Technical Note I

Project:	Wisbech Area Transport Study	**To:**	Fenland District Council
Subject:	Sensitivity testing in relation to housing option development in Fenland and Kings Lynn and West Norfolk Districts	**From:**	Atkins
Date:	22 October 2014	**cc:**	Cambridgeshire County Council

1. Introduction

This Technical Note forms part of a series of documents for the Wisbech Area Transport Study (WATS). This sensitivity study focuses on assessing the transport impacts that may result is a more extreme travel pattern emerged from the mix of housing and employment growth in and around Wisbech in North Cambridgeshire. The study principally uses a SATURN (Simulation and Assignment of Traffic in Urban Road Networks) model for the purposes of testing different scenarios. This document should be read in conjunction with some of the earlier technical documents that form part of WATS. These documents can be found on Fenland District Council website at:

http://www.fenland.gov.uk/article/7085/Wisbech-Area-Transport-Study

Previous assessments were made of the overall transport implications for Wisbech considering all the housing and employment growth options within Fenland District, including 550 new homes within the Wisbech area as set out by Kings Lynn and West Norfolk (KL&WN) in their adopted core strategy. This previous testing made an assumption, based on the Fenland Local Plan that new homes and jobs were being developed so that people could live and work within the town. This sensitivity test is carried out to study the impact of a more extreme outcome of uncontrolled development growth catered for by a greater reliance on external trips from areas outside of the Wisbech transport network.

The forecast year modelled is 2031. This is consistent with the previous traffic modelling that has been undertaken. Among the four tested growth options reported in Technical Note H, only the following two growth scenarios are considered for this study:

- Do-Minimum scenarios for 2031, to include all committed developments and background growth, controlled to TEMPRO 6.2growth projections (DM) for areas outside Wisbech;
- Do-Something scenarios for 2031, to include the DM above + Wisbech Transport Mitigation Strategy + FDC Growth Option 1 + KL&WN development with 550 dwellings (north access) controlled to TEMPRO 6.2 growth projections for areas outside Wisbech, i.e., DS1 scenario reported in Technical Note H.

Two major more extreme forecasting procedures are considered for this sensitivity test:

- What if the trip ends across development sites are considered independently, i.e. origin and destination trips from development are unable to follow existing trends and more reliance is placed on more distant settlements;
- What if the new developments are more attractive to areas outside Wisbech favouring long distance trips

These new tests are referred to as Sensitivity Tests and the previous tests are referred as Central Case hereafter in this report.

2. Forecast Year Scenario Definitions

The forecast year for this study is 2031; and the forecast scenarios for this study are Do Minimum (DM), Do Something (DS) scenario. The definitions of these forecast year scenarios are given in the sections below.

Do Minimum

The DM scenario consists of all committed housing and employment developments within Wisbech as outlined in the revised brief. For light vehicles, the total growth level is controlled to the levels as defined by TEMPRO 6.2 (Trip End Model Projections) growth forecasts for areas outside Wisbech. For heavy vehicles, the total growth level is controlled to the levels as defined by National Transport Model (NTM) 2009 (Revised May 2010).

Do Something

The DS scenario comprises all the committed developments included in the DM scenario, and Fenland developments from option 1 together with the Kings Lynn & West Norfolk homes adjacent to Wisbech. The KL&WN development is considered with a north access configuration.

All the forecast year network changes and Kings Lynn development site access assumptions are to be referred to from Technical Note H.

The locations of the development sites are shown in Figure 2.1 within the Fenland District boundaries and Figure 2.2 for the sites beyond the District boundary. Table 2.1 and Table 2.2 summarises the Housing and Employment development assumptions considered in all forecast scenarios.

Table 2.1 – Housing Growth Figures 2011-2031

Housing Trajectory Element	No of additional dwellings (2011 – 2031)	
	DM	DS
Commitments	860	860
Windfall	600	600
Fenland – East Opportunity Zone	-	1000
Fenland – zone	-	750
Kings Lynn & West Norfolk – new development	-	550
Total	**1460**	**3760**

* *Commitments from 2008-2011 is 265 dwelling units as per updated brief*

Table 2.2 –Employment Growth Figures 2011-2031

Employment Element	DM	DS1
Total Jobs	551	1304

Figure 2-1 – Development Sites in Fenland District Council Area

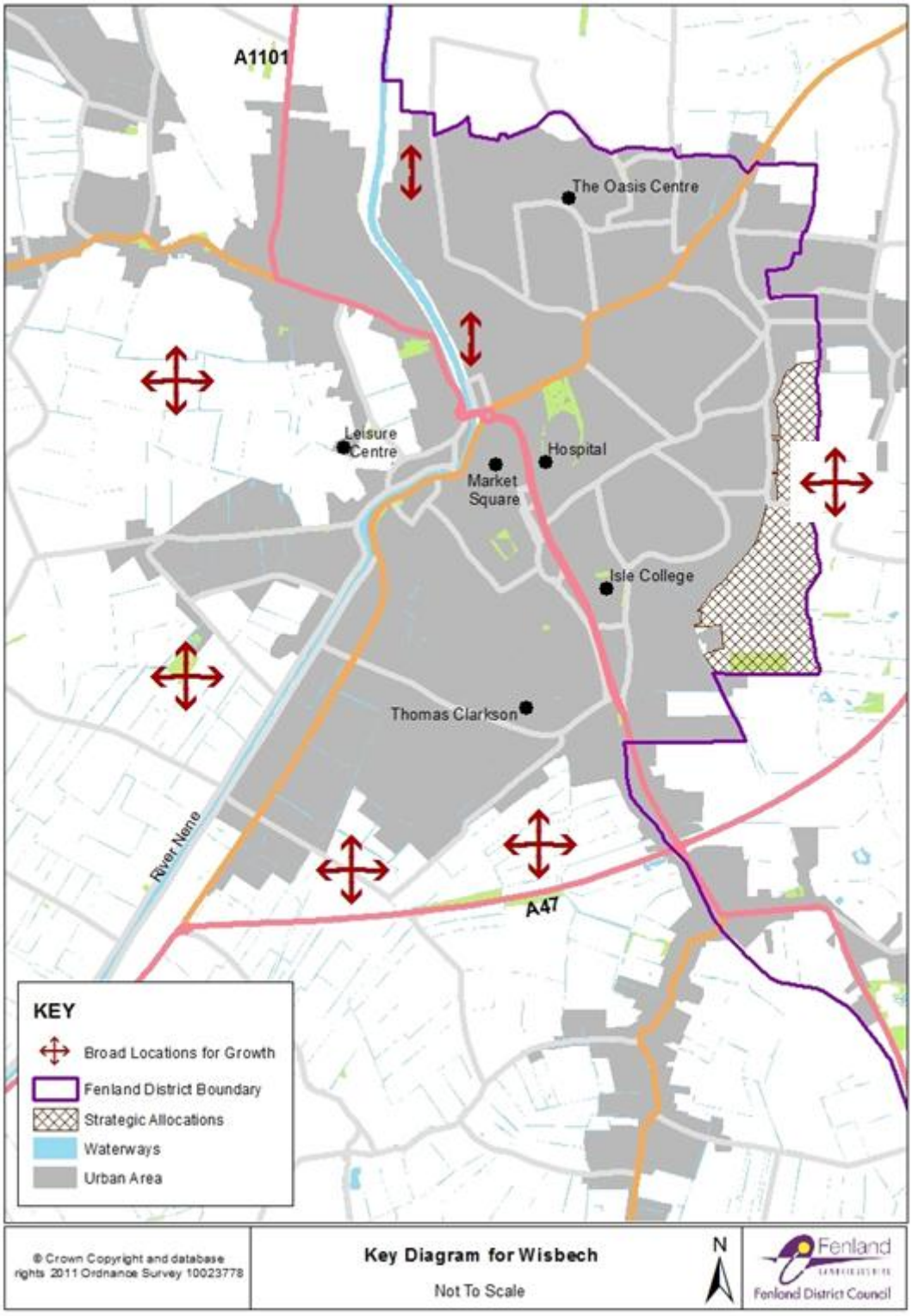
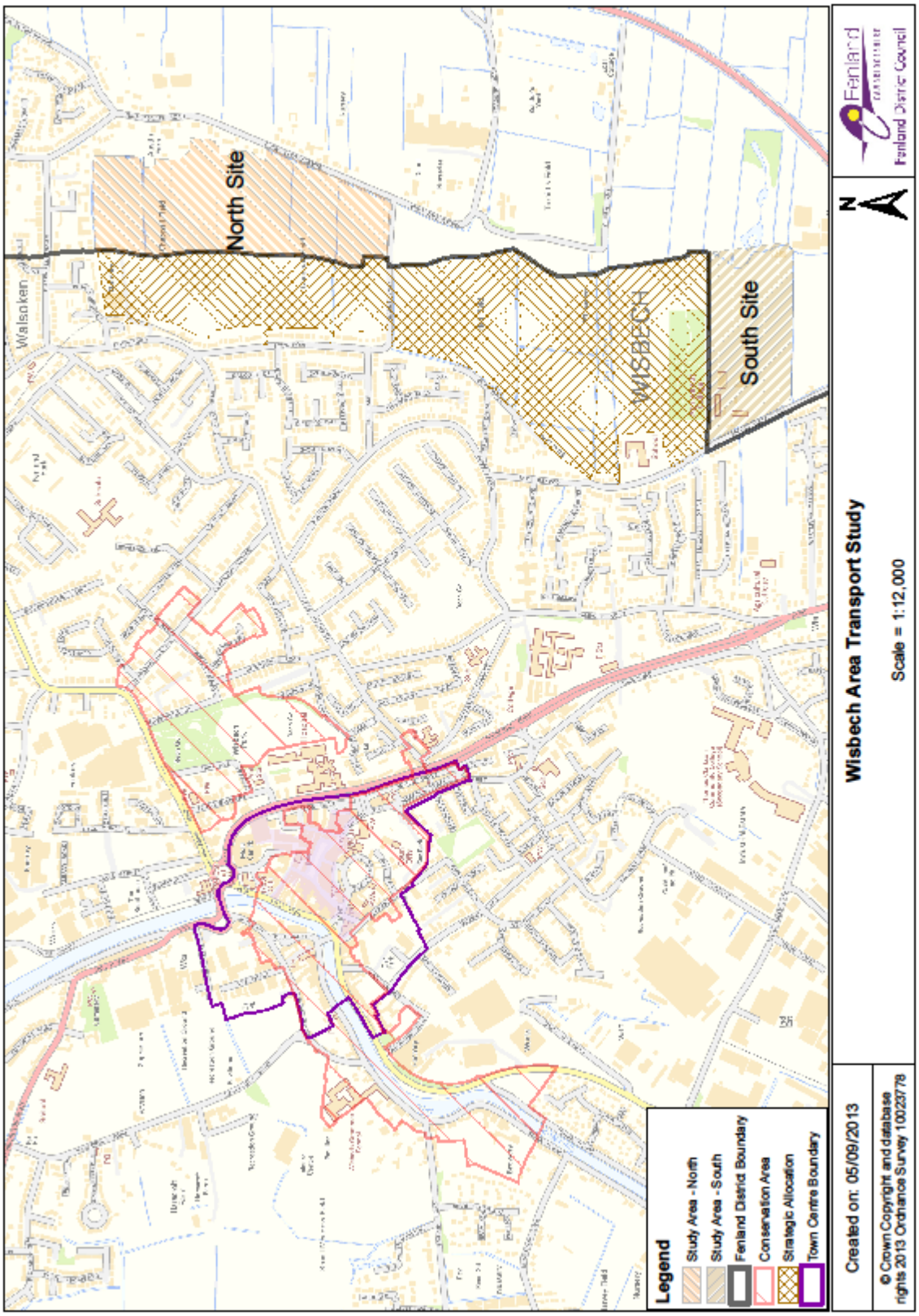


Figure 2-2 East Wisbech Development Sites



Forecast Year Demand

The methodology to produce the forecast year demands for 2031 demand matrices for the WATS SATURN model are set out below. The process uses several different growth sources:

- TEMPRO 6.2 provides projections of growth over time for use in local and regional transport models. It presents projections of growth in planning data, car ownership, and resultant growth in trip-making by different modes of transport under a constant cost assumption. The information is provided for over 2,500 zones nationally, which can be aggregated into towns, districts or counties. For this study, trip end growth data for Wisbech, Fenland, Cambridgeshire and Rest of Country has been extracted from TEMPRO and is used to provide forecasts of all light vehicle user classes (i.e. UC1 to UC4) for areas outside Wisbech.
- User classes UC1 to UC4 in the model represents lights vehicles which consist of cars and LGVs combined (LV). Generally growth in car traffic is derived from TEMPRO and LGVs from ERTG. Since the Wisbech model does not have separate cars and LGV a combined growth factor has been calculated taking into account the time period of the model and the proportional split between LGV and cars for each of the four user classes. These growth factors have been used to calculate uplifts that have been applied to the TEMPRO car only growth factors. The uplift applied to respective time periods for UC1 to UC4 are shown in Table 2.3.

Table 2.3 – LV uplift factors applied to 2031 TEMPRO car only growth factors

Time Period	Uplift applied
AM	6.00 %
IP	5.02 %
PM	4.37 %

- The growth factor above adds extra LGVs to the car only TEMPRO growth by taking into account the higher growth forecast for LGV's in ERTG as derived from NTM2009
- For the heavy vehicle user classes (i.e. UC5 & UC6), trip end growth factors from NTM 2009 (May 2010 revision) was used. The NTM 2009 published by Department for Transport (DfT) provides forecasts of road traffic growth by region and by vehicle type.
- The FDC SHLAA document, 2007 Employment Land Review document and other planning application data provide information on the committed housing and employment developments in and around Wisbech which are included in all forecast year scenarios (i.e. DM, DS1 & DS2). KL&WN are not considering an employment allocation within their boundary around Wisbech.
- The FDC Neighbourhood Planning study provides housing and employment information to be included in the DS1 scenario supplemented by updated housing and employment growth figures provided by FDC in December 2011.
- TRICS (Trip Rate Information Computer System) is a database of surveys from developments across the county, which can be interrogated to provide an estimate of the number of trips that will be generated by a new development. The information can be tailored to suit the individual development, taking into account trends in that area of the country, and/or location of the development within or outside a town, and/or its size etc.
- The forecast year demand matrices were calculated separately for each user class, time period, forecast year and scenario. Table 2.4 below summarises the growth approach undertaken for forecasting matrices to 2031.

Table 2.4 - Matrix growth factors for light vehicle user classes from 2008 to 2031

Origins /Destinations	Growth Factors
Development sites	TRICS/Fuel/Income
Wisbech Town	Fuel/Income
Rest of Model	TEMPRO/Fuel/Income

Sensitivity Test Final Forecast Year Matrices

The matrix building process is changed from our previous studies at the stage of balancing the demand to test the extreme case uncontrolled development. Two changes were made to the methodology:

- Previously the number of origin/generation trips were balanced to the destination/attraction trips and separately distributed to the identified trip end targets both within the internal study area and the external zones. In other words an average value was found between the two estimates of trip end generation and attraction. Depending on the nature of the forecasts and identified new trip generators the estimates of trip end generation could be out of balance. For instance where additional "planning" effort has been made to identify land available for employment this could be a more dominant source of trip generation.

  The sensitivity test process considers these two values (generation or attraction) separately and now each trip end target is assumed to create new trips. Hence the estimates of trip generation and attraction producing trips equal to their sum rather than the average value.

- The long distance trips are made attractive by introducing a new damping factor to the logit function. This increases the attraction (or decreases the impedance) of long distance trips and decreases the attraction of small distance trips in the gravity model for new development sites. The damping factor used to manipulate the logit function is as below:

$$0.5 < (\sqrt{\boldsymbol{trip\ distance}} / \sqrt{\mathbf{15km}}) < 1.5$$

  i.e. trips which are 15km long or above are assumed to be long distance trips and their attraction is increased by a factor obtained as above but controlled to a maximum change of 50% and vice versa for trips lesser than 15km.

The following Table 2.5 compares the process followed in previous studies against the sensitivity test.

Table 2.5 – Comparison of Matrix building process

	Central Case	Sensitivity Test
Trip Rate	Same	Same
Trip End Generation and Attraction	Same	Same
Balancing between Attraction and Generation totals	Balanced to the average of generation and attraction. e.g.: If the rates suggests are 100 trips generated and 200 trips attracted from all new developments, then these are matched at 150 new trips (150 new attraction trip ends all to development zones & 150 generation trip ends all to development zones)	Balancing process removed. Both production and attractions trip ends are considered separately. i.e they are considered to be a exclusively new trips. e.g.: If there are 100 trips ends generated and 200 trips ends attracted from all new developments, then we will have 300 new trips (300 new attraction trip end of which 100 is from development zones and 200 from existing zones & 300 generation trip end of which 200 is from development zones and 100 from existing zones)
New Trips distribution	The new trips generated/attracted will be balanced and constrained within existing non development and new development zones without increasing the overall trips generated and attracted from existing non development zones. i.e overall zone totals in existing non development zones remains unchanged (constrained) compared to application of background growth alone	The new trips generated/attracted are assumed to create new trips by increasing the trips generated and produced from existing non development zones. i.e trips in existing non development zones increased further beyond the background growth to accommodate new trips.
New green field zone trip distribution	Distributed by gravity model based on distance logit	Distributed by gravity model based on distance logit but skewed to favour long distance trips. An external factor is used to decrease the gravity of any trips less than 15km and increase the gravity of trips longer than 15km to the maximum of 50%.

After obtaining the new initial matrix using the modified methodology the assessment of the impact of non-car journeys including walking, cycling and public transport are carried out in a similar way consistent with previous studies.

As described in the modelling brief, mode choice factors from the Preferred Public Transport Option detailed in PT Tech Note (Technical Note C) dated 6th January 2011 have been taken into account. Thus after creating the demand matrices, a part of the demand which represents the likely ridership due to additional DM Bus Service – Route D has been sieved out from car user classes.

New cycle ways proposed in Wisbech area along Cromwell Road, Weasenham Lane, Elm Road, Sandy Lane to A1101 through the College of West Anglia Isle campus, old rail line between Wisbech and March, has been considered while building the DS matrices. The potential shift to cycle from car because of the new cycle ways has been calculated through the proportion of highway trip length getting benefited by the cycle way. These trips are then sieved out from the car user classes of the final DS matrices.

Table 2.6 below represents the final demand matrix totals after taking account of the PT ridership abstraction to the proposed new bus service and transfers from car to cycle as a result of new

designated cycle ways compared to the demand matrices of central case tests reported previously.

Table 2.6 – Matrix Totals

Scenario		AM	IP	PM
2008 Base		10,459	9,830	11,289
2031 DM Central case		14,238	14,004	15,475
2031 DM Sensitivity Test		14,970	15,452	16,680
Sensitivity Test - Central Case	*Difference*	*732*	*1,448*	*1,205*
	% Difference	*5.14%*	*10.34%*	*7.78%*

2031 DM Central case		15,030	14,669	16,232
2031 DM Sensitivity Test		16,530	16,525	18,158
Sensitivity Test - Central Case	*Difference*	*1,500*	*1,856*	*1,926*
	% Difference	*9.98%*	*12.65%*	*11.87%*

3. Forecast Results

Matrix Sector Analysis

The demand matrices are sectored as Internal (Wisbech Town Centre) and External (rest of the zones) to study the changes to the trip distribution with the changed methodology. Table 3.1 to Table 3.2 below summarises the comparison of demand distribution between Central Case and Sensitivity Tests.

Table 3.1– Matrix Sector Analysis

		2031 DM				2031 DS			
AM Peak		Internal		External		Internal		External	
	Central Case	3030	(21.3%)	2477	(17.4%)	3580	(23.8%)	2844	(18.9%)
	Sensitivity Test	3070	(20.5%)	2617	(17.5%)	3570	(21.6%)	3177	(19.2%)
Internal	Difference	40	(-0.8%)	139	(0.1%)	-10	(-2.2%)	334	(0.3%)
	Central Case	3380	(23.7%)	5351	(37.6%)	3504	(23.3%)	5102	(33.9%)
	Sensitivity Test	3798	(25.4%)	5485	(36.6%)	4354	(26.3%)	5428	(32.8%)
External	Difference	419	(1.6%)	134	(-0.9%)	849	(3.0%)	326	(-1.1%)

Inter Peak		Internal		External		Internal		External	
	Central Case	2832	(20.2%)	3056	(21.8%)	3303	(22.5%)	3279	(22.4%)
	Sensitivity Test	3026	(19.6%)	3452	(22.3%)	3353	(20.3%)	3749	(22.7%)
Internal	Difference	194	(-0.6%)	397	(0.5%)	50	(-2.2%)	470	(0.3%)
	Central Case	2853	(20.4%)	5263	(37.6%)	3063	(20.9%)	5024	(34.2%)
	Sensitivity Test	3526	(22.8%)	5447	(35.3%)	4002	(24.2%)	5421	(32.8%)
External	Difference	673	(2.4%)	185	(-2.3%)	939	(3.3%)	397	(-1.4%)

PM Peak		Internal		External		Internal		External	
	Central Case	3280	(21.2%)	3840	(24.8%)	3796	(23.4%)	4043	(24.9%)
	Sensitivity Test	3320	(19.9%)	4228	(25.4%)	3764	(20.7%)	4581	(25.2%)
Internal	Difference	40	(-1.3%)	388	(0.5%)	-32	(-2.7%)	539	(0.3%)
	Central Case	2858	(18.5%)	5497	(35.5%)	3184	(19.6%)	5208	(32.1%)
	Sensitivity Test	3410	(20.4%)	5721	(34.3%)	4129	(22.7%)	5683	(31.3%)
External	Difference	552	(2.0%)	224	(-1.2%)	946	(3.1%)	475	(-0.8%)

Table 3.1 shows that the percentage contribution of internal trips originating and destining within Wisbech Town centre and External to External Trips which passes through Wisbech Town centre goes down. Meanwhile trips coming in or going out of Wisbech Town centre from/to External zones increases as long distance trips are made more attractive and with Wisbech traffic shown to grow in a less sustainable and uncontrolled way.

Overall in matrix size, using the modified approach there is always an increase in demand compared to Central case because of the increase in demand due to revised method of growth employed.

Network Statistics

The results from each forecast year and time period vary in terms of the level of congestion, delay and overall journey time in and around Wisbech, therefore each value has been taken from the AM, IP and PM time periods, with the worse performing time period highlighted.

Table 3.2 below summarises the key SATURN statistics for both Central case tests and sensitivity tests.

- Transient Queues (in PCU hours) – For example, at traffic signals the transient queue corresponds to the queue that develops during the red phase and then dissipates during the subsequent green phase.
- Over-Capacity Queues (in PCU hours) – These occur only for turning movements in excess of capacity where a permanent queue builds up which is unable to clear in a single cycle.
- Link Cruise Time (in PCU hours) – This is the time spent travelling on links within the model, as distinct from time spent in queues at junctions.
- Total Travel Time (in PCU hours) – This is the sum of Transient Queue time, Over-Capacity Queue time and Link Cruise time.
- Total Distance (in km) – This is the total distance travelled by all vehicles in the network.
- Average Speed (in kph) – This is the average speed of vehicles in the network. (It is simply the Total Distance divided by the Total Travel Time).
- Average Trip Time (in PCU hours) – This is the average length of time taken for each trip. (It is calculated as the Total Travel Time divided by the number of trips.)
- Average Trip Distance (in km) – This is the average distance covered by each trip. (It is calculated as the Total Distance divided by the number of trips.)

The SATURN summary statistics from Table 3.2 clearly show that as demand increases on the Do-Minimum network compared to the central case, the level of congestion and delay increases through time as expected. This is reflected in the increase of the Total Travel Time, Transient and Over-Capacity queues, along with the decrease in Average Speed across the network.

Both DM and DS are getting worse when allowed to grow in an uncontrolled way, but DS scenario copes better than DM scenario despitethe additional development demand. This might be because of the infrastructure changes which form part of the Wisbech Transport Mitigation Strategy.

Table 3.2– Summary of SATURN Statistics

Indicator	Time Period	2008	2031 DM Central Case	2031 DM Sensitivity Test	2031 DS Central Case	2031 DS Sensitivity Test
Transient Queues (PCU hrs)	Am	283	661	761	650	880
	IP	232	650	852	609	880
	Pm	318	872	1,105	829	1,173
Over-Capacity Queues (PCU hrs)	Am	20	340	583	206	608
	IP	1	297	640	125	361
	Pm	4	664	1,216	405	1,067
Link Cruise Time (PCU hrs)	Am	1,432	2,151	2,304	2,099	2,426
	IP	1,342	2,104	2,384	2,044	2,394
	Pm	1,582	2,351	2,589	2,284	2,689
Total Travel Time (PCU hrs)	Am	1,735	3,152	3,648	2,955	3,914
	IP	1,575	3,051	3,876	2,779	3,636
	Pm	1,904	3,887	4,909	3,518	4,929
Total Distance (km)	Am	92,224	129,770	137,678	132,494	149,882
	IP	87,130	128,558	142,669	130,478	149,736
	Pm	100,980	140,815	153,555	142,901	164,689
Average Speed (kph)	Am	53.2	41.2	37.7	44.8	38.3
	IP	55.3	42.1	36.8	47.0	41.2
	Pm	53.0	36.2	31.3	40.6	33.4
Average Trip Time (PCU hrs)	Am	0.17	0.22	0.24	0.20	0.24
	IP	0.16	0.22	0.25	0.19	0.22
	Pm	0.17	0.25	0.29	0.22	0.27
Average Trip Distance (km)	Am	8.82	9.11	9.20	8.82	9.07
	IP	8.86	9.18	9.23	8.89	9.06
	Pm	8.95	9.10	9.21	8.80	9.07
Trips Loaded	Am	10,459	14,238	14,970	15,030	16,530
	IP	9,830	14,004	15,452	14,670	16,525
	Pm	11,289	15,475	16,680	16,232	18,158

Highway Flow Difference

The change in flow pattern, congestion levels and re-routing are analysed through the flow difference plots between the sensitivity test scenario and the central case scenario. AM peak which is the worst case scenario is used for this analysis.

Figure 3.1 shows the flow difference plots for central case and sensitivity test DM. This shows heavier congestion on A1101 from Lincolnshire to Wisbech and the adjacent Roman Bank minor road, on the A47 between Cromwell Road and Elm High Road and correspondingly on the B1169 and B1166 minor roads from Wisbech to Guyhirn avoiding A47. This shows that the rat running on the minor roads to avoid A1101 and A47, which is already observed to be happening in present base scenario, has increasing propensity and worsens over time. From the earlier WATS testing work, it was identified that there is likely to be additional use of A47 and that there was a need for an additional east – west route in Wisbech in addition to A47 and Weasenham Lane. As this DM test does not include any additional route, the traffic on A47 and Weasenham Lane worsens.

Figure 3-1 Highway Flow Difference (2031 AM Peak) – DM Sensitivity – DM Central Forecast

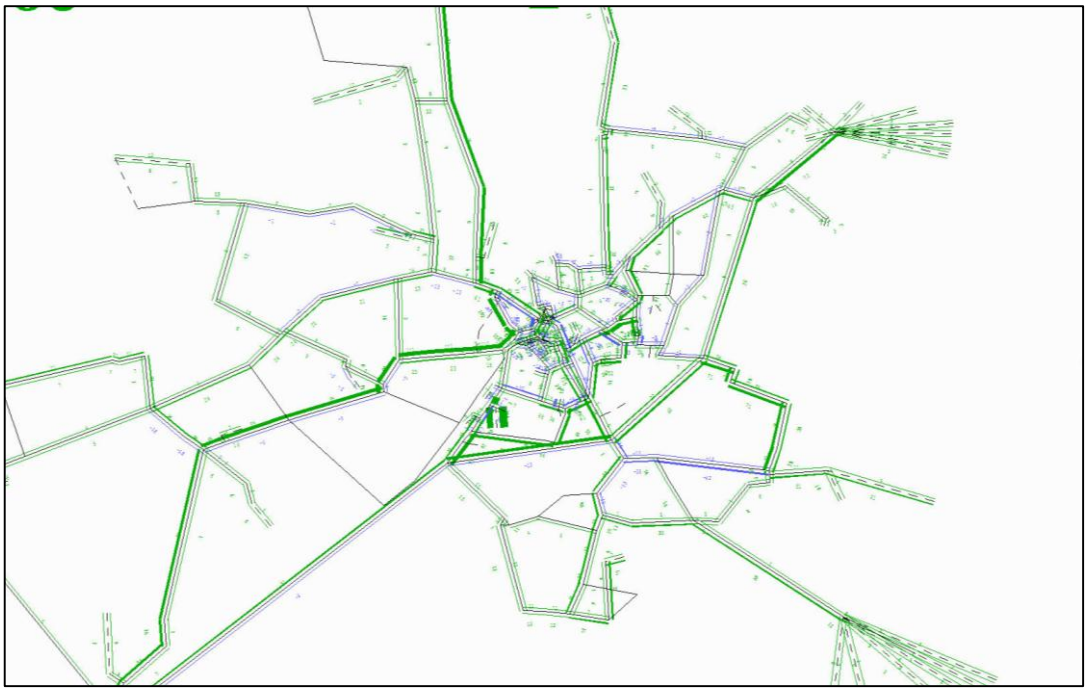


Figure 3-2 Highway Flow Difference (2031 AM Peak) – DS Sensitivity – DS Central Forecast

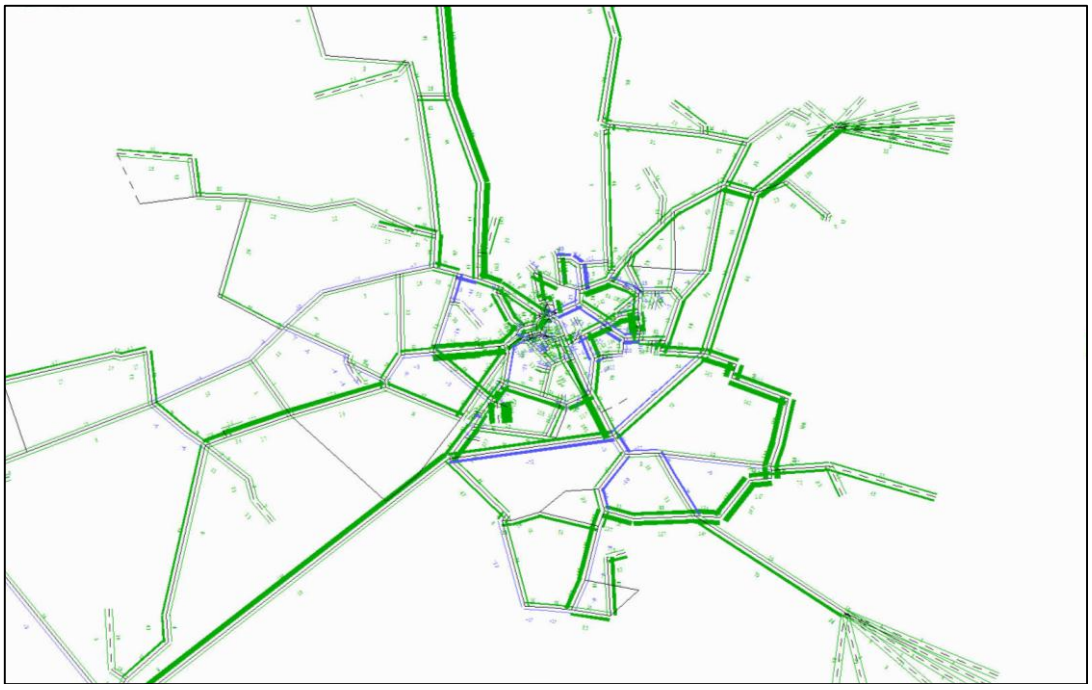


Figure 3.2 shows the flow difference plots for central case and sensitivity DS, which includes all the proposed development for Wisbech as defined by the Local Plan and the Wisbech transport mitigation strategy. This plot shows there a significant improvement to A47 between Cromwell Road and Broad End Road including Elm High Road. This does seem to suggest that there would be significant use of the new East – West road and also the Link Road and River Crossing to the west of Wisbech. This also shows benefits to Freedom Bridge and the centre of town. This plot is suggesting that even with increased traffic being loaded into A47, there are improvements to the strategic road network and that local people will make use of the new mitigation measures. The main matter on the A47 being slight increases on A47 Cromwell Road, Wisbech to A47/A141 Guyhirn.

4. Summary

This piece of work has focused upon:

- The analysis of potential highway impacts to Wisbech and the surrounding Transport network, where a more extreme case of less controlled growth was tested. This reflecting longer trips, (especially those away from Wisbech) associated with the development and growth sites than the earlier Wisbech Area Transport Study testing. The assessment of alternative mode choice on the residual trip generation (and subsequent analysis) follows the identical procedure to the Core tests previously conducted with consistent outputs extracted.

The headline information regarding the transport impacts of the additional sensitivity testing is as follows:

- Though the demand between all sectors goes up with the less controlled growth, most of this growth is expected to be served by neighbouring areas. This is shown by increases in the number of external trips into Wisbech, including showing the increased draw of the employment opportunities if that demand is no longer served by the local (Wisbech) workforce;
- The travel network performance worsens in both DM and DS when allowed to grow in a less controlled way, but DS scenario continues to perform better than DM scenario in terms of network speeds. This is in all time periods (despite the additional development trip demand) because of the improvements to the strategic road network. The modelling shows local people will be able to make good use of the new mitigation measures;
- Rat running from A47 on to minor roads is expected to get worse with time due to more congestion on A47 if the mitigation measures are not considered.
- The DM traffic on A47 and Weasenham Lane is expected to get worse without an additional east – west route in Wisbech as proposed.

It is noted the impacts of a disposition with less sustainable patterns has appreciably more severe impacts on the network. This reinforces the need for concerted efforts in Wisbech to form a vibrant and attractive place to combine housing and employment opportunities together.

These sensitivity tests are viewed as an extreme forecast of likely traffic outcomes, however, the results are useful in reviewing potential alternative outcomes of the growth patterns and to assess the flexibility and efficiency of the mitigation strategy to that growth.