Screenlines		**56%**	**81%**		**100%**
				Pass Rate in Original NSSM		**56%**	**94%**		**100%**

3.50 The table shows that in the Interpeak, all screenlines pass in terms of GEH in the enhanced version of the NSSM. Looking further at the flow difference criteria, seven screenlines are outside of the 5% flow criterion, which is one less than the original NSSM. However, most of these screenlines are within 10% which is acceptable. The three screenlines which have a flow difference of more than 10% are Screenline C (EB), Screenline E (WB) and Screenline F (WB), all three are validation screenlines.

Table 3-13: Screenline Validation results for Enhanced NSSM: PM Peak

Screenline	Cal/Val	Dir	Obs	Mod	% Diff	<5%	<10%	GEH	GEH <5
A	Val	NB	4,020	3,897	-3.1%	Pass	Pass	2.0	Pass
		SB	4,312	4,160	-3.5%	Pass	Pass	2.3	Pass
B	Cal	EB	2,761	2,700	-2.0%	Pass	Pass	1.2	Pass
		WB	4,109	3,927	-4.0%	Pass	Pass	2.9	Pass
C	Val	EB	1,140	1,221	+7.2%	Fail	Pass	2.4	Pass
		WB	1,564	1,579	+0.9%	Pass	Pass	0.4	Pass
D	Cal	NB	1,123	1,223	+8.9%	Fail	Pass	2.9	Pass
		SB	1,652	1,681	+2.0%	Pass	Pass	0.7	Pass
E	Val	EB	1,315	1,494	+13.6%	Fail	Fail	4.8	Pass
		WB	1,762	1,867	+6.0%	Fail	Pass	2.5	Pass
F	Val	EB	3,214	3,301	+2.7%	Pass	Pass	1.5	Pass
		WB	3,308	3,408	+3.0%	Pass	Pass	1.7	Pass
G	Cal	NB	1,976	1,855	-6.1%	Fail	Pass	2.8	Pass
		SB	1,353	1,293	-4.5%	Pass	Pass	1.7	Pass
H	Cal	In	1,773	1,733	-2.2%	Pass	Pass	0.9	Pass
		Out	1,496	1,576	+5.4%	Fail	Pass	2.0	Pass
				Pass Rate of all Screenlines		**63%**	**94%**		**100%**
				Pass Rate in Original NSSM		**75%**	**100%**		**100%**

3.51 The table shows that in the PM Peak, all screenlines pass in terms of GEH in the enhanced version of the NSSM. Looking further at the flow difference criteria, six screenlines fail at the 5% flow difference criteria within the enhanced NSSM version, whereas there were four that failed within the original NSSM. Only Screenline E (EB) does not meet the 10% flow difference criteria.

Journey Time Analysis

3.52 Table 3-14 outlines the TAG criteria for journey time validation.

Table 3-14: Journey Time Validation Criterion and Guidelines

Description of Criteria	Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

3.53 As outlined as part of the ASR, it was identified that journey time calibration was a focus of the modelling enhancements, especially to improve routes between North Somerset and Bristol.

Data from the calibration of the original NSSM was used, the routes are outlined below in Table 3-15.

Table 3-15: Journey Time Routes used in original NSSM (taken from NSSM LMVR, September 2020)

Route	Name	Start	End	Distance (km)
A	A38	Churchill	South Bristol Link Road	15.9
B	A369	Portishead	B3129	8.8
C	A370 (WsM to Brockley)	WsM	Brockley	15.8
D	A370 (Brockley to Bristol)	Brockley	Brunel Way	11.2
E	A371/A368	WsM	Churchill	10.4
F	B3128/B3130	Clevedon	Brunel Way	16.6
G	B3133	Langford	Clevedon	14.2
H	Barrow Street	A38	Weston Road	3.0
I	Downside Road	Brockley	Winford	7.7
J	M5 J18 to J21	J18	J21	23.2
K	Nailsea/Backwell	Backwell	Stone Edge Batch	5.5
L	Nailsea to M5 J18 via Causeway	Nailsea	M5 J18	20.5
M	Nailsea to M5 J18 via Pound Lane	Nailsea	M5 J18	14.1
N	Portbury Lane	Nailsea	A369	7.3
O	M5 J21 to J23	J21	J23	24.7
P	A370 (South of WsM)	A38	WsM	11.1
Q	A38 (South of Churchill)	A370	Churchill	19.2
R	A38 (East Brent to Dunball)	Dunball	A370	12.3
S	Burnham-on-Sea to M5 J23	Burnham-on-Sea	M5 J23	11.3

3.54 Table 3-16 shows how the enhanced model validates in 97% of the routes with observed journey time data used in the original NSSM in the AM Peak.

3.55 Table 3-17 shows how the enhanced model validates in 97% of the routes with observed journey time data used in the original NSSM in the Interpeak.

3.56 Table 3-18 shows how the enhanced model validates in 100% of the routes with observed journey time data used in the original NSSM in the PM Peak.

Table 3-16: Journey Time Validation: AM Peak

Route and Direction					Enhanced NSSM		*Original NSSM*	
		Observed (mm:ss)	Modelled (mm:ss)	Difference (mm:ss)	% Difference	Within 15%?	*% Difference*	*Within 15%?*
A	NB	16:25	16:26	00:01	0%	Pass	*-3%*	*Pass*
	SB	16:36	14:48	-01:48	-11%	Pass	*-7%*	*Pass*
B	EB	14:05	12:04	-02:01	-14%	Pass	*-23%*	*Fail*
	WB	10:49	09:39	-01:10	-11%	Pass	*-18%*	*Fail*
C	EB	22:03	20:01	-02:02	-9%	Pass	*-17%*	*Fail*
	WB	18:37	18:51	00:14	1%	Pass	*-3%*	*Pass*
D	EB	19:12	16:04	-03:08	-16%	Fail	*-34%*	*Fail*
	WB	12:15	12:08	-00:07	-1%	Pass	*-2%*	*Pass*
E	EB	19:02	19:15	00:13	1%	Pass	*2%*	*Pass*
	WB	15:30	14:13	-01:17	-8%	Pass	*-8%*	*Pass*
F	EB	25:04	23:13	-01:51	-7%	Pass	*-17%*	*Fail*
	WB	20:24	20:37	00:13	1%	Pass	*0%*	*Pass*
G	NB	23:40	23:17	-00:23	-2%	Pass	*-5%*	*Pass*
	SB	24:45	23:27	-01:18	-5%	Pass	*-8%*	*Pass*
H	NB	04:20	04:26	00:06	2%	Pass	*-3%*	*Pass*
	SB	04:43	04:00	-00:43	-15%	Pass	*-16%*	*Pass*
I	EB	10:19	10:32	00:13	2%	Pass	*2%*	*Pass*
	WB	10:31	10:45	00:14	2%	Pass	*-4%*	*Pass*
J	NB	14:05	13:37	-00:28	-3%	Pass	*-4%*	*Pass*
	SB	13:01	12:33	-00:28	-4%	Pass	*-4%*	*Pass*
K	NB	12:08	10:19	-01:49	-15%	Pass	*-6%*	*Pass*
	SB	11:48	10:23	-01:25	-12%	Pass	*8%*	*Pass*
L	NB	18:39	17:59	-00:40	-4%	Pass	*-5%*	*Pass*
	SB	19:05	18:53	-00:12	-1%	Pass	*-6%*	*Pass*
M	NB	19:10	17:52	-01:18	-7%	Pass	*-13%*	*Pass*
	SB	17:58	16:36	-01:22	-8%	Pass	*-7%*	*Pass*
N	NB	11:04	10:01	-01:03	-9%	Pass	*-18%*	*Fail*
	SB	10:31	10:21	-00:10	-2%	Pass	*-9%*	*Pass*
O	NB	12:52	13:24	00:32	4%	Pass	*4%*	*Pass*
	SB	13:03	13:39	00:36	5%	Pass	*4%*	*Pass*
P	NB	12:00	12:18	00:18	3%	Pass	*0%*	*Pass*
	SB	11:34	11:19	-00:15	-2%	Pass	*2%*	*Pass*
Q	NB	13:59	12:50	-01:09	-8%	Pass	*3%*	*Pass*
	SB	13:32	12:14	-01:18	-10%	Pass	*1%*	*Pass*
R	NB	12:59	12:42	-00:17	-2%	Pass	*-2%*	*Pass*
	SB	13:39	13:09	-00:30	-4%	Pass	*-4%*	*Pass*
S	NB	07:12	07:07	-00:05	-1%	Pass	*-2%*	*Pass*
	SB	08:00	08:07	00:07	1%	Pass	*1%*	*Pass*
		Pass rate over all journey time routes				*97%*		*84%*

Table 3-17: Journey Time Validation: Interpeak

Route and Direction			Enhanced NSSM				*Original NSSM*	
		Observed (mm:ss)	Modelled (mm:ss)	Difference (mm:ss)	% Difference	Within 15%?	*% Difference*	*Within 15%?*
A	NB	15:39	14:59	-00:40	-4%	Pass	*-7%*	*Pass*
	SB	16:58	14:43	-02:15	-13%	Pass	*-12%*	*Pass*
B	EB	10:34	08:53	-01:41	-16%	Fail	*-12%*	*Pass*
	WB	10:30	09:16	-01:14	-12%	Pass	*-17%*	*Fail*
C	EB	18:14	18:01	-00:13	-1%	Pass	*-6%*	*Pass*
	WB	18:01	17:40	-00:21	-2%	Pass	*-4%*	*Pass*
D	EB	12:22	11:55	-00:27	-4%	Pass	*-6%*	*Pass*
	WB	12:53	12:21	-00:32	-4%	Pass	*-8%*	*Pass*
E	EB	15:30	13:16	-02:14	-14%	Pass	*-15%*	*Fail*
	WB	15:10	13:17	-01:53	-12%	Pass	*-14%*	*Pass*
F	EB	19:30	19:32	00:02	0%	Pass	*-1%*	*Pass*
	WB	20:02	19:48	-00:14	-1%	Pass	*-4%*	*Pass*
G	NB	22:04	21:59	-00:05	0%	Pass	*-4%*	*Pass*
	SB	22:14	23:32	01:18	6%	Pass	*2%*	*Pass*
H	NB	04:06	03:52	-00:14	-6%	Pass	*-6%*	*Pass*
	SB	04:30	03:51	-00:39	-14%	Pass	*-14%*	*Pass*
I	EB	10:27	10:01	-00:26	-4%	Pass	*-5%*	*Pass*
	WB	10:31	10:46	00:15	2%	Pass	*-7%*	*Pass*
J	NB	13:23	13:01	-00:22	-3%	Pass	*-3%*	*Pass*
	SB	13:15	12:25	-00:50	-6%	Pass	*-6%*	*Pass*
K	NB	10:52	10:02	-00:50	-8%	Pass	*-8%*	*Pass*
	SB	11:27	10:30	-00:57	-8%	Pass	*-7%*	*Pass*
L	NB	17:44	16:46	-00:58	-5%	Pass	*-6%*	*Pass*
	SB	18:21	17:11	-01:10	-6%	Pass	*-5%*	*Pass*
M	NB	16:55	16:13	-00:42	-4%	Pass	*-6%*	*Pass*
	SB	17:30	16:33	-00:57	-5%	Pass	*-7%*	*Pass*
N	NB	09:34	09:03	-00:31	-5%	Pass	*-10%*	*Pass*
	SB	10:08	10:26	00:18	3%	Pass	*-4%*	*Pass*
O	NB	12:48	13:27	00:39	5%	Pass	*5%*	*Pass*
	SB	13:10	13:30	00:20	3%	Pass	*3%*	*Pass*
P	NB	11:50	11:38	-00:12	-2%	Pass	*2%*	*Pass*
	SB	11:32	11:10	-00:22	-3%	Pass	*1%*	*Pass*
Q	NB	13:49	13:00	-00:49	-6%	Pass	*4%*	*Pass*
	SB	13:28	12:06	-01:22	-10%	Pass	*0%*	*Pass*
R	NB	13:08	12:37	-00:31	-4%	Pass	*-4%*	*Pass*
	SB	13:25	12:41	-00:44	-5%	Pass	*-6%*	*Pass*
S	NB	07:18	07:12	-00:06	-1%	Pass	*-1%*	*Pass*
	SB	07:50	07:51	00:01	0%	Pass	*0%*	*Pass*
		Pass rate over all journey time routes				*97%*		*95%*

Table 3-18: Journey Time Validation: PM Peak

Route and Direction		Enhanced NSSM					*Original NSSM*	
		Observed (mm:ss)	Modelled (mm:ss)	Difference (mm:ss)	% Difference	Within 15%?	*% Difference*	*Within 15%?*
A	NB	15:38	15:49	00:11	1%	Pass	*-3%*	*Pass*
	SB	18:01	16:01	-02:00	-11%	Pass	*-8%*	*Pass*
B	EB	11:02	09:54	-01:08	-10%	Pass	*-12%*	*Pass*
	WB	13:02	11:21	-01:41	-13%	Pass	*-20%*	*Fail*
C	EB	19:03	19:24	00:21	2%	Pass	*-4%*	*Pass*
	WB	20:32	21:10	00:38	3%	Pass	*-5%*	*Pass*
D	EB	12:13	13:10	00:57	8%	Pass	*1%*	*Pass*
	WB	13:56	16:01	02:05	15%	Pass	*6%*	*Pass*
E	EB	15:35	16:28	00:53	6%	Pass	*13%*	*Pass*
	WB	17:32	16:58	-00:34	-3%	Pass	*-8%*	*Pass*
F	EB	19:50	20:01	00:11	1%	Pass	*-2%*	*Pass*
	WB	23:06	22:28	-00:38	-3%	Pass	*-8%*	*Pass*
G	NB	23:40	23:35	-00:05	0%	Pass	*-7%*	*Pass*
	SB	24:27	24:39	00:12	1%	Pass	*-5%*	*Pass*
H	NB	04:14	04:06	-00:08	-3%	Pass	*-4%*	*Pass*
	SB	04:31	04:11	-00:20	-7%	Pass	*-10%*	*Pass*
I	EB	10:59	10:56	-00:03	0%	Pass	*-6%*	*Pass*
	WB	10:54	10:38	-00:16	-2%	Pass	*-7%*	*Pass*
J	NB	13:04	12:55	-00:09	-1%	Pass	*-1%*	*Pass*
	SB	15:31	13:42	-01:49	-12%	Pass	*-12%*	*Pass*
K	NB	10:54	11:10	00:16	2%	Pass	*0%*	*Pass*
	SB	10:50	10:18	-00:32	-5%	Pass	*-7%*	*Pass*
L	NB	18:31	17:32	-00:59	-5%	Pass	*-7%*	*Pass*
	SB	20:15	18:08	-02:07	-10%	Pass	*-10%*	*Pass*
M	NB	17:33	16:50	-00:43	-4%	Pass	*-9%*	*Pass*
	SB	19:39	20:09	00:30	3%	Pass	*8%*	*Pass*
N	NB	10:08	09:13	-00:55	-9%	Pass	*-14%*	*Pass*
	SB	12:58	14:11	01:13	9%	Pass	*7%*	*Pass*
O	NB	12:40	13:20	00:40	5%	Pass	*5%*	*Pass*
	SB	12:54	13:38	00:44	6%	Pass	*6%*	*Pass*
P	NB	11:55	11:55	00:00	0%	Pass	*3%*	*Pass*
	SB	11:39	11:24	-00:15	-2%	Pass	*2%*	*Pass*
Q	NB	13:31	12:39	-00:52	-6%	Pass	*6%*	*Pass*
	SB	13:24	12:52	-00:32	-4%	Pass	*6%*	*Pass*
R	NB	13:20	13:05	-00:15	-2%	Pass	*-2%*	*Pass*
	SB	13:18	12:51	-00:27	-3%	Pass	*-4%*	*Pass*
S	NB	07:19	07:20	00:01	0%	Pass	*0%*	*Pass*
	SB	07:39	07:55	00:16	3%	Pass	*3%*	*Pass*
		Pass rate over all journey time routes				*100%*		*97%*

Calibration: Motorway Junctions – Turning Counts

3.57 As with the link counts in Table 3-7, turning counts are considered calibrated where:

- movements have a GEH of less than 5.
- for flow difference between the observed and modelled flow
  (1) if the observed flow is less than 700 vehicles, and the difference is less than 100 vehicles.
  (2) if the observed flow is between 700 and 2700 vehicles, and the difference is less than 15%.
  (3) if the observed flow is more than 2700 vehicles, and the difference is less than 400 vehicles.

3.58 The Table 3-19 shows junction turning counts at M5 Junction 21, the main gateway to A370 corridor, thus proving good correlation with the observed data. Compared with the original NSSM, the results are broadly similar. There is an improvement in the Interpeak from the M5 northbound to the A370 westbound, and in the PM peak from the M5 northbound to A370 eastbound which now both pass TAG criteria. In the AM peak, only one turn fails which is from the A370 west to the A370 east.

3.59 Looking at the total flows into and out of J21 in all three time periods, the junction passes where modelled flows are within 3% of observed flows.

Table 3-19: M5 Junction J21 turning flows

Time period	From	To	Obs	Enhanced NSSM Modelled	%Diff	GEH	Enhanced NSSM TAG criteria	Original NSSM TAG criteria
AM	M5 N	A370 E	114	84	-26%	3.0	Pass	Pass
	M5 N	A370 W	1,214	1,214	0%	0.0	Pass	Pass
	A370 E	M5 S	129	147	14%	1.6	Pass	Pass
	A370 E	A370 W	630	644	2%	0.5	Pass	Pass
	A370 E	M5 N	229	155	-32%	5.3	Pass	Pass
	M5 S	A370 W	313	331	6%	1.0	Pass	Pass
	M5 S	A370 E	115	91	-21%	2.4	Pass	Pass
	A370 W	M5 N	1,768	1,833	4%	1.5	Pass	Pass
	A370 W	A370 E	585	442	-24%	6.3	Fail	Pass
	A370 W	M5 S	304	346	14%	2.3	Pass	Pass
	Total Entry Flow		**5,401**	**5,287**	**-2%**	**1.6**	**Pass**	**Pass**
IP	M5 N	A370 E	79	106	35%	2.8	Pass	Pass
	M5 N	A370 W	972	1,063	9%	2.8	Pass	Fail

Time period	From	To	Obs	Enhanced NSSM Modelled	%Diff	GEH	Enhanced NSSM TAG criteria	Original NSSM TAG criteria
	A370 E	M5 S	92	138	50%	4.3	Pass	Pass
	A370 E	A370 W	574	490	-15%	3.6	Pass	Pass
	A370 E	M5 N	62	77	25%	1.8	Pass	Pass
	M5 S	A370 W	201	267	33%	4.3	Pass	Pass
	M5 S	A370 E	77	106	37%	3.0	Pass	Pass
	A370 W	M5 N	922	918	0%	0.1	Pass	Pass
	A370 W	A370 E	561	479	-15%	3.6	Pass	Pass
	A370 W	M5 S	209	207	-1%	0.1	Pass	Pass
	Total Entry Flow		**3,749**	**3,850**	**3%**	**1.6**	**Pass**	**Fail**
PM	M5 N	A370 E	215	120	-44%	7.3	Pass	Fail
	M5 N	A370 W	1,897	1,984	5%	2.0	Pass	Pass
	A370 E	M5 S	148	124	-16%	2.1	Pass	Pass
	A370 E	A370 W	722	730	1%	0.3	Pass	Pass
	A370 E	M5 N	80	87	9%	0.8	Pass	Pass
	M5 S	A370 W	362	406	12%	2.2	Pass	Pass
	M5 S	A370 E	137	117	-15%	1.8	Pass	Pass
	A370 W	M5 N	1,130	1,056	-7%	2.2	Pass	Pass
	A370 W	A370 E	576	582	1%	0.2	Pass	Pass
	A370 W	M5 S	311	282	-9%	1.7	Pass	Pass
	Total Entry Flow		**5,578**	**5,488**	**-2%**	**1.2**	**Pass**	**Pass**

3.60 Table 3-20 and Table 3-21 show entry flows at major junctions along M5, at junction 19, 20, and 21 for the AM and PM Peak respectively.

Table 3-20: AM Peak Entry Flows: M5 Junction J21, J20 and J19

	Entry arm	Observed	Enhanced NSSM Modelled	Diff	% Diff	GEH	Enhanced NSSM TAG criteria	Original NSSM TAG criteria
J21	M5 SB offslip	1328	1299	-29	-2%	0.80	Pass	Pass
	A370 (East)	988	947	-41	-4%	1.32	Pass	Pass
	M5 NB offslip	428	422	-6	-1%	0.29	Pass	Pass
	A370 (West)	2657	2655	-2	0%	0.04	Pass	Pass
	Total	**5401**	**5323**	**-78**	**-1%**	**1.07**	**Pass**	**Pass**
J20	M5 NB offslip	1084	935	-149	-14%	4.69	Pass	Pass
	M5 SB offslip	492	497	5	1%	0.22	Pass	Pass
	Ettlingen Way	1473	1689	216	15%	5.43	Pass	Fail
	Total	**3049**	**3121**	**72**	**2%**	**1.30**	**Pass**	**Pass**
J19	Dock Road	258	233	-25	-10%	1.60	Pass	Pass
	M5 SB offslip	1497	1474	-23	-2%	0.60	Pass	Fail
	A369	1258	1070	-188	-15%	5.51	Pass	Fail
	M5 NB offslip	779	724	-55	-7%	2.01	Pass	Fail
	A369 Portbury Hundred	1429	1303	-126	-9%	3.41	Pass	Pass
	Total	**5221**	**4804**	**-417**	**-8%**	**5.89**	**Fail**	**Pass**

3.61 For the AM Peak, individual turning movements pass the TAG criteria in the Enhanced model. In terms of total flows in and out of junctions, only J19 fails individual turning movements TAG criteria, which is as observed flows are greater than 2,700 vehicles, modelled flows need to be within 400 vehicles to pass TAG criteria, therefore J19 only fails by 17 vehicles.

Table 3-21: PM Peak Entry Flows: M5 Junction J21, J20 and J19

	Entry arm	Observed	Enhanced NSSM Modelled	Diff	% Diff	GEH	Enhanced NSSM TAG criteria	Original NSSM TAG criteria
J21	M5 SB offslip	2112	2104	-8	0%	0.17	Pass	Pass
	A370 (East)	950	941	-9	-1%	0.29	Pass	Pass
	M5 NB offslip	499	522	23	5%	1.02	Pass	Pass
	A370 (West)	2017	1941	-76	-4%	1.71	Pass	Pass
	Total	**5578**	**5508**	-70	**-1%**	**0.94**	**Pass**	**Pass**
J20	M5 NB offslip	649	662	13	2%	0.51	Pass	Pass
	M5 SB offslip	930	790	-140	-15%	4.77	Fail	Pass
	Ettlingen Way	1289	1377	88	7%	2.41	Pass	Pass
	Total	**2868**	**2829**	**-39**	**-1%**	**0.73**	**Pass**	**Pass**
J19	Dock Road	514	612	98	19%	4.13	Pass	Pass
	M5 SB offslip	1496	1727	231	15%	5.75	Fail	Fail
	A369	1331	1289	-42	-3%	1.16	Pass	Pass
	M5 NB offslip	422	381	-41	-10%	2.05	Pass	Fail
	A369 Portbury Hundred	1009	903	-106	-11%	3.43	Pass	Pass
	Total	**4772**	**4912**	**140**	**3%**	**2.01**	**Pass**	**Fail**

3.62 In the PM Peak, J21 pass the TAG criteria on all entry arms. At J20, one entry arm fails (M5 SB offslip), however, overall, the junction passes. At J19, one entry arm fails (M5 SB offslip), however, overall, the junction passes. For those entry links that do fail, those links are close to passing.

3.63 The original NSSM only provides observed interpeak data for J21. Comparing the original NSSM to the enhanced version, the junction performs better in the enhanced model.

3.64 It should be noted that Table 3-20 and Table 3-21 take the actual link flows from the model, whilst Table 3-19 takes the turning movement by performing select link analysis on each of the entry arms to junction 21 of the M5 which produces slight differences in the calculations of the actual flows, hence the slight differences between the entry totals of the tables.

3.65 Table 3-22 show the entry flows at J21 of the M5 for the IP. All entry arms pass TAG criteria in the Enhances NSSM.

Table 3-22: IP Entry Flows: M5 Junction J21

	Entry arm	Observed	Enhanced NSSM Modelled	Diff	% Diff	GEH	Enhanced NSSM TAG criteria	Original NSSM TAG criteria
J21	M5 SB off-slip	1051	1169	118	11%	3.54	Pass	Fail
	A370 (East)	728	706	-22	-3%	0.82	Pass	Pass
	M5 NB off-slip	278	373	95	34%	5.27	Pass	Fail
	A370 (West)	1692	1622	-70	-4%	1.72	Pass	Pass
	Total	**3749**	**3870**	**121**	**3%**	**1.96**	**Pass**	**Fail**

Calibration: Motorway Junctions – Queuing and Capacity Issues

3.66 In the original NSSM LMVR paragraph 7.5.8 states that there are existing capacity issues at Junction 21 which have been represented within the model. These include the northbound onslip, the southbound offslip, and the nearby Queensway junction. These have been reviewed to ensure that these capacity issues still exist within the enhanced model.

3.67 On the northbound onslip the NSSM report refers to queuing in the AM Peak on this link. The original model has a V/C ratio of 103%. The enhanced model has a V/C of 107%.

3.68 On the southbound offslip in the PM, the original NSSM details queuing issues on the southbound carriageway due to high numbers of vehicles leaving the carriageway at this junction. There have been no changes to the calibration of the turning movement between the carriageway and the offslip that was added as part of the original NSSM. There is also no difference in V/C across the whole of the junction between the original and enhanced NSSM.

3.69 The original NSSM did not reflect the blocking back from the Queensway junction that can emerge during the PM peak period and reach back to Junction 21. The original NSSM did state that the journey times on this route did match well with Trafficmaster observed travel time data. This enhanced model also matches well along this route.

Summary

3.70 Although matrix estimation has not been undertaken in the build of the enhanced NSSM, the results show that the calibration is broadly similar to the original NSSM with the enhancements undertaken. In addition, validation has not been negatively impacted in the enhanced model compared with the original NSSM.

3.71 Therefore, given these results, it has been concluded that this model is robust enough to be taken forward for forecasting.

Note on COVID Impacts

3.72 For this study, the base year of the model is 2018 which is pre-COVID. As indicated in TAG unit M4, there is a need to understand the impact of COVID on traffic flows at a local level compared with forecasted growth from the National Trip End Model (NTEM) and undertake a proportionate forecasting approach if deemed necessary to bring the forecast in line with post-COVID traffic levels before using NTEM.

3.73 For this, we have looked at seven permanent ATC sites across North Somerset as well as locations along the M5 for three months in 2018 (base year) and 2023 (present day), to be compared against each other and against the estimated growth outlined in NTEM. TEMPro growth for the North Somerset is around 4% over this period (and between 4 and 6% across Somerset, the South West (as defined in TEMPro), and GB as a whole).

3.74 The results show that there is a variable difference in growth between 2018 and 2023 compared with the Trip End Model Presentation Program (TEMPro) which houses the NTEM forecasts. This COVID analysis is shown in Appendix E.

3.75 Looking at observed traffic flows during this period comparing 2018 and 2022 12-hour flows over a three-month period (Mar to May):

- On the SRN, observed flows show varying changes between -1 to 4% over the period comparing annual traffic.
- Across other routes in North Somerset, change in flow is much more varied. For example, one location (Colliters Way, SBL) has a 5-day increase of up to 15% from 2018, whereas the A370 Main Road in Flax Bourton sees a 7-day decrease of around 18% from 2018.

3.76 The data shows that there is no compelling evidence that there is a change in flows due to COVID. Given this, and that economic appraisal is not part of this study, we are recommending that a proportionate response is to undertake no change to the current forecasting process. The data shows that forecasting using NTEM growth factors from 2018 to 2041 without rebasing/reforecasting will not underrepresent traffic levels on the network and hence will not systematically underestimate the impacts of developments.

Public Transport

3.77 A TRACC-based PT model has been developed to assess the potential impact of mitigation measures on mode shift under different development scenarios. This model is intended to provide public transport generalised costs to inform the DIADEM Variable Demand Model. Prior to the project, no existing public transport model for the North Somerset area was available, prompting the need for the development of a new model.

3.78 TRACC software is a multi-modal transport accessibility analysis tool. TRACC analysis calculates travel times for non-highway modes (including rail, bus, walking and cycling) to give accurate journey times from many origins to many destinations in one calculation. It uses a physical network (i.e. roads and rail tracks) and public transport timetables to analyse travel times, distances, and accessibility across a defined network.

3.79 The creation of a TRACC model allowed for the assessment of journey times to various origin/destination points within and just beyond the North Somerset border using a pre-determined set of parameters. Although not a traditional form of public transport assignment model, TRACC can be used effectively to produce the data that would inform variable demand modelling (generalised cost of travel by public transport). An advantage to its use is that the PT network and service data is readily available in suitable format, and models do not require complex calibration.

3.80 Using procedures within TRACC, PT travel times and distances for origin and destination movements corresponding to the NSSM zone system have been extracted as key inputs into the variable demand model. These PT cost matrices reflect the bus and rail service routes and timetables in the base year. By including new or enhanced PT services proposed as mitigation for developing scenario impacts, we can capture the effect on origin-destination PT generalised costs.

PT Model Construction

3.81 The model base year matches the highway model base year of 2018. The PT network was created using OpenStreetMap, with timetables obtained from DataCutter (a licenced repository of publicly available GTF (general transit feed) specifications). Timetable data has been included for the following PT modes:

- Bus.
- Coach.
- Rail.
- Ferry.

3.82 Origin and destination locations have been based on the population weighted centroid location of the NSSM zones. This has been done to ensure consistency between the generalised costs of travel calculated from the PT and highway models. Each zone centroid is linked to the walk network at its nearest point, and trips will use this walk network to access PT stops. The walk trip, rather than the centroid, represents the access/egress to PT stops, and therefore reflects any changes in walk network on access/egress times during a test scenario.

3.83 Where centroids were initially located far from the road network, they have been brought closer in order to enable connectivity within the model calculations. In instances where the nearest road link to a centroid was designated as motorway (with walk speed of 0, i.e. no walking allowed), its location was altered towards the nearest alternative road type which allows walking.

Model Calculations

3.84 Route times have been extracted from the TRACC model for each origin/destination pair in the zone system. Route time includes:

- Access walk time.
- Wait time.
- PT in-vehicle time.
- Interchange walk/wait (if relevant).
- Egress walk time.

3.85 The model is able to represent mitigation scenarios in two ways:

- Inclusion of proposed mitigation services in TRACC service timetable – this will be appropriate where a specific new service, or enhanced frequency of existing service is proposed.
- Manual adjustment of cost skim matrix for selected sector to sector movements – this will be appropriate to reflect broad enhancement to PT accessibility.

3.86 Two calculation runs were performed to assess the base network: Origin-Destination and Stop Frequency.

3.87 The Origin-Destination calculation represents a network accessibility calculation which can provide travel time or distance from origin to destination by varied modes of transport (public transport and walk, cycle and car). For the purposes of the project, a 'Public Transport and Road Network' combined calculation mode was selected, to calculate travel times using both the activated PT network and activated road network. For this form of calculation, walking time is determined using the road links in the road network between origin/destination points to the PT stops and between PT stops.

3.88 Key parameters inputted into the Origin-Destination model calculation are outlined in Table 3-23.

Table 3-23: Key OD TRACC Parameter Inputs

Parameter	Input	Explanation
PT Mode	Bus, Coach, National Rail & Ferry	Choice of PT modes to be assessed.
Day/Time	Monday	Day of the week that the calculation is based on.
Start/End Time	07:00 – 19:00	Time of day when the calculation is run from/to.
Walk Speed	4.8Km/h	The walk speed when not on the network. Only applies to the walk between an origin and the road network, the road and a destination, and point where a PT stop is located off a road. When walking ON a road network, the default speeds internal to TRACC are used.
Walk Variance (when not on network)	4.0	Represents a multiplier applied to the straight-line distance from an origin point, a destination or PT stop to the nearest point on the road network. Accounts for any variation in the route taken, given that the route is unlikely to be a straight line.
Max. O/D Distance (as the crow flies)	200Km	This is the maximum straight-line distance from an origin to a destination. O/D pairs with a straight line greater than specified (e.g. 100km) are ignored in the calculation.
Maximum Internal Connection Distance	500 Meters	Represents the interchange distance between PT services. This is the maximum distance the calculation allows to walk between two different PT stops mid-journey. Connection distance applied to the road network (due to the inclusion of the 'Use road network for internal interchange' parameter, see below).
Interchange Penalty	5 Minutes	A time applied when interchanging between services. Added in the middle of the journey before boarding the next service, not at the end.
Use Road Network for Internal Interchange	True	Allows utilisation of the road network for interchanging from stop to stop.
Direction	Outbound	The direction used when calculating travel time/distance – outbound calculates from origin to destination.
Max. External Connection Distance	800 / 2000 / 5000 meters (see 3.89)	The maximum straight-line distance travelled from the origin to the nearest road, and from the nearest road to the destination. Access to the road network only granted to the closest road link.
Max. Connection Distance to First Stop	2000 / 2000 / 5000 meters (see 3.89)	A straight-line buffer with a radius of Xm that sits around the origin point and the destination point. Only stops within these buffers can be used as first or las stops for the journey, and

Source: Visography TRACC Help Guide v.1.2.1

3.89 Due to the nature of the TRACC software, pre-determined input distances were required for the Maximum External Connection Distance and Maximum Connection Distance to First Stop. As these represent maximum distances from O/D points to the road network and nearest PT stops respectively, there is a risk that too short a distance could prevent some O/D points from being accessible within the model, whilst too great a distance could over-estimate accessibility (especially in rural areas). As such, three separate model runs were completed (with all other input parameters kept the same), with the variations in distance parameters shown in Table 3-24. Whilst c.3,906 O/D points were not accessible within both Run 1 and 2, this number was reduced to c.786 O/D points in Run 3 – low enough for 5km distances to be taken forward as the parameter values used within both the base network and forecast model calculations.

Table 3-24: Variations in Base Network TRACC Model Runs

Parameter	Run 1 (Standard TRACC inputs)	Run 2 (2km)	Run 3 (5km)
Max. External Connection Distance	800m	2000m	5000m
Max. Connection Distance to First Stop	2000m	2000m	5000m

3.90 The locations of centroids (O/D points) for all inaccessible pairings were assessed using GIS, and all deemed to be plausible (being located in suitably rural/inaccessible areas).

3.91 Stop frequency calculations were also carried out in parallel with each iteration of the OD calculation runs. The stop frequency calculation presents an overview of the frequency of PT services at each stop. For the purposes of the project, the data output took the form of a .CSV report.

3.92 As with the OD calculation, the stop frequency run required several key parameters to be input prior to running, displayed in Table 3-25.

Table 3-25: Key Stop Frequency TRACC Parameter Inputs

Parameter	Input	Explanation
PT Mode	Bus, Coach, National Rail & Ferry	Choice of PT modes to be assessed.
Day/Time	Monday	Day of the week that the calculation is based on.
Start/End Time	07:00 – 19:00	Time of day when the calculation is run from/to.
Set Frequency	Service Frequency	Choice of either: *Service Frequency:* Provides the frequency value (number of services per hour) for the service that has the highest frequency at each stop that meet the transport mode and time criteria specified. *Combined Stop Frequency:* Provides a total frequency value for all services at that stop that meet the transport mode and time criteria specified. Result is the sum of all service frequencies.

3.93 Service Frequency was selected as the Set Frequency input, in order to represent the main levels of service provided at each PT stop. This also avoids generating values for wait times at stops with multiple services being much lower in the model than in reality. It must be noted however, that wait times for infrequent services sharing stops with more frequent routes will be underestimated when using this Set Frequency parameter.

Variable Demand Model

Introduction

3.94 This chapter discusses the development, calibration, and validation of the Variable Demand Model (VDM). As noted in TAG Unit M2.1, there is a presumption that the effect of variable demand impacts should be estimated quantitatively unless there is a compelling reason not to do so. TAG Unit M2.1 §2.2 notes that 'it may be acceptable to limit assessment to a fixed demand analysis if there is no congestion or crowding on the network in the forecast year under current conditions.

3.95 Current evidence demonstrates congestion, and delay exists across the highway network under current conditions. Therefore, there is no compelling reason not to quantitatively assess the effects of variable demand in the traffic forecasting.

3.96 Note that when TAG Unit M2.1 is referred to, this is the unit current at the time of model development i.e. the version published in May 2023.

Model Form

3.97 The VDM has been developed within the standard Department for Transport (DfT) tool DIADEM (Dynamic Integrated Assignment and Demand Modelling).

3.98 DIADEM is designed to enable practitioners to set up and run variable demand models. It allows for setting up a multi-stage transport demand model and finding equilibrium between demand and supply, using the SATURN package as the highway supply model. The process iterates between demand calculations and highway assignments until a converged solution is reached.

3.99 DIADEM is compliant with TAG with respect to model form, most notably model hierarchy and incremental nature of the model. The approach makes use of cost changes from relative differences between Base Year and Forecast Year travel costs, operated using a pivot point approach. Thus, the demand model form is incremental rather than absolute, which estimates changes in trip patterns relative to a set of reference demand matrices derived from observed data.

3.100 Forecast changes in demand from the reference point are based on relative changes in travel costs and journey times. Changes in demand due to external factors such as population, employment and income, are applied separately to establish the reference matrices from the Base Year demand.

Segmentation

3.101 Table 3-26 describes the model segmentation within the VDM with respect to modelled time periods and journey purposes and modes.

Table 3-26: VDM Segmentation Parameters

Parameter	Values	Notes
Modelled Time Slices	AM = 07:00-10:00 IP = 10:00-16:00 PM = 16:00-19:00 OP = 19:00-07:00	AM, IP, and PM travel costs derived from average period hour calibrated assignments. OP travel costs have been derived from an uncalibrated assignment of average hour data OP demand onto the IP network to represent uncongested conditions.
Time Period Factors	AM = 3 IP = 6 PM = 3 OP = 12	Simple calculation consistent across all movements and purposes as average period demand is assigned.
Assigned User Classes	From assignment models: – Car Employer's Business – Car Commute – Car Other – Light Goods Vehicles – Heavy Goods Vehicles	
VDM Demand Segments	Demand Segments (DS): 1. Home Based Employer's Business 2. Non-Home-Based Employer's Business 3. Home Based Work 4. Home Based Other 5. Non-Home Based Other 6. Light Goods Vehicles 7. Heavy Goods Vehicles 8. Fixed Employer's Business 9. Fixed Work 10. Fixed Other	Fixed elements relate to External-to-External travel patterns that are assumed not to be subject to VDM response.

3.102 Home-based demand segments are represented as all-day Production-Attraction (PA) demand, whilst non-home-based demand segments are represented as average hour Origin-Destination (OD) demand. All demand segments represent car available travel only.

3.103 A representation of Public Transport (PT) is required for the VDM. Base Year PT demand was derived from the highway demand by applying the relative proportions of car to PT travel calculated from 2011 Census Journey-to-Work (JTW) data. PT travel cost matrices were extracted from the TRACC PT model. PT fare matrices were derived based on the Regional Traffic Model (RTM) distance-based fare function below:

$$F = 0.28d^{0.9}$$

Where: F is the fare, d is the in-vehicle distance, derived from the TRACC analysis.

3.104 Both highway and PT responses are modelled for the home-based and non-home-based demand segments. Forecast highway travel costs respond to changes in demand within each demand-supply loop in DIADEM, whilst PT costs are fixed. Goods vehicle traffic does not have a demand response, but route choice is modelled within the highway assignment.

3.105 The zone system within the demand model is identical to the zone system applied in the NSSM.

Generalised cost formulation

3.106 Generalised costs of travel are calculated using the guidance set out in TAG Unit M2. Within the DIADEM software, generalised costs of travel are represented in units of time, specifically generalised minutes. The formulation of the generalised costs of travel are given below:

$$G_{car} = 60.\left(t + \frac{VOC.d + toll}{VoT}\right)$$
$$G_{PT} = 60.\left(t + \frac{fare}{VoT}\right)$$

Where: G_{car} and G_{PT} are the generalised cost of travel for car and PT respectively

t is the travel time

d is the trip distance

$toll$ and $fare$ represent any monetary costs

VoT is the value of time, varying by purpose

VOC is the vehicle operating cost

3.107 The highway travel times, toll costs and trip distances are calculated by skimming the reference and forecast SATURN assignments. This happens automatically during the DIADEM run.

3.108 Public transport fare and perceived travel time (with appropriate weightings for walk, wait, in-vehicle, and interchange time) matrices were defined as fixed inputs into the VDM.

3.109 Values of time and vehicle operating costs applied to the highway and public transport cost matrices were derived from the May 2025 TAG Databook. This is consistent with the economic parameters applied in the highway assignment model.

Generalised cost parameters

3.110 The generalised cost parameters used in the VDM have been derived from the May 2025 TAG Databook. This is the same TAG Databook used to define the Value of Time and Vehicle Operating Cost values in the highway assignment.

3.111 Values of Time (VoT) and Vehicle operating Cost (VOC) are shown for the 2018 Base Year in Table 3-27.

Table 3-27: Generalised cost parameters for the 2018 Base Year (pence per hour)

Demand Segment	Highway VoT	Highway VoC	PT VoT
Home-based employer's business	1891.14	18.14	2286.21
Non-home-based employer's business	1891.14	18.14	2286.21
Home-based work	1256.54	9.34	1528.23
Home-based other	900.67	9.34	697.53
Non-home-based other	900.67	9.34	697.53

Cost damping

3.112 TAG Unit M2.1 states that it may be necessary to include cost damping within the realism testing phase of the VDM. This is due to strong evidence that the sensitivity of demand responses to changes in generalised cost will reduce with increasing trip lengths.

3.113 There are two common approaches to cost damping set out in TAG:

- Varying cost as a function of distance, with common cost damping parameters are set out related to the distance function (TAG Unit M2.1 §3.3.15); and
- A power function of utility, for which common cost damping assumptions referred (TAG Unit M2.1 §3.3.18), for which a beta value of 0.75 (centre of range) was assumed and a value for mu estimated to set the mean generalised cost.

3.114 The function of distance approach was selected. Cost damping is informed by realism testing. Therefore, this is an iterative process within realism testing. Within TAG, commonly used values are provided (α: 0.5, k: 30km, d': 30km); however, these are merely a guideline. TAG suggests that values are experimented with such that the results of the realism tests accord with TAG.

3.115 The final cost damping parameters applied in the NSSM VDM are shown in Table 3-28.

Table 3-28: Cost Damping Parameters

	K		A		d'	
	HW	PT	HW	PT	HW	PT
HB Emp Bus	60	60	0.8	0.4	60	60
NHB Emp Bus	60	60	0.8	0.4	60	60
HB Commute	17	17	0.1	0.2	17	17
HB Others	10	10	0.5	0.4	10	10
NHB Others	10	10	0.5	0.4	10	10

Choice model equations

3.116 The VDM is a hierarchical logit model operated via an incremental pivot point approach against the calibrated Base Year model. This calculates the likelihood of travellers making one choice over many alternatives based on changes in travel costs. Mode, destination and (macro) time period choices are represented in the demand model.

3.117 The time period choice formulation is as follows:

$$T_{t*i*} = T_{**i*} \cdot \frac{\sum_{mj} T^0_{tmij} e^{\theta_t \Delta C_{t*i*}}}{\sum_{tmj} T^0_{tmij} \, e^{\theta_t \Delta C_{t*i*}}}$$

3.118 with the change in composite travel cost across all modes calculated as follows:

$$\Delta C_{t*i*} = ln\left(\frac{\sum_{mj} T^0_{tmij} e^{\theta_m \Delta C_{tmi*}}}{\sum_{mj} T^0_{tmij}}\right)$$

3.119 The mode choice formulation, for choice between car and public transport, is then given by:

$$T_{tmi*} = T_{t*i*} \cdot \frac{\sum_j T^0_{tmij} e^{\theta_m \Delta C_{tmi*}}}{\sum_j T^0_{tPij} \, e^{\theta_m \Delta C_{tPi*}} + T^0_{tCij} e^{\theta_m \Delta C_{tCi*}}}$$

3.120 with the change in composite travel costs by mode calculated as follows:

$$\Delta C_{tmi*} = \ln\left(\frac{\sum_j T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}{\sum_j T^0_{tmij}}\right)$$

3.121 Finally, trip distribution is calculated as a function of the change in generalised cost as follows:

$$T_{tmij} = T_{tmi*} \cdot \frac{T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}{\sum_j T^0_{tmij} e^{\lambda_d \Delta C_{tmij}}}$$

3.122 with the change in generalised cost of travel, ΔC_{tmij}, calculated directly from the highway assignment skims.

3.123 In these formulations, the following parameters are used:

T_{tmij} is the output demand

T^0_{tmij} is the input demand

ΔC_{tmij} is the change in composite travel cost

θ_t is the time period choice sensitivity parameter

θ_m is the mode choice sensitivity parameter

i is the production or origin

j is the attraction or destination

t is the time period

m is the mode

$*$ represents aggregation across production, attraction, time period or mode

C is the car mode and P is the public transport mode.

3.124 In-line with guidance in TAG Unit M2.1, commuting trips are doubly constrained to ensure each zone produces and attracts a fixed number of total trip ends. Employer's business and other trips are singly constrained at the production end.

Choice model sensitivity parameters

3.125 Mode, destination and (macro) time period choices are represented in the demand model. The destination parameters give the sensitivities per minute of generalised car time; the mode and time parameters define the sensitivity of these choices relative to destination choice. These parameters imply that mode and (macro) time period choices are equally sensitive to changes in generalised car time.

3.126 In line with guidance in TAG Unit M2.1, destination choice sensitivity parameter values and main mode choice scaling factors are applied to composite costs of travel. The main mode choice scaling factors used are the median TAG values taken from TAG M2.1 current at the time of model development, shown in Table 3-29. Destination choice parameter values, shown in Table 3-30, have been calibrated through realism testing and are all within +/- 25% of the median values presented in TAG M2.1 current at the time of model development.

Table 3-29: TAG Median Main Mode Choice Scaling Parameters Used in NSSM VDM

Trip Purpose	NSSM Main Mode Choice Scaling Parameter
Home-based employer's business	0.45
Non-home-based employer's business	0.73
Home-based work	0.68
Home-based other	0.53
Non-home-based other	0.81

Table 3-30: Destination Choice Sensitivity Parameters Used in NSSM VDM

Trip Purpose	Car Median Value	Car NSSM Value	Car % Diff	PT Median Value	PT NSSM Value	PT % Diff
Home-based employer's business	0.067	0.050	-25%	0.036	0.027	-25%
Non-home-based employer's business	0.081	0.061	-25%	0.042	0.032	-25%
Home-based work	0.065	0.081	+25%	0.033	0.041	+25%
Home-based other	0.090	0.113	+25%	0.036	0.045	+25%
Non-home-based other	0.077	0.096	+25%	0.033	0.041	+25%

Convergence

3.127 All variable demand models iterate between the demand model and the assignment (or supply) model. This is because the volume of demand affects highway travel times, which in turn affect the volume of demand and so on.

3.128 It is important to monitor the convergence of this iterative process. Poor convergence causes noise in the model outputs, which in turn introduces errors into subsequent analyses such as economic and environmental appraisal.

3.129 TAG requirements for VDM convergence are set out in TAG Unit M2.1 §6.3. This defines the demand/supply gap as the preferred measure of convergence and states that 'tests indicate that gap values of less than 0.1% can be achieved in many cases, although in more problematic systems this may be nearer to 0.2%. Where the convergence level, as measured by the %GAP, is over 0.2% remedial steps should be taken to improve the convergence, by increasing the assignment accuracy.'

3.130 Convergence of the demand model was calculated over the whole model. Based on TAG guidance, the stopping criteria in DIADEM was set to 0.1%.

3.131 The gap values achieved during realism testing, along with the number of demand-assignment loops required, are shown in Table 3-31. This shows that all realism tests converged to a gap value of less than 0.1% within 10 iterations.

Table 3-31: Realism test convergence statistics

Realism Test	% Gap	Number of Loops
Fuel Cost Realism Test (10%)	0.08%	9
Fare Realism Test (10%)	0.09%	9

Calibration

3.132 The VDM has been calibrated using realism tests as defined in TAG Unit M2.1 §6.4.

3.133 Outturn demand elasticities have been calculated using the formula specified in the guidance:

$$e = \frac{\log(T^1) - \log(T^0)}{\log(C^1) - \log(C^0)}$$

Where: T^1 and T^0indicate values of demand in the test and base runs

C^1 and C^0 indicate levels of cost in the test and base runs

3.134 The realism of both fuel cost vehicle kilometre elasticities and public transport fare elasticities have been assessed by running tests in the VDM. Highway travel time elasticities have been estimated from the fuel cost realism test. This is explained in the next sections.

Fuel cost realism test

3.135 The latest iteration of the Base model introduces changes confined solely to the Generalised Cost parameter. No network modifications or adjustments to demand model components have been made. Given that the underlying demand relationships and model structure remain unchanged, the adjustment to the Generalised Cost parameter is expected to have only a negligible effect on overall sensitivity. Therefore, a rerun of the elasticity test is not considered necessary.

3.136 The fuel price realism test analysed the impact on car vehicle kilometres with respect to a 10% increase in car fuel costs.

3.137 The guidance on fuel cost elasticities in TAG Unit M2.1 §6.4 states that the overall annual fuel cost elasticity across purposes should lie in the range -0.15 to -0.35. Guidance around expected purpose variation is also provided as follows:

- values for business travel are expected to be in the region of -0.1;
- values for commuting are expected to be in the region of -0.25; and
- values for discretionary travel are expected to be closer to -0.4.

3.138 The outturn fuel cost elasticities for the VDM are reported for trips originating in the internal model area and are shown in Table 3-32.

Table 3-32: Internal area fuel cost elasticities, by purpose and time period

Purpose	AM	IP	PM	Annual
Employer's Business	-0.23	-0.23	-0.13	**-0.20**
Home Based Work	-0.14	-0.14	-0.12	**-0.13**

Other	-0.38	-0.36	-0.27	**-0.34**
All Purpose	**-0.25**	**-0.30**	**-0.19**	**-0.25**

3.139 Table 3-32 shows that elasticity of car trip distance with respect to a 10% increase in car fuel cost is within the criteria range presented in TAG.

3.140 Further analysis was undertaken to assess the elasticities only for trips originating in areas accessible to Weston-super-Mare, Worle, Yatton, and Nailsea & Backwell train stations. This represents a corridor within which mode shift between car and PT would be more achievable than in the rural areas of the authority. The elasticities for this sub-area are shown in Table 3-33, and are closer to the TAG values.

Table 3-33: Fuel cost elasticities along rail corridor, by purpose and time period

Purpose	AM	IP	PM	Annual
Employer's Business	-0.24	-0.24	-0.14	**-0.22**
Home Based Work	-0.16	-0.16	-0.15	**-0.16**
Other	-0.40	-0.38	-0.27	**-0.36**
All Purpose	**-0.26**	**-0.33**	**-0.21**	**-0.28**

3.141 Using the fuel realism test results, highway journey time elasticities for the internal model area were estimated and are shown in Table 3-34. As described in TAG Unit M2 (May 2025), the elasticities with respect to highway journey times should be no greater than -2.0 for all journey purposes. This shows that all elasticities are lower than the TAG criteria and shows a sensible pattern across the purposes and by time period with the AM being higher than the inter-peak, which in turn is higher than the PM.

Table 3-34: Internal area journey time elasticities, by purpose and time period

Purpose	AM	IP	PM	Annual
Employer's Business	-0.54	-0.49	-0.29	**-0.45**
Home Based Work	-0.58	-0.48	-0.48	**-0.53**
Other	-1.14	-0.97	-0.85	**-0.98**

Public transport fare realism test

3.142 The public transport fare realism test analysed the impact on public transport trips in response to a 10% increase in public transport fares.

3.143 TAG Unit M2.1 quotes a public transport fare elasticity range of -0.2 to -0.9, i.e. a relatively wide range of values, based on 2004 TRL (Transport Research Laboratory) work.

3.144 The public transport fare elasticities for the VDM are reported for trips originating in the internal model area in Table 3-35. This shows that the annual outturn elasticities for each purpose are within the criteria range set out in TAG.

Table 3-35: Public transport fare elasticities, by purpose and time period

Time Period	AM	IP	PM	Annual
Employer's Business	-0.44	-0.42	-0.37	**-0.42**
Home Based Work	-0.47	-0.47	-0.49	**-0.47**
Other	-0.30	-0.41	-0.26	**-0.32**
All Purpose	**-0.38**	**-0.42**	**-0.32**	**-0.39**

Summary

3.145 The VDM for this enhanced North Somerset Strategic Model has been developed in DIADEM and its build has been defined and aligned to TAG.

3.146 The VDM is a hierarchical logit model operated via an incremental pivot point approach against the calibrated Base Year model. The model has three demand responses: macro time period choice, mode choice, and destination choice.

3.147 The model has been subjected to realism testing and this shows that responses are within the criteria specified in TAG.

4. Forecast Model Development

Forecast Year Model Updates

4.1 For this North Somerset Local Plan modelling, three 2041 scenarios have been created. These are:

- 'Without Local Plan' Scenario.
- 'With Local Plan' Scenario.
- 'With Local Plan plus Mitigation' Scenario.

4.2 Each of those will be discussed in turn in this report. The assumptions for these scenarios are also detailed in the Modelling Trip Generation Note (Stage 7 Modelling - Trip Gen Note v6.0) which is included as an Appendix to the TA and therefore should be read alongside the following chapters.

Update to Value of Time (VoT) and Vehicle Operating Cost (VOC)

Highway Model

4.3 The PPM and PPK values have been updated using the values from the May 2025 TAG Databook, with HGV values for PPM have been factored by two in accordance with guidance outlined in Section 3.

4.4 Table 4-1 shows the PPM and PPK factors used for the 2041 Forecast Scenarios.

Table 4-1: PPM and PPK Values used for 2041 Forecast Scenarios

		AM Peak		Inter Peak		PM Peak	
		ppm	ppk	ppm	ppk	ppm	ppk
2041 Forecast Scenarios	Car Commute	39.73	7.87	40.71	7.87	40.3	7.87
	Car Employer's Business	26.64	3.62	27.08	3.62	26.73	3.62
	Car Other	18.38	3.62	19.58	3.62	19.25	3.62
	LGV	29.54	12.37	29.54	12.37	29.54	12.37
	HGV	61.72	40.96	61.72	40.96	61.72	40.96

Variable Demand Model

4.5 The 2041 values of time and vehicle operating costs input into the VDM are shown in Table 4-2.

Table 4-2: Generalised cost parameters for the 2041 'Without Local Plan' forecast year

	Highway VoT (pence per hour)	Highway VOC (pence per km)	PT VoT (pence per hour)
Home based employer's business	2422.34	7.87	2927.89
Non-home-based employer's business	2422.34	7.87	2927.89
Home based work	1609.50	3.62	1957.17
Home based other	1153.66	3.62	893.31
Non-home-based other	1153.66	3.62	893.31

Forecast Year Growth Calculation

Growth Rates for Car Demand within North Somerset Local Authority

4.6 As outlined in the ASR, highway trip growth between base year and future year has been based upon the forecast growth contained in the National Trip End Model (NTEM), at a spatial area consistent with the defined zone system. 'With Local Plan' modelling, the approach is to include both committed and Local Plan developments within the 'With Local Plan' scenario and constrain this to TEMPro growth at a NSC level. This allows total demand to meet NTEM levels with the location of the growth amended to reflect the proposed Local Plan strategy.

4.7 To growth the 2018 base demand up to 2041, growth forecasts for cars have been calculated using the TEMPro 8 software and NTEM 8.0 dataset. Growth forecasts have been calculated for 2041 which is the extent of the Local Plan period.

4.8 Growth factors have been calculated for the following geographical areas:

- Middle Layer Super Output Area (MSOA) level within North Somerset using alternative assumptions based on information captured in the Uncertainty Log.
- District level for all districts surrounding the North Somerset region (i.e. City of Bristol, Bath and North East Somerset, South Gloucestershire, Mendip, Sedgemoor).
- County level for all counties within the South West outside of this area (i.e. Cornwall, Devon, Dorset, Wiltshire, Somerset and Gloucestershire).
- Regional level for all other regions outside of the South West (for example, East Midlands and Wales).

4.9 For the North Somerset area, the forecast growth as taken from TEMPro v8.0 is shown in Table 4-3. This table also compares the number of dwellings and jobs assumed as part of the committed developments and the Local Plan to be compared with TEMPro.

4.10 It should be noted for this strategic modelling, only housing developments over 100 dwellings and employment sites over 1 hectare have been included and allocated to the responding MSOA. Any sites less than these sizes would be incorporated within the remaining TEMPro growth.

Table 4-3: TEMPro vs Local Plan and Committed Development Growth: North Somerset

	Households					
	TEMPro Growth			Committed and Local Plan information from NSC (over 100 dwellings)		
	2018	2041	*Growth*	No of committed dwellings	No of Local Plan dwellings	Difference
North Somerset (total)	94,145	109,920	*15,775*	4,958	13,105	-2,288

	Jobs					
	TEMPro Growth			Committed and Local Plan information from NSC (over 1 hectare)		
	2018	2041	*Growth*	No of committed jobs	No of Local Plan jobs	Difference
North Somerset (total)	96,402	105,316	*8,914*	6,063	6,286	-3,435

4.11 For dwellings, TEMPro states that between 2018 and 2041, 15,775 houses will be built in North Somerset between 2018 and 2041, compared with 18,063 dwellings specified as committed or as part of the Local Plan. To ensure that household growth is constrained to TEMPro, it has been decided to constrain household growth at a wider spatial level. TAG M4 paragraph 7.3.4: "*Adjustments may be required based on local uncertainty assumptions, but at an appropriate spatial level growth must be constrained to NTEM to avoid optimism or pessimism bias*". Therefore, it was decided to constrain household growth to a WECA level (across the City of Bristol, B&NES and South Gloucestershire). This would suggest that growth in North Somerset may be higher than other WECA regions.

4.12 For jobs, TEMPro states that there will be 8,914 jobs created in North Somerset between 2018 and 2041, compared with 12,349 jobs specified as committed or as part of the Local Plan (of those developments greater than 1 hectare). To ensure that job growth is constrained to TEMPro, it has been decided to constrain employment growth at a wider spatial level. TAG M4 paragraph 7.3.4: "*Adjustments may be required based on local uncertainty assumptions, but at an appropriate spatial level growth must be constrained to NTEM to avoid optimism or pessimism bias*". Therefore, it was decided to constrain job growth to a WECA level (across the City of Bristol, B&NES and South Gloucestershire). This would suggest that growth in North Somerset may be higher than other WECA regions.

4.13 Table 4-4 shows the update to TEMPro growth for households across the WECA region, with a proportionate reduction in households across the other three regions to accommodate the additional growth in North Somerset that has been used in this modelling.

4.14 Table 4-5 shows the update to TEMPro growth for employment across the WECA region, with a proportionate reduction in jobs across the other three regions to accommodate the additional growth in North Somerset that has been used in this modelling.

Table 4-4: Household: Constrained to WECA levels

	Households (constrained to WECA)					
	TEMPro Growth			Committed and Local Plan information from NSC (over 100 dwellings)		
	2018	2041	*Growth*	No of committed households	No of Local Plan households	Difference from TEMPro
North Somerset (total)	94,145	109,920	*15,775*	4,958	13,105	2,288
Bristol, City of	192,511	222,338	*29,827*		28,869	-2,288
South Gloucestershire	116,107	142,781	*26,674*		25,818	
Bath and North East Somerset	78,259	92,992	*14,733*		14,260	

Table 4-5: Employment: Constrained to WECA levels

	Jobs (constrained to WECA)					
	TEMPro Growth			Committed and Local Plan information from NSC (over 1 hectare)		
	2018	2041	*Growth*	No of committed jobs	No of Local Plan jobs	Difference from TEMPro
North Somerset (total)	96,402	105,316	*8,914*	6,063	6,286	3,435
Bristol, City of	271,262	296,368	*25,106*		23,345	-3,435
South Gloucestershire	162,577	176,588	*14,011*		13,028	
Bath and North East Somerset	104,417	114,282	*9,865*		9,173	

4.15 For each of these individual developments (both committed and Local Plan), trip rates have been specified within the Modelling Trip Generation Note. Therefore, for the development of the matrices, these developments have been allocated to the MSOA's they are located and have been removed from the TEMPro growth using alternative planning assumptions to ensure no double counting of growth.

4.16 Each of the MSOAs in North Somerset contain multiple model zones. Depending on the locations of developments, development within an MSOA may not be located within only one model zone. Thus, two sets of alternate planning assumptions are applied:

- For model zones which have specific proposed development sites that were identified within the Uncertainty Log, growth in households and jobs is based on background growth and the additional housing and jobs associated with the proposed developments.
- Background growth only is applied to model zones where specific developments are not proposed to be located within them.

4.17 Growth rates for development and non-development model zones were extracted from the Trip End Model Presentation Program (TEMPro), a viewer for the NTEM dataset. This was done for both origin and destination trip growth at a time period level, and production and attraction trip growth for an average weekday, for each of the MSOAs in the North Somerset Local Authority area.

4.18 Production (P) and attraction (A) growth rates are used for home–based trips, and origin (O) and destination (D) growth rates are applied for non-home-based trips. Table 4-6 shows the growth rates of car trips for development MSOAs in North Somerset Authority, whilst Table 4-7 shows the growth rate of car trips for non-development MSOAs.

Table 4-6: Growth rates for zones with specific developments in North Somerset

North Somerset MSOAs	AM		IP		PM		Average Weekday	
	O	D	O	D	O	D	P	A
E02003065	1.07	1.06	1.07	1.06	1.07	1.06	0.99	1.07
E02003067	1.04	1.06	1.05	1.05	1.04	1.05	0.99	1.05
E02003068	1.05	1.06	1.05	1.05	1.04	1.06	0.99	1.05
E02003069	1.05	1.06	1.06	1.06	1.07	1.06	1.00	1.07
E02003070	1.05	1.05	1.06	1.06	1.07	1.07	0.97	1.06
E02003072	1.06	1.07	1.07	1.07	1.08	1.06	1.01	1.07
E02003073	1.05	1.05	1.06	1.05	1.06	1.05	0.97	1.06
E02003075	1.05	1.06	1.05	1.06	1.05	1.05	0.98	1.05
E02003076	1.06	1.06	1.07	1.07	1.07	1.07	0.97	1.07
E02003077	1.05	1.05	1.05	1.06	1.06	1.07	0.97	1.06
E02003084	1.06	1.06	1.07	1.06	1.07	1.06	1.07	1.08
E02003085	1.06	1.07	1.06	1.06	1.07	1.06	1.07	1.07
E02003087	1.05	1.06	1.06	1.07	1.07	1.08	1.00	1.06
E02003088	1.05	1.05	1.06	1.06	1.06	1.05	0.99	1.06
E02006845	1.06	1.05	1.07	1.06	1.07	1.07	0.98	1.07
E02006846	1.07	1.07	1.07	1.07	1.07	1.06	0.97	1.07

Table 4-7: Growth rates for all other zones with background growth only in North Somerset

North Somerset MSOAs	AM		IP		PM		Average Weekday	
	O	D	O	D	O	D	P	A
E02003066	1.04	1.06	1.04	1.09	1.07	1.08	0.98	1.04
E02003071	1.06	1.05	1.06	1.05	1.06	1.06	1.01	1.07
E02003074	1.05	1.05	1.06	1.07	1.06	1.06	0.97	1.07
E02003078	1.07	1.06	1.07	1.07	1.08	1.07	1.00	1.07
E02003079	1.06	1.07	1.07	1.07	1.08	1.08	0.97	1.07
E02003080	1.05	1.06	1.06	1.05	1.06	1.05	1.04	1.06
E02003081	1.06	1.05	1.06	1.07	1.06	1.08	1.02	1.06
E02003082	1.05	1.05	1.06	1.05	1.07	1.04	1.05	1.06
E02003086	1.03	1.06	1.05	1.04	1.05	1.04	1.04	1.06
E02003089	1.06	1.05	1.06	1.04	1.06	1.03	1.05	1.06

Growth rates for car demand outside North Somerset Local Authority

4.19 For model zones outside North Somerset, growth in demand was taken directly from NTEM. Authority level growth rates were extracted from TEMPro for Authorities in the County of Somerset and the West of England Combined Authority region, whilst County level growth rates were extracted for the remainder of the South West region. Outside of the South West, Region level growth rates were applied. These are shown in Table 4-8 and are in the range of 11-19% growth except for North Somerset which is showing lower growth due to the committed and local plan developments.

Table 4-8: Growth rates applied outside of North Somerset

	Area Description	AM		IP		PM		Average Weekday	
Level	**Name**	**O**	**D**	**O**	**D**	**O**	**D**	**P**	**A**
Authority	Bristol City	1.15	1.15	1.16	1.16	1.16	1.16	1.20	1.17
Authority	South Gloucestershire	1.14	1.15	1.15	1.15	1.15	1.15	1.17	1.16
Authority	Bath and NE Somerset	1.15	1.15	1.16	1.16	1.16	1.16	1.18	1.17
Authority	Mendip	1.14	1.14	1.15	1.15	1.15	1.15	1.12	1.16
Authority	North Somerset	1.06	1.06	1.06	1.06	1.07	1.06	1.03	1.07
Authority	Sedgemoor	1.14	1.14	1.15	1.15	1.15	1.16	1.17	1.16
County	Cornwall	1.15	1.15	1.16	1.16	1.16	1.16	1.19	1.17
County	Devon	1.16	1.16	1.17	1.17	1.17	1.17	1.17	1.18
County	Dorset	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.13
County	Gloucestershire	1.15	1.15	1.16	1.16	1.16	1.16	1.17	1.17
County	Somerset	1.15	1.15	1.16	1.15	1.16	1.16	1.17	1.17
County	Wiltshire	1.14	1.14	1.15	1.15	1.15	1.15	1.14	1.16
Region	Wales	1.11	1.11	1.12	1.12	1.12	1.12	1.12	1.12
Region	West Midlands	1.16	1.16	1.16	1.16	1.16	1.16	1.17	1.17
Region	Yorkshire and Humber	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.13
Region	East	1.12	1.12	1.13	1.13	1.13	1.13	1.13	1.14
Region	East Midlands	1.16	1.16	1.16	1.16	1.17	1.17	1.18	1.18
Region	London	1.14	1.14	1.15	1.14	1.15	1.14	1.19	1.16
Region	North West	1.13	1.13	1.14	1.14	1.14	1.14	1.14	1.14
Region	Scotland	1.12	1.12	1.12	1.12	1.12	1.12	1.13	1.13
Region	South East	1.11	1.11	1.12	1.12	1.12	1.12	1.12	1.13
Region	South West	1.16	1.16	1.17	1.17	1.17	1.17	1.17	1.18
Region	North East	1.12	1.12	1.13	1.13	1.13	1.13	1.13	1.13

Growth rates for public transport trips

4.20 Growth rates for public transport were calculated at the Authority, County and Regional level, without addition of specific development demand. This is at a lower level of disaggregation than applied for car growth and reflects the lower level of detail, and wider uncertainty, in the base year public transport demand matrices. Table 4-9 summarises the growth rate for public transport.

Table 4-9: Public transport trip growth rates

	Area Description	AM		IP		PM		Weekday Average	
Level	Name	O	D	O	D	O	D	P	A
Authority	Bristol City	1.05	1.06	1.04	1.06	1.05	1.06	1.01	1.01
Authority	South Gloucestershire	1.08	1.08	1.06	1.05	1.06	1.05	1.08	1.02
Authority	Bath and NE Somerset	1.06	1.09	1.05	1.07	1.07	1.06	1.04	1.03
Authority	Mendip	1.04	1.02	1.04	1.03	1.04	1.03	0.96	0.99
Authority	North Somerset	1.00	0.96	0.98	0.96	0.98	0.96	0.85	0.93
Authority	Sedgemoor	1.00	1.06	1.05	1.05	1.08	1.04	0.99	1.00
County	Cornwall	1.05	1.04	1.03	1.03	1.04	1.03	1.00	0.98
County	Devon	1.04	1.05	1.04	1.04	1.04	1.04	0.98	0.99
County	Dorset	1.00	0.99	0.99	0.98	0.99	0.99	0.93	0.94
County	Gloucestershire	1.07	1.06	1.06	1.05	1.06	1.06	1.01	1.01
County	Somerset	1.04	1.04	1.04	1.04	1.04	1.05	0.99	0.99
County	Wiltshire	1.05	1.04	1.04	1.04	1.05	1.04	0.99	1.00
Region	Wales	0.95	0.95	0.93	0.93	0.93	0.93	0.87	0.87
Region	West Midlands	1.04	1.04	1.03	1.03	1.04	1.04	1.00	1.00
Region	Yorkshire and Humber	0.98	0.98	0.96	0.96	0.97	0.97	0.93	0.93
Region	East	1.02	1.02	1.02	1.01	1.02	1.02	0.94	0.97
Region	East Midlands	1.05	1.05	1.04	1.04	1.04	1.04	1.00	1.00
Region	London	1.02	1.03	1.03	1.03	1.04	1.04	1.03	1.02
Region	North West	0.99	0.99	0.98	0.98	0.98	0.98	0.94	0.94
Region	Scotland	0.92	0.92	0.90	0.90	0.91	0.91	0.85	0.85
Region	South East	1.00	1.00	0.99	0.98	1.00	0.99	0.94	0.95
Region	South West	1.04	1.05	1.04	1.04	1.04	1.04	0.98	0.99
Region	North East	0.94	0.94	0.92	0.92	0.93	0.93	0.88	0.88

Growth rates for goods vehicles trips

4.21 Growth rates for HGV and LGV were interpolated from data provided in 'Scenario 1' of Road Traffic Forecast 2018 (RTF18), published by the DfT and applied as a global factor to the LGV and HGV demand matrices. 'Scenario 1' provides the central estimate of traffic growth in RTF18. The estimated growth in demand between 2018 and 2041 is 32% for LGVs and 8% for HGVs, as shown in Table 4-10.

Table 4-10: Growth rates for goods vehicles (2018-2041)

		Traffic - Billion Vehicle miles (bvm)					
Vehicle Type	**Road Type**	**2015**	**2018 Interpolated**	**2040**	**2041 Interpolated**	**2045**	**Factor (2018-2041)**
LGV	All	4.1	4.7	6.2	6.2	6.4	1.32
HGV	All	1.4	1.4	1.5	1.5	1.6	1.08

'Without Local Plan' Scenario

Introduction

4.22 The first scenario modelled is the 'Without Local Plan' Scenario. This reflects 2041 demand within North Somerset constrained to TEMPro growth levels with the location of the growth changed to match the Committed Developments strategy.

Committed Developments

4.23 For the committed, reference case growth (which is assumed to be in place regardless of the outcome of the Local Plan), this takes into consideration information provided by NSC and other relevant stakeholders to ensure the local planning data has been included within the model in line with TAG guidance where applicable. This information from North Somerset is shown in Appendix F. Both the list of committed developments and the Uncertainty Log outlines the housing and employment developments planned across the North Somerset. For the purposes of this assessment, an additional study has been undertaken to compare both the information from North Somerset alongside the Uncertainty Log to understand the similarities and the differences between the list and make sure that both sources of data are included within the 'With Local Plan' Scenario.

4.24 The Uncertainty Log allocates developments into one of four categories defined by the likelihood that they will be implemented. These categories are taken from TAG Unit M4 Table A2 as shown in Table 4-11. For the purposes of creating the core demand, only the categories of 'near certain' and 'more than likely' have been included.

4.25 It is assumed that the list of Committed Developments provided from NSC outside of the Uncertainty Log are More Than Likely/Near Certain and therefore outweigh any information within the Uncertainty Log if the development exists in both documents.

4.26 The Uncertainty Log details the size of the development, timing and phasing of developments, location, year of completion and the level of uncertainty in terms of TAG guidance.

Table 4-11: Classification of future inputs

Table A2 Classification of Future Inputs

Probability of the Input	Status	Core Scenario Assumption
Near certain: The outcome will happen or there is a high probability that it will happen.	Intent announced by proponent to regulatory agencies. Approved development proposals. Projects under construction.	This should form part of the core scenario
More than likely: The outcome is likely to happen but there is some uncertainty.	Submission of planning or consent application imminent. Development application within the consent process.	This could form part of the core scenario [Refer to Section Developing the Core Scenario]
Reasonably foreseeable: The outcome may happen, but there is significant uncertainty	Identified within a development plan. Not directly associated with the transport strategy/scheme, but may occur if the strategy/scheme is implemented. Development conditional upon the transport strategy/scheme proceeding. Or, a committed policy goal, subject to tests (e.g. of deliverability) whose outcomes are subject to significant uncertainty	These should be excluded from the core scenario but may form part of the alternative scenarios
Hypothetical: There is considerable uncertainty whether the outcome will ever happen.	Conjecture based upon currently available information. Discussed on a conceptual basis. One of a number of possible inputs in an initial consultation process. Or, a policy aspiration	These should be excluded from the core scenario but may form part of the alternative scenarios

Source: TAG Unit M4 Appendix A

Committed Development Allocations

4.27 The Committed Development allocations are outlined in Table 4-12 for residential and Table 4-13 for employment. Table 4-12 shows the number of dwellings assumed at each location, the location can be seen in Section 3 of the main report. The table also shows the existing donor SATURN zone that has been used to create the trip distribution of the new zone. Table 4-13 shows the size of each employment site assumed at each location. The table also shows the existing donor SATURN zone that has been used to create the trip distribution of the new zone.

Table 4-12: Demand for 'Without Local Plan' Scenarios, Residential (Committed)

Housing Development	SATURN Zone	Donor Zone	Type of development	No of houses
Parklands Village	90025	30024	Committed	2671
Winterstoke Village	90010	30014	Committed	1229
Locking Road Car Park	90011	30008	Committed	230
Land west of Winterstoke Road	90020	30009	Committed	134
Sunnyside Road	90021	30009	Committed	120
Youngwood Lane	90003	30089	Committed	329
Dark Lane, Backwell	90036	30130	Committed	125
Monaghan Mushroom Farm, Stock Lane, Langford	90041	30081	Committed	120

Table 4-13: Demand for 'Without Local Plan' Scenarios, Employment (Committed)

Employment Development	SATURN Zone	Donor Zone	Type of development	Site area (ha)
Haywood Village Business Quarter, Weston-super-Mare	90004	30014	Committed	21.5
Gordano Gate, Portishead	90014	30139	Committed	1.1
West Wick Business Park, Weston-super-Mare	90012	30032	Committed	5.3
Summer Lane, North of A370, Weston-super-Mare	90019	30167	Committed	2.24
Moor Park, A371	90017	30014	Committed	1.23
Land to the west of Kenn Road, Clevedon	90018	30063	Committed	9

Trip rates – Committed Developments

4.28 For committed sites, trip rates have been allocated from the list provided within the Modelling Trip Generation note. Trip rates have been chosen based on the size and location of the proposed committed development.

Table 4-14: Trip Rates used for Committed Developments

Location	Trip Rate Location
Parklands Village	Edge of Town/Suburban
Winterstoke Village	Edge of Town/Suburban
Locking Road Car Park	Town Centre/Edge of Town Centre
Land west of Winterstoke Road	Edge of Town/Suburban
Sunnyside Road	Town Centre/Edge of Town Centre
Youngwood Lane	Edge of Town/Suburban
Dark Lane, Backwell	Edge of Town/Suburban
Monaghan Mushroom Farm, Stock Lane, Langford	Edge of Town/Suburban

Highway Network – Committed Schemes

4.29 The Uncertainty Log provided by North Somerset Council outlines the housing and schemes that are planned for the North Somerset region. In terms of the highway network, infrastructure schemes that are 'near certain' or 'more than likely' have been included within the assessment, in line with TAG guidance. The Uncertainty Log is shown in Appendix E.

4.30 The highway improvement schemes coded onto the Base Year network to create the 2041 'Without Local Plan' highway network are:

- J21 Northbound Merge Scheme.
- Banwell Bypass.
- North – South Link Road at Locking Parklands.
- Junction Improvements along A38.
- BSIP Schemes – these were discussed and agreed with NSC based on designs available at the time of modelling.
- Wolvershill Developments Eastern Link Road.

4.31 Key points of the schemes are elaborated below.

J21 Northbound Merge Scheme

- The existing northbound merge is currently a single lane. This scheme increases this to two lanes wide to increase traffic capacity from Weston-super-Mare onto the motorway.
- Within the model, the scheme has been implemented by adding an additional lane and doubling the capacity at the merge.

Banwell Bypass

- The Banwell Bypass scheme has been taken from the Banwell Bypass modelling provided by National Highways. The scheme runs to the north of Banwell, with a roundabout at the western end of the bypass located to the east of Summer Lane, and a priority junction to the east of Banwell located near Towerbrook, which will then remove through traffic through the centre of Banwell. The bypass also has junctions with Wolvershill Road and Moor Lane (although the latter is not included within this modelling due to the minor nature of the road).
- At the junction with Wolvershill Road, which is modelled as signal controlled, the southern section of Wolvershill Road is open only for buses or active travel.

- The scheme also involves some minor changes to the eastern end of Banwell, with a new alignment to link the A368 to Castle Hill to remove pressure on the current junction at East Street/Castle Hill.

North – South Link Road at Locking Parklands

- The North / South Link Road acts as a connection between A371 and Churchland Way.
- Scheme details are sourced from North Somerset council website[1].
- Single lane configuration has been assumed throughout North-South Link Road. Spigots for zone loaders are provided along Lower Parade Ground Road and Anson Road.

Junction Improvements along A38

- Information has been taken from the public consultation on these proposals (https://a38mrn-engagement.com/).
- Barrow Gurney Junction Improvement: changes to improve the traffic signals at this junction including a separate left turn lane for traffic from A38 to Barrow Street.
- Airport Roundabout: lane widening to two lanes at the entry and exits of both roundabouts on A38 accessing Bristol Airport.
- Downside Road Junction Improvement: two lanes have been provided between the Airport and through Downside Road and West Lane in both directions and changes to the three junctions in line with the proposals.
- Strawberry Line Crossing: a signalised pedestrian and cycle crossing has been provided near Cross.
- Rook's Bridge: reduction of speed to 48kph on A38 through Rooksbridge village.
- Edithmead Roundabout: a signalised Hamburger roundabout where the right turning movement from M5 off-slip is connected to A38 through the Hamburger link.

BSIP Schemes

- Barrow Gurney – Eastbound and Westbound bus priority on A38 at junction with Barrow Street. In the model, bus lanes have been added in each direction, whilst eastbound a left turn flare has been removed, and westbound reduced to one lane from two lanes for straight on movement. Traffic signals have been updated.
- Brockley Combe – Eastbound and Westbound bus priority on A370 at junction with Brockley Combe Road and Brockley Lane. In the model, right hand turn flares have been removed to accommodate the bus lanes. In a westbound direction, there is a banned right-hand turn onto Brockley Lane northbound. Traffic signals have been updated to reflect bus only movement.
- Wood Hill – Eastbound and Westbound bus priority on A370 at junction with Wrington Road, Congresbury. In the model, left hand flare from Wrington Road has been removed, traffic signals have been added which reflect bus only movement.
- A369 Martcombe Road – Bus lane priority on A369 Martcombe Road at junction with High Street, Portbury. In the model, reduced to one plus flare from two lanes to accommodate the bus lane, traffic signals updated.
- Beggars Bush Lane – Westbound bus priority on A369 Abbots Leigh Road with junction of B3129 Beggars Bush Lane. In the model, traffic signal timings have been updated.
- Churchill Gate – Northbound and Southbound bus priority on the A38 onto new proposed roundabout at the intersection of the A38 and A368. In the model, a signalised roundabout has replaced a four-arm signalised junction.
- Lime Kiln roundabout – Bus lanes on eastbound, westbound and northbound arms of roundabout, at the intersection of A38 Bridgewater Road and A4174 Colliters Way. In the model, on the westbound approach to the roundabout on the A38, the number of lanes reduced from three to two.
- Backwell Crossroads – Southbound bus lane, A370 bound traffic from Dark Lane is closed. In the model, northbound traffic from Dark Lane has been banned, traffic signals updated.
- Portbury Hundred – Bus lane on A369 towards junction 19 of M5. In the model, reduced A369 from two lanes to one lane to accommodate bus lane.

[1] North South Link Road Layout

- A369 Bridge Road – At the junction of A369 Abbots Leigh Road and B3129 Bridge Road, bus lanes have been added on the A369. In the model, A369 eastbound reduced to one lane plus a righthand flare at traffic signals from two lanes to accommodate the bus lane.
- B3440 Queensway – Two new roundabouts in place of traffic signals with bus priorities. In the model, two roundabouts replace two signalised junctions. One at the junction of the B3440 Bristol Road and Queen's Way, the second at the junction of Queen's way and Walford Avenue in Weston super Mare.
- B3133 South Way / Central Way – Bus priority at roundabout for eastbound on Southern Way and westbound on Central Way in Clevedon. In the model, flares added to each approaching arm of the roundabout.
- Ettlingen Way Roundabout, Clevedon – Eastbound on Ettlingen Way and Northbound on Central Way bus priority. In the model, northbound approach to roundabout (Central Way) reduced from two lanes to one lane plus a flare to accommodate bus lane.
- Tickenham Road / Northern Way, Clevedon – Larger roundabout with eastbound and westbound bus priority on Tickenham Road. In the model, capacity of the roundabout has increased.
- A370 Long Ashton Bypass – Bus lane in place of 2+ lane. In the model, reduced from two lanes to one lane eastbound to accommodate the bus lane.
- B3440 from J21 M5 – Northbound and Westbound bus lanes on the slip road from the A370 onto the B3440 in Weston super Mare. In the model, B3440 from A370 westbound, Weston super Mare, reduced to one lane from two lanes.

Wolvershill Developments Eastern Link Road

- The Wolvershill Developments Eastern Link Road acts as a connection between the Banwell Bypass and Wolvershill Road to the east of the Wolvershill Developments.

Public Transport Network – Committed Schemes

4.32 An updated public transport model was created in the TRACC software using the base PT model network as a starting point. The public transport network was updated to use 2025 service patterns. The public transport network was also updated to reflect the proposed MetroWest Phase 1 re-opening of the Portishead Line to provide an hourly service between Portishead and Bristol Temple Meads, with new stations at Pill and Portishead. These schemes were coded as follows:

- The alignment of the rail line following the existing Portishead branch line.
- The opening of two new rail stations at Pill and Portishead, with Pill railway station sited at the location of the existing station, and Portishead station sited east of Portishead town centre, as proposed in the MetroWest Phase 1 plans.
- The addition of a new rail service from Bristol Temple Meads to Portishead. Whilst the exact timings of this proposed route is not known, it was assumed to operate every day, operating hourly each way from 05:00 to 23:00. The total route journey time was estimated to be around 34 minutes each way between Bristol Temple Meads and Portishead, calling at Bedminster, Parson Street, and the new Pill and Portishead stations.
- Enhanced half hourly service between Severn Beach and Bristol Temple Meads (inclusion of Portway Station along route).
- Enhanced half hourly Westbury line rail service.
- Enhanced half hourly Gloucester line rail service (adding Charfield station to the route).
- New hourly Henbury line rail service.

4.33 Following discussions with North Somerset Council, the 2025 public transport network was also updated to increase the current 125 bus service to an hourly frequency to reflect the future plans for bus services within the area.

4.34 As well as the above enhancements made to the TRACC model, BSIP assumptions were also required for this work. These were undertaken outside of the TRACC model and applied directly to the public transport generalised cost matrices output from the TRACC model. This reflects the objectives of BSIP to enhance public transport journey times across broad corridors.

4.35 The BSIP work undertaken throughout the region is expected to provide bus travel time savings along several routes. To calculate the assumptions for the reduction in bus travel times, a Traffic Advisory Leaflet[2] published by the Department for Transport in April 2001 was used as guidance. It should be noted that more up to date guidance could not be found.

4.36 This leaflet suggested that fully enforced bus lanes could reduce travel times by 7 to 9 minutes along a 10km, highly congested bus route. The leaflet also suggested that modelling, confirmed by on street surveys, indicates Bus SCOOT can reduce bus travel times by 2 to 4 minutes on a 10km bus route with time savings of 1 to 10 seconds (an average of 4 seconds) per junction.

4.37 The above estimations are assuming highly congested bus routes. However, not all routes within the BSIP schemes are considered to be highly congested and therefore it was decided to apply lower reductions in journey time savings. Time savings have been halved to represent the lower levels of congestion. To incorporate peak times, the AM and PM have been given greater time savings than the Interpeak.

4.38 The average time savings (4 seconds) provided in DfT's Traffic Advisory Leaflet was used for time savings due to junction improvements.

4.39 To calculate the time savings, the time savings per 10 kilometres was factored to time savings per kilometre. The length of the proposed bus lanes was then either sourced from plan drawings or were measured in Google maps. The time saving per kilometre was then factored based on the proposed bus lane length.

4.40 The signal time savings at Barrow Gurney and Queensway were based on delay in the model, with the delay halved to account for buses not always reaching lights at the start of the red cycle.

4.41 Table 4-15 sets out the seconds per kilometre assumptions. Table 4-16 and Table 4-17 set out the Barrow Gurney and Queensway signal time savings respectively.

Table 4-15: Seconds per kilometre assumptions

Seconds per 1km			
AM	IP	PM	Traffic Scenario
27.0	21.0	27.0	congested
13.5	10.5	13.5	less congested

Table 4-16: Barrow Gurney signal time savings (seconds)

AM	IP	PM
8	6	9

Table 4-17: Queensway signal time savings (seconds)

AM	IP	PM
7	6	12

4.42 The breakdown of which assumptions were used for each of the BSIP schemes can be found in Appendix G.

4.43 When running the model, the same model calculations and analysis as undertaken on the base network, and detailed in Chapter 3 were undertaken on the forecast year network, the above assumptions were then added to the TRACC model results to produce forecast year travel time and fare matrices for input into the VDM.

[2] https://tsrgd.co.uk/pdf/tal/2001/tal-6-01.pdf

Public Transport: TRACC outputs

4.44 TRACC produces a report which sets out the total walk time, wait time, and public transport in vehicle time for each zone-to-zone movement that is deemed accessible based on the parameters set out in the section.

4.45 TRACC also produces an individual path report for each of the zone-to-zone movements that are deemed accessible. The path report sets out the route path taken between each origin and destination point within the model including the bus stop/ train station used to start the public transport section of the journey, the stops passed through, and the end stop before interchanging/walking to the destination.

4.46 After getting the following output from the TRACC runs, the individual OD pairs spreadsheet output is processed and converted into Matrix format for parameters such as Access time, Wait time, In vehicle time, Interchange time, Egress time, and In-vehicle distance.

4.47 TAG perception factors for walk and wait times were applied to the actual time and then total perceived journey time is calculated and used as journey time input for the VDM runs.

4.48 In case of PT fare, the calculation is carried out based on the RTMs' distance-based function using In vehicle distance details obtained from the TRACC.

$$F= 0.28\ d^{0.9}$$

Here F is fare in pounds and d is the distance in Km.

4.49 Since the above RTM fare function is based on 2015 fares, the calculated fare is further uplifted to 2041 using factor fare uplift factor which is calculated based on the GDP and RPI changes in the TAG data book.

Variable Demand Modelling

4.50 The calibrated DIADEM VDM setup was used to forecast the effects of updated highway and PT travel costs on the choice of time period, mode, and destination of trips.

4.51 The pivot point for the 2041 'Without Local Plan' VDM was the base year model, including the base year highway assignments, base year PT fares and journey times, and the 2018 values of time and vehicle operating costs. Forecast year inputs were the forecast year highway networks, forecast year PT fares and journey times, and the 2041 values of time and vehicle operating costs. Reference demand was input based on applying the growth rates to the 2018 base year demand. This produced trip matrices growth to account for changes in population, employment, trip rates, and car ownership levels, but without any consideration of demand changes due to changes in travel cost.

4.52 No other parameters were changed from the calibrated VDM, including the destination choice lambda values, and mode and time period choice theta scaling values. In addition, the convergence criteria remained at 0.1% across the internal area where the demand model was applied.

4.53 VDM has not achieved the convergence in terms of Gap Value of 0.1% within the maximum iteration of 20. Therefore, the loop with the lowest gap value has been considered as the best iteration which is loop 17 as shown in Table 4-18.

Table 4-18: 2041 'Without Local Plan' VDM convergence statistics

Scenario	Maximum Number of Iteration	Loop with lowest GAP value	Gap value of the converged lowest loop
2041 'Without Local Plan'	20	17	0.14%

4.54 Demand matrices were compared pre- and post-VDM to ensure the responses looked plausible. As shown in Table 4-19, there is little change in car vehicle trips, but a large decrease in PT passenger demand. This can be attributed to mode shift towards car in future as the cost of car travel falls (DfT core scenario assumes that as electric car uptake increases average vehicle tax and fuel costs will decline).

Table 4-19: Change in 12-hour demand totals, 2041 'Without Local Plan' forecast year

Purpose	Highway Reference Trips	PT Reference Trips	Highway Post-VDM Trips	PT Post-VDM trips	Highway % Change	PT % Change
Employer's Business	160,699	27,197	161,013	22,493	*0.2%*	*-17.3%*
Home Based Work	487,683	80,497	487,679	72,960	*-0.0%*	*-9.4%*
Other	1,103,592	168,334	1,097,777	143,303	*-0.5%*	*-14.9%*
LGV	255,434	-	255,434	-	*0.0*	-
HGV	110,788	-	110,788	-	*0.0*	-

Post VDM Highway Model Statistics

4.55 Table 4-20 sets out the assignment convergence statistics 2041 'Without Local Plan' Scenario. The table shows the results for the last four iterations of each assigned peak. The table shows that both peak models converge within the TAG criteria.

Table 4-20: Convergence Statistics: 2041 'Without Local Plan'

Time period	Assignment Loop*	%Flows	%GAP
AM	29	98.0	0.026
	30	98.8	0.014
	31	98.5	0.019
	32	98.6	0.029
PM	25	98.4	0.019
	26	98.8	0.014
	27	98.6	0.015
	28	98.9	0.014

* Last four iterations presented, as per the convergence stopping requirement

4.56 Table 4-21 and Table 4-22 shows model statistics taken from both the enhanced NSSM Base and the 2041 'With Local Plan' models. The table shows that there is an increase in total travel time and travel distance between the base model and the 2041 model which is due to the increased demand between 2018 and 2041. This increase in demand is likely to cause the reduced average speed across the 2041 'With Local Plan' model compared with the base.

Table 4-21: Model Statistics: Enhanced NSSM Base vs 2041 'Without Local Plan' – AM Peak

	Enhanced NSSM Base		2041 'Without Local Plan'		Change from Base to 2041	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	12,826	69,000	16,760	84,672	**31%**	**23%**
Travel distance (pcu kms)	720,693	4,266,547	885,409	5,153,215	**23%**	**21%**
Average Speed (kph)	56.2	61.8	52.8	60.9	**-6%**	**-1%**

Table 4-22:Model Statistics: Enhanced NSSM Base vs 2041 'Without Local Plan' – PM Peak

	Enhanced NSSM Base		2041 'Without Local Plan'		Change from Base to 2041	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	13,096	67,380	17,373	82,985	**33%**	**23%**
Travel distance (pcu kms)	722,988	4,087,010	892,422	4,953,396	**23%**	**21%**
Average Speed (kph)	55.2	60.7	51.4	59.7	**-7%**	**-2%**

'With Local Plan' Scenario

Introduction

4.57 This reflects 2041 demand within North Somerset constrained to TEMPro growth levels with the location of the growth changed to match the Local Plan strategy. This scenario therefore includes schemes and developments as part of the Local Plan as well as committed developments.

Local Plan allocations

4.58 The Local Plan allocations are outlined in Table 4-23.This table shows the number of dwellings assumed at each location, the location can be seen in Section 3 of the main report. The table also shows the existing donor SATURN zone that has been used to create the trip distribution of the new zone.

Table 4-23: Demand for 'With Local Plan' Scenarios, Residential (Committed and Local Plan)

Housing Development	SATURN Zone	Donor Zone	Type of development	No of houses
Wolvershill (north of Banwell)	90009, 90026, 90027	30040	Local Plan	3300
Woodspring	90001	30174	Local Plan	3500
Land at Barrow Wood B (HE203010)	90005	30123	Local Plan	145
Land north of Nailsea	90046	30104	Local Plan	381
Land off Pound Lane, Nailsea	90016	30096	Local Plan	100
Poplar Farm, Nailsea	90022	30093	Local Plan	130
Youngwood Farm, Nailsea	90023	30090	Local Plan	120
Land north of Youngwood Lane, Nailsea	90024	30114	Local Plan	316
Land east of Backwell Site A, Backwell	90029	30131	Local Plan	500
Land east of Backwell Site B, Backwell	90042	30131	Local Plan	450
Former Leisuredome allocation/Parklands Site B (phase E)	90028	30024	Local Plan	420
Weston Rugby Club	90002	30009	Local Plan	182
Dolphin Square	90032	30008	Local Plan	126
Land north of Banwell Road Locking/Elborough	90033	30024	Local Plan	315
Castlewood	90015	30086	Local Plan	120

Housing Development	SATURN Zone	Donor Zone	Type of development	No of houses
North West Nailsea	90030	30095	Local Plan	225
Wyndham Way Broad Location	90008	30139	Local Plan	485
Black Rock, North of Clevedon Road (HE20124)	90034	30138	Local Plan	100
Land at Tower Farm (HE2068)	90035	30137	Local Plan	400
Grove Farm	90007	30132	Local Plan	515
Land at Lodway Farm (HE20491)	90037	30162	Local Plan	160
Land east of Gordano Services (HE206)	90038	30162	Local Plan	200
Pill Green (HE2015)	90039	30162	Local Plan	600
Land at Pill Road (HE201097)	90040	30162	Local Plan	100
Land north of Colliter's Way	90006	30150	Local Plan	215

Table 4-24: Local Plan Allocations: demand for 'With Local Plan' Scenario, Employment

Employment Development	SATURN Zone	Donor Zone	Type of development	Site area (ha)
Wolvershill Business Park	90013	30038	Local Plan	6.5
Parklands West Wick roundabout, WsM	90031	30026	Local Plan	12.3
Woodspring Business Park (As part of wider Strategic Location)	90043	30174	Local Plan	4
North Nailsea (As part of North Nailsea site)	90044	30104	Local Plan	1.1
Nailsea and Backwell Business Park - close to station (As part of east of Backwell site)	90045	30131	Local Plan	5
Wyndham Way	90008	30140	Local Plan	c1.0 (est. 500 jobs, site area TBC)

Trip rates – Local Plan Development

4.59 Trip rates for each of the Local Plan developments have been developed and agreed with NSC. To ensure a more robust modelling approach, trip rates have been developed for specific locations of developments. This takes into consideration factors such as the location and size of development as well as approved trip rates for other developments within the vicinity of the site. All of these trip rates are also detailed in the Modelling Trip Generation Note which is appended to the Transport Assessment.

Table 4-25: Trip Rates used for Other developments

Location	Trip Rate Location
Wolvershill (north of Banwell)	Neighbourhood centre
Woodspring	Neighbourhood centre
Land at Barrow Wood B (HE203010)	Neighbourhood centre
Land north of Nailsea	Edge of Town/Suburban
Land off Pound Lane, Nailsea	Edge of Town/Suburban
Poplar Farm, Nailsea	Edge of Town/Suburban
Youngwood Farm, Nailsea	Edge of Town/Suburban
Land north of Youngwood Lane, Nailsea	Edge of Town/Suburban
Land east of Backwell Site A, Backwell	Edge of Town/Suburban
Land east of Backwell Site B, Backwell	Edge of Town/Suburban
Former Leisuredome allocation/Parklands Site B (phase E)	Edge of Town/Suburban
Weston Rugby Club	Town Centre/Edge of Town
Dolphin Square	Town Centre/Edge of Town
Land north of Banwell Road Locking/Elborough	Edge of Town/Suburban
Castlewood	Edge of Town/Suburban
North West Nailsea	Edge of Town/Suburban
Wyndham Way Broad Location	Town Centre/Edge of Town
Black Rock, North of Clevedon Road (HE20124)	Town Centre/Edge of Town
Land at Tower Farm (HE2068)	Town Centre/Edge of Town
Grove Farm	Edge of Town/Suburban
Land at Lodway Farm (HE20491)	Edge of Town/Suburban
Land east of Gordano Services (HE206)	Edge of Town/Suburban
Pill Green (HE2015)	Edge of Town/Suburban
Land at Pill Road (HE201097)	Edge of Town/Suburban
Land north of Colliter's Way	Neighbourhood centre

Highway Network

4.60 For the 2041 'With Local Plan' Scenario, a number of network changes have been made in the Banwell/Wolvershill Road area to reflect the Wolvershill development. This includes:

- Reduction of speed limit to 20mph on Wolvershill Road between Banwell Bypass and Summer Lane.
- Upgrade of the existing priority junction to signals at A371/Summer Lane.
- Signalised shuttle on Wolvershill Road.

Highway Demand

4.61 To create the highway demand for the 'With Local Plan', a reduction on origin-destination car trips was applied to selected movements based on internalisation strategies for each individual development within Wolvershill. These internalisation strategies are outlined in and are detailed further in the TA.

Table 4-26: Internalisation Strategies

Location	Residential Allocation (Total Homes)	Employment Allocation (Ha)	Internalisation Factor	Trip Reduction – AM Peak (%)	Trip Reduction – PM Peak (%)
Wolvershill		6.5	Employment > 5 Ha	10%	10%
Wolvershill	3,300		Education (Winterstoke Hundred)	8%	0%

Public Transport Network

4.62 The 'With Local Plan' public transport model contains the committed schemes in the public transport model (discussed above) and two additional bus service changes to the PT network:

- Addition of a bus route from Weston-super-Mare to Bristol via Locking Castle, Worle Sainsbury's, Worle Station, West Wick, Wolvershill, Banwell, Winscombe, Airport, Bedminster, Bristol.
- Current bus service 7 in Weston-super-Mare to become circular, continuing on from Locking Parklands to Worle Sainsbury.

Variable Demand Modelling

4.63 Variable demand model assumptions are detailed in section 4.50 to section 4.52 and do not change between without and 'With Local Plan' Scenarios.

4.64 VDM has not achieved the convergence in terms of Gap Value of 0.1% within the maximum iteration of 20. Therefore, the loop with the lowest gap value has been considered as the best iteration which is loop 14 as shown Table 4-27.

Table 4-27: 2041 'With Local Plan' VDM convergence statistics

Scenario	Maximum Number of Iteration	Loop with Lowest Gap Value	Gap value of the lowest loop
2041 'With Local Plan'	20	14	0.13%

4.65 Demand matrices were compared pre- and post-VDM to ensure the responses looked plausible. As shown in Table 4-28, there is a small decrease in car vehicle trips, with an associated increase in PT passenger demand. The higher public transport usage (relative to the 'Without Local Plan' scenario can be attributed to the increased car congestion with the additional local plan development trips leading to a mode shift, of both new development trips and existing car users, towards public transport.

Table 4-28: Change in 12-hour demand totals, 2041 'With Local Plan' forecast year

Purpose	Highway Reference Trips	PT Reference Trips	Highway post-VDM Trips	PT post-VDM Trips	Highway % Change	PT % Change
Employer's Business	165,385	27,197	164,569	28,775	*-0.5%*	*5.8%*
Home Based Work	506,521	80,497	502,198	85,480	*-0.9%*	*6.2%*
Other	1,148,194	168,334	1,137,480	191,069	*-0.9%*	*13.5%*
LGV	256,764	-	256,764	-	*0.0*	-
HGV	111,163	-	111,163	-	*0.0*	-

Post VDM Highway Model Statistics

4.66 Table 4-29 sets out the assignment convergence statistics for 2041 Without and 'With Local Plan' Scenarios. The table shows the results for the last four iterations of each assigned peak. The table shows that both peak models converge within the TAG criteria for convergence.

Table 4-29: Convergence Statistics: 2041 'Without Local Plan' and 'With Local Plan'

	2041: 'Without Local Plan'	2041: 'Without Local Plan'	2041: 'Without Local Plan'	2041: 'With Local Plan'	2041: 'With Local Plan'	2041: 'With Local Plan'
Time period	**Assignment Loop***	**%Flows**	**%GAP**	**Assignment Loop***	**%Flows**	**%GAP**
AM	29	98.0	0.026	27	98.1	0.036
	30	98.8	0.014	28	98.2	0.027
	31	98.5	0.019	29	98.6	0.024
	32	98.6	0.029	30	98.5	0.030
PM	25	98.4	0.019	33	98.5	0.015
	26	98.8	0.014	34	99.0	0.017
	27	98.6	0.015	35	98.7	0.018
	28	98.9	0.014	36	98.7	0.016

* Last four iterations presented, as per the convergence stopping requirement

4.67 Table 4-30 and Table 4-31 shows the model statistics for the Without and 'With Local Plan' Scenarios. The table shows that the total car travel time and car travel distance for the 'With Local Plan' Scenario are higher than the 'Without Local Plan' Scenario. This would be expected due to the higher demand in the 'With Local Plan' Scenario. Average car speed within the fully modelled area is 8-9% lower in the 'With Local Plan' Scenario compared to the 'Without Local Plan' Scenario.

Table 4-30: Model Statistics: 2041 ‘With’ and ‘Without Local Plan’ Scenarios – AM Peak

	2041 ‘Without Local Plan’		2041 ‘With Local Plan’		Impact of Local Plan	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	16,760	84,672	18,966	88,205	**13.2%**	**4.2%**
Travel distance (pcu hrs)	885,409	5,153,215	926,111	5,259,353	**4.6%**	**2.1%**
Average Speed (kph)	52.8	60.9	48.8	59.6	**-7.6%**	**-2.1%**

Table 4-31: Model Statistics: 2041 ‘With’ and ‘Without Local Plan’ Scenarios – PM Peak

	2041 ‘Without Local Plan’		2041 ‘With Local Plan’		Impact of Local Plan	
Parameter	**Simulation**	**Full Model**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	17,373	82,985	19,797	86,872	**14.0%**	**4.7%**
Travel distance (pcu hrs)	892,422	4,953,396	929,900	5,059,678	**4.2%**	**2.1%**
Average Speed (kph)	51.4	59.7	47.0	58.2	**-8.6%**	**-2.5%**

4.68 Figure 4-1 to Figure 4-10 shows the actual flow difference between the ‘With Local Plan’ and ‘Without Local Plan’ Scenarios. Green bandwidths indicate an increase in actual flow and blue bandwidths indicate a decrease in actual flow in the ‘With Local Plan’ Scenario. The figures show the following locations:

- Weston super Mare.
- Backwell.
- Clevedon.
- Congresbury.
- Portishead.

4.69 As expected, with an increase in demand in the ‘With Local Plan’ Scenario, there is generally an increase in actual flow on most of the network.

Figure 4-1: Actual Flow Difference, Weston super Mare, AM

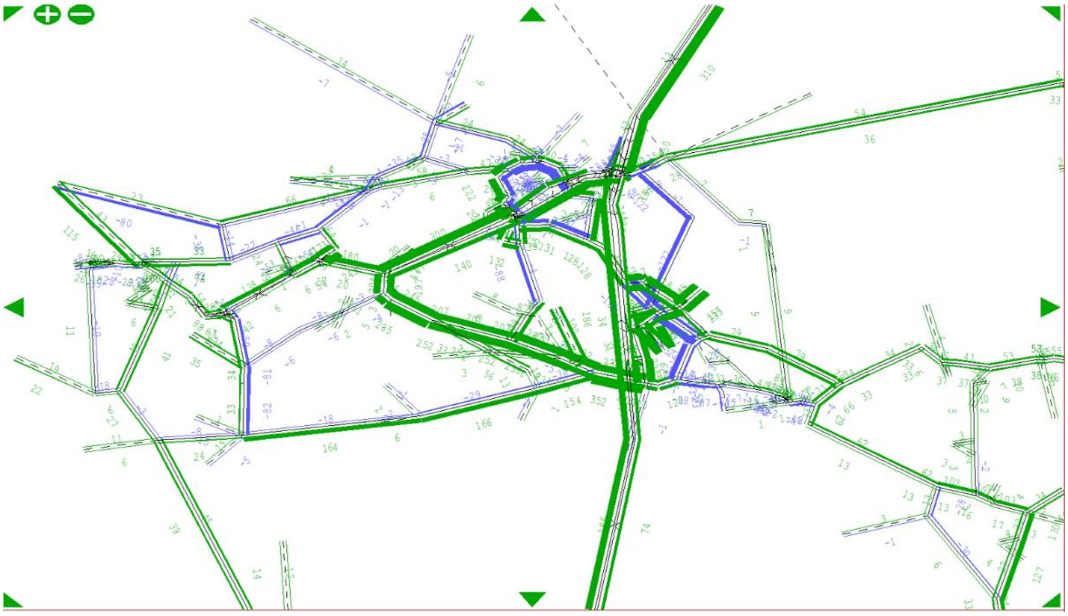


Figure 4-2: Actual Flow Difference, Backwell, AM

Figure 4-3: Actual Flow Difference, Clevedon, AM

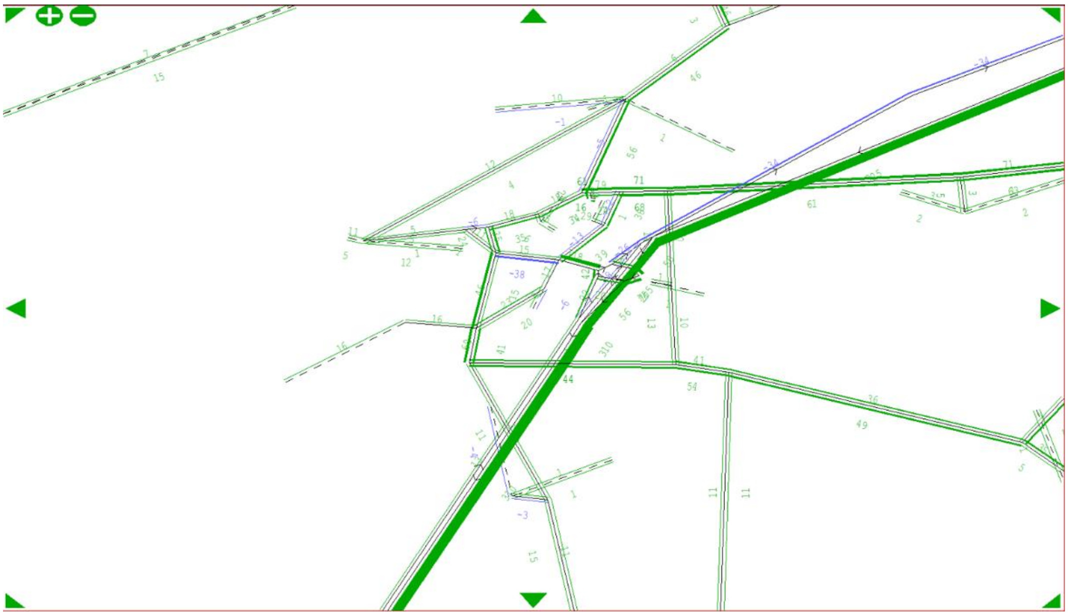


Figure 4-4: Actual Flow Difference, Congresbury, AM

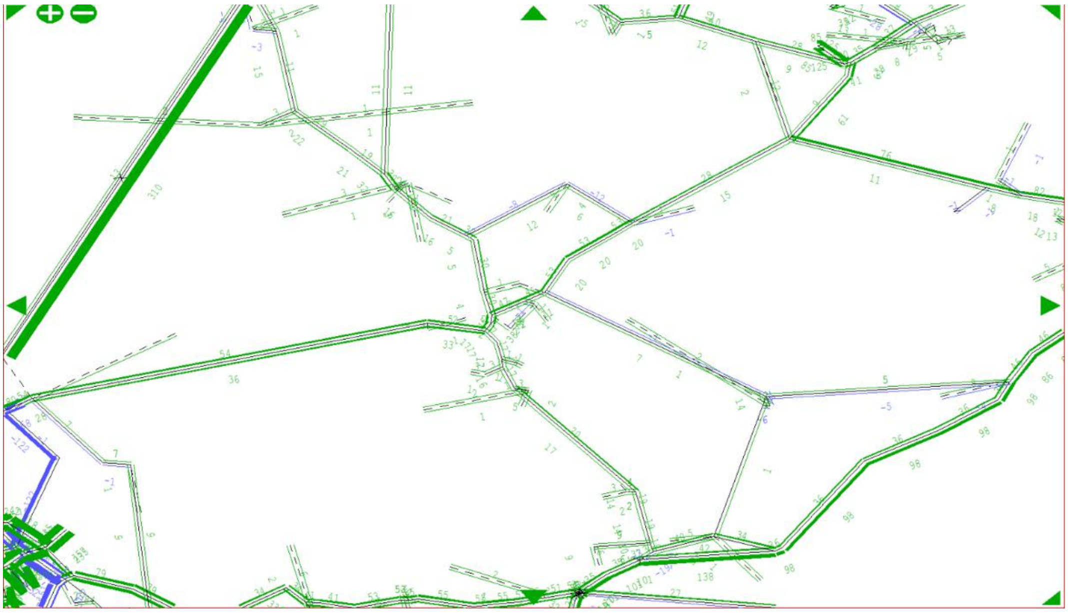


Figure 4-5: Actual Flow Difference, Portishead, AM

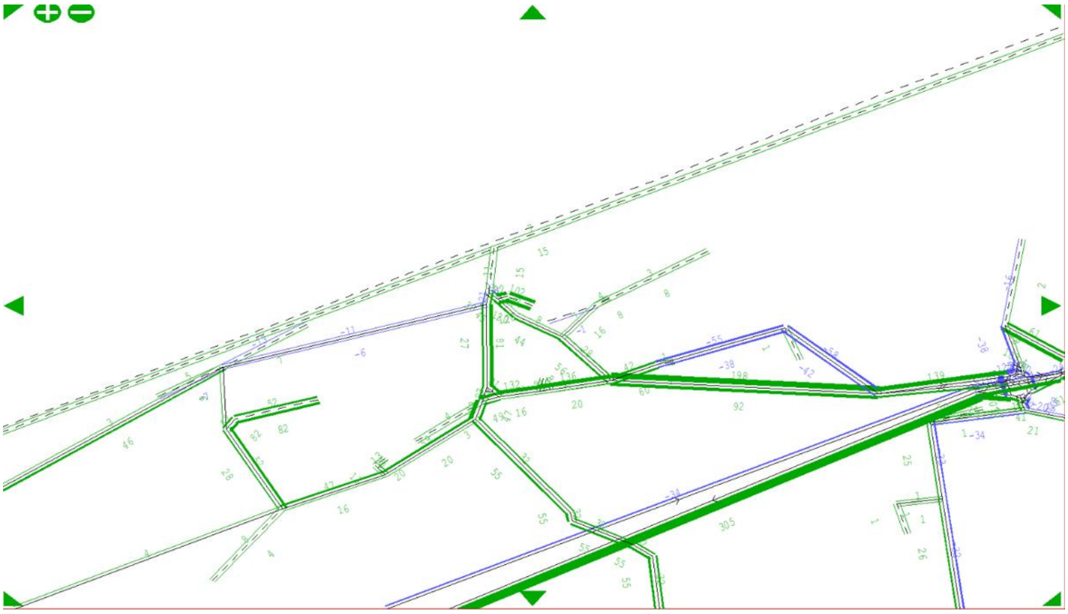


Figure 4-6: Actual Flow Difference, Weston super Mare, PM

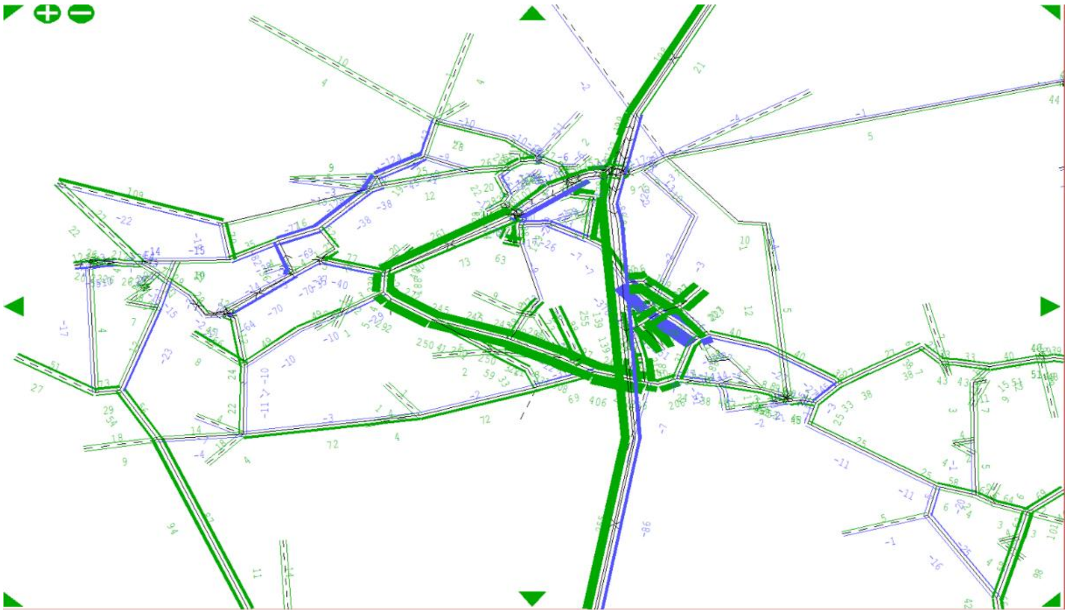


Figure 4-7: Actual Flow Difference, Backwell, PM

Figure 4-8: Actual Flow Difference, Clevedon, PM

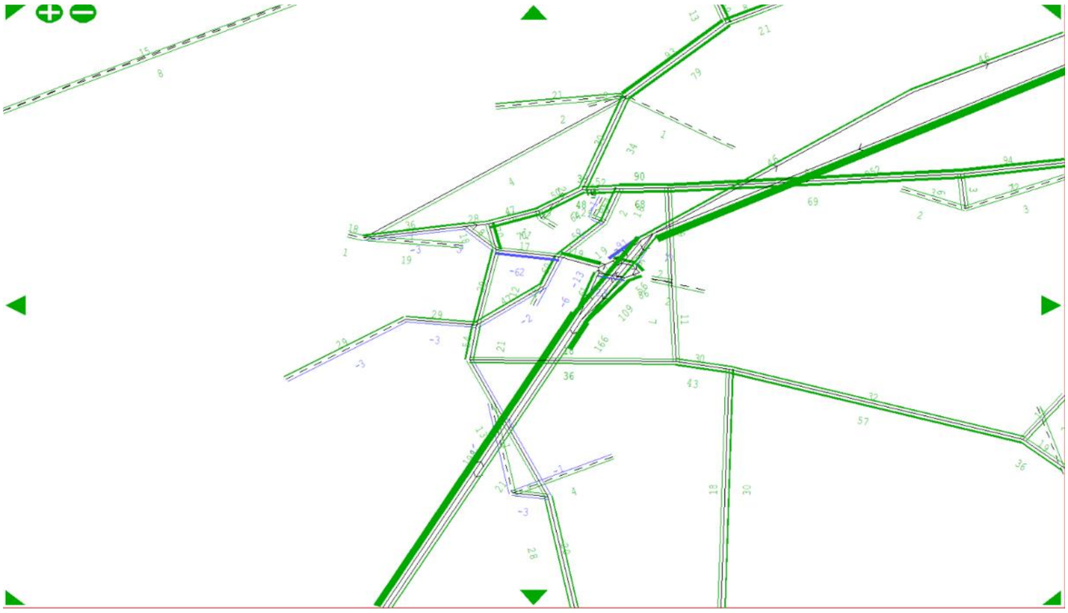


Figure 4-9: Actual Flow Difference, Congresbury, PM

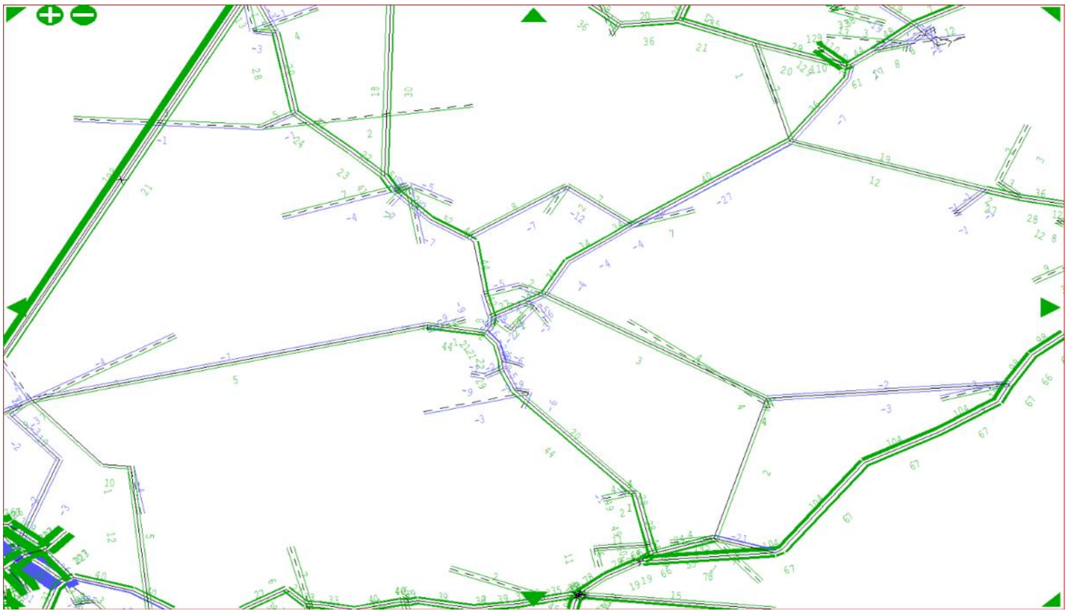
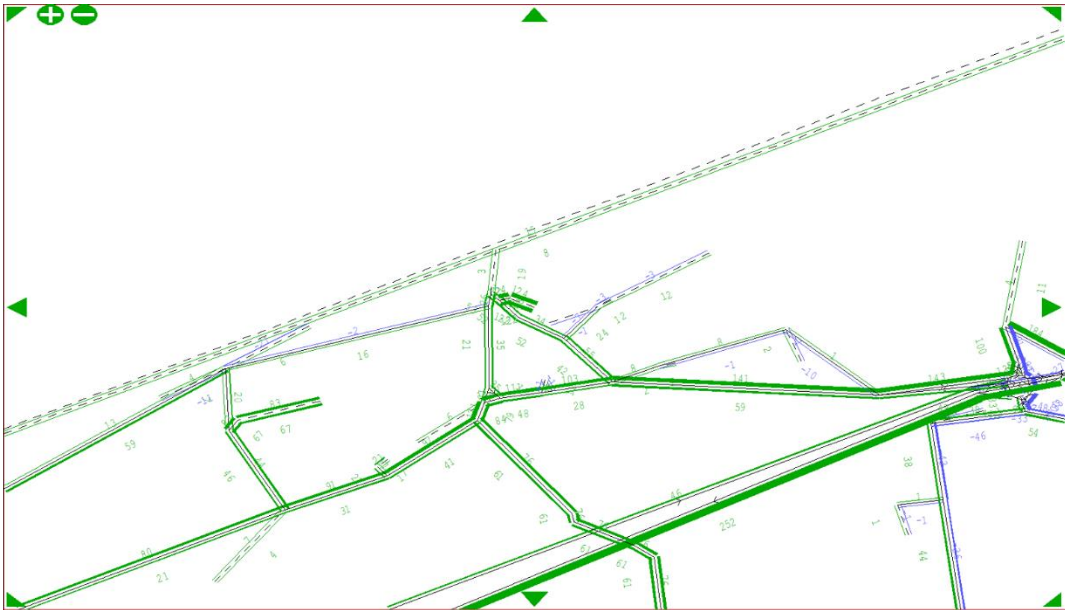


Figure 4-10: Actual Flow Difference, Portishead, PM



‘With Local Plan plus Mitigation’ Scenario

Introduction

4.71 For the Local Plan plus Mitigation scenario, the ‘With Local Plan’ Scenario has been taken and PT and highway mitigation measures have been added as agreed with NSC. This includes assumptions on internalisation and reduction in local plan development trips due to policy/other schemes implemented in the area.

Highway Network

4.72 The following updates have been made to the highway network between the ‘With Local Plan’ and ‘With Local Plan plus Mitigation’ scenarios:

- **Airport Roundabout (WsM) Junction Improvements:** Due to additional development in Weston super Mare, a junction improvement scheme has been developed for Airport Roundabout in Weston-super-Mare as shown in Figure 4-11. This comprises a segregated left turn lane of the A370 eastern approach to the Airport Roundabout, and two continuous lanes between Airport Roundabout and Runway Roundabout; and
- **M5 Junction 20 Signalisation:** it has been proposed as mitigation to provide signals at M5 Junction 20 to improve the operation of the roundabout and two exit lanes on Ettlingen Way.
- **Marsh Lane Active Travel:** A traffic restriction was implemented between the north of Church Road and Gordano Way to ensure that only active travel modes are permitted.
- **Rural Quiet Lanes:** 20mph speed limit traffic calming was applied for areas within Nailsea and Backwell shown in Figure 4-12. A 10% modal shift was applied for trips between Backwell, Nailsea, Clevedon. 120 seconds delay was applied to Riverside as part of the scheme in Western-super-Mare.
- **M5 J19 Lane Reallocation:** Additional, lane allocation for those travelling from the gyratory towards Portbury to the south of the junction as shown in Figure 4-13.
- **East of Backwell link:** Bypass from those travelling along the A370 and Station Road.

Figure 4-11: Proposed Design of Airport Roundabout

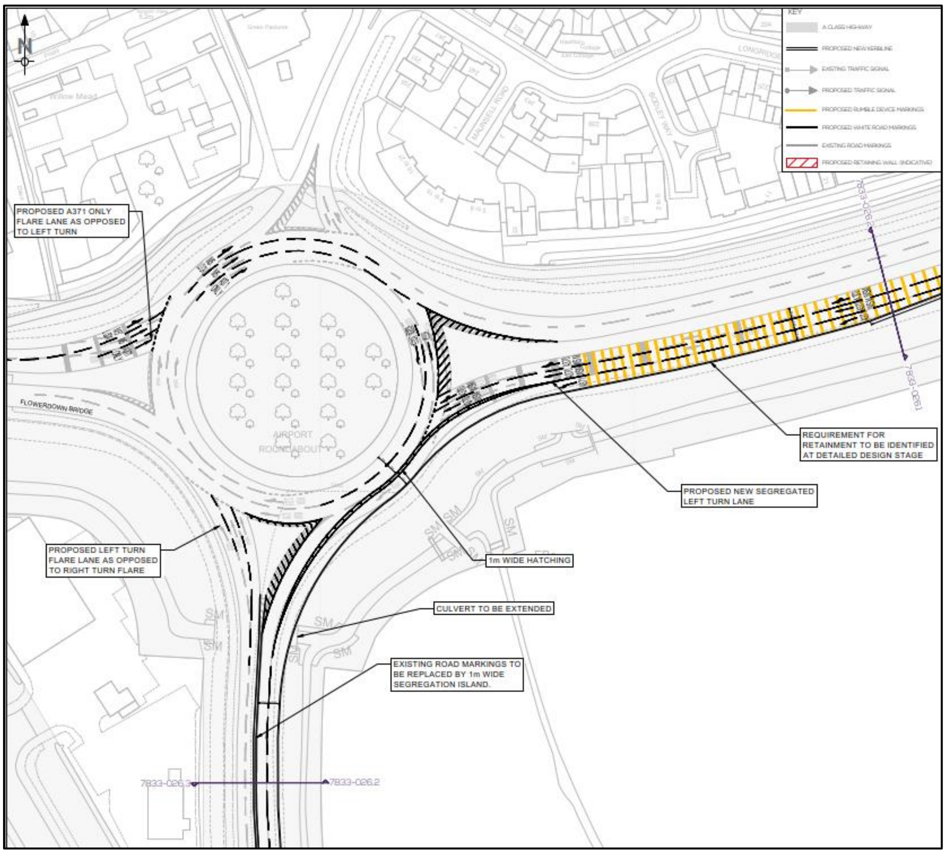


Figure 4-12: Rural Quiet Lanes 20mph Traffic Calming

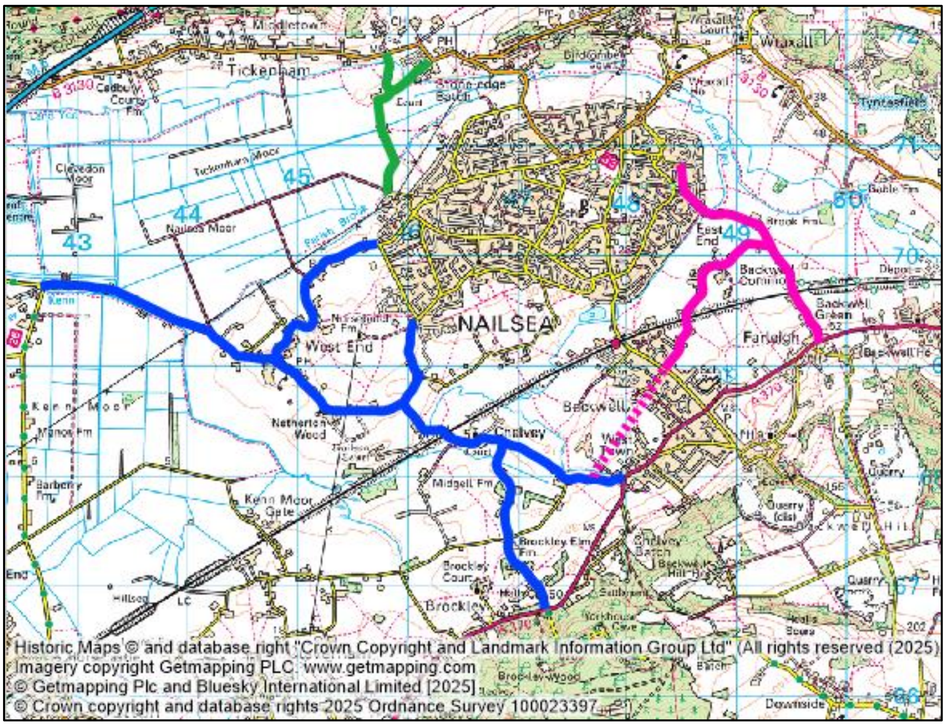
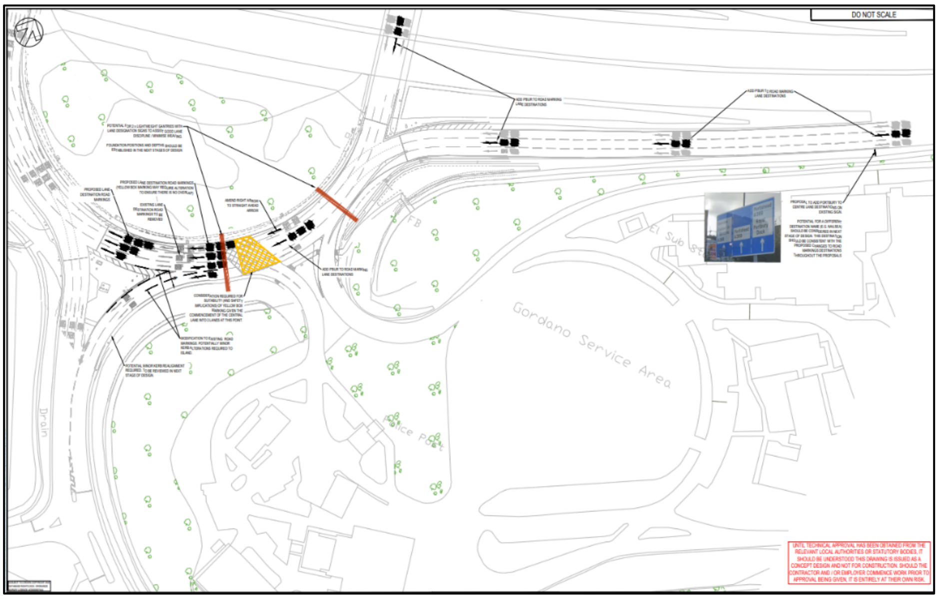


Figure 4-13: M5 Junction 19 Lane Reallocation



Highway Demand

4.73 To create the highway demand for the 'With Local Plan plus Mitigation', a reduction on origin-destination car trips was applied to selected movements based on the mitigation strategies for each individual development. These mitigation strategies are outlined in Table 4-32, and are detailed further in the TA.

Table 4-32: Mitigation Strategies

Location	Scheme	Mitigation	Strategy	Reduction
All development Zones	Masterplanning, LTNs, travel planning etc.	Blanket Reduction	Trips less than 6 miles to/from each development zone	10%
Wolvershill	Walking and cycling improvements - Closure of WR	Trips between Worle and Banwell	All trips between zones within the Worle to Banwell area.	8%
Wolvershill	Walking and cycling improvements to station	Trips within 2km radius of any Worle line Station	All trips that have an origin within 2km of Worle station with a destination within 2km of any station on the Worle line for the AM and IP (all stations between Bristol TM and WSM). In the PM the reverse applies.	8%
Land north of Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	4%
Land north of Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	2%
Land off Pound Lane, Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	7%
Land off Pound Lane, Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%
Poplar Farm, Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	7%
Poplar Farm, Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%
Youngwood Farm, Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	6%
Youngwood Farm, Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%

Location	Scheme	Mitigation	Strategy	Reduction
Land north of Youngwood Lane, Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	6%
Land north of Youngwood Lane, Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%
Land east of Backwell Site A, Backwell	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	5%
Land east of Backwell Site A, Backwell	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	3%
Land east of Backwell Site B, Backwell	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	5%
Land east of Backwell Site B, Backwell	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	3%
Youngwood Lane	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	7%
Youngwood Lane	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%
North West Nailsea	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	7%
North West Nailsea	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	4%
Grove Farm	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	5%

Location	Scheme	Mitigation	Strategy	Reduction
Grove Farm	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	3%
Dark Lane, Backwell	Improvements to Festival Way	Trips along Festival Way – Long Ashton and Bristol	All trips between zones within the Festival Way area.	5%
Dark Lane, Backwell	Delivery of walking and cycling measures within N&B Transport Strategy	Trips within 2km radius site, and trips within 2km radius of any N&B line station.	All trips that have an origin within 2km of N&B station with a destination within 2km of any station on the N&B line for the AM and IP (all stations between Bristol TM and WSM) In the PM the reverse applies.	3%
Weston Rugby Club	Active Travel Improvements	Trips within 5km of site	All trips to/from Weston Rugby club only to/from zones within 5km of site	15%
Wyndham Way	New linkages to wider active travel network	Trips within 5km of site	All trips between zones within 5km of Wyndham Way	5%
Rural Quiet Lanes	Active Travel Improvements	Trips between Backwell, Nailsea, Clevedon and Yatton.	All trips between zones within Backwell, Nailsea, Clevedon and Yatton.	10%

4.74 As a blanket reduction, it has been assumed that there will be a 10% reduction of all car trips to/from each development zone within a six-mile radius due to various policies such as master planning, LTN's, and travel planning.

4.75 For each development location, a reduction of car trips has been applied to/from each development zone based on the measures indicated in Table 4-32. If an origin-destination movement is featured in more than one mitigation strategy, then the percentage reductions are added together. Figure 4-14 to Figure 4-31 show the zones affected by each mitigation strategy:

Figure 4-14: Worle to Banwell- zones impacted by mitigation strategy

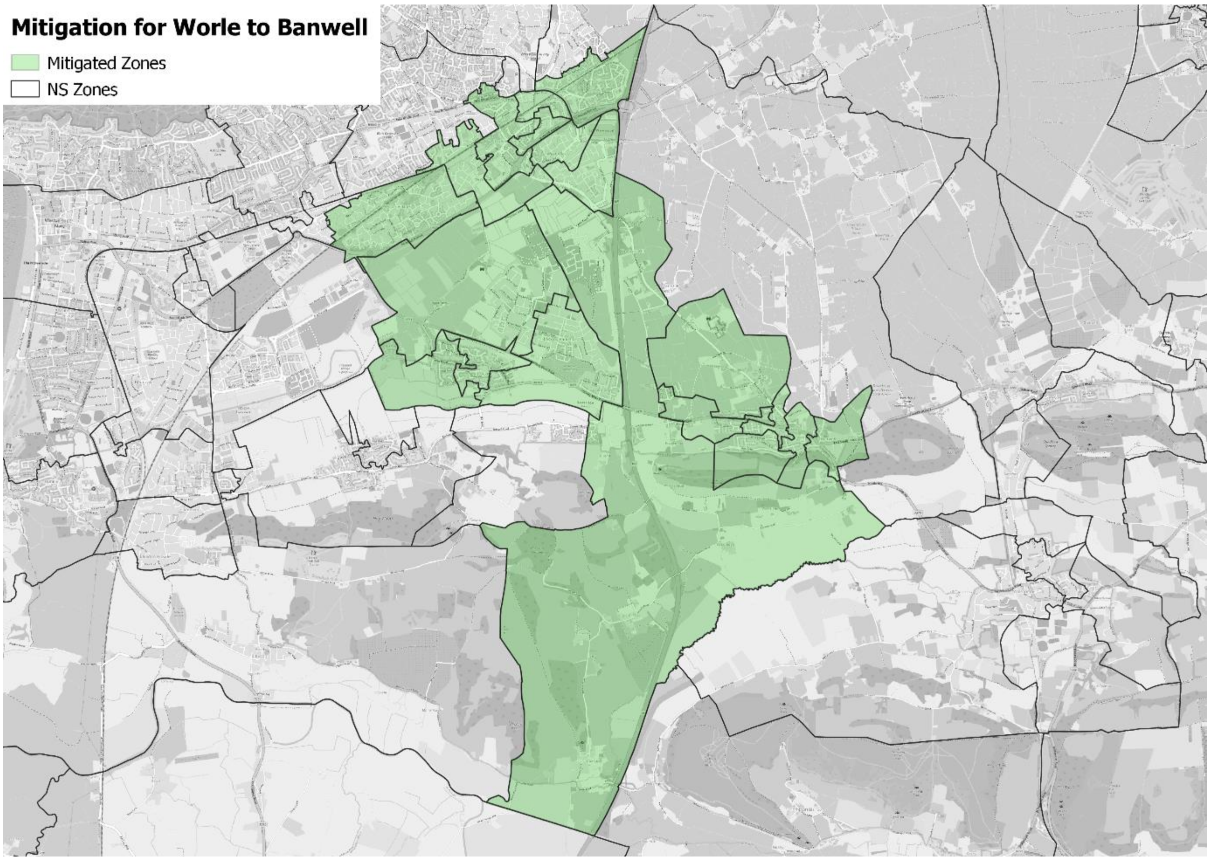


Figure 4-15: Worle to Nailsea & Backwell Stations: zones impacted by mitigation strategy

Figure 4-16: Festival Way: zones impacted by mitigation strategy

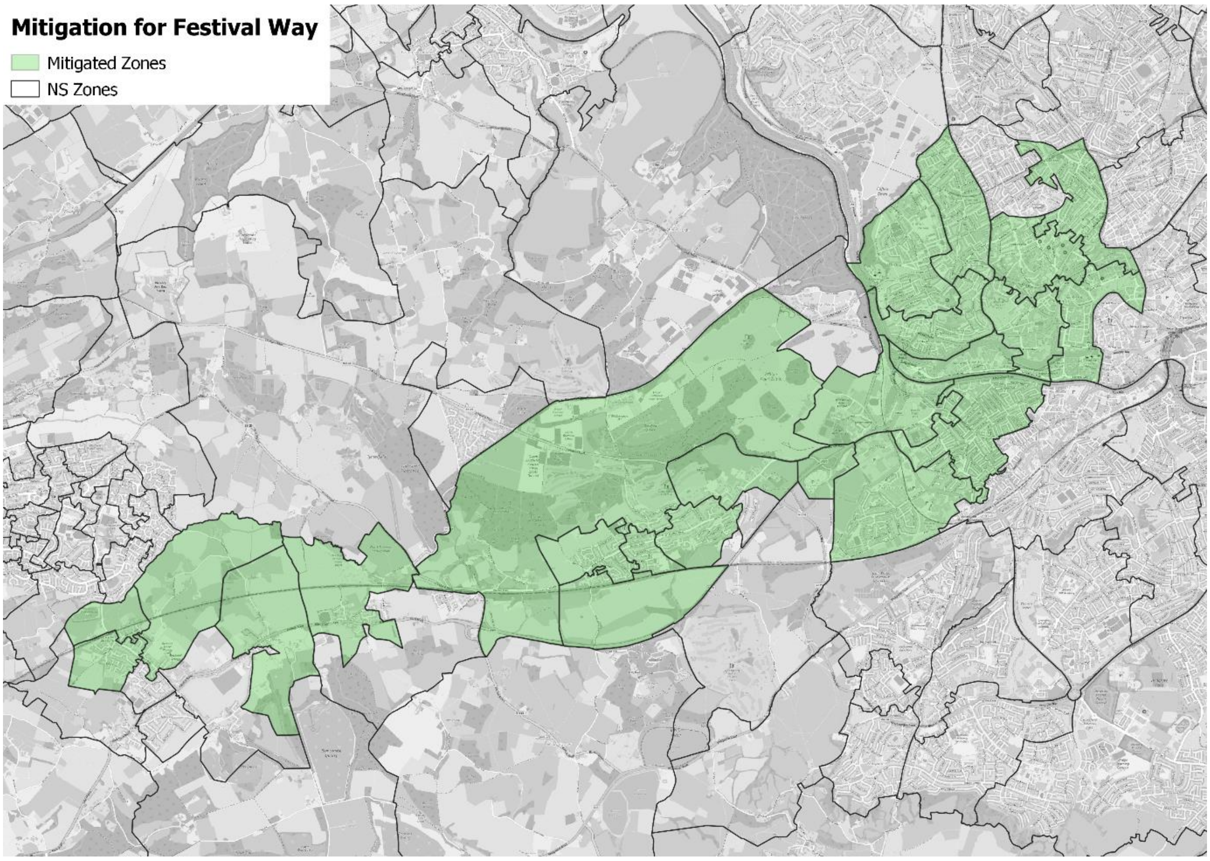


Figure 4-17: Developments near to Nailsea Station to Nailsea & Backwell Stations: zones impacted by mitigation strategy

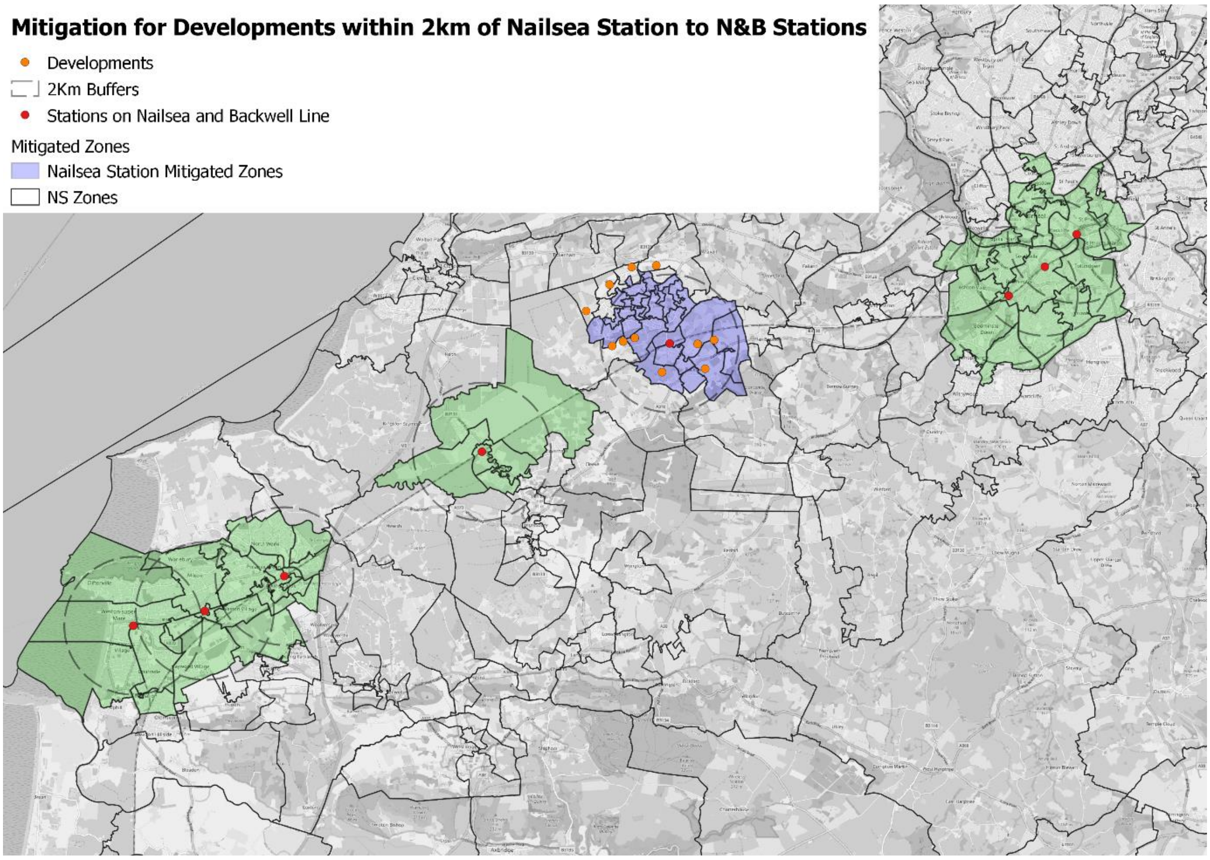


Figure 4-18: Land North of Nailsea: zones impacted by mitigation strategy

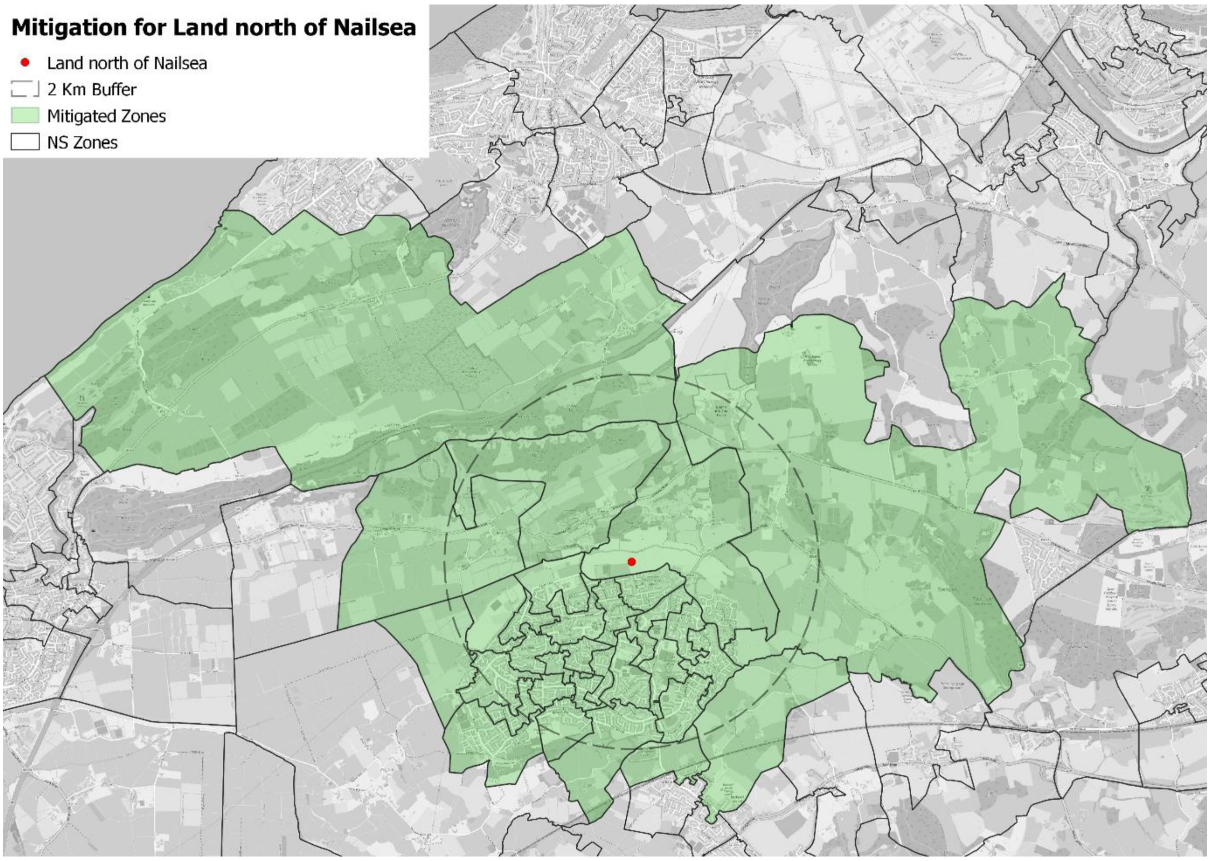


Figure 4-19: Land off Pound Lane, Nailsea: zones impacted by mitigation strategy

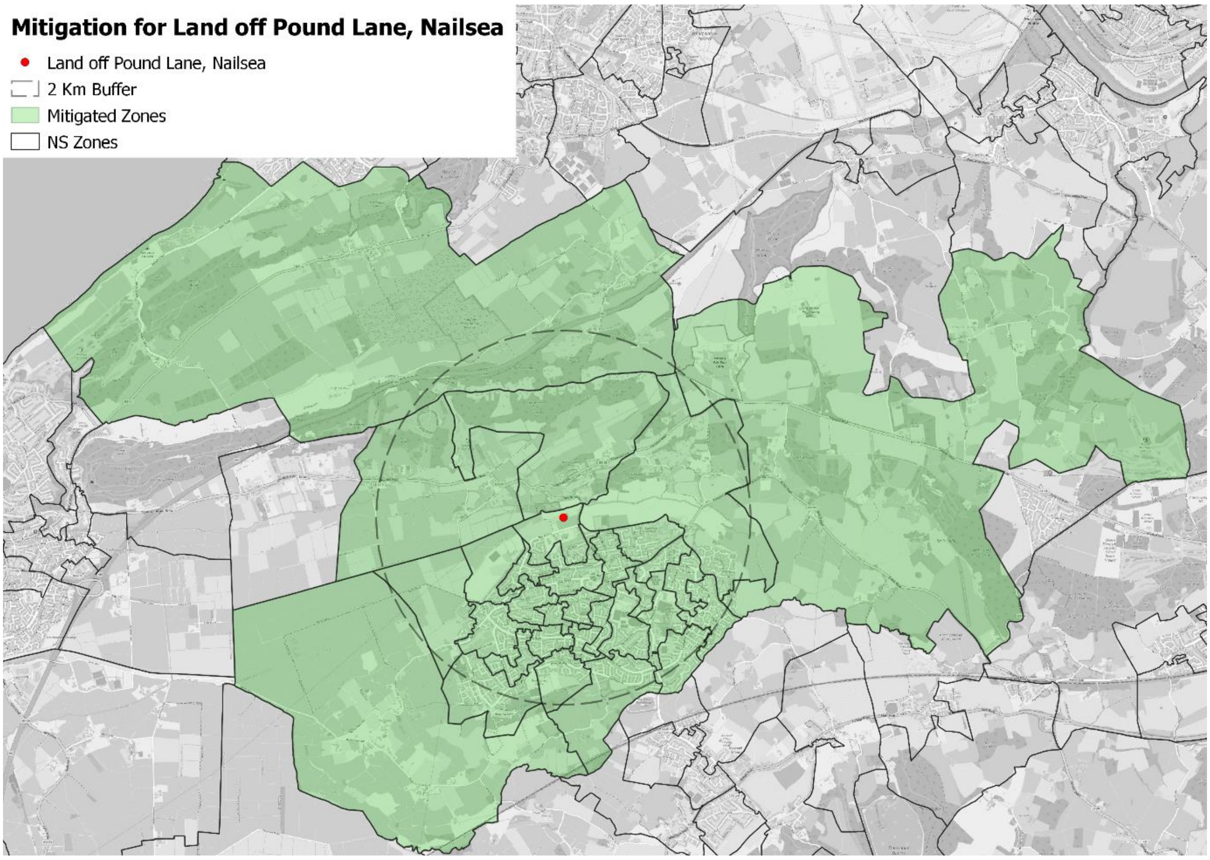


Figure 4-20: Poplar Farm, Nailsea: zones impacted by mitigation strategy

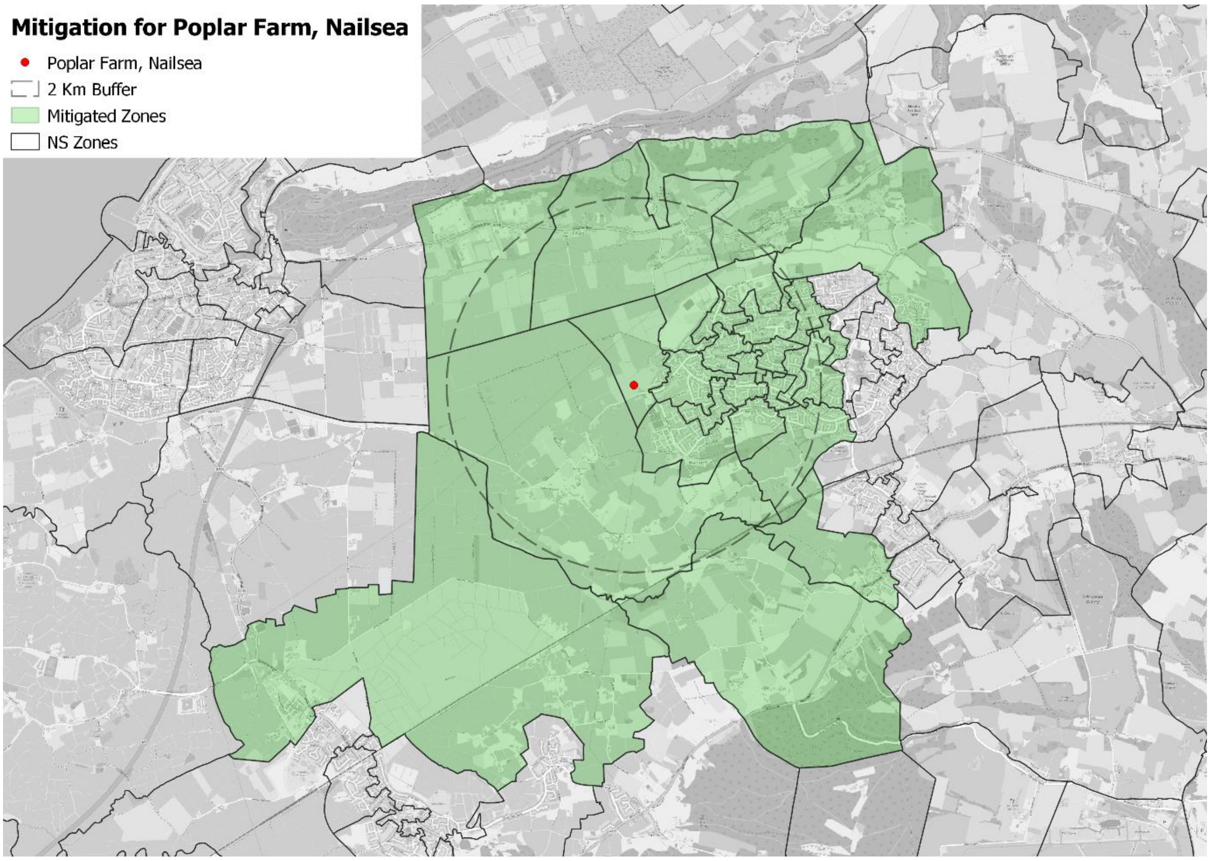


Figure 4-21: Youngwood Farm, Nailsea: zones impacted by mitigation strategy

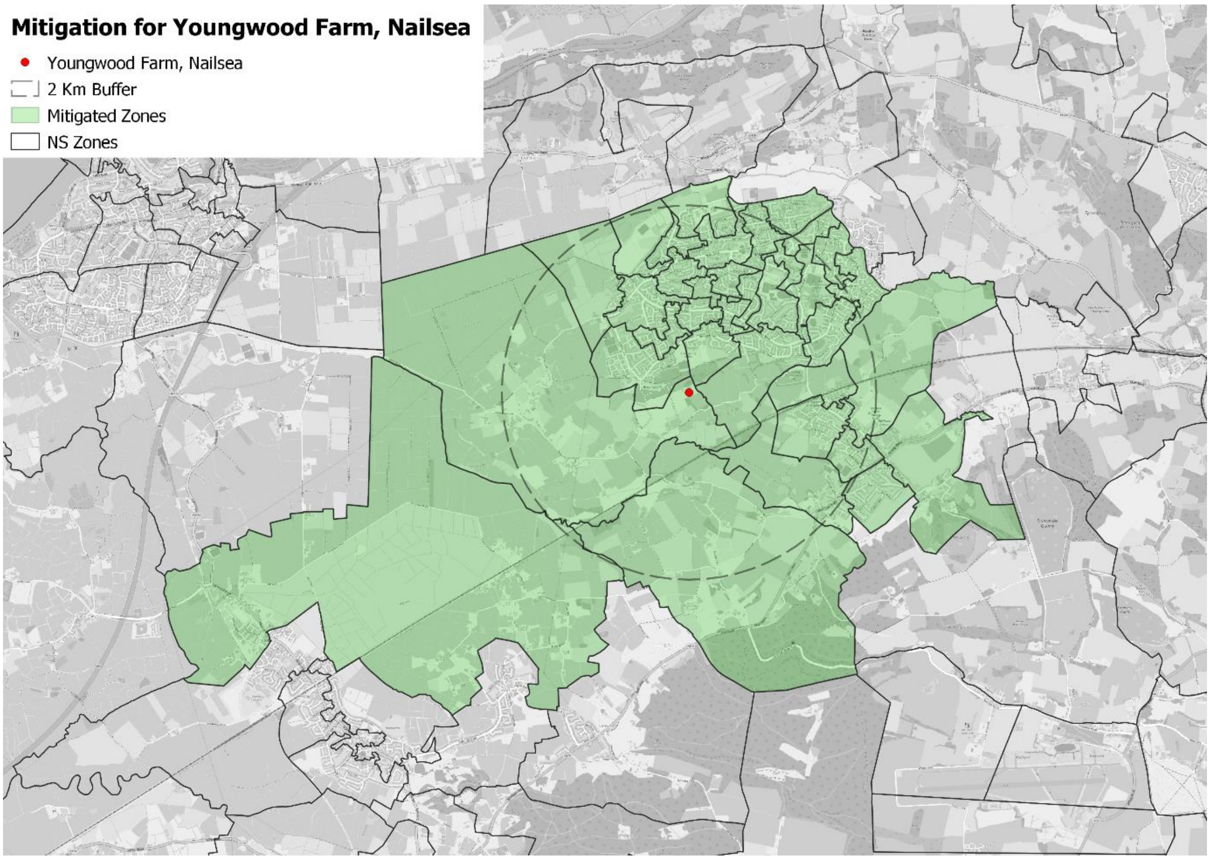


Figure 4-22: Land north of Youngwood Lane, Nailsea: zones impacted by mitigation strategy

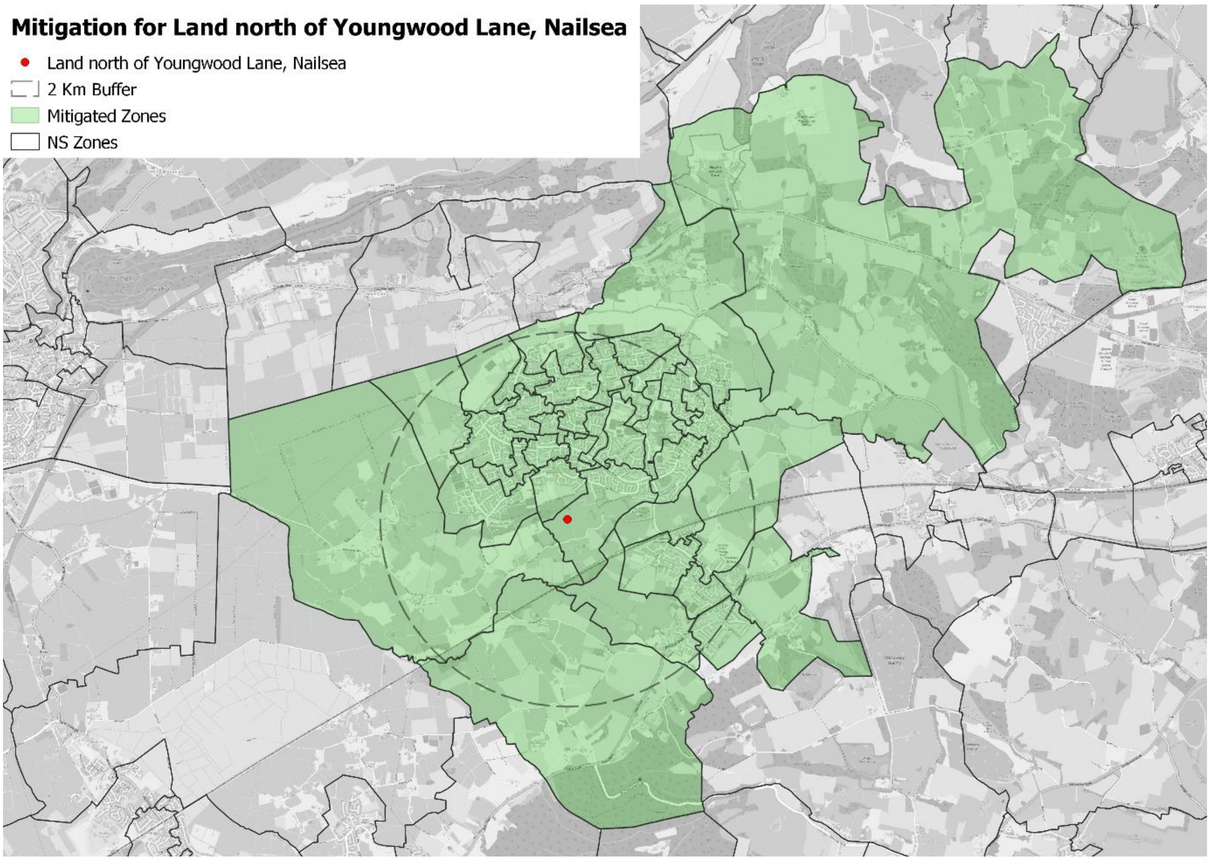


Figure 4-23: Land east of Backwell Site A, Backwell: zones impacted by mitigation strategy

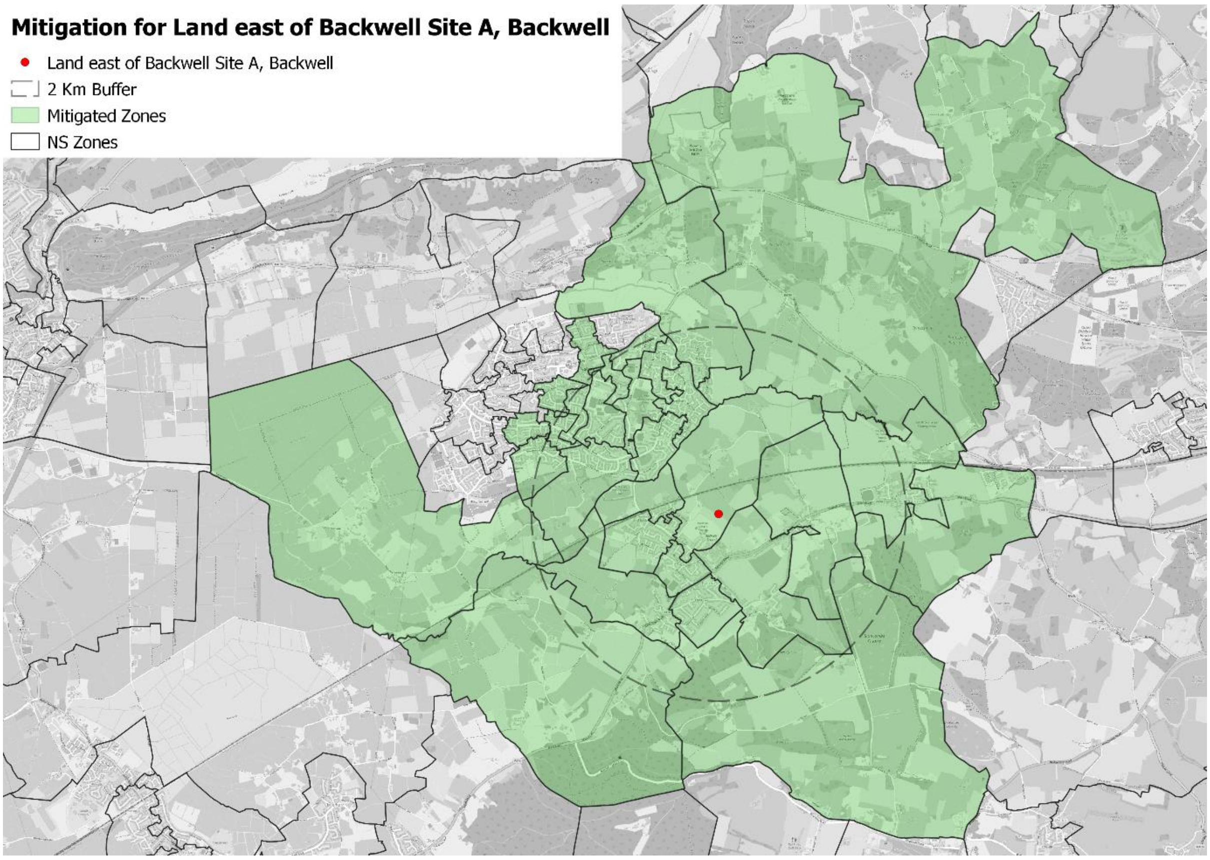


Figure 4-24: Land east of Backwell Site B, Backwell: zones impacted by mitigation strategy

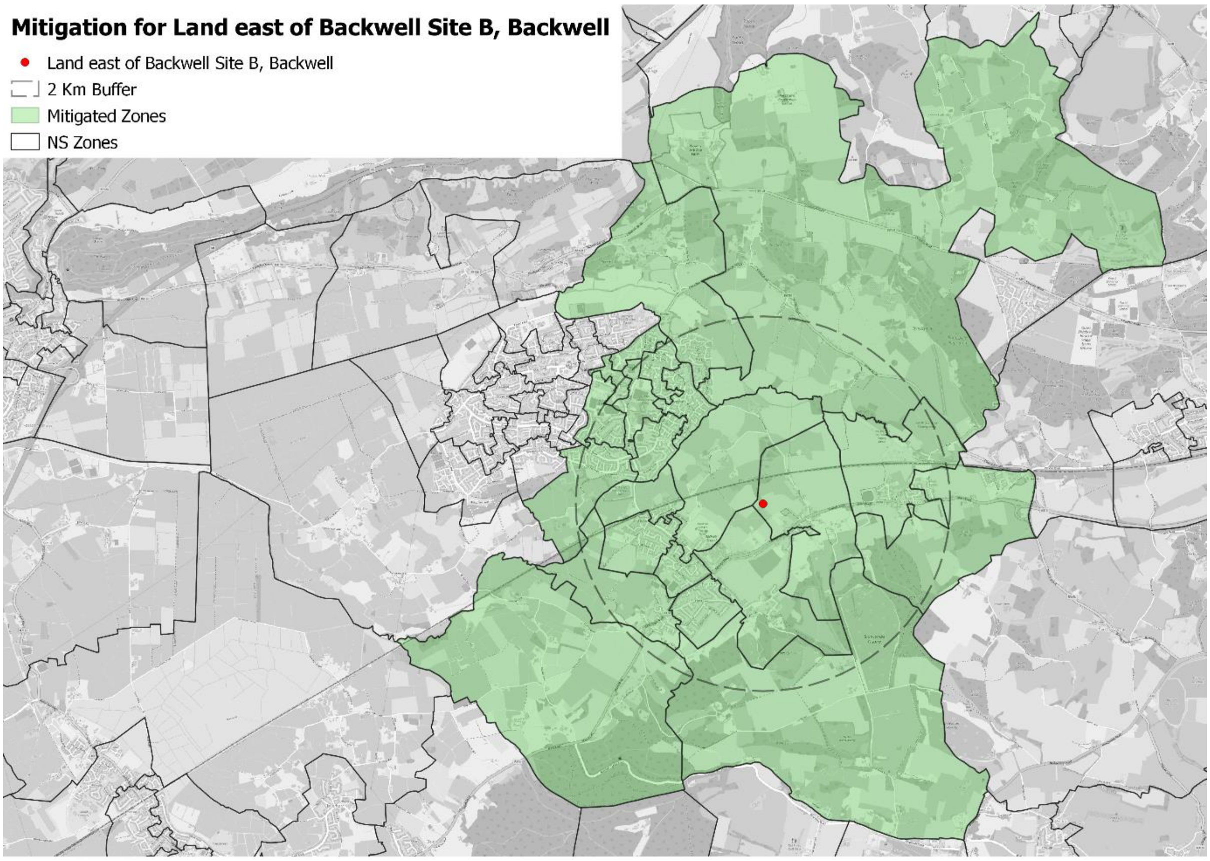


Figure 4-25: Youngwood Lane: zones impacted by mitigation strategy

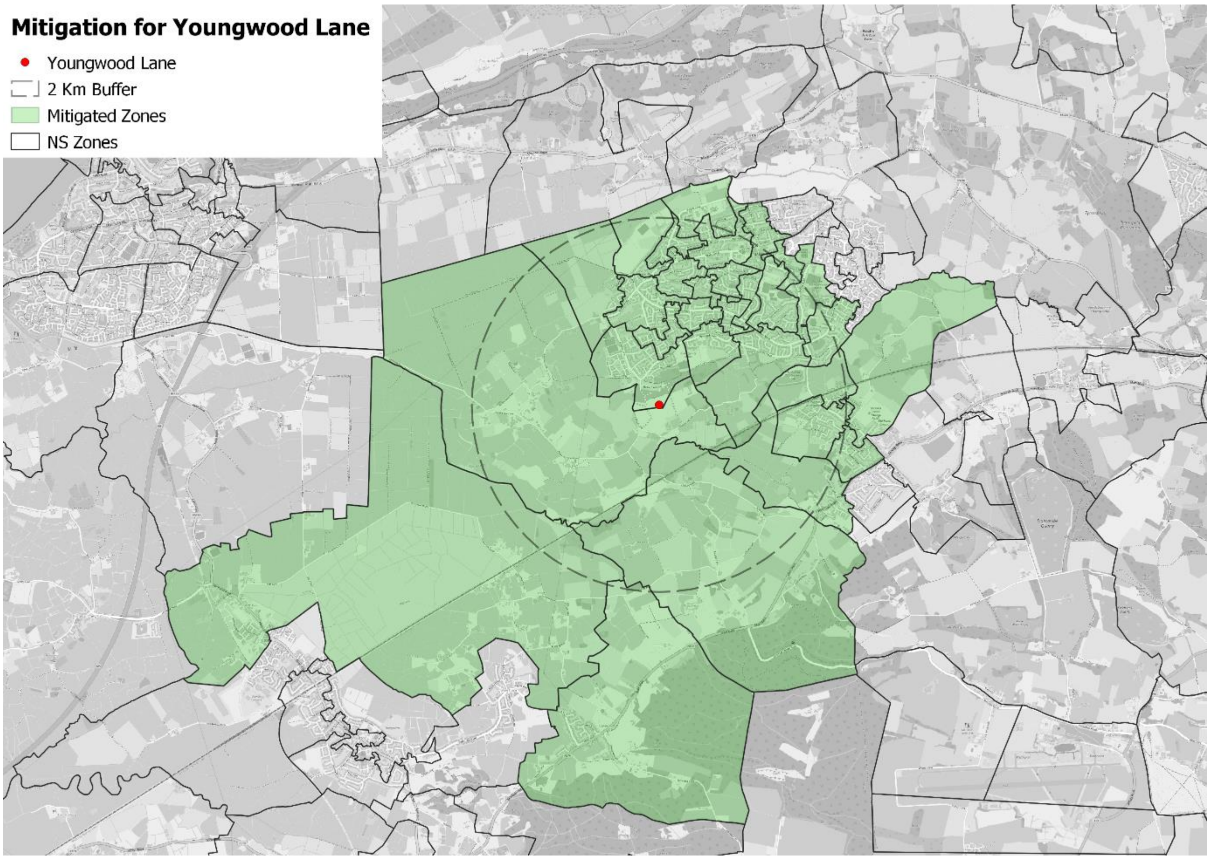


Figure 4-26: North West Nailsea: zones impacted by mitigation strategy

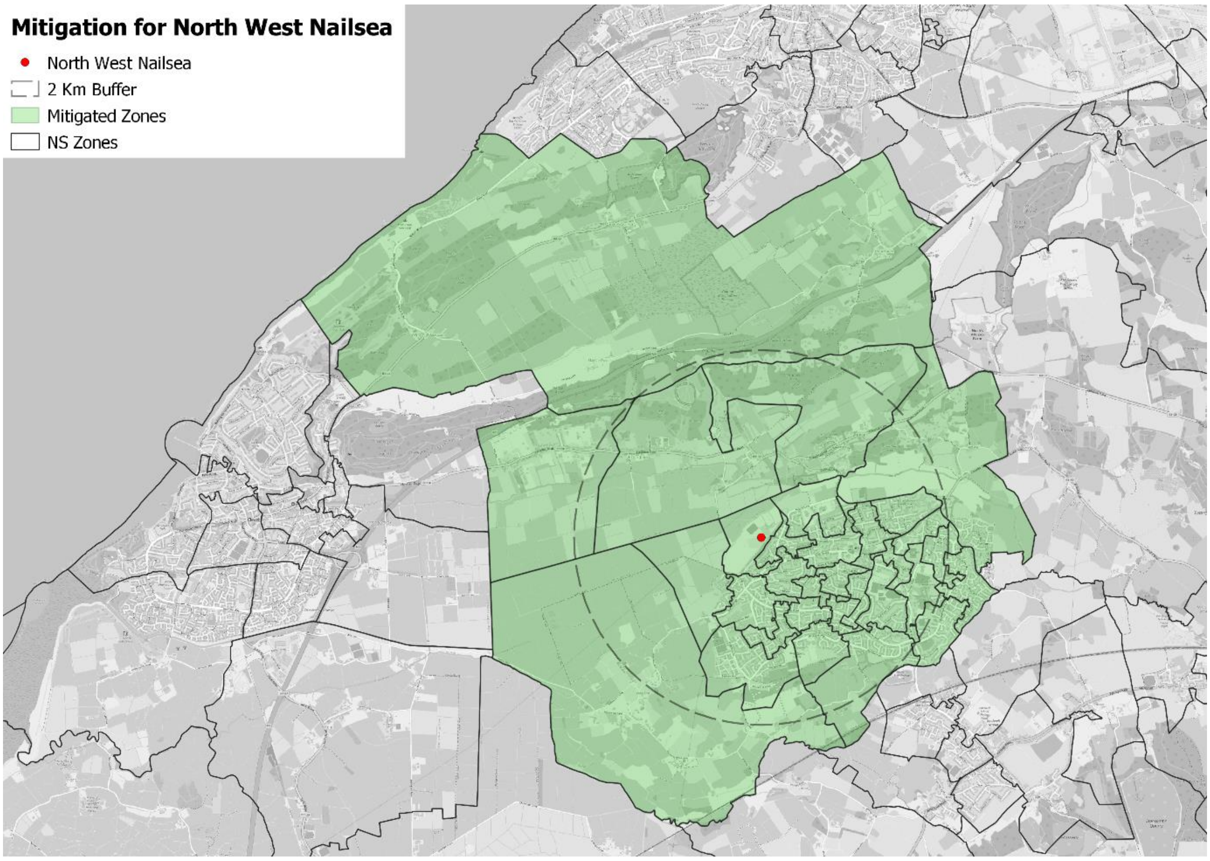


Figure 4-27: Grove Farm: zones impacted by mitigation strategy

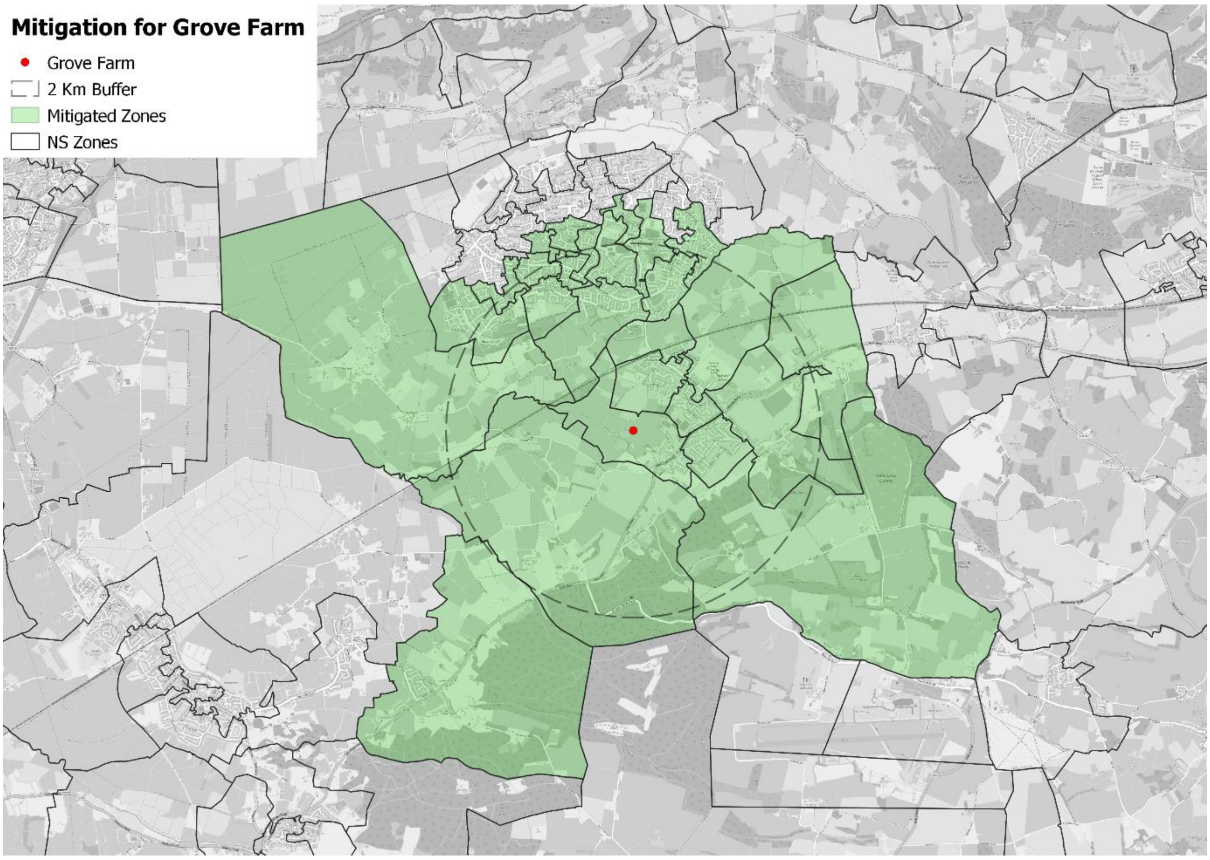


Figure 4-28: Dark Lane, Backwell: zones impacted by mitigation strategy

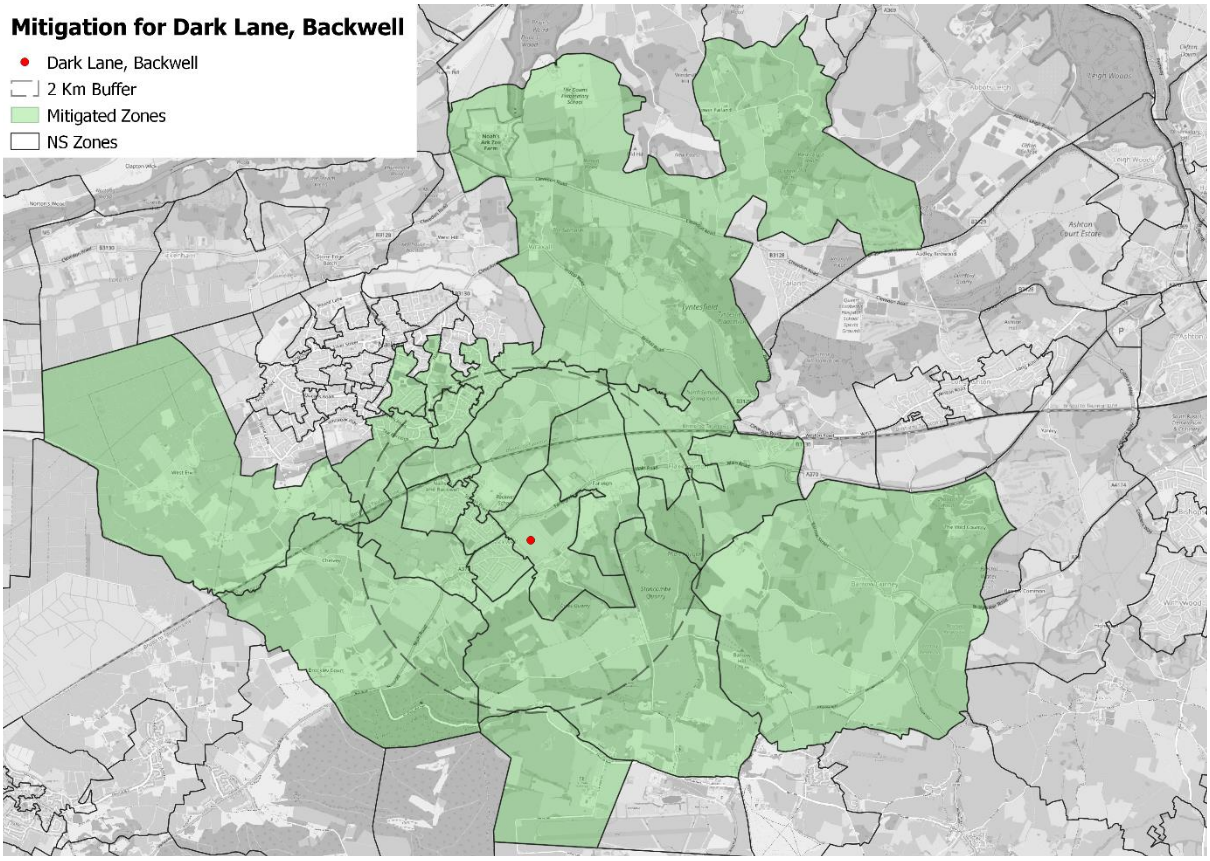


Figure 4-29: Weston super Mare Rugby Club: zones impacted by mitigation strategy

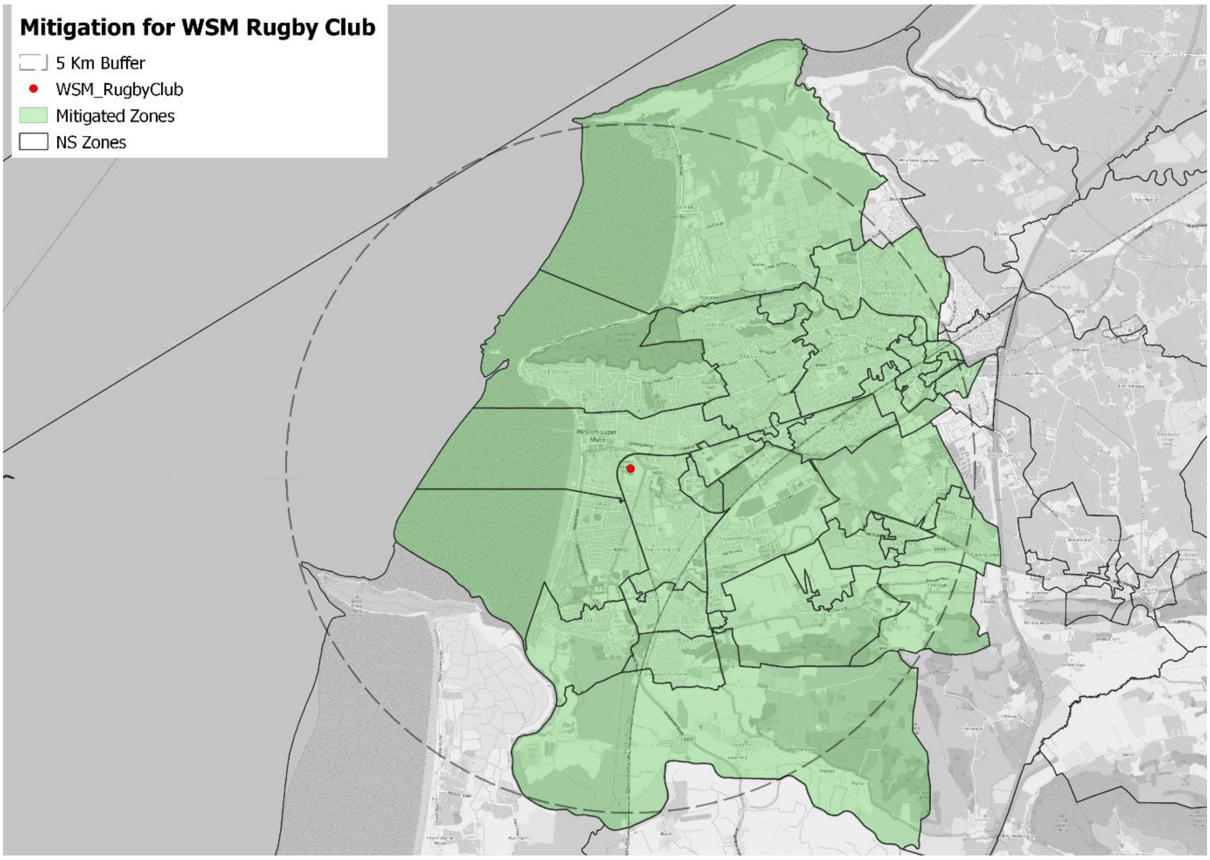


Figure 4-30: Wyndham Way: zones impacted by mitigation strategy

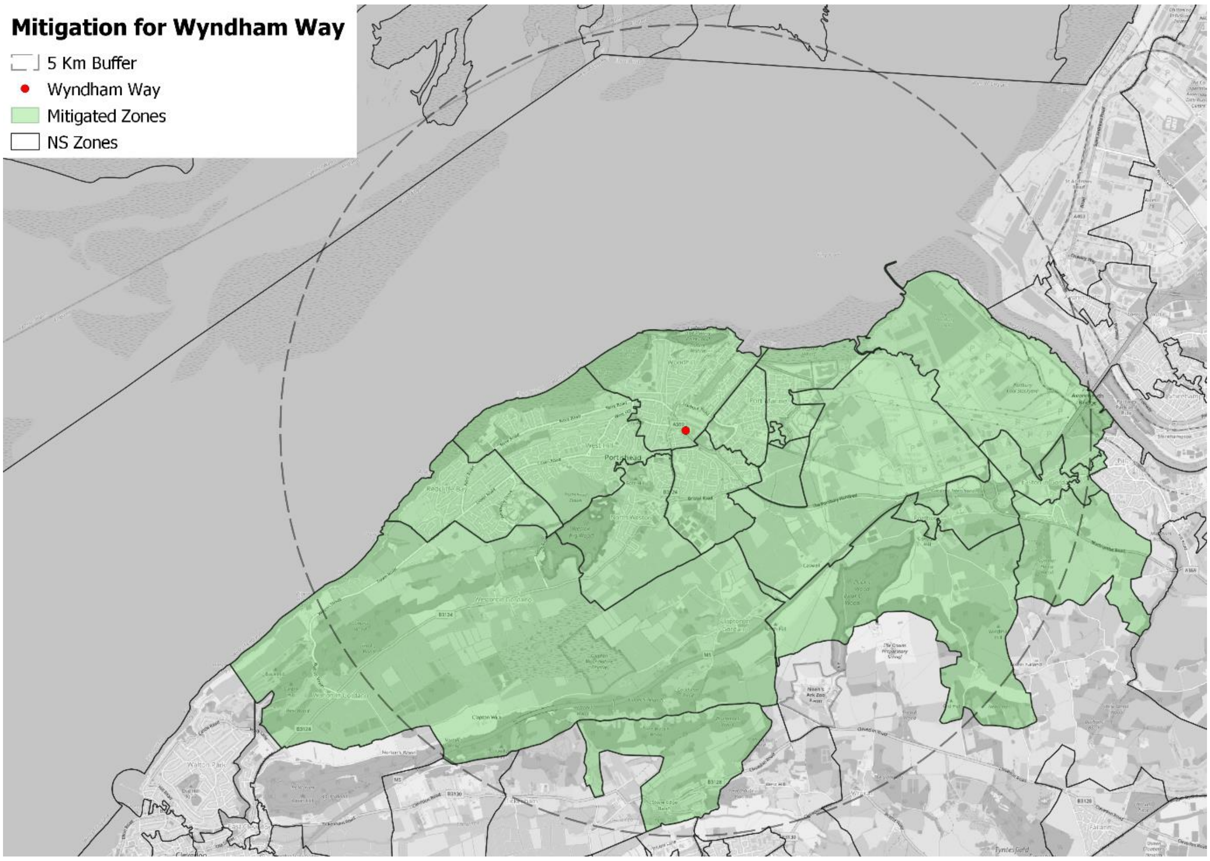
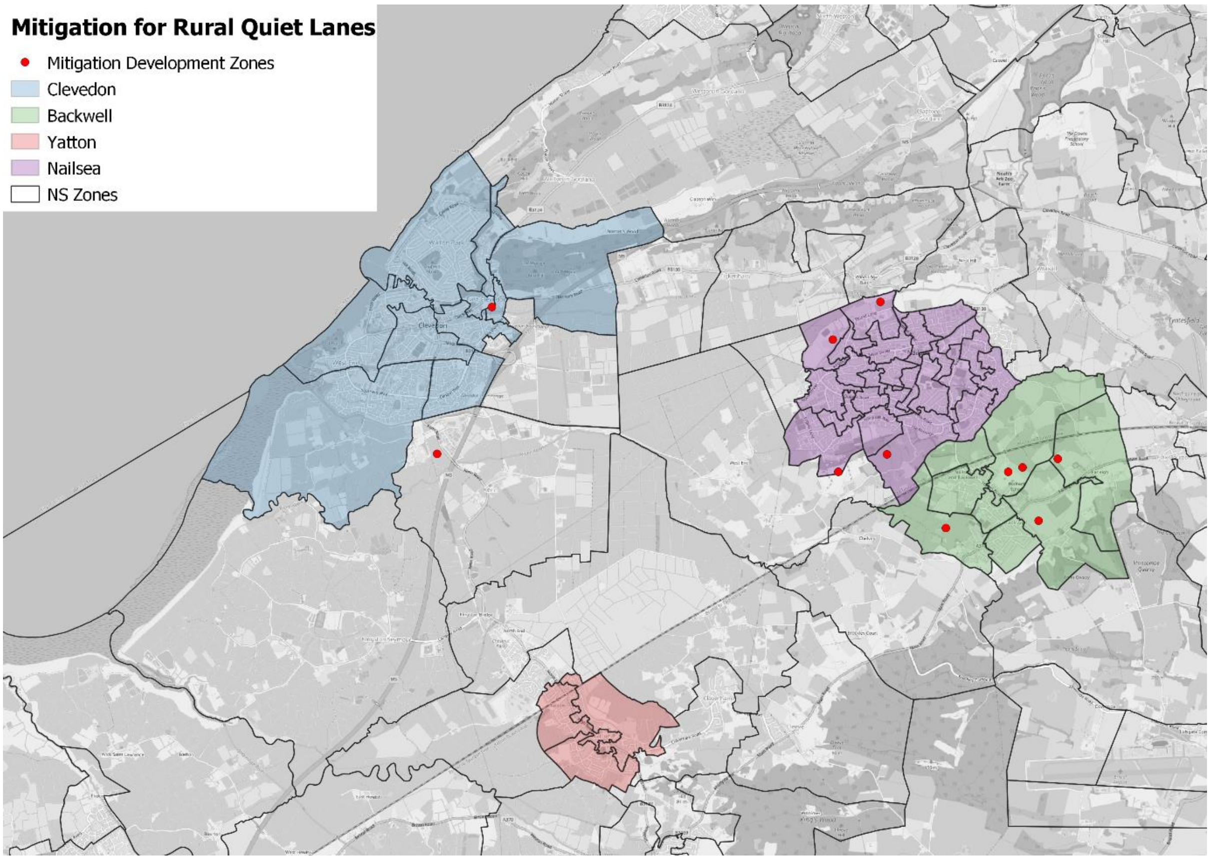


Figure 4-31: Rural Quiet Lanes: zones impacted by mitigation strategy



Public Transport Network

4.76 The 'With Local Plan plus Mitigation' public transport model used the 'With Local Plan' public transport model, detailed in section 9, with the following additions to the Public Transport network (as defined by North Somerset Council):

- The X5 Weston-super-Mare service to Portishead and Bristol via Worle and Clevedon, has an increased frequency, changing from one hour to every 30 minutes.
- The X6 Bristol Bus Station to Dial Hill Road has been extended to Clevedon employment allocation.
- The X10 service Clevedon to Cribbs Causeway via Portishead has been changed to hourly and extended to employment site east of J20, Weston-super-Mare and Worle.
- A new hourly bus service from Clevedon to Backwell via Nailsea serving demand from employment allocations in Clevedon, Youngwood Lane and Grove Farm has been added.
- X8 and X9 Bristol to Nailsea services has been extended to Young Wood Lane developments.
- The 36 service to Bishopsworth extended to serve the Woodspring development.
- Slight route diversion of A1 Airport flyer, A4 Air Decker, U2 unibus and Falcon to serve the proposed Woodspring development/Barrow Wood.

Variable Demand Modelling

4.77 Variable demand model assumptions are detailed in section 4.50 to section 4.52 and do not change between the Without Local Plan, 'With Local Plan' and With Local Plan plus Mitigation scenarios.

4.78 VDM has not achieved the convergence in terms of Gap Value of 0.1% within the maximum iteration of 20. Therefore, the loop with the lowest gap value has been considered as the best iteration which is loop 17 as shown Table 4-33.

Table 4-33: 2041 'With Local Plan plus Mitigation' VDM convergence statistics

Scenario	Maximum Number of Iteration	Loop with lowest GAP value	Gap value of the lowest loop
2041 'Without Local Plan'	20	17	0.13%

4.79 Demand matrices were compared pre- and post-VDM to ensure the responses looked plausible, the comparison is shown in Table 4-34. Compared to the 'With Local Plan' scenario, with mitigation there is a larger decrease in car vehicle trips (-1.3% vs -0.9%), and a larger increase in PT passenger demand (+23.1% vs +10.6%) suggesting a greater shift to public transport as a result of the mitigation measures.

Table 4-34 Change in 12-hour demand totals, 2041 'With Local Plan plus Mitigation' forecast year

Purpose	Highway Reference Trips	PT Reference Trips	Highway Post-VDM Trips	PT Post-VDM trips	Highway % Change	PT % Change
Employer's Business	164,625	27,197	162,575	31,504	*-1.2%*	*15.8%*
Home Based Work	502,544	80,497	497,345	87,448	*-1.0%*	*8.6%*
Other	1,131,880	168,334	1,115,379	220,943	*-1.5%*	*31.3%*
LGV	256,764	-	256,764	-	*0.0*	-
HGV	111,163	-	111,163	-	*0.0*	-

Post VDM Highway Model Statistics

4.80 Table 4-35 shows the convergence statistics for the ‘With Local Plan plus Mitigation’ and ‘With Local Plan’ Scenarios.

Table 4-35: 2041 ‘With Local Plan plus Mitigation’ and ‘With Local Plan’

	2041: ‘With Local Plan plus Mitigation’			2041: ‘With Local Plan’		
Time period	**Assignment Loop***	**%Flows**	**%GAP**	**Assignment Loop***	**%Flows**	**%GAP**
AM	26	98.0	0.022	27	98.1	0.036
	27	98.1	0.029	28	98.2	0.027
	28	98.5	0.021	29	98.6	0.024
	29	98.4	0.028	30	98.5	0.030
PM	33	98.9	0.017	33	98.5	0.015
	34	98.5	0.018	34	99.0	0.017
	35	99.0	0.017	35	98.7	0.018
	36	98.3	0.018	36	98.7	0.016

4.81 Table 4-36 and Table 4-37 shows the model statistics for the ‘With Local Plan plus Mitigation’ and ‘With Local Plan’ Scenarios. In the fully modelled area the ‘With Local Plan plus Mitigation’ scenario total car travel time is 4% lower and total car travel distance is 1% lower than in the ‘With Local Plan’ Scenario. As a result average car speeds are 3% higher in the plus mitigation scenario. This would be expected due to the mitigation measures applied which reduce car demand and therefore road congestion.

Table 4-36: 2041 ‘With Local Plan plus Mitigation’ and ‘With Local Plan’ Scenarios – AM Peak

	2041 ‘With Local Plan’		2041 ‘With Local Plan’ plus Mitigation		Impact of Mitigation	
Parameter	**Simulation**	**Simulation**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	18,291	87,342	18,966	88,205	**-3.6%**	**-1.0%**
Travel distance (pcu hrs)	919,349	5,237,634	926,111	5,259,353	**-0.7%**	**-0.4%**
Average Speed (kph)	50.3	60	48.8	59.6	**3.1%**	**0.7%**

Table 4-37: 2041 'With Local Plan plus Mitigation' and 'With Local Plan' Scenarios – PM Peak

	2041 'With Local Plan'		2041 With Local Plan plus Mitigation		Impact of Mitigation	
Parameter	**Simulation**	**Simulation**	**Simulation**	**Full Model**	**Simulation**	**Full Model**
Total travel time (pcu.hrs)	19,797	86,872	19,073	85,836	**-3.7%**	**-1.2%**
Travel distance (pcu hrs)	929,900	5,059,678	922,064	5,032,232	**-0.8%**	**-0.5%**
Average Speed (kph)	47.0	58.2	48.3	58.6	**2.8%**	**0.7%**

4.82 Figure 4-32 to Figure 4-41 shows the actual flow difference between the 'With Local Plan plus Mitigation' and 'With Local Plan' Scenarios. Green bandwidths indicate an increase in actual flow and blue bandwidths indicate a decrease in actual flow in the 'With Local Plan plus Mitigation' scenario compared with the 'With Local Plan' Scenario. The figures show the following locations:

- Weston super Mare.
- Backwell.
- Clevedon.
- Congresbury.
- Portishead.

Figure 4-32: Actual Flow Difference, Weston super Mare, AM

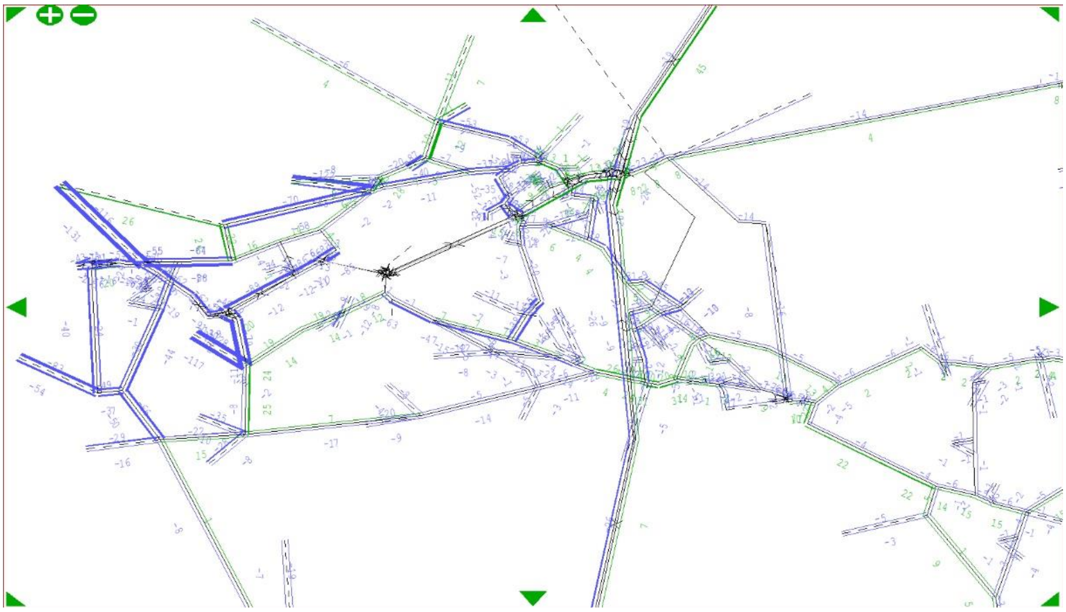


Figure 4-33: Actual Flow Difference, Backwell, AM

Figure 4-34: Actual Flow Difference, Clevedon, AM

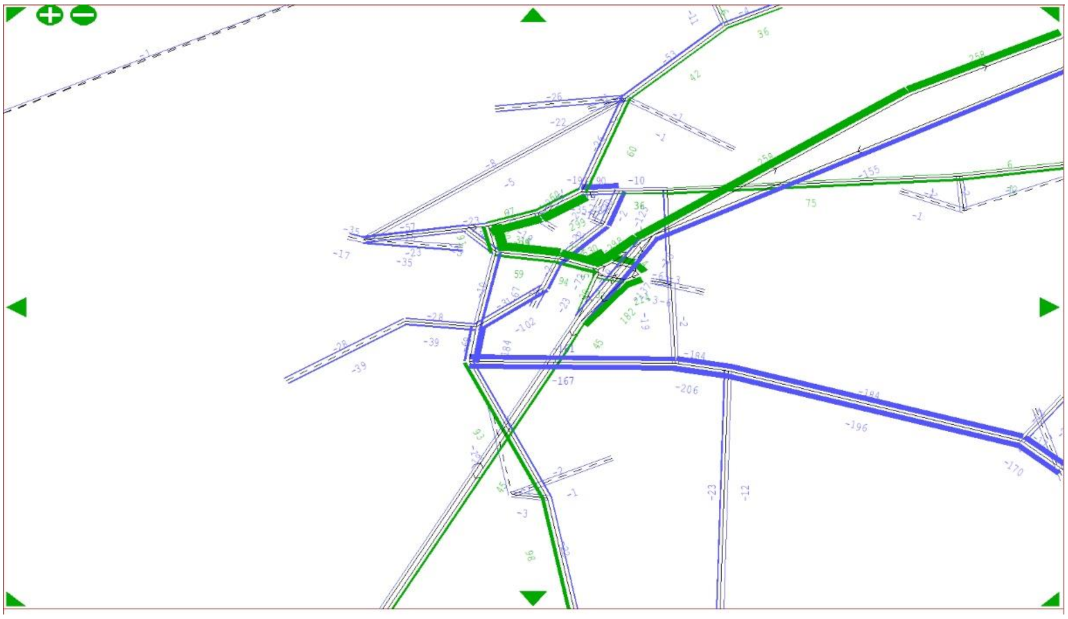


Figure 4-35: Actual Flow Difference, Congresbury, AM

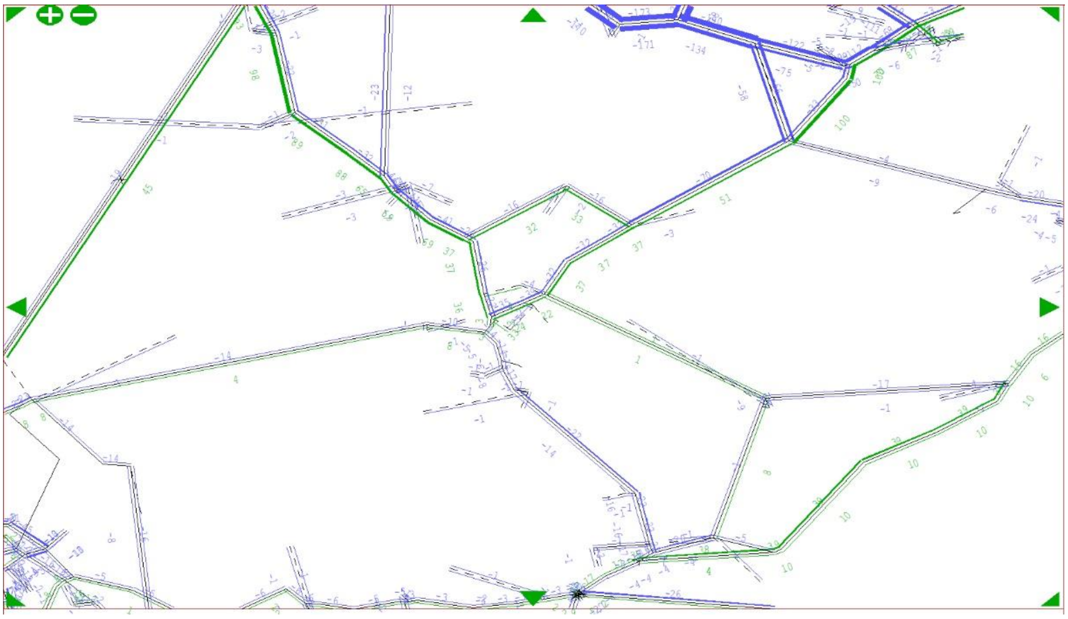


Figure 4-36: Actual Flow Difference, Portishead, AM

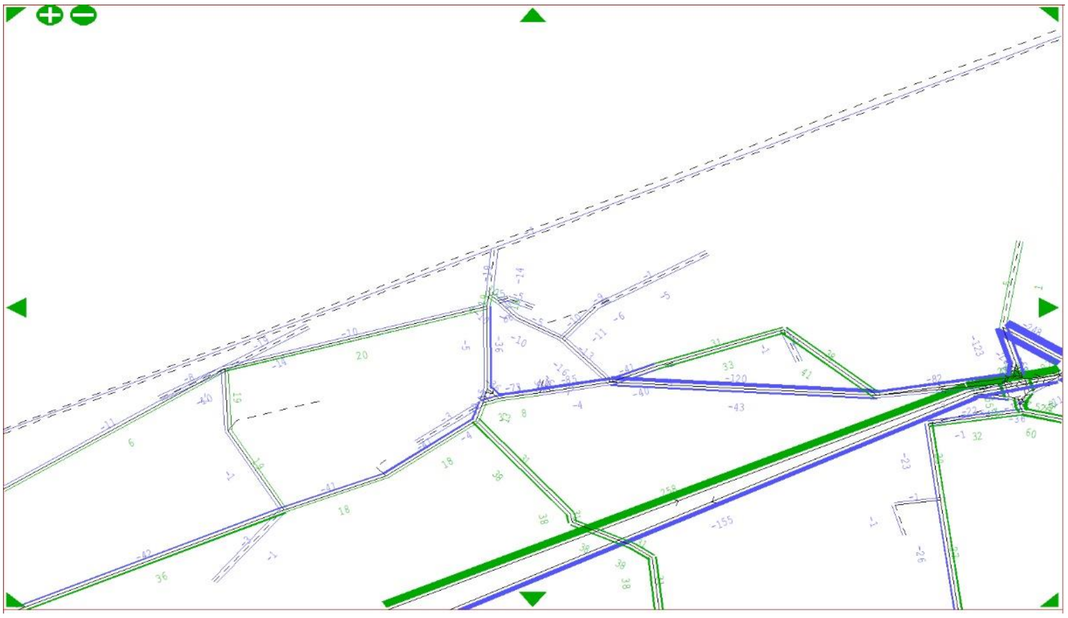


Figure 4-37: Actual Flow Difference, Weston super Mare, PM

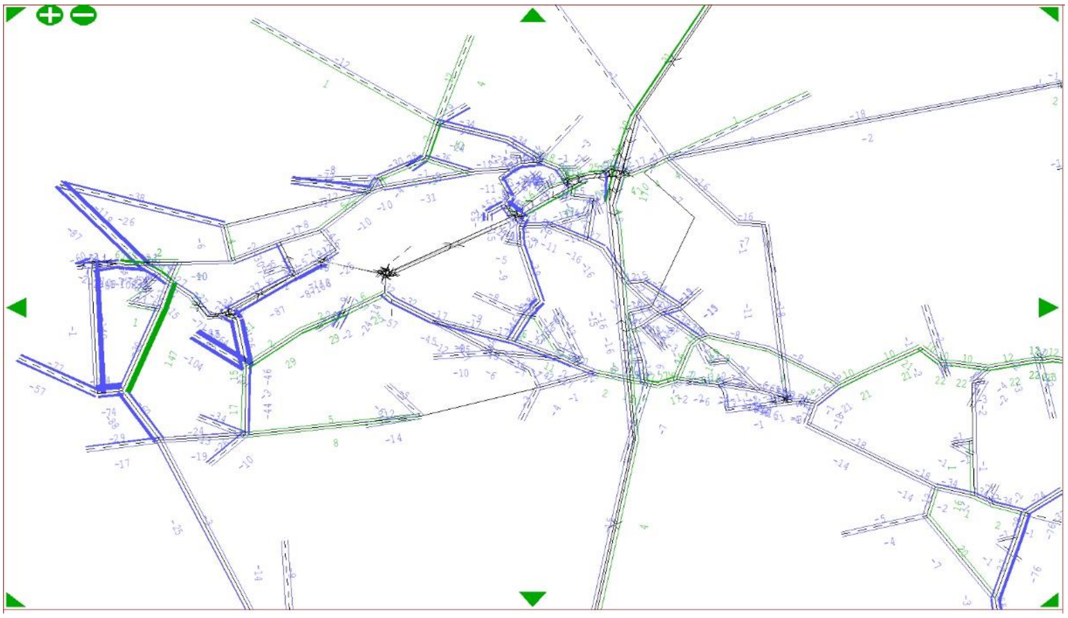


Figure 4-38: Actual Flow Difference, Backwell, PM

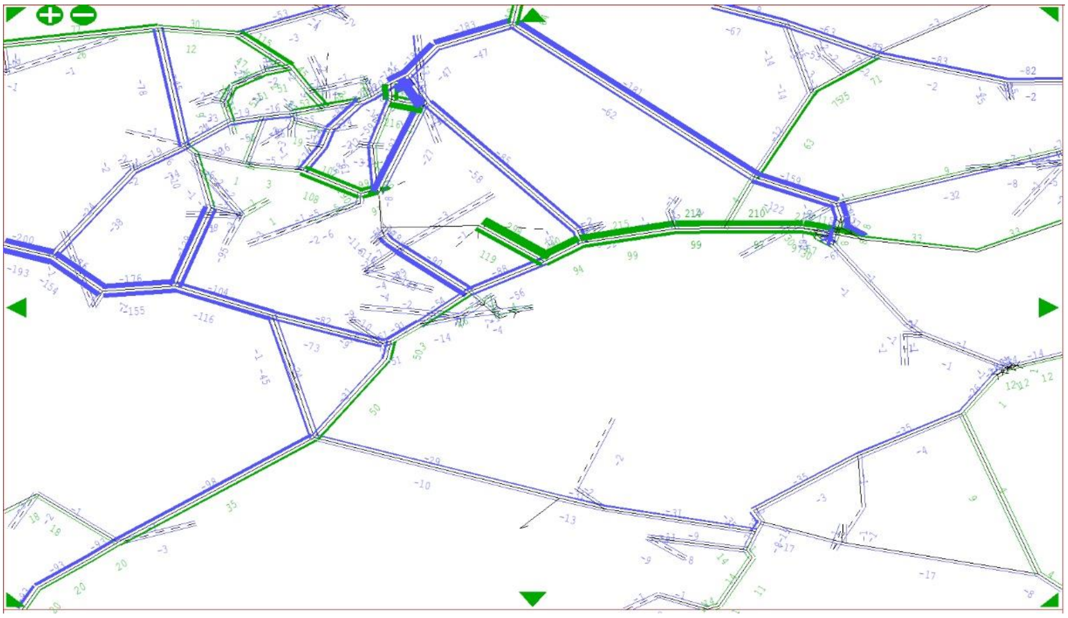


Figure 4-39: Actual Flow Difference, Clevedon, PM

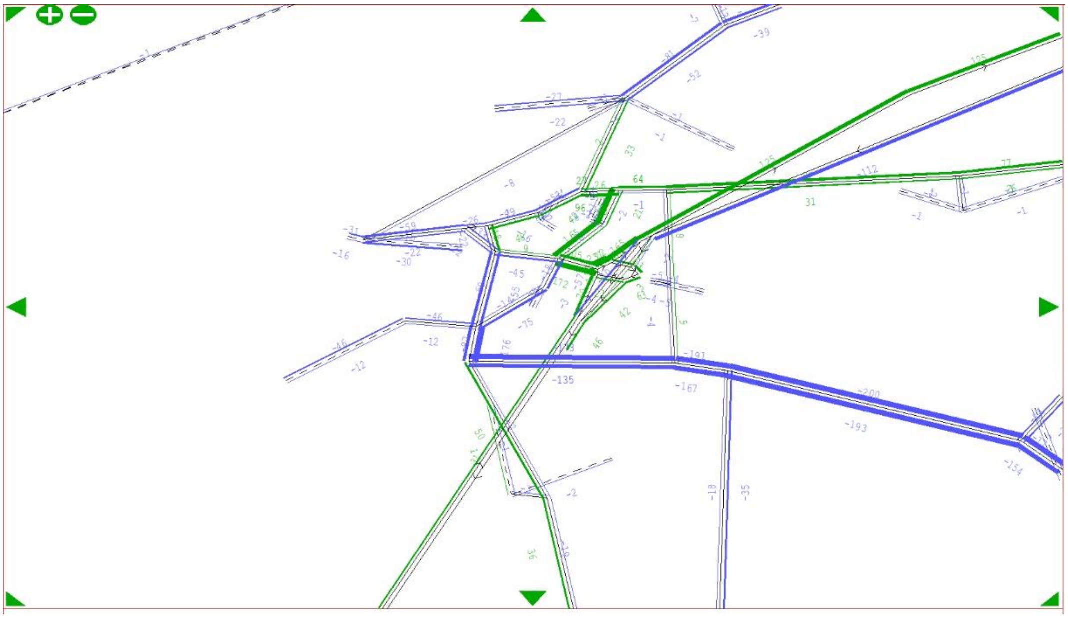


Figure 4-40: Actual Flow Difference, Congresbury, PM

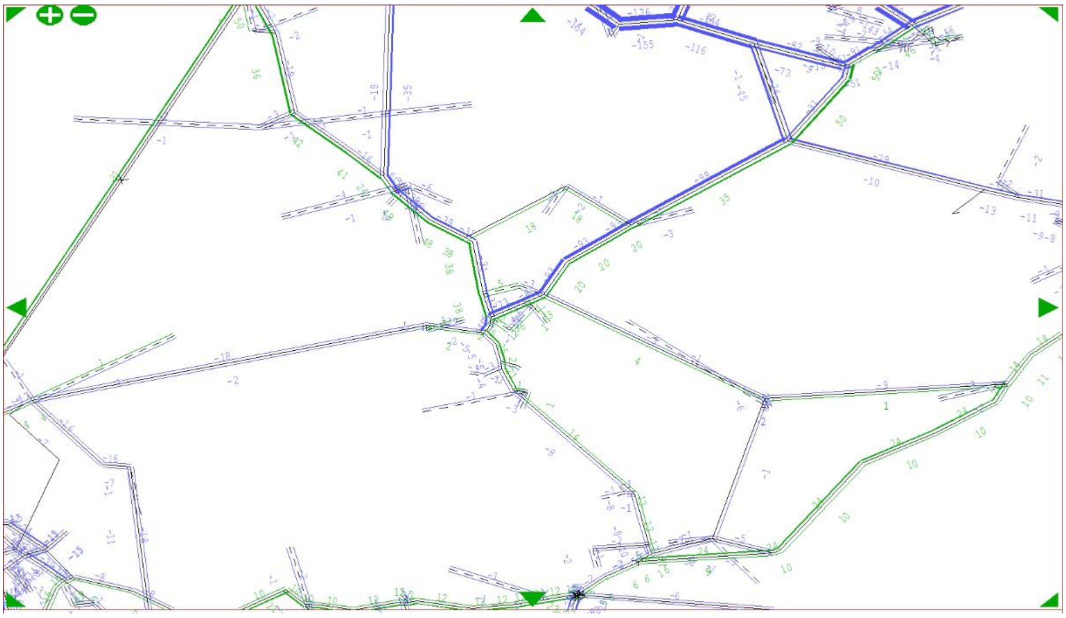
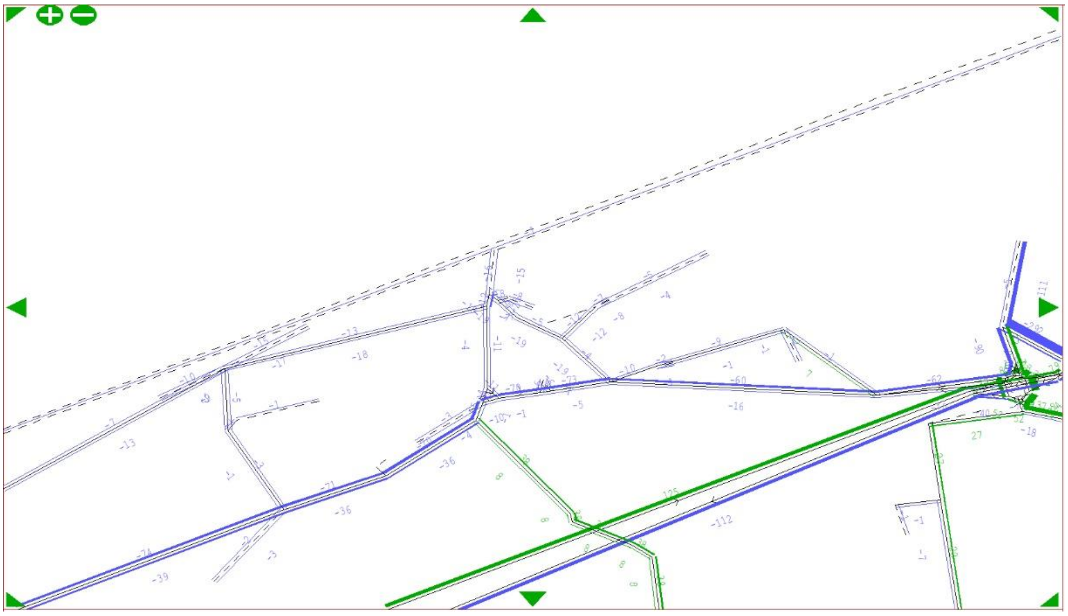


Figure 4-41: Actual Flow Difference, Portishead, PM



5. Summary

5.1 AECOM has been commissioned by North Somerset Council (NSC) to provide transport consultancy services in relation to their emerging Local Plan for 2041. As part of this, strategic transport modelling has been undertaken to be used as evidence for developing and appraising the transport impacts of the Local Plan.

5.2 For the 2018 Base Year, an enhanced version of the TAG-compliant NSSM highway assignment model has been developed and utilised. This is supported by a public transport supply model, developed in TRACC, with both models feeding transport costs into a TAG compliant variable demand model developed in DIADEM.

5.3 For the forecast year, 2041 'With' and 'Without Local Plan' scenarios have been developed. The 'With Local Plan' Scenario is constrained to TEMPro forecasts across the West of England area with the spread of development across West of England Combined Authority amended to incorporate the planned Local Plan strategies and committed developments.

5.4 The 2041 forecast year highway network contains the M5 J21 Northbound Merge Scheme, Banwell Bypass, the North-South Link Road, and A38 Junction Improvement schemes as well as BSIP schemes. The 2041 public transport model includes the re-opened Portishead Rail Line, new stations at Pill and Portishead, and associated hourly rail services as well as BSIP schemes.

5.5 The base year travel costs, 2041 reference demand, and 2041 highway and public transport networks have been processed through the VDM to produce traffic and demand forecasts incorporating changes in housing, employment, trip rates, car ownership, economic parameters, and travel costs.

5.6 From these results, mitigation measures have been identified and tested within the 'With Local Plan' Scenarios to create a 'With Local Plan plus Mitigation' scenario. These mitigation measures include policy-based mitigations as well as specific measures for each Local Plan development.

Appendix A: North Somerset Local Plan Modelling, Appraisal Specification Report

Appendix B: NSSM LMVR

Appendix C: Link Results

Appendix D: Screenline Results

Appendix E: Uncertainty Log

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