Tunbridge Wells Local Plan - Local Junction Capacity Sensitivity Testing Technical Note

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Date: 28/11/2023
Document Reference: 1
Revision: 2

1. Introduction

This Technical Note builds upon the work undertaken in Stage 1, Stage 2, and Stage 3 Part 1 of the Local Plan transport modelling, specifically the development of an updated Local Plan scenario for analysis of potential transport mitigations. At the end of Stage 3 Part 1, a scenario *Local Plan High Modal Shift* was identified. This scenario focusses on modal shift from car to sustainable transport modes around the new Local Plan sites based on both developer and council investment in public transport services and active travel infrastructure.

Following completion of the strategic modelling of the "Local Plan High Modal Shift" scenario, a review was undertaken to understand the remaining 'Major' hotspots in Tunbridge Wells Borough. Four 'Major' hotspot locations were identified:

Table 1 'Major' hotspot junction locations in need of mitigation

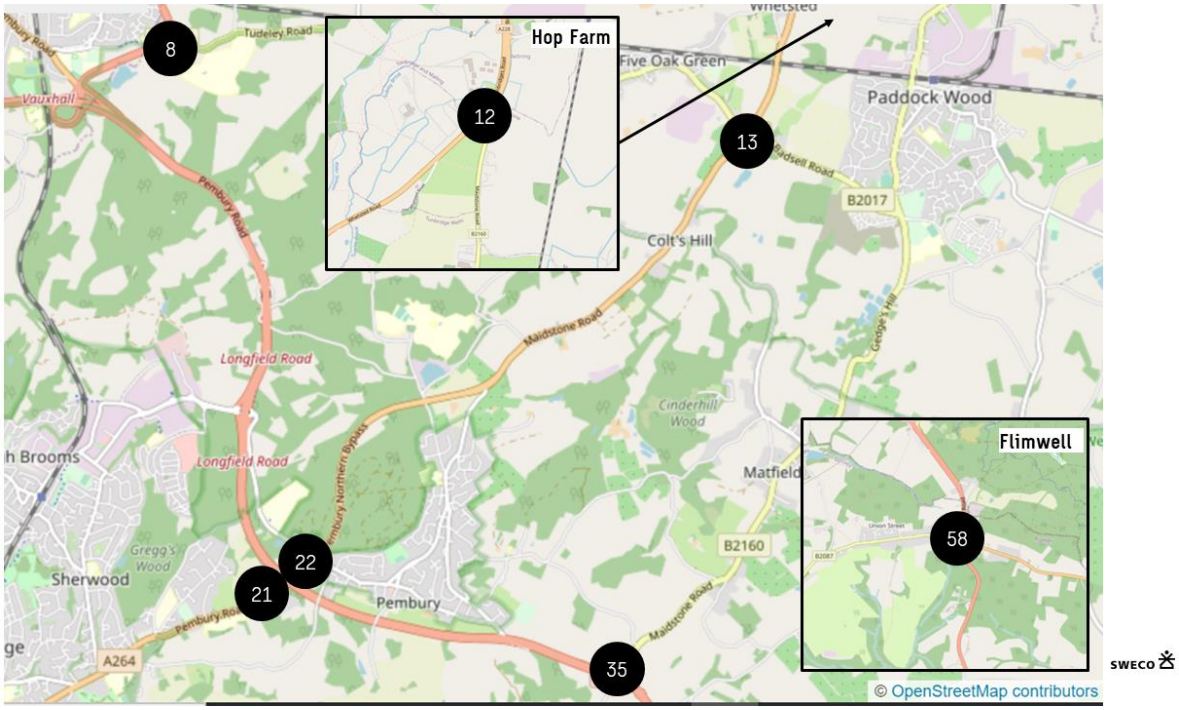
Model ID for junction	Location	Road classification	Arm name
8	Tonbridge /Tudeley	A26	Woodgate Way (N)
		B2017	Tudeley Road (E)
		A26	Woodgate Way (SW)
		Unclassified	Tudeley Lane (W)
12	Hop Farm Roundabout	A228	Branbridges Road (NE)
		B2160	Maidstone Road (SE)
		A228	Whetsted Road (SW)
		Unclassified	Hop Farm (NW)
13	Badsell Roundabout	A228	Maidstone Road (N)
		B2017	Badsell Road (E)
		A228	Maidstone Road (S)
		B2017	Badsell Road (NW)
35	Kippings Cross Roundabout	B2160	Maidstone Road (N)
		A21	Hastings Road (E)
		Unclassified	Dundale Road (S)
		A21	Hastings Road (W)

In addition, National Highways have raised queries around three specific junction locations. These locations are:

Table 2 National highways identified key junctions

Model ID for junction	Location	Road classification	Arm name
21	Pembury Road A21 flyover South West Dumbbell	A21	NB Slip (N)
		A228	Pembury Road (NE)
		A264	Pembury Road (SW)
22	Pembury Road A21 flyover North East Dumbbell	A21	SB Slip (N)
		A228	Pembury Northern Bypass (E)
		Unclassified	Tesco Superstore (S)
		A228	Pembury Road (W)
58	Flimwell Crossroads	A21	London Road (N)
		A268	Hawkhurst Road (E)
		A21	London Road (S)
		B2087	High Street (W)

The location of the junctions referenced above are shown in **Figure 1.1** below. Figure 1-1 Hotspot and Junction Locations



This Note sets out potential mitigation measures for each of the Four 'Major' hotspot locations to remove any remaining residual impacts the Local Plan is creating in terms of additional congestion and delay at these locations, in comparison with the Reference Case (RC). The National Highways additional junctions has been assessed as part of wider strategic analysis to understand if there are knock on impacts that will require mitigation once the 'Major' hotspots discussed in this Note are addressed.

Mitigation Design and Costs

The potential mitigation measures set out within this Note are high-level concept designs and are subject to further design work including technical and safety audit. The level of assessment set out

within the Note has previously been agreed with Kent County Council (KCC) and National Highways (NH) as being proportionate for the Local Plan stage, but it is acknowledged that the further technical design and safety audit work will be required at planning application stage. All flare lengths and new/improved traffic lanes shown on the concept design plans have a Design Manual for Road and Bridges (DMRB) standard carriageway width of 3.65m metres. This is achieved through the provision of new carriageway, thus ensuring that the existing lane widths on the unaffected links are maintained.

High Level Costs exclude costs associated with the diversion of statutory undertakers' apparatus and detailed design. However, it is not proportionate at the strategic Local Plan making stage to go to this level of detail, which will be addressed at planning application stage. Furthermore, costs will vary depending on the level of construction, electrical or survey work required, as well as the equipment suppliers any contractors may use. Notwithstanding, the high level costs presented within this Note are considered to be generous estimates of reasonable costs appropriate for this stage of the Local Plan process.

Strategic Model Scenarios

The Strategic Highway Modelling scenarios have been used to feed demand into the localised junction models used to identify working mitigations for the key hotspot locations. A summary of the strategic model scenarios used for the analysis set out in this Technical Note is provided below:

- **Base Case (BC) –** Base network and base demand as per survey period of 2018. The outputs of this model are outlined in the original LMVR document and have been accepted by all key stakeholders to be within TAG guidance and acceptable as the BC to be used for wider Local Plan highway modelling analysis.

- **Reference Case (RC) –** Base network with agreed junction upgrades to take account of committed developer mitigations as part of committed developments already modelled in the demand. Demand uplifted using TRICS for sites in Tunbridge Wells borough and TEMPRO (version NTEM 7.2 as set out in August 2023 'Stage 1 TN Model Preparation v5 Final' technical note) for areas outside of Tunbridge Wells borough.

- **Local Plan Modal Shift (LPMS) –** The underlying travel demand in the model has been uplifted from RC based on the agreed TRICS based Local Plan trip rates for the Local Plan sites. This scenario then also includes mitigation in the form of modal shift to sustainable transport modes from car as a result of Local Plan developer and council future investments. The modal shift levels are the 'High' scenario as outlined in the Technical Note (TN) for Stage 3 Part 1. The network is per RC except around the A228 Colts Hill and A228/B2017 junction. To reflect issues identified in the model around the A228/B2017 junction acting as a bottleneck, this scenario includes capacity enhancements in these locations to best replicate the expected demand on the wider network as a result of removing these bottlenecks through the implementation of capacity enhancements.

- **Local Plan Highways (LPH)** – This scenario will focus on a final run in the strategic highway model which includes the final list of potential highway mitigation measures identified for Local Plan in terms of addressing network changes. Demand will be based on the Local Plan Modal Shift (LPMS) scenario underlying demand. This analysis will be undertaken at a later stage upon receiving final stakeholder comments with agreement on the set of mitigations to include in the Strategic Highway Model.

Further detail on how the LPMS demand has been derived can be found in Technical Note "Stage 3 Part 1 TN Modal Shift Proposal Final 11.09.2023 Final". It should also be noted that 10% modal shift was previously agreed by KCC for Paddock Wood and NH, and the high modal shift scenario adopted for this assessment is within this parameter at 9%.

As part of the detailed junction analysis in this report, our reporting focuses on the RC and LPMS scenarios. This is to reflect the LPMS has the expected flows along the A228 by removing key constraints around Badsell Roundabout junction and Colts Hill and KCC support on measures to increase modal shift across the borough. Parallel work has recently been undertaken between TWBC and KCC to ensure measures to increase modal shift will happen through the wider LCWIP and BSIP processes.

Model Years and Mitigation Implementation Year

The full model year is 2038. The 2038 modelling has been used to understand if there is a need for changes to the transport network as a result of Local Plan trip growth.

2. Review of Key Strategic Model Outputs

Junction Flow Changes

This is a high-level summary of the junction flows at the key junction locations identified in Section 1. The analysis includes total flow analysis for each junction based on the AM and PM Peaks. The scenarios considered include BC, RC, and LPMS. The colours on the table denote the scale of flows and change with green showing lower levels of flow or flow differences between scenarios whilst red denotes large amounts of flow or large changes in flow between scenarios.

Table 3 Key junction flow changes between Base Case, Reference Case, and Local Plan

		Base Case (BC)		Ref Case (RC)		Local Plan Modal Shift (LPMS)		BC vs RC		RC vs LPMS	
Model ID	**Junction**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
8	A26 / B2017	2,639	2,520	3,586	3,067	3,743	3,156	36%	22%	4%	3%
12	A228 / B2160	3,263	2,874	3,699	3,286	3,817	3,536	13%	14%	3%	8%
13	A228 / B2017	2,512	2,493	3,088	3,011	3,806	3,586	23%	21%	23%	19%
22	A21 SB / A228 / A264	1,586	2,193	2,351	2,908	2,571	3,037	48%	33%	9%	4%
21	A21 NB / A228 / A264	2,344	2,502	3,695	3,533	3,871	3,735	58%	41%	5%	6%
35	A21 / B2160	2,967	2,644	3,342	3,327	3,484	3,523	13%	26%	4%	6%
58	A21 / A268 / B2087	1,947	1,662	2,340	1,993	2,371	2,028	20%	20%	1%	2%

In terms of Local Plan, the key metric is the comparison between Reference Case and Local Plan in terms of where the most significant demand growth occurs as an indication of where mitigation may be required. For all junctions except the A228/B2017 junction, the level of growth observed is less than 10%. The growth observed for this comparison is lower than the growth observed between BC and RC, often a multiple of this rate. With some of the junctions already approaching capacity in the Base Year, there may be a need for KCC and NH to intervene to address underlying issues resulting from background growth before the additional flows associated with the Local Plan become an issue to consider.

Flimwell Crossroads

The data shows that for Flimwell Crossroads (junction 58 A21 / A268 / B2087) there is not projected to be a significant increase in highway flows as a result of Tunbridge Wells borough Local Plan development growth.

Link Capacity Review

A high level analysis has been undertaken to understand the impact of Local Plan development demand on key links close to Paddock Wood on the A228 and B2017. A summary of the Volume over Capacity (V/C) analysis is presented below.

Table 4 A228 and B2017 link capacity analysis

A228 Maidstone Road (north of Badsell Junction)

Scenario	AM				PM			
	northbound		southbound		northbound		southbound	
	Demand	V/C	Demand	V/C	Demand	V/C	Demand	V/C
2018 Base	734	46	1,039	65	964	61	644	41
2038 Ref Case	959	60	1,145	72	1,027	65	877	55
2038 Local Plan Modal Shift (LPMS)	1,067	67	1,363	86	1,112	70	1,012	64

A228 Maidstone Road (Colts Hill)

Scenario	AM				PM			
	northbound		southbound		northbound		southbound	
	Demand	V/C	Demand	V/C	Demand	V/C	Demand	V/C
2018 Base	677	66	915	90	920	90	670	66
2038 Ref Case	830	81	1,127	111	990	97	882	86
2038 Local Plan Modal Shift (LPMS)	955	94	1,306	128	1,115	109	1,160	114

A228 Maidstone Road (Colts Hill) New Road

Scenario	AM				PM			
	northbound		southbound		northbound		southbound	
	Demand	V/C	Demand	V/C	Demand	V/C	Demand	V/C
2018 Base	677	43	915	58	920	58	670	42
2038 Ref Case	830	52	1,127	71	990	62	882	55
2038 Local Plan Modal Shift (LPMS)	955	60	1,306	82	1,115	70	1,160	73

B2017 Badsell Road (Five Oak Green)

Scenario	AM				PM			
	eastbound		westbound		eastbound		westbound	
	Demand	V/C	Demand	V/C	Demand	V/C	Demand	V/C
2018 Base	282	31	416	46	512	57	331	37
2038 Ref Case	455	51	615	68	644	72	405	45
2038 Local Plan Modal Shift (LPMS)	509	57	898	100	832	92	481	53

The V/C is based on the strategic model link flows divided by the overall identified link capacity, based on the descriptions provided by National Highways in the Design Manual for Roads and Bridges (DMRB) TA 79/99.

A228

The data analysis shows that there is a significant capacity issue on the A228 link through Colts Hill, south of the Badsell Roundabout junction with the B2017. As a result, the model was updated with a higher capacity link that replicates building a new road to modern standards with wider lanes and pavements provided. The analysis in the table for *'New Road'* shows that this new link will alleviate the V/C issues along this link. Stantec have designed up the Colts Hill Bypass link for the area that links into a potentially expanded Badsell Roundabout. The trigger point is estimated to be approximately 2,000 dwellings.

The data shows that the link to the north of the Badsell Roundabout is projected to remain within capacity over the Local Plan period.

B2017 (Five Oak Green)

Although the data analysis shows that congestion rises along the B2017 through Five Oak Green link in the Local Plan scenario, the demand is not seen as being of a level to justify a major expansion in link capacity or a new link road such as the Five Oak Green bypass that was previously considered . However, it is recommended that consideration be given to the implementation of enhanced traffic management through the area to better support the flow of vehicles whilst also integrating this with enhanced infrastructure for people walking, wheeling and cycling in the area to enable them to safely travel along and across the link. More broadly the sustainable transport measures should be designed to maximise accessibility to Paddock Wood rail services to reduce the need for car travel on this link. The design and implementation of such measures would be expected to be linked to Travel Plans and Monitor and Manage agreements for all major Local Plan developments in the wider Paddock Wood area.

3. Overview of Junction Modelling Undertaken

The findings from the local junction modelling have been used to confirm potential mitigation solutions at the key hotspots with the aim to produce nil detriment to the junction's capacity performance when compared to the Reference Case scenario. The junctions have been modelled using industry standard software. Junctions9 software has been used for modelling roundabouts, specifically the Arcady model for roundabouts. The traffic signal junctions have been modelled using LinSig3 software.

Junction Capacity Appraisal – Definition of Modelling Terms

Volume to Capacity ratio (V/C) – This comes from the Strategic Saturn highway model. It is a measure of the performance of a junction – over 95% a junction is generally agreed to be operating above capacity. There are a number of junctions with Volume / Capacity close to or greater than 95% in the RC. Where the Volume / Capacity is similar or at a lower level in the Local Plan scenario, mitigation measures are not put forward. The Transport Assessment for the Local Plan focuses on identifying potential measures that may need to be secured to address severe impacts occurring as a result of the allocated development sites only.

ARCADY LOS = Level of Service – The Junction modelling software refers to Level of Service values contained in the Highway Capacity Manual (HCM 2000). In this instance, model outputs show the unsignalised level of service values for each peak hour, based on the average delay per arriving vehicle. The LOS system uses the following alphabetised categories:

- A = Free flow
- B = Reasonably free flow
- C = Stable flow
- D = Approaching unstable flow
- E = Unstable flow
- F = Forced or breakdown flow

Queue Length – The queue lengths stated in the capacity assessment results represent the average maximum queue lengths in Passenger Car Units (PCUs) on each approach arm across the peak hour. They are therefore indicative of queuing extents at the busiest point of the peak hour and are not representative of average conditions. This applies to all models used.

ARCADY RFC = Ratio of Flow to Capacity – The ratio of flow to capacity provides a measure of the utilised capacity of a junction approach arm. Arms exceeding a ratio of 0.85 (i.e. 85% capacity utilised) are considered to be approaching capacity and characteristically have light-to-moderate levels of queued traffic flow. Arms exceeding a ratio of 1.00 (i.e. 100% capacity utilised) are considered to be over capacity and are characterised as having heavy volumes of queued traffic.

ARCADY results that exceed RFCs of 1.00 generate queue lengths that are subject to exponential growth. For this reason, queue lengths attributed to overcapacity approach arms should be seen as indicative rather than representative. The capacity assessment tables within this technical note use a colour-coding system to assist in appraisal:

- Arms with an RFC of less than 0.85 are coloured green.
- Arms with an RFC between 0.85 and 0.99 are coloured amber.
- Arms with an RFC of 1.00 or more are coloured red.

LINSIG DOS = Degree of Saturation – The degree of saturation is an output from LINSIG which provides a measure of the utilised capacity of a signalised junction approach lane. It is directly comparable to the RFC outputs obtained from ARCADY assessments (see above). The colour-coding system used to categorise DOS in the model results tables is as follows:

- Lanes with a DOS of less than 85% are coloured green.
- Lanes with a DOS between 85% and 99% are coloured amber.
- Lanes with a DOS of 100% or more are coloured red.

Derivation of Localised Modelling

The list of schemes agreed and set out in Section 3 onwards of this Technical Note for localised modelling was agreed with TWBC as a result of Stage 3 Part 1 Modelling analysis.

Traffic Flows for Localised Models

Strategic modelling has initially been used as an indicator to identify junctions that could be over capacity. Where a potential need for mitigation has been identified, the traffic flows for the localised traffic model of the identified junctions have been derived as follows:

1. Extract traffic flows from the strategic model for Reference Case and Local Plan scenarios.
2. Input strategic model flows into the localised junction models. This will mean both traffic growth and any changes in network assignment will be taken into account.

This method has been adopted upon previous consultation with KCC and NH to ensure accuracy on future year junction demand.

Layout

There are no topographical surveys available for this analysis. As a result, Ordnance Survey mapping has been used to identify the geometric configuration for the mitigation solutions outlined within this Note.

4. Junction 8 A26 Woodgate Way/B2017 Tudeley Road/Tudeley Lane

Summary of Strategic Modelling Results and Reason for Mitigation

The data shows that even with high modal shift alongside the local plan growth, demand through this junction will increase. Cumulatively there is approximately an additional 150 vehicles through the junction in the Local Plan scenarios. In the Local Plan Modal Shift scenario without any highway changes, the highest Volume-to-Capacity ratio (V/C) is 101% in the AM peak and 96% in the PM peak, as summarised in the table below.

Table 5 Strategic Highway Modelling outputs for Junction 8 A26 / B2017

ID Junction	Description	2038 Reference Case (RC)					Local Plan Modal Shift (LPMS)				
		V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
AM	A26 Woodgate Way (N)	99	1,307	94	4	86	100	1,315	98	6	95
	B2017 Tudeley Road (E)	91	931	94	2	52	102	1,066	98	18	114
	A26 Woodgate Way (SW)	96	1,118	94	4	55	99	1,133	98	6	64
	Tudeley Lane (W)	63	231	94	1	25	65	228	98	1	27
PM	A26 Woodgate Way (N)	93	1,161	83	2	46	96	1,182	85	3	52
	B2017 Tudeley Road (E)	41	461	83	0	17	44	512	85	0	19
	A26 Woodgate Way (SW)	96	1,275	83	1	74	97	1,292	85	2	83
	Tudeley Lane (W)	36	170	83	0	17	38	171	85	0	17

From the above table it can be seen that the SATURN Strategic modelling indicates that this junction would operate close to capacity in the Local Plan scenario tested. The three key arms in the junction, A26 Woodgate Way (N) arm, the A26 Woodgate Way (SW) arm, and the B2017 Tudeley Road (E) arm see the biggest delays in the AM Peak, with the B2017 Tudeley Road (E) arm in particular impacted by Local Plan demand changes, jumping from 91% V/C to 102% V/C. As a result, a requirement to undertake localised junction modelling to identify a junction mitigation has been identified.

Localised Junction Model – Existing Junction Layout

Sweco have developed an ARCADY junction model to test the existing junction layout against future highway demand projections within the 2038 Reference Case and 2038 Local Plan scenarios, and then develop mitigation concept design to address the identified capacity issues. The concept design is then modelled in order to demonstrate the effectiveness of the mitigation solution.

The ARCADY model outputs for the current junction layout are set out in **Figure 4-1** below.

Figure 4-1 Arcady Results – Current Junction Layout and Future Year Demand (2038)

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Ref Case 2038							
1 - A26 North	3.1	8.01	0.74	A	2.5	7.02	0.69	A
2 - B2017 Tudeley Rd	22.9	80.67	1	F	0.9	6.36	0.45	A
3 - A26 south	4.5	13.72	0.81	B	3.5	9.22	0.77	A
4 - Five Oak Green Rd	0.7	10.41	0.4	B	0.3	6.43	0.23	A
	Local Plan Modal Shift (LPMS) 2038							
1 - A26 North	3.3	8.31	0.75	A	2.7	7.7	0.72	A
2 - B2017 Tudeley Rd	71.6	198.89	1.12	F	1	6.67	0.49	A
3 - A26 south	4.6	13.87	0.82	B	3.9	10.13	0.78	B
4 - Five Oak Green Rd	0.7	10.22	0.39	B	0.4	6.77	0.24	A

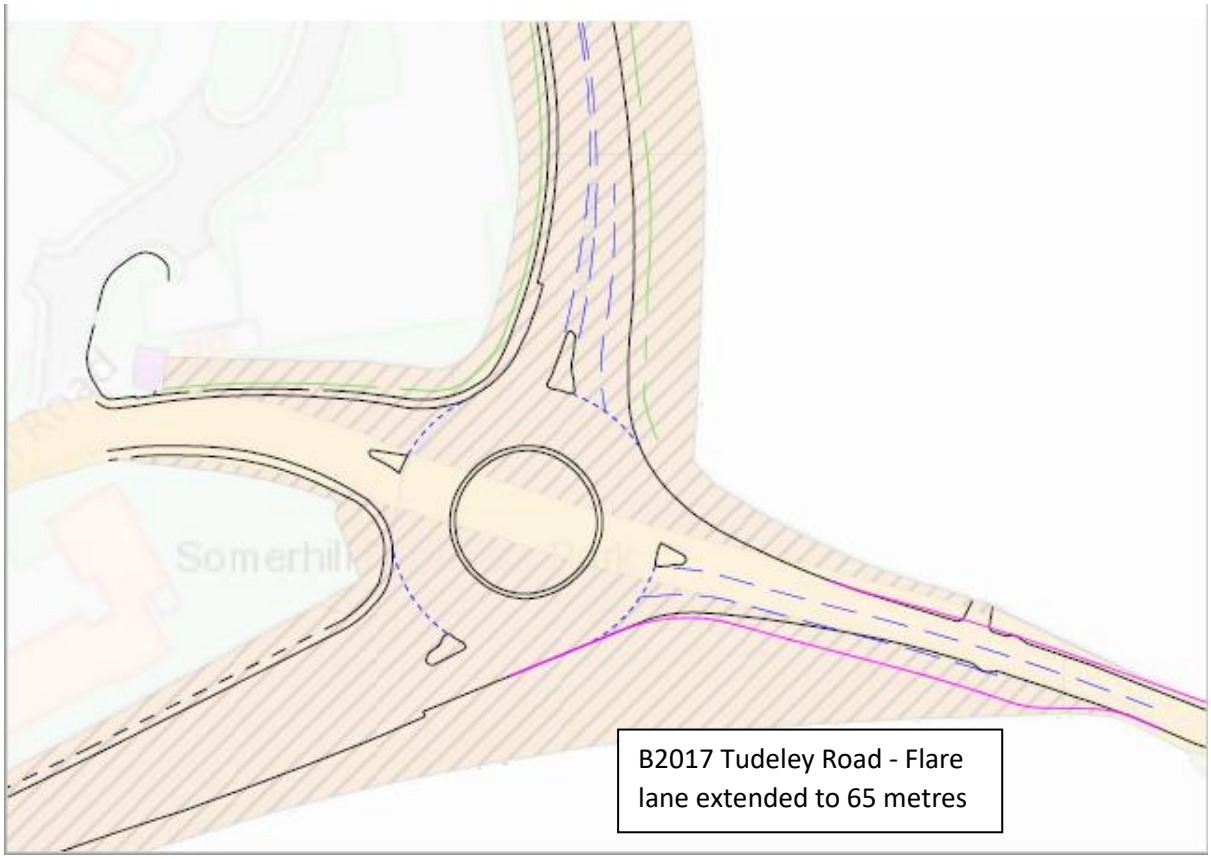
The results show that in the PM peak, there are no capacity issues predicted at this junction with a Level of Service (LoS) of 'A' recorded in all scenarios, except the A26 south arm with a LoS of 'B'. However, the arm is still considered to be reasonably free flowing.

In the AM Peak, the B2017 Tudeley Road is shown to be operating at capacity in the RC and over capacity with an RFC over 100% in the Local Plan scenario, as highlighted in the LoS of 'F' for this arm.

Potential Mitigation and Boundary Analysis

The mitigation measure identified to deliver improved infrastructure performance when considering additional future growth is to provide additional capacity on the B2017 Tudeley Road approach to the junction. The potential mitigation solution identified is the provision of a second lane on the approach to the roundabout. The resultant concept design is illustrated in **Figure 4-2** below.

Figure 4-2 Junction 8 – A26 / B2017 Mitigation Concept Design



The orange shaded area denotes land owned and publicly maintainable by KCC Highways, as obtained from KCC. As indicated on the drawing above, the carriageway widening that could be achieved on Tudeley Road, within the existing highway boundary, is a 65m flare. The running lanes on Tudeley Road have been assumed to be 3.65m each, and the westbound lane has been widened marginally on the north side to achieve 3.65m. The above concept design has been assessed in an ARCADY junction model as discussed below.

Localised Junction Model – Mitigation Solution

The result of the ARCADY model of the mitigation solution outlined above is summarised in **Figure 4-3**.

Figure 4-3 – Arcady Results: Mitigation Junction Layout (2038 Future Year Demand)

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Local Plan Modal Shift (LPMS) 2038							
1 - A26 North	3.3	8.31	0.75	A	2.7	7.7	0.72	A
2 - B2017 Tudeley Rd	4	12.73	0.79	B	0.6	3.79	0.35	A
3 - A26 south	5.6	16.99	0.85	C	3.9	10.11	0.78	B
4 - Five Oak Green Rd	0.8	11.72	0.43	B	0.4	6.77	0.24	A

The Tudeley Road arm LoS has fallen to 'B', with an RFC of 79 and a queue of just 4 PCUs. This represents a significant reduction in queueing and delay on the B2017 arm to below RC levels. There are marginal increases in RFC on the other arms, however these are considered negligible. Therefore, our analysis shows that the suggested concept design would lead to 'nil-detriment' in the area.

The junction modelling analysis indicates that a 65 metre flare will be sufficient to deliver the benefit required to bring this junction performance back to RC levels.

DMRB Design Compliance

The identified mitigation measure would be designed in accordance with CD 116 – Geometric design of roundabouts. These works are very minor and therefore, departures from standards are not anticipated. The initial feasibility layout is largely limited to the westbound approach to the roundabout on the Tudeley Road arm, with the immediate approach flare retained.

Safety Review

The highway improvement works are minor in nature. The primary safety consideration would be securing adequate visibility towards and through the junction. It is considered that these can be easily provided. Furthermore, as there are no existing or proposed pedestrian movements crossing or travelling along the southern edge of Tudeley Road, these highway improvement works would not negatively impact pedestrian safety.

Estimated Year of Implementation

2031 onwards as Paddock Wood developments come online.

Cost and Budget

A high-level cost estimate is expected to be approximately £500,000. This would be within the identified Stantec proposed masterplan budget (as part of the Strategic Sites Infrastructure Plan) for a mitigation at this location of £1,000,000. The Infrastructure Delivery Plan has identified a cost of £1,500,000 for the wider works.

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5. Junction 12 A228 Branbridges Road / B2160 Maidstone Road / A228 Whetsted Road

Summary of Strategic Modelling Results and Reason for Mitigation

As illustrated by the SATURN modelling results summarised below, the greatest impact of the Local Plan on this junction are experienced in the AM Peak as a result of additional traffic on the B2160 and A228 SW approach arms. As a result, a requirement to undertake localised junction modelling to identify a junction mitigation has been identified.

Table 6 Strategic Highway Modelling outputs for Junction 12 A228 / B2160

ID Junction	Description	2038 Reference Case (BAA)					2038 Local Plan with A228 upgrades (EAB)				
		V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
AM	A228 Branbridges Road (NE)	100	2,116	98	3	34	103	2,128	102	33	80
	B2160 Maidstone Road (SE)	105	587	98	22	170	108	615	102	31	219
	A228 Whetsted Road (SW)	92	958	98	3	50	99	1,035	102	6	67
	Unnamed Road (NW)	15	39	98	0	24	16	39	102	0	25
PM	A228 Branbridges Road (NE)	70	1,493	84	0	13	79	1,674	91	0	15
	B2160 Maidstone Road (SE)	85	667	84	2	46	101	754	91	12	95
	A228 Whetsted Road (SW)	107	1,032	84	44	201	109	1,012	91	54	243
	Unnamed Road (NW)	42	93	84	1	30	43	96	91	1	31

Localised Junction Model – Existing Junction Layout

Sweco have developed an ARCADY junction model to test the existing junction layout against future highway demand projections within the Reference Case and Local Plan scenarios. On the results of the ARCADY model, a mitigation concept design to address the identified capacity issues has been identified. The concept design is then modelled in order to demonstrate the effectiveness of the mitigation solution.

The ARCADY model outputs for the current junction layout are set out in **Figure 5-1** below.

Figure 5-1 Arcady Results – Current Junction Layout and Future Year Demand (2038)

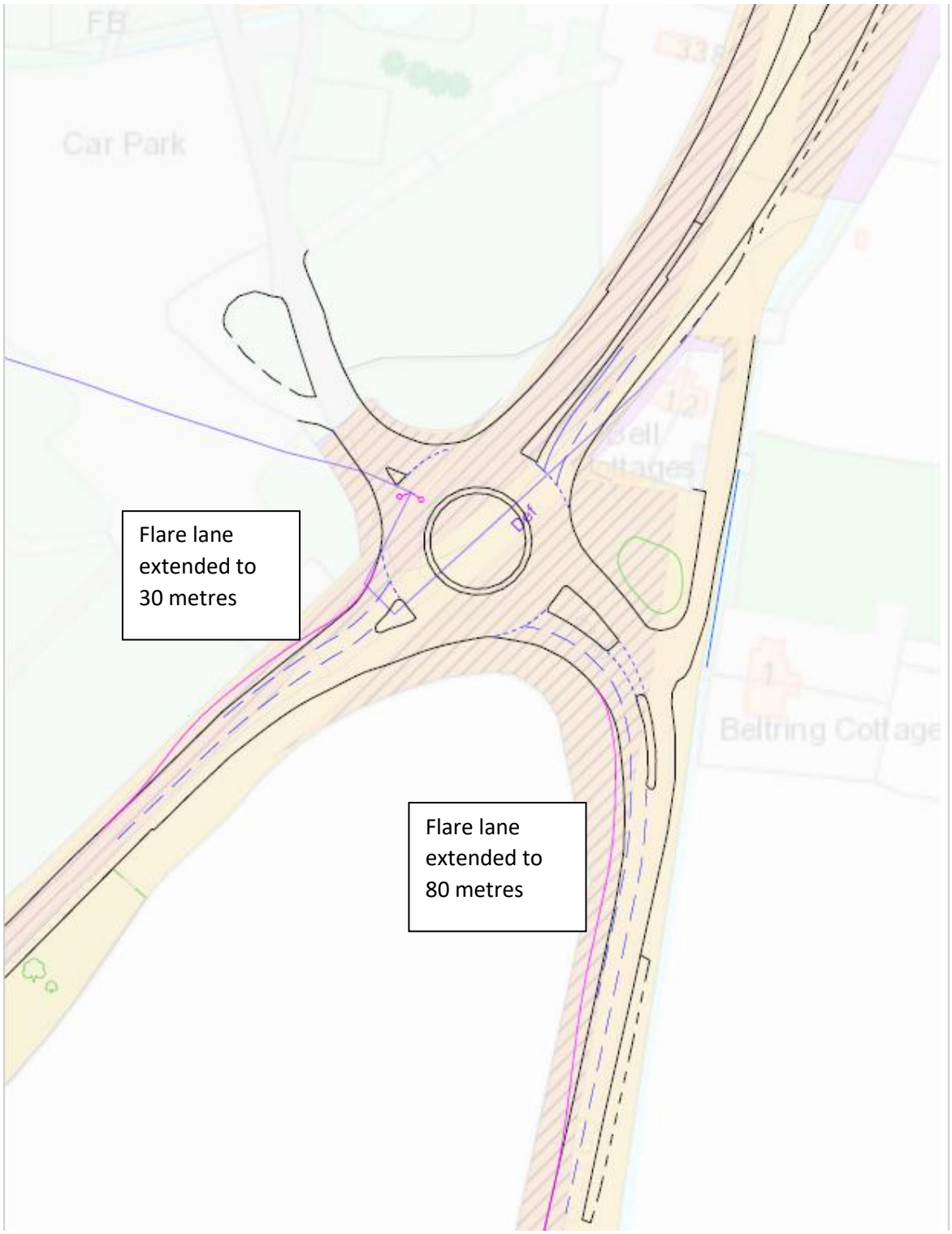
	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Ref Case 2038							
1 - A228 Branbridges Road	22.1	35.88	0.97	E	2.4	5.28	0.69	A
2 - B2160 Maidstone Road	10.8	63.67	0.94	F	4.9	25.2	0.83	D
3 - A228 Whetsted Road	7.8	28.51	0.89	D	23.5	74.71	1	F
4 - Hop Farm Village	0.1	9.27	0.08	A	0.4	14.2	0.27	B
	Local Plan Modal Shift (LPMS) 2038							
1 - A228 Branbridges Road	29.4	46.14	0.99	E	3.6	7.23	0.77	A
2 - B2160 Maidstone Road	17.4	93.12	1	F	15.6	70.36	0.97	F
3 - A228 Whetsted Road	15.4	51.15	0.96	F	24.3	78.14	1	F
4 - Hop Farm Village	0.1	10.37	0.1	B	0.4	15.09	0.29	C

The results show that in the RC scenario, the junction approaches capacity in the AM Peak on the three key arms of the A228 North and South arms, and the B2160 arm. In the PM Peak, the B2160 arm and A228 South arm (Whetsted Road) are also shown to be operating at capacity with a LoS of 'F'.

Potential Mitigation and Boundary Analysis

The mitigation measure identified to ensure better junction performance when considering additional future growth is to provide additional capacity on both the A228 SW approach arm, and the B2160 approach arm. This would be achieved through the provision of extended flare lengths to accommodate 2 lanes on each. The concept design of this measure is illustrated in **Figure 5-2** below.

Figure 5-2 – Junction 12 A228 / B2160 Mitigation Concept Design



The mitigation solution includes the provision of an additional 30 metres of extra flare lane on the A228 (SW) arm approaching the roundabout, whilst the flare on the B2160 approach arm to roundabout would be extended by 80 metres. As illustrated, the full extent of these works can be accommodated within existing public highway and thus, this mitigation solution would be wholly achieved within highway land. The geometry of the roundabout and other approaches remains the same, whilst no additional crossings are included.

Localised Junction Model – Mitigation Solution

The result of the ARCADY model of the mitigation layout outlined above is summarised in **Figure 5-3** below.

Figure 5-3 – Arcady Results: Mitigation Junction Layout (2038 Future Year Demand)

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Local Plan Highways (LPH) 2038							
1 - A228 Branbridges Road	29.6	46.35	0.99	E	3.6	7.23	0.77	A
2 - B2160 Maidstone Road	2.8	15.2	0.72	C	2.9	13.05	0.73	B
3 - A228 Whetsted Road	3.8	12.36	0.78	B	4.4	14.78	0.81	B
4 - Hop Farm Village	0.1	10.92	0.1	B	0.5	16.69	0.31	C

The output shows that the mitigation solution assessed would resolve the issues on the B2160 and A228 South arms in both AM and PM Peak. The respective LoS for each arm respectively falls from levels of 'F' in the Local Plan scenario without highway changes to LoS 'B' or 'C'.

The A228 Branbridges Road arm that was an issue in the RC scenario with LoS 'E' in the AM Peak, remains at LoS 'E'. The queue for this arm rises by approximately 7 PCUs and delay in seconds increases by approximately 11 seconds in the AM Peak. Though this is an issue to be considered from a junction performance perspective, these impacts are not seen as severe enough to warrant further Local Plan led junction improvement works or mitigation.

DMRB Design Compliance

The identified mitigation measure would be designed in accordance with CD 116 – Geometric design of roundabouts. These works are very minor, fitting within highway land with no CPO needed, and therefore, departures from standards are not anticipated. The initial feasibility layout is largely limited to the southeast and southwest approaches to the roundabout on the A228 Whetsted Road and B2160 Maidstone Road arms respectively, with the immediate approach flares and roundabout geometry retained.

Safety Review

The highway improvement works are minor in nature. The primary safety consideration would be securing adequate visibility towards and through the junction. It is considered that these can be easily provided without the need for third party land.

Estimated Year of Implementation

2031 onwards as Paddock Wood developments come online.

Cost and Budget

A high-level cost estimate is expected to be approximately £250,000. This is within the identified Stantec proposed masterplan budget and Infrastructure Delivery Plan estimate of £1,000,000 for mitigation at this location. As a result, there is no additional funding requirement identified for this location.

6. Junction 13: A228 Maidstone Road / B2017 Badsell Road

Summary of Strategic Modelling Results and Reason for Mitigation

The table below sets out key information from the strategic model in terms of delay and flows when comparing the RC scenario with the LPMS scenario at the A228 / B2017 junction.

Table 7 Strategic Highway Modelling outputs for Junction 13 A228 / B2017 prior to A228 layout changes

ID Junction	Description	2038 Reference Case (RC)					Local Plan Modal Shift (LPMS) pre A228 changes				
		V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
AM	A228 Maidstone Road (N)	111	1,194	99	68	239	113	1,192	104	77	273
	B2017 Badsell Road (E)	108	619	99	31	198	116	676	104	56	346
	A228 Maidstone Road (S)	94	825	99	3	35	102	842	104	13	79
	B2017 Badsell Road (NW)	66	450	99	1	22	71	486	104	1	24
PM	A228 Maidstone Road (N)	94	893	93	2	26	101	965	101	14	69
	B2017 Badsell Road (E)	68	484	93	1	17	85	590	101	2	23
	A228 Maidstone Road (S)	100	993	93	5	50	104	984	101	28	132
	B2017 Badsell Road (NW)	102	641	93	13	92	110	689	101	40	244

The RC shows underlying issues on all arms. Of particular note are the A228 North arm and B2017 East arm in the AM Peak, and the A228 South arm and B2017 North West arm in the PM Peak.

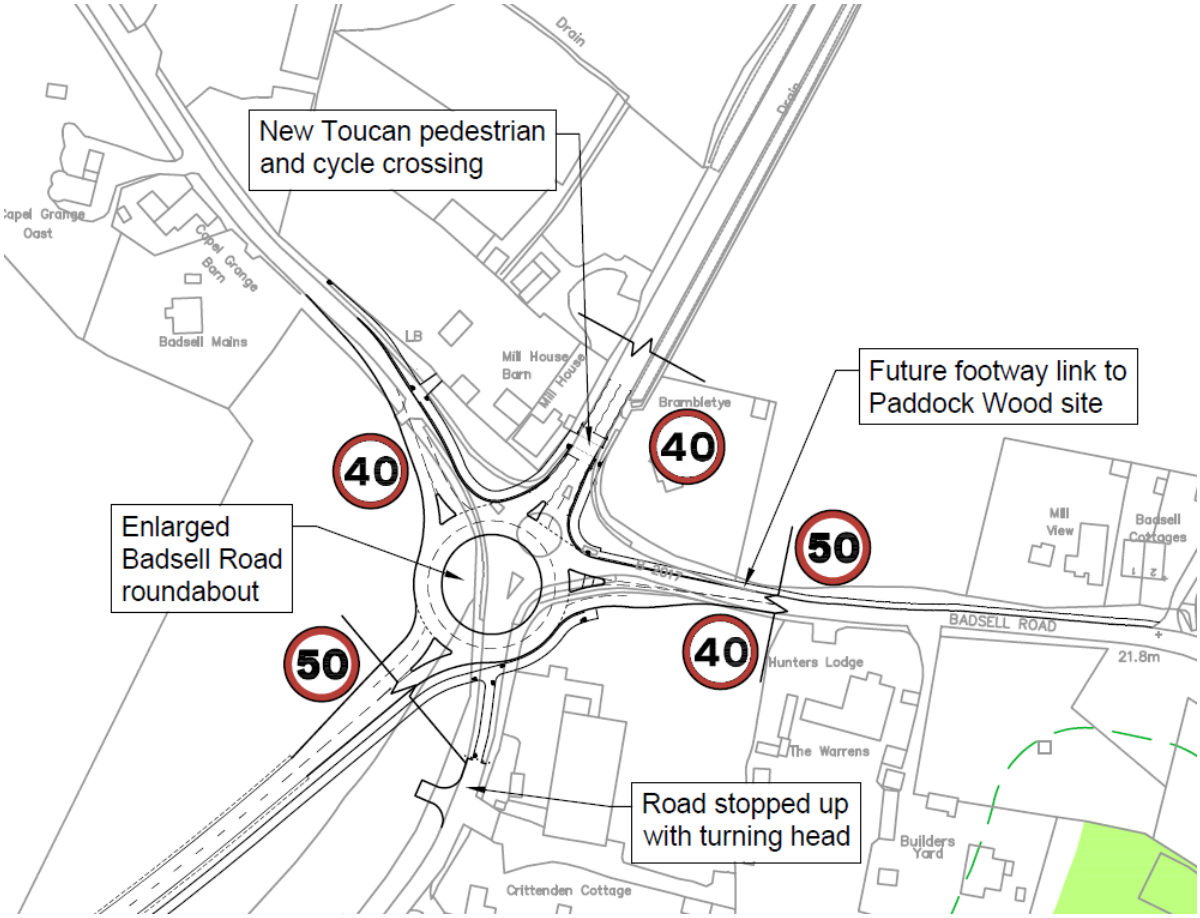
When Local Plan demand is added, without changing the junction or link layout along the A228 corridor, it can be seen that the junction fails to function properly, with significant congestion experienced on all arms in both the AM and PM Peaks. This highlights the need for additional capacity at the junction.

A scheme is being developed by Stantec on behalf of developers in the area. Following initial discussions with Stantec, Sweco has sought to replicate the overall principles of the Stantec proposals in the localised junction modelling for this junction without the ability to directly test the final design. The changes made have been:

- Increase the size of the roundabout with two lane approaches on all arms as well as two lanes around the roundabout.
- Additional capacity on the A228 south of the roundabout around Colts Hill to take account of the proposed Colts Hill bypass being designed by Stantec.

The proposed scheme considered within the mitigation modelling is shown in **Figure 6.1** below.

Figure 6-1 – Junction 13 A228 / B2017 Mitigation Concept Design



The results of the revised Strategic Highway model run with the changes at Badsell Roundabout and A228 Colts Hill represented in the model are set out below.

Table 8 Strategic Highway Modelling outputs for Junction 13 A228 / B2017 after A228 layout changes

ID Junction	Description	2038 Reference Case (RC)					Local Plan Modal Shift (LPMS) post A228 changes				
		V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
AM	A228 Maidstone Road (N)	111	1,194	99	68	239	103	1,373	88	31	148
	B2017 Badsell Road (E)	108	619	99	31	198	106	1,001	88	38	157
	A228 Maidstone Road (S)	94	825	99	3	35	70	933	88	1	29
	B2017 Badsell Road (NW)	66	450	99	1	22	43	498	88	0	20
PM	A228 Maidstone Road (N)	94	893	93	2	26	77	1,026	73	1	23
	B2017 Badsell Road (E)	68	484	93	1	17	54	664	73	1	15
	A228 Maidstone Road (S)	100	993	93	5	50	81	1,073	73	1	35
	B2017 Badsell Road (NW)	102	641	93	13	92	71	824	73	1	31

The Sweco LPMS model run with changes to the A228 network included shows that all arms perform better in the AM and PM peaks compared to their equivalent in the RC. In the PM Peak all arms work within capacity as well as the A228 South arm and B2017 North West arm in the AM Peak. Congestion remains on the A228 North and B2017 East arms, albeit these levels of congestion are a reduction on the projected RC levels.

The flows have been shared with Stantec for them to undertake further model runs as part of the masterplan work to finalise the design required for the junction to operate with the Local Plan growth.

7. Junctions 21 and 22: A21 / A228 / Tesco

Summary of Modelling Results and Reason for Mitigation

Analysis has been undertaken of the two junctions that meet at the A21 slips where the A228 / A264 crosses the A21 by overbridge. The data from the strategic SATURN model is presented below.

Table 9 Strategic Highway Modelling outputs for Junctions 21 and 22 A21 / A228 / A264

Junction		Description	2018 Base Case (BC)			2038 Reference Case (RC)					Local Plan Modal Shift (LPMS)				
			V/C	Flow pcu	Jct V/C	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
South West Dumbbell	AM	A21 NB Slips (N)	53	467	68	62	550	85	1	19	63	553	94	1	19
		A228 Pembury Road (NE)	60	797	68	82	1,312	85	1	14	95	1,505	94	3	20
		A264 Pembury Road (SW)	81	1,079	68	94	1,833	85	1	18	102	1,814	94	26	66
	PM	A21 NB Slips (N)	33	220	82	63	472	81	1	21	84	568	88	2	28
		A228 Pembury Road (NE)	79	1,052	82	88	1,483	81	1	15	94	1,481	88	3	18
		A264 Pembury Road (SW)	93	1,231	82	80	1,578	81	0	15	86	1,686	88	1	16
North East Dumbbell	AM	A21 SB Slips (N)	51	329	45	101	570	76	8	69	96	533	82	4	45
		A228 Pembury Northern Bypass (E)	37	495	45	69	744	76	2	25	86	984	82	3	32
		Tesco (S)	15	82	45	35	87	76	0	27	67	108	82	1	53
		A228 Pembury Road (W)	51	681	45	72	950	76	0	21	71	946	82	0	21
	PM	A21 SB Slips (N)	60	298	62	103	496	94	13	111	104	477	97	17	143
		A228 Pembury Northern Bypass (E)	52	696	62	82	971	94	2	29	84	1,020	97	3	31
		Tesco (S)	63	285	62	145	293	94	53	924	146	292	97	54	943
		A228 Pembury Road (W)	69	914	62	86	1,148	94	0	28	94	1,247	97	1	40

South West Dumbbell

The analysis shows that when comparing the RC demand with the Local Plan demand, with no changes to existing junction layout, that in the AM Peak there is an increase in queueing and delay on the A264 South West arm.

A further analysis was undertaken in ARCADY junction modelling and the results are presented in **Figure 7-1** below.

Figure 7-1 – Arcady Results: A21/A228 South West Dumbbell

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Ref Case 2038							
1 - A21	1.6	8.76	0.56	A	1.3	9.88	0.55	A
2 - A228 Pembury Road	6.4	14.96	0.83	B	10.2	21.74	0.89	C
3 - A264 Pembury Road	536.4	1237.87	0.98	F	152.5	345.46	0.97	F
	Local Plan Modal Shift (LPMS) 2038							
1 - A21	1.5	9.35	0.56	A	2.4	14.16	0.66	B
2 - A228 Pembury Road	18.4	37.47	0.94	E	14	29.95	0.91	D
3 - A264 Pembury Road	581.5	1350.41	0.99	F	217.7	519.05	0.96	F

The results show that through RC background growth, the junction faces significant issues in terms of operation, primarily related to the additional demand on the A264 arm coming out of Royal Tunbridge Wells. In theory the A21 arm works in both peaks but the additional demand on the A228/A264 arms may lead to the junction as a whole operating over capacity at certain times.

The Local Plan scenario sees a worsening of delay on the A264 arm in particular in both peaks. However, it is strongly considered that the Local Plan demand will not be the main driver of congestion issues at this junction, but rather an issue caused by predicted background growth. It is reasonable to expect RC issues to be addressed by the highway authority and that any such enhancements would in

turn accommodate the extra demand generated by Local Plan through a monitor and manage approach.

North East Dumbbell

Reviewing the outputs from the Strategic Highway Model, the AM Peak sees a reduction in queueing vehicles coming off the A21 SB slips from 8 vehicles (circa 50 metres) to 4 vehicles (circa 25 metres). In the PM Peak the queue for the same arm increases from 13 vehicles to 17 vehicles (circa 100 metres). The length of the existing slip before joining the A21 is 205 metres, meaning the future queue is still within the length of the existing slip lane. The other arms don't see significant delay or demand changes.

A further ARCADY junction model analysis was undertaken, and the results are presented in **Figure 7-2** below.

Figure 7-2 – Arcady Results: A21/A228 North-East Dumbbell

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Ref Case 2038							
1 - A21	4.6	26.1	0.78	D	3.8	23.91	0.75	C
2 - A228 Pembury Northern	1.9	7.3	0.5	A	2.9	9.2	0.66	A
3 - Tesco	0.6	19.16	0.26	C	16.4	167.1	0.93	F
4 - A228 Pembury Road	2	6.61	0.57	A	3.4	8.58	0.7	A
	Local Plan Modal Shift (LPMS) 2038							
1 - A21	3.7	19.5	0.73	C	3.6	23.16	0.73	C
2 - A228 Pembury Northern	2.7	9.49	0.67	A	3.2	9.62	0.69	A
3 - Tesco	1	27.29	0.39	D	17.9	180.47	0.91	F
4 - A228 Pembury Road	2.1	6.64	0.56	A	3.9	10.34	0.76	B

The junction model analysis only outlines a potential issue on the Tesco arm. However, this is seen as a minor issue overall given the identified queues. All other arms have a LoS between 'A' and 'C'. The A21 arm has improved queueing and delay figures in the LPMS scenario compared to the RC.

8. Junction 35: Kippings Cross Roundabout (A21 / B2160)

Summary of Modelling Results and Reason for Mitigation

The data below highlights the expected demand increase through Kippings Cross as a result of new Local Plan development growth strategy in Tunbridge Wells borough.

Table 10 Strategic Highway Modelling outputs for Junction 35 A21 / B2160

	Description	2038 Reference Case (RC)					Local Plan Modal Shift (LPMS)				
		V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)	V/C	Flow pcu	Jct V/C	Avg Q (pcu)	Delays (sec)
AM	B2160 Maidstone Road (N)	104	833	90	23	122	108	827	93	41	208
	A21 (E)	114	1,161	90	85	358	117	1,189	93	102	419
	Dundale Road (S)	14	27	90	0	30	14	27	93	0	30
	A21 Hastings Road (W)	61	1,321	90	0	13	66	1,441	93	0	14
PM	B2160 Maidstone Road (N)	70	394	81	1	27	74	435	86	1	28
	A21 (E)	69	922	81	1	49	72	957	86	1	53
	Dundale Road (S)	24	86	81	0	20	26	89	86	0	21
	A21 Hastings Road (W)	92	1,924	81	0	21	97	2,042	86	1	27

The data shows that for the AM Peak, though there are significant underlying issues in terms of queue and delay on the B2160 North and A21 East arms, the existing issues are slightly exacerbated as a result of additional Local Plan demand, as shown in the LPMS scenario. This is replicated in the PM Peak with the A21 West arm.

It should also be noted that the model analysis relates to junction arm approaches, and so it does not take account of exit issues, namely the A21 exit towards Blue Boys Roundabout, where the A21 narrows from dual carriageway to single carriageway. Congestion and delay issues have been observed when the link demand is highest along the A21 towards Hastings (eastbound) as a result.

As a result, a requirement to undertake localised junction modelling to identify a junction mitigation has been identified.

Localised Junction Model – Existing Junction Layout

Sweco have developed an ARCADY junction model to test the existing junction layout against future highway demand projections within the Reference Case and Local Plan scenarios. The data is presented in **Figure 8-1** below.

Figure 8-1 – Arcady Results: Existing Kippings Cross Junction

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Ref Case 2038							
1 - B2160	10.8	45.32	0.93	E	1.5	12.33	0.58	B
2 - A21 east	45.3	117.36	1.05	F	2.2	7.87	0.67	A
3 - Dundale Road	0.3	39.43	0.23	E	0.2	8.79	0.18	A
4 - A21 west	2.5	6.16	0.69	A	55.4	87.44	1.03	F
	Local Plan Modal Shift (LPMS) 2038							
1 - B2160	15	62.19	0.96	F	1.5	11.32	0.58	B
2 - A21 east	67.9	167.49	1.1	F	2.5	8.72	0.7	A
3 - Dundale Road	0.3	43.93	0.25	E	0.3	9.51	0.19	A
4 - A21 west	3.4	7.76	0.76	A	110.2	156.68	1.09	F

When reviewing the junction in isolation, the junction model output confirms what has been observed from the strategic junction model in terms of arms with delay that require mitigation. The key arms in need of mitigation in the AM Peak are the B2160 North and A21 East arms, whilst the A21 West arm in the PM Peak requires mitigation.

Option Development

On the results of the ARCADY model, a mitigation concept design development process to address the identified capacity issues has been undertaken. **Table 8-1** describes the mitigations considered to date as part of this assessment and why they have either not resolved the capacity issues (highlighted red) or have not been acceptable to key stakeholders (highlighted orange). The end of the table identifies two options in green that Sweco have taken forward for further design and modelling analysis.

Table 8-2 – Mitigation Options Investigated to Date as Part of this Assessment

ID	Status	Option	Description	Pros	Cons	Stakeholder Feedback
KX1	Dismissed	Partial signalisation Option 1	Signal control of B2160 with stop line/ signal on adjacent circulatory area.	Deliverable within existing highway footprint. Allows traffic to clear roundabout and exit B2160.	Potential queueing on roundabout blocking wider movements Requires ongoing revenue for signals management.	Not favoured by KCC or NH due to potential queueing issues.
KX2	Dismissed	Partial signalisation Option 2	Signal control of the eastbound A21 and B2160 with stop lines/ signals on immediately adjacent circulatory area.	Deliverable within existing highway footprint. Allows traffic to clear roundabout and exit B2160.	Requires ongoing revenue for signals management.	Not favoured by KCC or NH due to potential queueing issues.
KX3	Dismissed	Indirect signals	Signal control of eastbound A21 and B2160 with stop lines at least 20 metres in advance of roundabout to hold traffic back which allows normal roundabout function to continue.	Roundabout operates more efficiently as queuing held back from junction. Deliverable within existing highway footprint.	Queueing on approach roads leading to delays. Marginal reduction in road safety (5% increase in risk score). Requires ongoing revenue for signals management.	Not favoured by KCC or NH due to potential safety issues.
KX4	Dismissed	Narrowing B2160 approach	Narrowing of the B2160 approach to Kippings Cross so that the traffic flow from this link will be constrained to reduce its attractiveness as a route.	Deliverable within existing highway footprint.	Significant impact on queues on B2160 arm.	Not favoured by KCC or NH due to local opposition.
KX5	Dismissed	Redistributing B2160 traffic	Traffic is redistributed over the wider network away from the roundabout due to wider changes to the local road network.	No physical works at the roundabout are required.	Needs detailed wider traffic management works	Unlikely to be acceptable to local groups.

KX6	Unlikely to be accepted	Lane drop eastbound A21	Drop a lane a few hundred metres in advance of the roundabout to reduce entry flows from western arm of A21	Deliverable within existing highway footprint. Throttles traffic entry onto roundabout. No traffic control required. Queueing managed where there are few receptors	Queueing will be certain at peak times. Additional road safety risk at merge.	Unlikely to be acceptable to local groups.
KX7	Unlikely to be accepted	Nearside lane on eastbound A21 made left only.	Nearside lane becomes left turn in advance of junction for western arm of A21. Ahead/ right traffic stay in offside lane.	Deliverable within existing highway footprint. Throttles traffic entry onto roundabout. No traffic control required. Queueing managed where there are few receptors	Queueing will be certain at peak times. Additional road safety risk with drivers ignoring lane control.	Unlikely to be acceptable to local groups.
KX8	Unlikely to be accepted	Widening A21 east of junction	Widening eastern arm A21 for a section to move merge point further east; potentially to Blue Boys Roundabout.	Additional stacking space to east of junction will help keep roundabout clear.	If queueing does take place, it will impact local receptor fronting road. Risk of induced demand and queueing returning through roundabout after a relatively short time.	Unlikely to work as a standalone option.
KX9	Unlikely to be accepted	Cross roads and signalisation	Replace roundabout with a signalised crossroads.	Deliverable within existing highway footprint. Control over flows. Detection can be used to hold eastbound A21 traffic to allow roundabout to clear. Better access for NMUs.	Costly and requires ongoing revenue for signals management. Queueing on western arm of A21 still likely.	Indicative junction modelling shows significant delay and congestion issues retained.

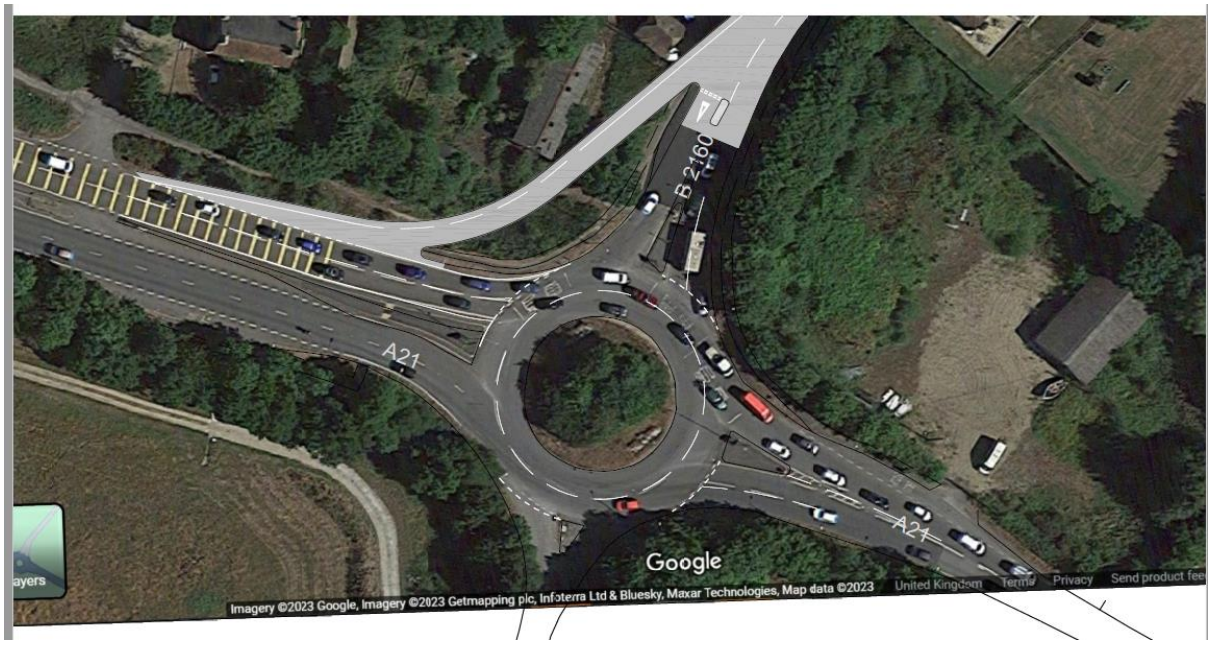
KX10	Potential to be taken forward	Modified roundabout layout to achieve the following: Left turn bypass from A21 to B2160 Widening on entry on B2160 Widening on A21 westbound entry	Modification to roundabout to provide a bypass for left turning traffic to the B2160. Increasing the width of the B2160 so there are two lanes on the approach to the roundabout. Both lanes would be right turns to the A21	Removes left turners from roundabout allowing more stacking space for traffic staying on A21. Increases capacity for traffic leaving B2160 Increased capacity for traffic heading west on A21	Costly and requires third party land, including removal of a barn to the north of junction. Queueing on western arm of A21 still likely as this is affected by the blocking back from Blue Boys roundabout	The roundabout exit eastbound could be widened so that the merge to one lane is improved and reduces the risk of blocking back into the roundabout circulatory. Would also require third party land. Initial junction modelling shows this can work as an option.
KX11	Potential to be taken forward	Full signalisation of the roundabout	Increase size of circulatory area to provide internal stacking space for full signalisation. Layout may be more oval than circular to fit mostly within existing junction footprint	Control over flows. Detection can be used to hold eastbound A21 traffic to allow roundabout to clear.	Requires ongoing revenue for signals management. Queueing on western arm of A21 still likely.	Depending on level of stacking space to be created there is potential for this option based on previous partial signalisation roundabout modelling results. Could be combined with widening A21 east of junction for extra merge capacity.

As indicated in Table 8.1, Sweco have identified two preferred options that have the potential to mitigate the impacts of Local Plan development growth. These are described in greater detail below.

KX10 Left turn slip lane

The outline concept design for KX10 identifies the need for some land take to the north west of the roundabout, potentially affecting a barn and land boundaries, as illustrated in **Figure 8.2** below. We note the existence of the listed building (Kippings Cross Farm House, Grade II) and the Historic Farmstead. However, indications are that the improvements sit outside the curtilage of the land boundaries.

Figure 8-3 – Kippings Cross Left Turn Slip Lane



The general arrangement provides a left turn lane from the A21 western arm to Maidstone Road (B2160) of around 90 metres in length. Traffic exits the A21 into a nearside taper becoming the left turn lane.

There are two sub-options for traffic joining Maidstone Road.

- Left turn lane traffic gives way to traffic leaving the northern arm of the roundabout.
- Left turn lane traffic has priority and traffic leaving the northern arm of the roundabout gives way. This option is illustrated in the image above.

KX11 Modified roundabout

The outline concept design for KX11 is the provision of signals to manage traffic flows through the junction. In order to accommodate acceptable stacking spaces at the stop lines within the junction, a much larger roundabout is required, as illustrated in **Figure 8-3** below. As with the previous scheme, there would be a need for some land take including land from all four corners of the current junction in order to support a larger roundabout footprint than is currently there.

Figure 8-4 – Kippings Cross Partial Signalised Roundabout Junction

The general arrangement is for a roundabout elongated along the east-west axis and offset to the west of the current roundabout with a footprint of around 85 metres by 45 metres.

The junction is signalised in two locations.

- A21 western arm/ adjacent circulatory area for a single lane.
- B2160 Maidstone Road/ adjacent circulatory area for two lanes.

The junction has three lanes on its northern side with the nearside lane providing a free flow left turn and then generally a two-lane circulatory area other than a single northbound lane on the western side of the circulatory area.

The A21 eastern arm has a two-lane approach for approximately 60 metres and Maidstone Road has a two-lane approach for approximately 20 metres.

The A21 eastbound exit has a merge largely consistent with the existing layout.

Localised Junction Model – Potential Junction Layout

KX10 model results

This junction mitigation option is assessed in isolation of upstream capacity issues on the A21 east of the Kippings Cross junction. The results of the ARCADY analysis are set out in **Figure 8-4** below.

Figure 8-5 – KX10 ARCADY Analysis Results

	AM				PM			
	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
	Local Plan Modal Shift (LPMS) 2038							
1 - B2160	4.3	17.48	0.8	C	1.2	8.96	0.52	A
2 - A21 east	28.5	77.18	1.01	F	2	6.82	0.64	A
3 - Dundale Road	0.8	108.77	0.47	F	0.3	9.54	0.19	A
4 - A21 west	1.5	4.52	0.58	A	3.2	7.68	0.75	A

Though the analysis still shows capacity issues on the A21 east arm in the AM Peak, when this is compared to the Reference Case the level of congestion has fallen for this arm in terms of delay by about 40 seconds. The B2160 North arm sees a significant improvement with LoS 'C' instead of LoS 'E'in the AM Peak and LoS 'A' for all arms in the PM Peak.

Sweco view this as the preferred Local Plan mitigation as the results show that with added Local Plan demand the junction operates at an improved level compared to the RC. However, Sweco do recognise the potential impacts on third party land, including the need to take account of the listed building and historic farmstead,and the effect this may have on feasibility of such a scheme, subject to detailed design.

It is further recognised that there is a need to find a more robust long-term solution to fix the existing issues faced at this junction. KX11 builds upon KX10 to deliver a potentially more comprehensive junction layout that remedies not only Local Plan related queueing and delay but also impacts related to underlying growth around the RC.

A high level cost estimate is expected to be approximately £500,000. Whilst contingency has been considered, there will be a requirement to factor in costs such as land acquisition and utility diversions that is not possible to establish at this time. KX11 model results

This junction mitigation option is assessed in isolation of upstream capacity issues on the A21 east of the Kippings Cross junction. Due to the presence of signals in the design, the junction modelling has been undertaken in LinSig. The results of the LinSig analysis are set out in **Table 8.2**

Table 8-6– KX11 LinSig Analysis Results

Item	Lane Description	Ref Case 2038				Local Plan Modal Shift (LPMS) 2038			
		AM Peak		PM Peak		AM Peak		PM Peak	
		Deg Sat (%)	Mean Max Queue (pcu)	Deg Sat (%)	Mean Max Queue (pcu)	Deg Sat (%)	Mean Max Queue (pcu)	Deg Sat (%)	Mean Max Queue (pcu)
Network	-	93.60%	-	92.80%	-	93.40%	-	91.80%	-
1/2+1/1	B2160 approach Left Ahead	88.00%	10.9	74.70%	4.6	90.40%	11.8	82.50%	5.8
2/2+2/1	A21 east approach Left Ahead	93.60%	16.9	92.80%	14.2	93.40%	33.5	91.80%	13.3
3/1	Dundale Road approach Left	7.90%	0.1	12.90%	0.2	8.30%	0.1	13.60%	0.3
4/1	A21 west approach Ahead	45.90%	4.9	66.90%	9.5	50.40%	5.7	71.90%	11
4/2	A21 west approach Ahead	40.60%	4.3	59.20%	8	44.00%	4.8	62.00%	8.7
11/1	Circulatory before A21 West entry	8.60%	0.4	31.30%	1.6	8.50%	0.4	28.70%	1.3
12/2	Circulatory before B2160 entry Ahead	37.40%	3.8	35.50%	1.7	37.20%	3.7	29.40%	1.7
12/3	Circulatory before B2160 entry Ahead	55.20%	6.3	60.30%	3	58.30%	6.4	63.00%	4.3

The model results show some residual congestion on the A21 eastern approach in particular, and to a lesser extent in the PM Peak on the B2160 approach. However, overall, it is considered that this

solution provides a viable option that could be taken forward for further development to offset RC and Local Plan related additional highway demand issues at the Kippings Cross junction.

Wider Junction Context

Whilst the junction modelling for the Kippings Cross junction shows that the junction could operate effectively in isolation, its operation with or without mitigation is affected by the existing situation occurring at the Blue Boys junction and the wider capacity issue related to feeding a two lane dual carriageway into a single lane road on the A21. As a result, there is likely a need to add capacity on the A21 eastbound exit arm to stop traffic blocking back onto Kippings Cross.

10. Conclusions

This Technical Note has been prepared to address the remaining residual major hotspots identified in the Strategic Highway Modelling on the back of the high modal shift Local Plan demand model run. In summary:

- *Junction 8 A26 (Woodgate Way) / B2017 (Tudeley Road)* – our analysis indicates that a viable junction mitigation solution can be achieved for this junction through the provision of an extra lane on the B2017 approach to the existing roundabout.
- *Junction 12 A228 (Whetsted Road / Branbridges Road) / B2160 (Maidstone Road)* – our analysis indicates that a viable junction mitigation solution for this junction could be achieved by the provision of extra lanes on the B2160 and the A228 South West approaches to the existing roundabout.
- *Junction 13 A228 (Maidstone Road) / B2017* (Badsell Road) – our analysis indicates that the proposed Stantec design is viable. However, there is a need to confirm final layout with additional junction modelling and design analysis by Stantec.
- *Junctions 21 and 22 A21 / A228 (Pembury Northern Bypass) / A264* (Pembury Road)– though there is some additional queueing and delay identified at these junctions, the analysis indicates the existing layout and lane lengths cover the key queueing and delay at the north east dumbbell junction with A21 SB. The Analysis does however outline a need for work to offset congestion issues primarily related to the RC at the south eastern dumbbell.
- *Junction 35 Kippings Cross A21 (Hastings Road) / B2017* (Maidstone Road) – the latest modelling and analysis show there are two potential mitigation solutions that could address local plan growth, in the form of KX10 (primarily based around a new left slip lane from the A21 to the B2017, with widened approaches on other arms), and to tackle wider growth in the RC and include Local Plan issues in KX11 (based around an expanded elongated partially signalised roundabout).

Junctions with Direct Mitigations

As agreed with KCC/NH localised junction modelling has been undertaken to further understand the impacts of the Local Plan and mitigation measures on the operation of the individual junctions. Appropriate industry standard junction modelling software has been utilised, specifically ARCADY for roundabout and LinSig for signalised junctions.

It should be noted that these concept schemes are not intended to represent a preferred package of works or to advocate specific junction designs. The final design solutions would be developed as and when the individual proposals come forward to take account of any changes in traffic patterns and other infrastructure schemes coming forward in intervening years; and to ensure that inclusion of infrastructure for sustainable modes is considered first. They should be reviewed in parallel with an agreed 'Monitor and Manage' process. They nevertheless demonstrate that mitigations can be delivered.

It should be noted that none of the mitigation measures have been subject to a Road Safety Audit at this stage. Following standard processes, the physical mitigation measures should have a stage 1 Road Safety Audit completed before progressing to any further stage of design. As above, the mitigation presented in this report is to demonstrate that the level of development proposed is capable of mitigation. As discussed above, the final design solutions would be developed as and when the individual site proposals come forward. Notwithstanding the need for safety audits, this Note has not identified any safety concerns with the minor works being considered.

Conclusion

In conclusion, the sensitivity testing through the junction modelling and feasibility study set out within this Note demonstrates that the overall Local Plan growth, if accompanied by the appropriate mitigation measures, can be accommodated on the network without causing severe traffic impacts within the Borough. This demonstrates that the evidence base set out in the Transport Modelling report is robust, adequate and proportionate.