Appendix 1

QUEEN ADELAIDE LEVEL CROSSING TRAFFIC STUDY

Study on the impact of closing or restricting traffic on the B1382 Ely Road in Queen Adelaide, Cambridgeshire

Abstract

This report investigates the existing situation with traffic in the Queen Adelaide region of Cambridgeshire and considers the local and wider impact of closing or restricting traffic along the B1382 Ely Road to enable additional passenger service trains and freight to use the three level crossings that lead to Peterborough, Kings Lynn, and Norwich.

2020 Consultancy

January 2018

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1.0 Introduction

Cambridgeshire County Council commissioned 2020 Consultancy to carry out a traffic study focusing on three level crossings in Queen Adelaide in November 2016. The purpose of the study is to investigate the impact the three level crossings have on traffic in the region and the impact it would cause traffic if Network Rail increased the number of trains passing through the Ely region.

The three level crossings that form part of this study are located along the B1382 in Queen Adelaide and the railway lines carry passenger services and freight to Peterborough, Kings Lynn, and Norwich. There is an increasing demand to carry more passenger services and freight along all of these lines and along with a lack of junction / track capacity in the Ely area, the level crossings are a constrain to increasing train services.

Please see figure 1 below for a location plan of the area.

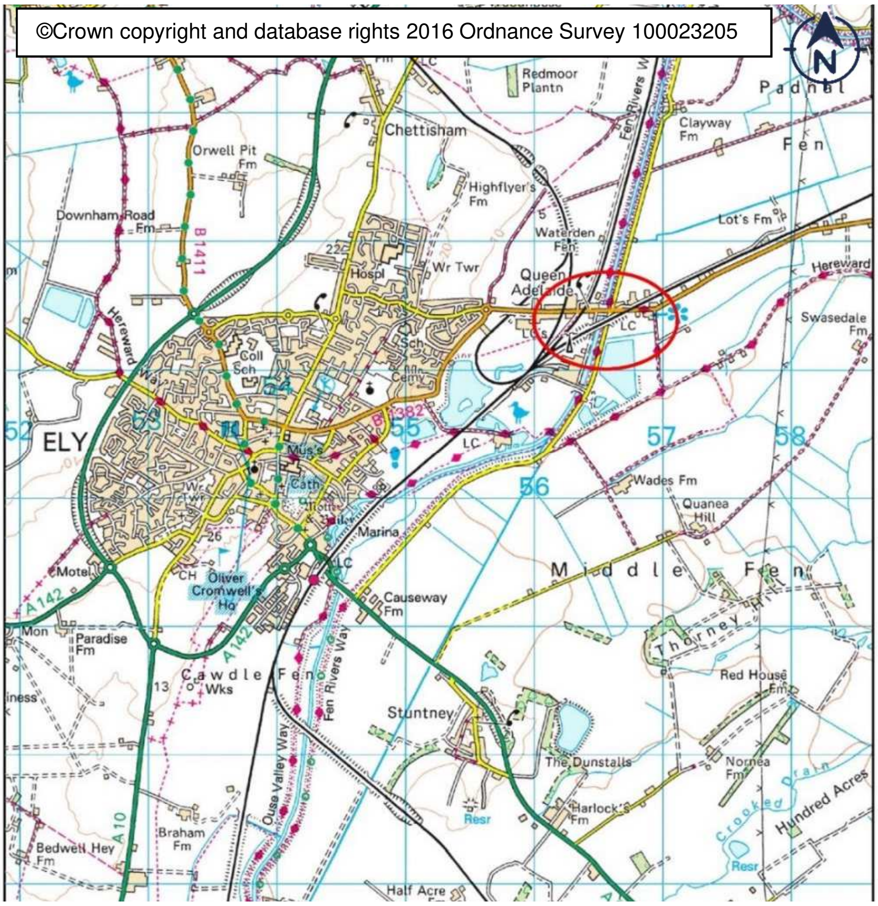


Figure 1

All three level crossings are currently automatic half barrier crossings. If rail infrastructure was upgraded for rail services the Queen Adelaide crossings would need to be upgraded to full barrier crossings to meet an acceptable level of risk for Network Rail.

The following information is found on Network Rails website regarding level crossings.

There are 6,300 level crossings on our rail network and we have a legal duty to assess, manage and control the risk for everyone.

Level crossings fall into five distinct categories but each is unique so we've worked with our rail industry partners to develop a standardised method for assessing crossing risk. Factors taken into account include frequency of trains, frequency and types of users and the environment and where the crossings are located.

Risk assessment

Level crossings are assessed at a frequency that is based on the level of risk a crossing poses. The assessment frequency ranges from 1¼ to 3¼ years.

We strive to improve safety by managing and mitigating the risk at crossings. Education and safety campaigns are a fundamental part of this.

A safer railway

We can eliminate risk by closing crossings where agreement can be reached to do so. As part of our commitment to a safer railway we have delivered the following so far:

- *Closed 900 crossings (804 closures in the five years to 2013, and to date 96 closures in the five years to 2019)*
- *Improved sighting at over 1,000 crossings*
- *Repositioned over 250 crossing phones into safe areas for users*
- *Installed overlay barriers at 45 open crossings*
- *Introduced a fleet of mobile safety vehicles*

Next steps

We are now working on:

- *The national rollout of red light safety cameras*
- *Power operated gates at user worked crossings*
- *Closing at least another 250 crossings*

Quotation from Network Rail website

The upgrade of barrier from half to full and the increase in trains would lead to a situation where barrier down time is too great, again leading to a level of risk which would be too high. To reduce this level of risk to an acceptable level there are a number of solutions which have been considered within this study report.

The study has been separated into five investigations that include:

1. Summary of the existing situation and usage of the level crossing;
2. Investigation as to how usage at the crossings may change over time;

3. An investigation of the impact of closing the level crossings now and in the future;
4. Investigation into potential ways to reduce the number of people using the level crossings;
5. Investigation into possible infrastructure solutions for closing the level crossings.

2.0 Background & Policy

2.1 National Policy

A level crossing is a place where a railway is crossed by another transport route (road, path, bridleway, etc) on the same level. There are about 6,300 level crossings in the country. There is inevitably risk on every level crossing: trains are heavy pieces of machinery, often travelling at high speed, and usually unable to stop within the distance that the driver can see ahead.

Drivers, pedestrians, wheelchair users, cyclists and horse-riders all present risks when crossing the railway. On average 12 people died in accidents on level crossings each year over the last ten years.

The Department for Transport and the Office of Road and Rail Regulation instigated a nationwide review of level crossings in order to reduce the possibility of incidents. The Department for Transport, Office of Road and Rail Regulation, highway authorities and their trade association, the Association of Transport Coordinating Officers (ADEPT), Highways England and the Health and Safety Executive have been part of the advisory group considering the closure of level crossing across the country.

2.3 County Policy

The Rights of Way Improvement Plan

The Rights of Way Improvement Plan (ROWIP) was adopted in 2006 as part of the Cambridgeshire Local Transport Plan 2006-2011. The Plan was formulated following considerable research, data gathering and extensive public and stakeholder consultation with the Local Access Forum playing a key part in the plan's development. The Plan is well used and has been invaluable to helping to bring improvements to the rights of way network and enhancing countryside access.

The ROWIP was updated in 2016. The update does not amend the policy basis of the existing ROWIP or LTP3 however it does update all Statements of Action that was published in the first ROWIP. The update demonstrates how Cambridgeshire County Council policies and plans for rights of way will contribute towards the County Council's vision – 'creating communities where people want to live and work: now and in the future'.

The Third Cambridgeshire Local Transport Plan

The Third Cambridgeshire Local Transport Plan (LTP3) covers the period 2011-2026 and demonstrates how transport policy contributes to the County Council's vision of "creating communities where people want to live and work: now and in the future." It provides a framework for the strategy, to ensure that planned development can take place in a sustainable way. The strategy looks to apply the LTP's overarching policies and objectives at a local level whilst reflecting the local needs and views. The LTP is a live document and is updated as required. The Transport Strategy for East Cambridgeshire forms part of the LTP3 suite of documents.

2.4 Cambridgeshire Transport Strategy

A number of schemes relevant to the alleviation of both rail congestion and traffic congestion (involving the potential removal of level crossings, or improvement to the rail network) are identified in the county's transport strategy. These include funding the Ely southern bypass, on which work is underway.

Scheme Reference	Schemes	Scheme Type	Relevant document / Source	Timescale	Cost £= <10k ££ <250k £££= <500k ££££= £500k+
	Major schemes				
LTTS	**Ely Southern Bypass** A southern bypass of Ely, allowing closure of the level crossing on the A142 and large increases in freight and passenger trains through Ely. More information on this scheme is available here: http://www.cambridgeshire.gov.uk/info/20051/transport_projects/63/ely_southern_bypass	Works	CCC Long Term Transport Strategy (2015)	By End of 2017	£35M

Other rail related projects identified in the strategy include the Ely North railway junction improvements, which in part could be dependent upon the rationalisation of the Queen Adelaide level crossings.

			Strategy (2015)		
LTTS	**Soham railway station** GRIP 3 Study and outline business case is currently been carried out for completion in early 2017.	Works	CCC Long Term Transport Strategy (2015)	2021	£6.5m (Cost from GRIP2 Study)
LTTS	**Ely North junction rail improvements.** Increased capacity through Ely North junction for freight and passenger trains.	Works	CCC Long Term Transport Strategy (2015)	By March 2024	Network Rail to fund and deliver

The council has identified anticipated traffic growth within the county until 2031. The estimates for Ely, including the impact of the Ely southern bypass, indicate an increase in traffic using Ely Road through the Queen Adelaide crossings.

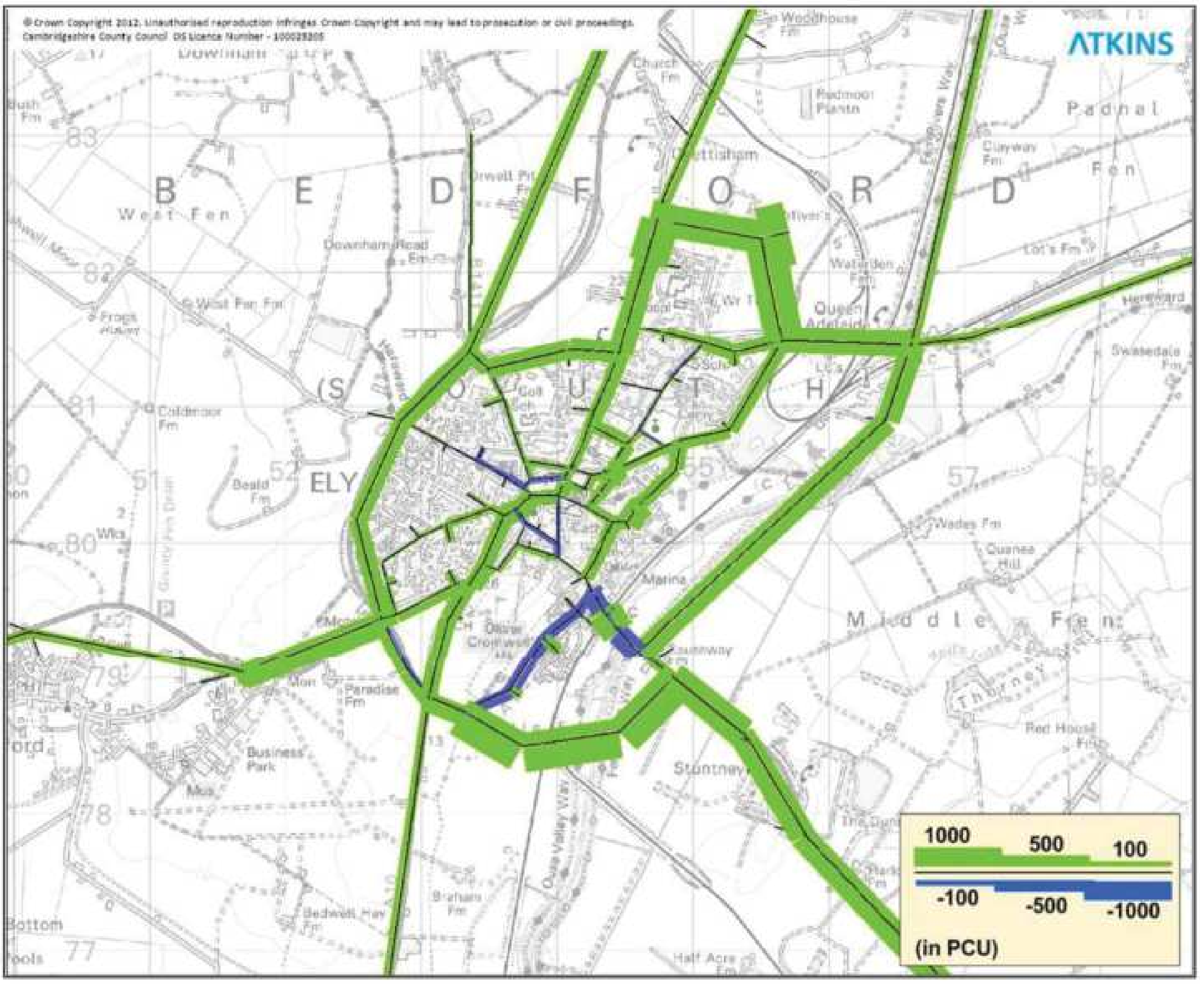


Figure 2: Anticipated increased traffic flows between 2011 and the 2031 Local Plan scenario (this assumes the Ely Southern bypass is open) – East Cambridgeshire Transport Strategy

2.5 Transport Strategy for East Cambridgeshire Policies

Transport Strategy for East Cambridgeshire

Key Issues

The Transport Strategy for East Cambridgeshire identifies a number of key issues include:

- Limited highway capacity
- Missing links on the walking and cycling network
- Impact of HGVs on village
- Availability of public transport in rural areas
- Improving the transport network without having a negative impact on the historic and natural environment can be difficult
- Dispersed rural communities mean that addressing transport needs sustainably can be difficult due to distances travelled
- Road safety issues associated with rural roads
- Access to Cambridge can be difficult during peak times
- Limited rail capacity

- Climate change impacts on transport infrastructure

The rail network

There is potential to increase rail travel within East Cambridgeshire, to help achieve this aim the council will:

- Build the case for opening new railway stations and railway lines, and for improvements to existing stations;
- Support Network Rail / Department for Transport (DfT) plans for improved rail frequencies and faster journey times;

There are a number of rail related schemes in the Ely area supporting the aspiration to improve rail efficiency, patronage, closure of level crossings and improvements to Ely North junction. Network Rail are programming the work to ensure that projects are delivered in the most effective way. This work has included the Ely North Junction and Ely Area Capacity Enhancements. There are a number of other rail infrastructure improvements being developed but these require Ely North Junction to be in place.

The cycle and pedestrian networks

Greater levels of walking and cycling are critical if existing traffic problems are not to be exacerbated. Investment in the cycle and pedestrian network is therefore a key investment priority. The benefits of walking and cycling (Active Travel) are greater than simply keeping additional vehicles off the road. Walking and cycling contribute to the health agenda, and can provide those without access to a car or a good public transport service to take advantage of opportunities to access employment, training and other essential services

The council aims to increase the levels of walking and cycling trip in Ely:

- Increase walking and cycling levels in Ely and its hinterland by enhancing and adding to the current networks.
- Develop the cycle network in and around Ely, providing greater opportunity for cycling to replace the use of the private car for more trips into the city.
- Enhance or develop rural cycle and pedestrian networks around key destinations in the rural area such as village colleges, larger village centres, major employment sites, doctor's surgeries, and transport hubs on the main transport corridors, especially through improvements to PROW.
- Develop a comprehensive longer distance cycle network across the district.
- To enhance cycle parking provision across the county, recognising that the lack of secure areas to park a bicycle can be a deciding factor in the choice to cycle.
- Ensure that developments in all areas of the county provide high quality linkages into existing pedestrian and cycle networks, and to key destinations where new links are needed.

- Identify and tackle local barriers to walking and cycling such as missing links, unsuitable provision, difficulties crossing the road and lack of cycle parking facilities

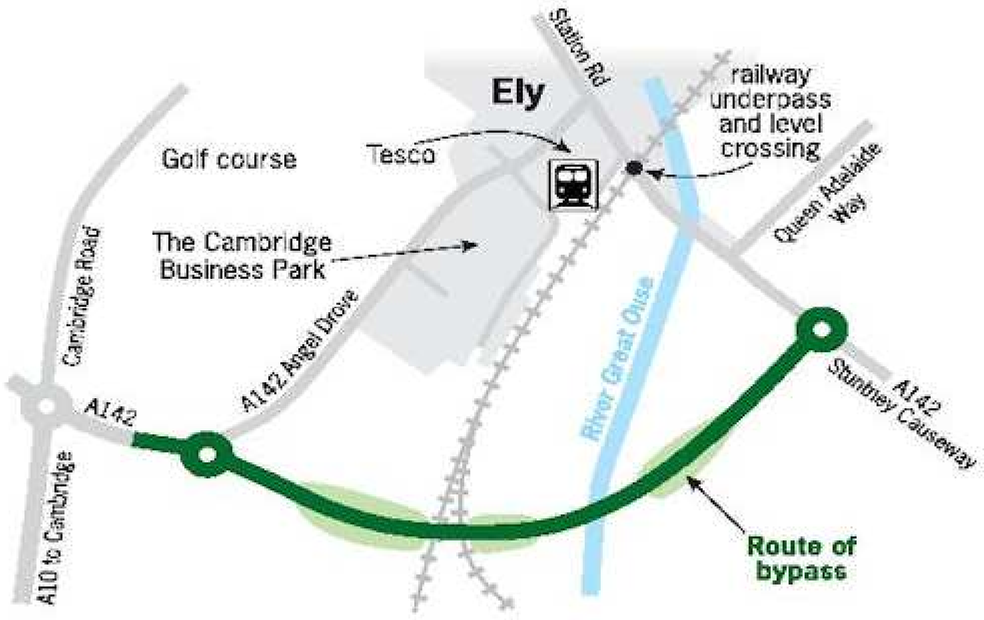
Where possible segregated cycleways, particularly on the main transport corridors and on busier rural routes would be introduced. However, there are areas where road provision will be the most appropriate solution for cyclists. In practical terms, there is a balance between usability, convenience, traffic and safety concerns that needs to be considered. Safe but inconvenient off-road routes are often not well used.

Freight movements and Heavy Goods Vehicles (HGVs)

The efficient movement of road and rail freight is essential to our economy and prosperity, with the demand for goods continuing to increase over the next 20-30 years. This will lead to increased freight traffic. East Cambridgeshire is a largely rural district, therefore heavy agricultural vehicles and machinery are commonplace on local and strategic roads. While the use of these heavy vehicles is vital for the successful operation of farms, the size and weight of the vehicles can impact on the quality of the road network and road verges.

Road freight and the use of inappropriate routes can have considerable impacts on villages in the county. It can lead to localised congestion, noise, vibration, and poor air quality, and can significantly impact on people's quality of life, health and well-being. Particular issues arise when these large vehicles attempt to negotiate small roads through villages, which were not built or designed to withstand road freight, in order to have a shorter journey.

The strategy aims to transfer freight onto the rail network, which could allow for a quadrupling of rail freight traffic through the county, and remove some pressure from the road network. Other schemes include the removal of level crossings, such as on the A142 at Ely, will address the local impacts of increased use of the rail network and demonstrates the council's commitment to the increased use of the strategic rail freight link. An integral part of the level crossing scheme is the Ely southern bypass which bridges both the Ouse and the railway.



Route of Ely southern bypass - Source: Transport Strategy for East Cambridgeshire

The freight strategy aims to minimise the environmental impact of HGVs and address safety issues for all users of the network. The strategy will also need to balance the needs of local communities and haulage operators.

Cambridgeshire County Council has a HGV Policy which aims to balance the needs of local communities with the requirements of lorry operators. It explains that the police are responsible for the enforcement of weight restrictions and the difficulties with restricting HGVs from using the road network. The council aims to better manage HGV traffic by giving freight companies information on appropriate routing when planning their journeys.

Policy TSEC 2: Accommodating demand in Ely
Travel demand within Ely would be accommodated on the constrained transport network in Ely:

- More people will walk, cycle and use public transport
- More people will car share
- Pedestrians, cyclists and buses will be prioritised for trips across Ely.
- General vehicular traffic will not be prohibited and accessibility will be maintained but a car journey may be longer and more time consuming than at present.
- General traffic levels will remain at current levels.

Policy TSEC 3: Accommodating demand in East Cambridgeshire
More travel demand would be accommodated in the constrained network in East Cambridgeshire:

- Passenger transport services on main corridors will be used for part or all of more trips to key destinations
- More people will walk and cycle
- More people will car share
- More locally led transport solutions will be provide passenger transport options in more remote areas that cannot viably be served by conventional bus services

Policy TSEC 10: Improving rail services

The County Council will work with other authorities and the rail industry to bring forward service enhancements and new infrastructure to increase rail use, through frequency and capacity improvements and increasing the proportion of freight moved by rail in line with the Strategy approach.

3.0 Existing Conditions

To gain a full understanding of the existing traffic conditions in the Queen Adelaide area 2020 Consultancy commissioned Automatic Traffic Surveys (ATC) and Automatic Number Plate Recognition Surveys (ANPR) to be undertaken in various locations across the Queen Adelaide area. The purpose of these surveys was to collect data such as the volume of traffic in the area, the origin and destination of traffic in the area, and the type of vehicle in the area such as vehicles, HGV's, and buses.

3.1 ANPR Surveys

Five ANPR survey locations were chosen to provide coverage of all routes into the Queen Adelaide region. Each location picked up traffic in each direction. The surveys were carried out over a period of three days, Tuesday 29th, Wednesday 30th, and Thursday 1st in November and December 2016 to enable an average to be calculated removing any unnatural flows that may have been experienced.

Due to the vast quantity of data the ANPR results have been adjusted to provide data for a 12-hour period which is 7am to 7pm. Therefore the figures shown below differ to the figures shown in the ATC surveys. It is also worth noting that ANPR cameras have a time period of 10 minutes for vehicles to pass through a second camera and be recorded as a continuation of journey. Therefore an ANPR camera will not pick up local traffic that start or stop between two cameras. This again results in the total volume of data differing from the ATC surveys.

Figure 3 provides a location plan for the ANPR surveys. The red and yellow indicators demonstrate the direction of traffic that was collected.

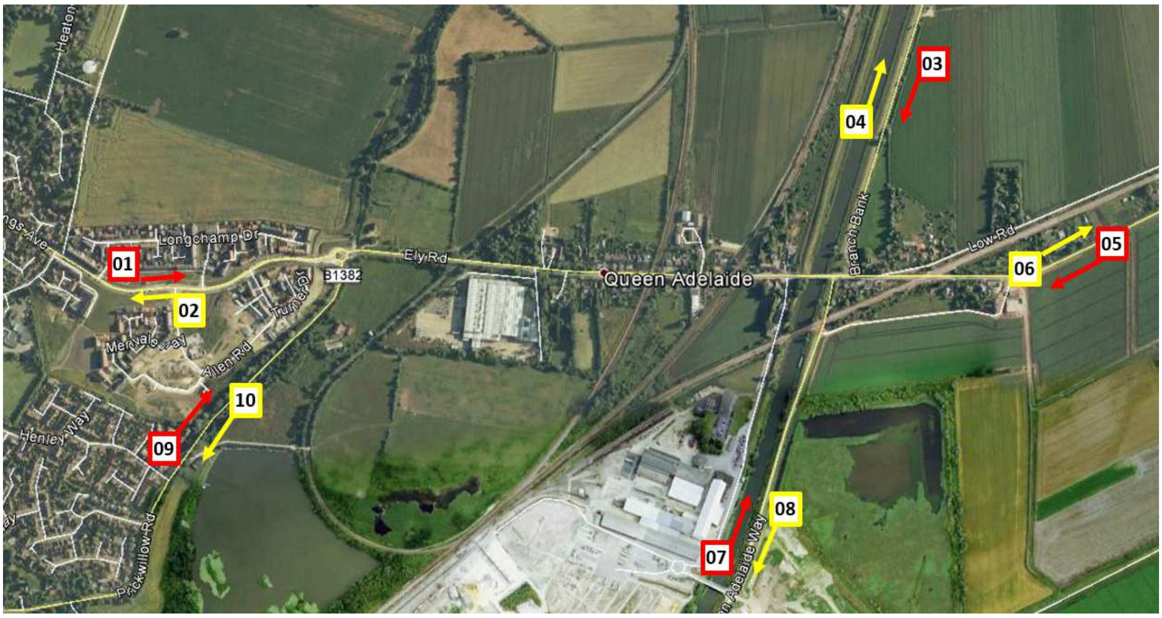


Figure 3 – ANPR survey locations

Table 1 below provides the results of the ANPR surveys averaged out over the three days. For information the numbers shown in figure 2 represent the following roads:

- 1 – Kings Avenue Eastbound
- 2 – Kings Avenue Westbound
- 3 – Branch Bank Southbound
- 4 – Branch Bank Northbound
- 5 – Ely Road Westbound
- 6 – Ely Road Eastbound
- 7 – Queen Adelaide Way Northbound
- 8 – Queen Adelaide Way Southbound
- 9 – Prickwillow Road Northbound
- 10 – Prickwillow Road Southbound

Origin	Destination	No. of vehicles	Crossings in Traffic Route
Kings Avenue EB (1)	Kings Avenue WB (2)	120	None
Kings Avenue EB (1)	Branch Bank NB (4)	84	Peterborough; Kings Lynn
Kings Avenue EB (1)	Ely Road EB (east of crossings) (6)	477	All
Kings Avenue EB (1)	Queen Adelaide Way SB (8)	219	Peterborough; Kings Lynn
Kings Avenue EB (1)	Prickwillow Road SB (10)	749	None
Branch Bank SB (3)	Kings Avenue WB (2)	107	Peterborough; Kings Lynn
Branch Bank SB (3)	Branch Bank NB (4)	14	None
Branch Bank SB (3)	Ely Road EB (east of crossings) (6)	224	Norwich
Branch Bank SB (3)	Queen Adelaide Way SB (8)	1,480	None
Branch Bank SB (3)	Prickwillow Road SB (10)	400	Peterborough; Kings Lynn
Ely Road WB (east of crossings) (5)	Kings Avenue WB (2)	588	All
Ely Road WB (east of crossings) (5)	Branch Bank NB (4)	317	Norwich
Ely Road WB (east of crossings) (5)	Ely Road EB (east of crossings) (6)	8	None
Ely Road WB (east of crossings) (5)	Queen Adelaide Way SB (8)	261	Norwich
Ely Road WB (east of crossings) (5)	Prickwillow Road SB (10)	827	All
Queen Adelaide Way NB (7)	Kings Avenue WB (2)	283	Peterborough; Kings Lynn
Queen Adelaide Way NB (7)	Branch Bank NB (4)	1,572	None
Queen Adelaide Way NB (7)	Ely Road EB (east of crossings) (6)	345	Norwich
Queen Adelaide Way NB (7)	Queen Adelaide Way SB (8)	17	None
Queen Adelaide Way NB (7)	Prickwillow Road SB (10)	100	Peterborough; Kings Lynn
Prickwillow Road NB (9)	Kings Avenue WB (2)	1,036	None
Prickwillow Road NB (9)	Branch Bank NB (4)	572	Peterborough; Kings Lynn
Prickwillow Road NB (9)	Ely Road EB (east of crossings) (6)	644	All
Prickwillow Road NB (9)	Queen Adelaide Way SB (8)	89	Peterborough; Kings Lynn
Prickwillow Road NB (9)	Prickwillow Road SB (10)	52	None
Total		**10,586**	

Table 1 – ANPR Results between 7am-7pm 3 day average

This data illustrates that on average some 10,500 vehicles pass through Queen Adelaide during a typical weekday (12 hours 7am to 7pm).

- The most common origin is from Queen Adelaide Way in a northbound direction heading north along Branch Bank with an average of 1,570 (15%) trips in this direction during the day.
- The second most common origin is from Branch Bank in a southbound direction heading south along Queen Adelaide Way with an average of 1,480 (14%) trips in this direction a day.

These trips represent typical tidal movements associated with the morning and evening peak traffic flows. These two movements represent 29% of the daily trips within the area and do not cross any of the three level crossings that form part of this study.

- A further 17% of journeys also do not involve vehicles using any of the three level crossings.

Therefore 48% of trips (some 5,000 of the 10,500 vehicles) in the Queen Adelaide area would not be impacted by changes to the operation of the level crossings in question.

- The ANPR surveys indicate that typically some 2,500 vehicles use all three of the level crossings during their journey (equalling 24% of the total traffic)
- Some 1,800 vehicles (or 17% of daily traffic) pass over the Peterborough and Kings Lynn level crossings but not the Norwich crossing, indicating these vehicles are either turning into, or out of, Branch Bank or Queen Adelaide Way thus not using Norwich crossing.
- Typically, some 1,200 vehicles (11% of traffic) use only use the Norwich level crossing. meaning that these vehicles are either turning into, or out of, Branch Bank or Queen Adelaide Way.
- The ANPR data indicates that 52% (or some 5,500 vehicles) of traffic in the Queen Adelaide area uses at least one level crossing.

The table below demonstrates the number of vehicles that passed over each crossing on average a day taken over a three-day period.

Crossing	ANPR No. of vehicles
Queen Adelaide (Peterborough)	4,392
Queen Adelaide (Kings Lynn)	4,392
Queen Adelaide (Norwich)	3,683

Table 2 – Number of vehicles passing over each crossing a day

3.2 ATC Surveys

Two ATC surveys were carried out as part of the study. One location was to the west of the Peterborough line (most western crossing) and the other location was to the east of the Norwich line (most eastern crossing). These surveys were carried out for a period of 14 days over the end of November 2015 and early December 2016 to capture a wide range of vehicle data to ensure any unusual traffic behaviour could be identified.

Figure 3 shows a location plan for the western survey and figure 4 shows a location plan for the eastern survey.

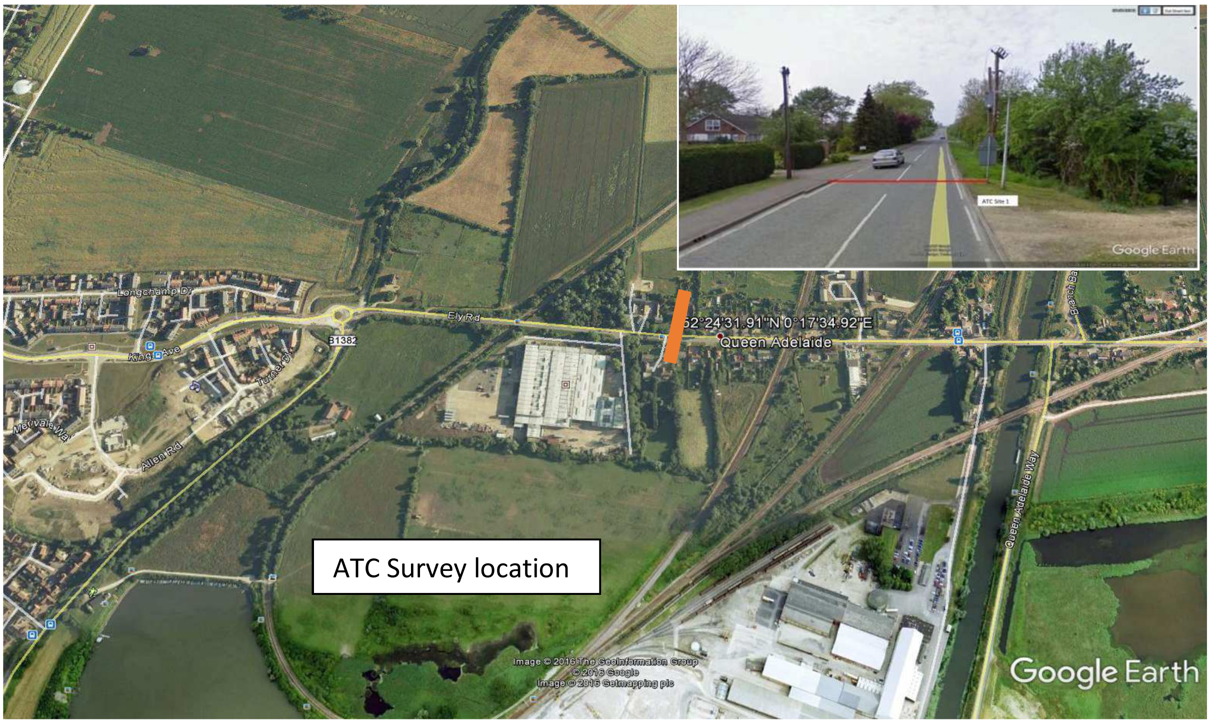


Figure 4 – Location Plan for the western ATC survey

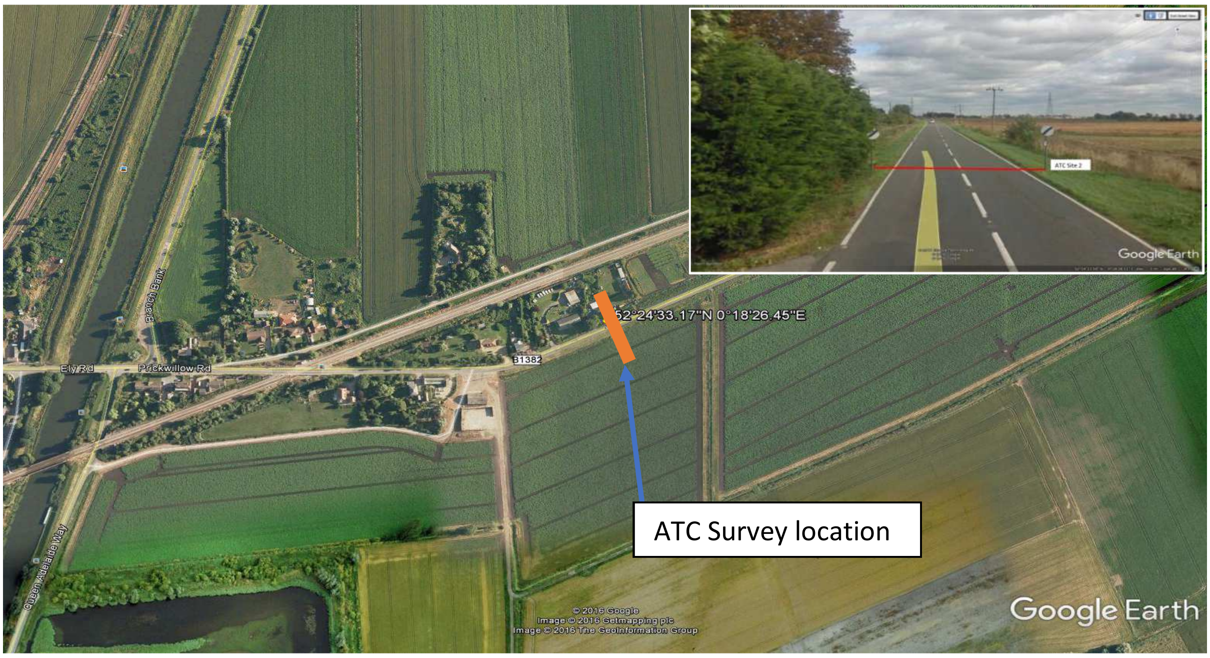


Figure 5 – Location Plan for the eastern ATC survey

The data from the western survey demonstrates that over the 14 days a total of 28,500 vehicles were recorded travelling eastbound and 31,600 vehicles were recorded travelling westbound. This totals 60,100 in both directions. The weekday average east bound was some 2,200 vehicles and west bound was some 2,500 vehicles.

Table 3 shows the western ATC survey figures split over each day of the week for eastbound traffic for week 1 and table 4 shows week 2. Table 5 shows the figures split over each day of the week for westbound traffic and table 6 shows week 2.

Week 1	Total number of vehicles EB
Monday	2179
Tuesday	2209
Wednesday	2186
Thursday	2248
Friday	2230
Saturday	1732
Sunday	1294
Average Mon-Fri	2210
TOTAL	**14078**

Table 3 – West ATC Traffic volume EB (Week 1)

Week 2	Total number of vehicles EB
Monday	2233
Tuesday	2174
Wednesday	2257
Thursday	2298
Friday	2364
Saturday	1779
Sunday	1319
Average Mon-Fri	2265
TOTAL	**14424**

Table 4 – West ATC Traffic volume EB (Week 2)

Week 1	Total number of vehicles WB
Monday	2360
Tuesday	2412
Wednesday	2406
Thursday	2474
Friday	2640
Saturday	1750
Sunday	1287
Average Mon-Fri	2458
TOTAL	**15329**

Table 5 – West ATC Traffic volume WB (Week 1)

Week 2	Total number of vehicles WB
Monday	2548
Tuesday	2457
Wednesday	2573
Thursday	2673
Friday	2813
Saturday	1783
Sunday	1383
Average Mon-Fri	2617
TOTAL	**16250**

Table 6 – West ATC Traffic volume WB (Week 2)

Table 7 shows the eastern ATC survey figures split over each day of the week for eastbound traffic for week 1 and table 8 shows week 2. Table 9 shows the figures split over each day of the week for westbound traffic and table 10 shows week 2.

Week 1	Total number of vehicles EB
Monday	1462
Tuesday	1603
Wednesday	1514
Thursday	1624
Friday	1527
Saturday	1115
Sunday	880
Average Mon-Fri	1546
TOTAL	**9725**

Table 7 – East ATC Traffic volume EB (Week 1)

Week 2	Total number of vehicles EB
Monday	1521
Tuesday	1502
Wednesday	1602
Thursday	1601
Friday	1619
Saturday	1108
Sunday	909
Average Mon-Fri	1569
TOTAL	**9862**

Table 8 – East ATC Traffic volume EB (Week 2)

Week 1	Total number of vehicles WB
Monday	1749
Tuesday	1820
Wednesday	1748
Thursday	1860
Friday	1964
Saturday	1148
Sunday	945
Average Mon-Fri	1828
TOTAL	**11234**

Table 9 – East ATC Traffic volume WB (Week 1)

Week 2	Total number of vehicles WB
Monday	1867
Tuesday	1768
Wednesday	1844
Thursday	1924
Friday	2070
Saturday	1185
Sunday	970
Average Mon-Fri	1894
TOTAL	**11628**

Table 10 – East ATC Traffic volume WB (Week 2)

As shown in the tables above traffic over the weekend is considerably lower than on weekdays. Therefore, figures 6 and 7 below demonstrate the combined traffic flow for each of the two sites to demonstrate traffic flow only on weekdays. Both graphs show that traffic flow is higher on Thursday and Friday of each week. It also demonstrates that site 1 (west of Peterborough rail line) is subject to higher traffic flows than site 2 (east of Norwich rail line) with over 1,300 more vehicles passing over site 1.

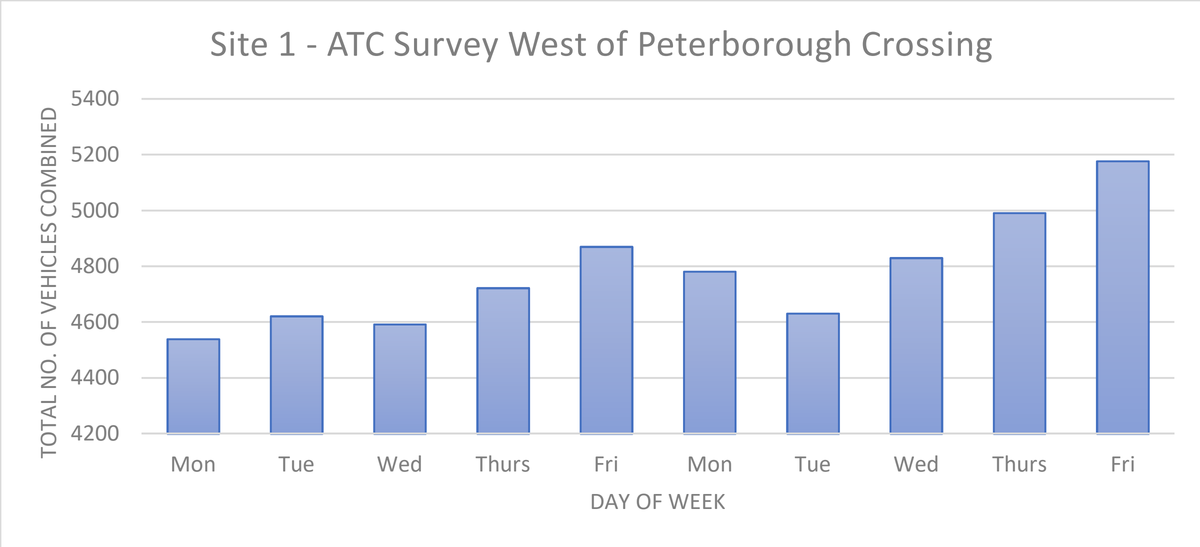


Figure 6 – Site 1 ATC Survey Monday – Friday combined

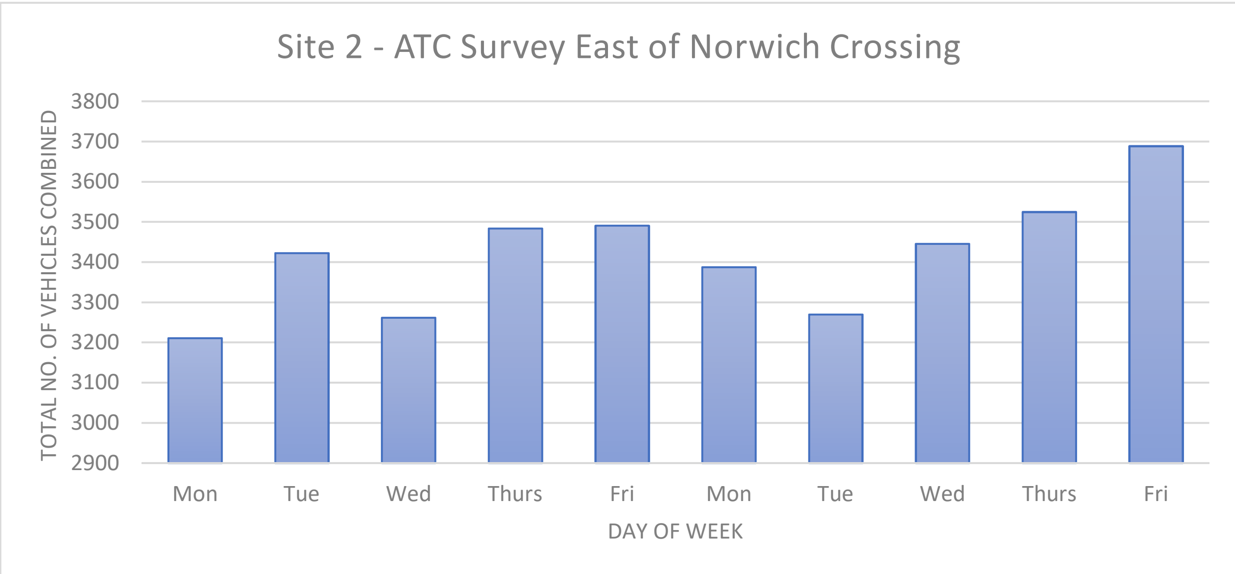


Figure 7 – Site 2 ATC Survey Monday – Friday combined

The ATC surveys also broke down the total number of vehicles into the class of vehicle that could demonstrate the type of vehicles travelling through the Queen Adelaide region. Table 11 provides guidance on the type of vehicle that belongs to the class of vehicle.

Table 12 provides a breakdown of the class of vehicle for the western ATC survey over the total survey period of 14 days for eastbound traffic and table 13 provides a breakdown of the class of vehicle over the total survey period of 14 days for eastbound traffic for week 2. Tables 14 and 15 provide the same information for westbound traffic.

Type	Axles	Groups	Description	Class		Parameters	Dominant Vechicle
	Light Vehicles						
Short up to 5.5m	2	1 or 2	Very Short Bicycle or Motorcycle	MC	1	d(1) < 1.7 and axles = 2	
	2	1 or 2	Short Saloon, Hatchback, Estate, 4WD, Pick-Up, Light Van, Bicycle, Motorcycle, etc.	SV	2	d(1) > 1.7m. d(1) <= 3.2m and axles = 2	
Medium 5.5m to 14.5m	3, 4 or 5	3	Short - Towing Trailer, Caravan, Boat, etc.	SVT	3	groups = 3, d(1) > 2.1m. d(1) <= 3.2m. d(2) >= 2.1m and axles = 3,4,5	
	Heavy Vehicles						
	2	2	Two Axle Truck or Bus	TB2	4	d(1) > 3.2m and axles = 2	
	3	2	Three Axle Truck or Bus	TB3	5	axles = 3 and groups = 2	
	> 3	2	Four Axle Truck	T4	6	d(1) > 3.2m. axles = 3 and groups = 3	
Long 11.5m to 19.0m	3	3	Three Axle Articulated Three axle articulated vehicle or rigid vehicle and trailer	ART3	7	d(1) > 3.2m. Axles = 3 and groups = 3	
	4	> 2	Four Axle Articulated Four axle articulated vehicle or rigid vehicle and trailer	ART4	8	d(2) < 2.1m or d(1) < 2.1m or d(1) > 3.2m axles = 5 and groups < 2	
	5	> 2	Five Axle Articulated Five axle articulated vehicle or rigid vehicle and trailer	ART5	9	axles = 6 and groups > 2 or axles 6 and groups = 3	
	> = 6	> 2	Six Axle Articulated Six (or more) axle articulated vehicle or rigid vehicle and trailer	ART6	10	axles = 6 and groups >2 or axles > 6 and groups = 3	

Table 11 – Class of Vehicle

Class of vehicle	Total number of vehicles EB
Class 1	129
Class 2	13015
Class 3	50
Class 4	750
Class 5	25
Class 6	58
Class 7	6
Class 8	15
Class 9	18
Class 10	12
TOTAL	**14078**

Table 12 – Class of vehicle EB (Week 1)

Class of vehicle	Total number of vehicles EB
Class 1	130
Class 2	13423
Class 3	56
Class 4	623
Class 5	102
Class 6	58
Class 7	1
Class 8	12
Class 9	11
Class 10	8
TOTAL	**14424**

Table 13 – Class of vehicle EB (Week 2)

Class of vehicle	Total number of vehicles WB
Class 1	127
Class 2	14164
Class 3	60
Class 4	793
Class 5	74
Class 6	37
Class 7	9
Class 8	21
Class 9	12
Class 10	32
TOTAL	**15329**

Table 14 – Class of vehicle EB (Week 1)

Class of vehicle	Total number of vehicles WB
Class 1	129
Class 2	14902
Class 3	103
Class 4	955
Class 5	30
Class 6	44
Class 7	6
Class 8	19
Class 9	28
Class 10	34
TOTAL	**16250**

Table 15 – Class of vehicle EB (Week 2)

Table 16 provides a breakdown on class of vehicle for the eastern ATC survey over the total period of 14 days for eastbound traffic and table 17 provides a breakdown of the class of vehicle over the total survey period of 14 days for eastbound traffic for week 2. Tables 18 and 19 provide the same information for westbound traffic.

Class of vehicle	Total number of vehicles EB
Class 1	60
Class 2	8949
Class 3	52
Class 4	583
Class 5	14
Class 6	14
Class 7	4
Class 8	18
Class 9	23
Class 10	8
TOTAL	**9725**

Table 16 – East ATC Class of vehicle EB (Week 1)

Class of vehicle	Total number of vehicles EB
Class 1	57
Class 2	8974
Class 3	41
Class 4	665
Class 5	36
Class 6	38
Class 7	1
Class 8	23
Class 9	21
Class 10	6
TOTAL	**14424**

Table 17 – East ATC Class of vehicle EB (Week 2)

Class of vehicle	Total number of vehicles WB
Class 1	66
Class 2	10185
Class 3	66
Class 4	716
Class 5	95
Class 6	26
Class 7	5
Class 8	28
Class 9	17
Class 10	30
TOTAL	**11234**

Table 18 – East ATC Class of vehicle WB (Week 1)

Class of vehicle	Total number of vehicles WB
Class 1	68
Class 2	10519
Class 3	65
Class 4	827
Class 5	17
Class 6	42
Class 7	6
Class 8	30
Class 9	16
Class 10	38
TOTAL	**11628**

Table 19 – East ATC Class of vehicle WB (Week 2)

Figures 8 and 9 below demonstrate the volume of traffic over each day of the week for week 1 and week 2 in the eastbound direction. As expected traffic flow is consistent over weekdays with a significant reduction over the weekend. This suggests that a large proportion of traffic is commuters using the route as part of their journey to work.

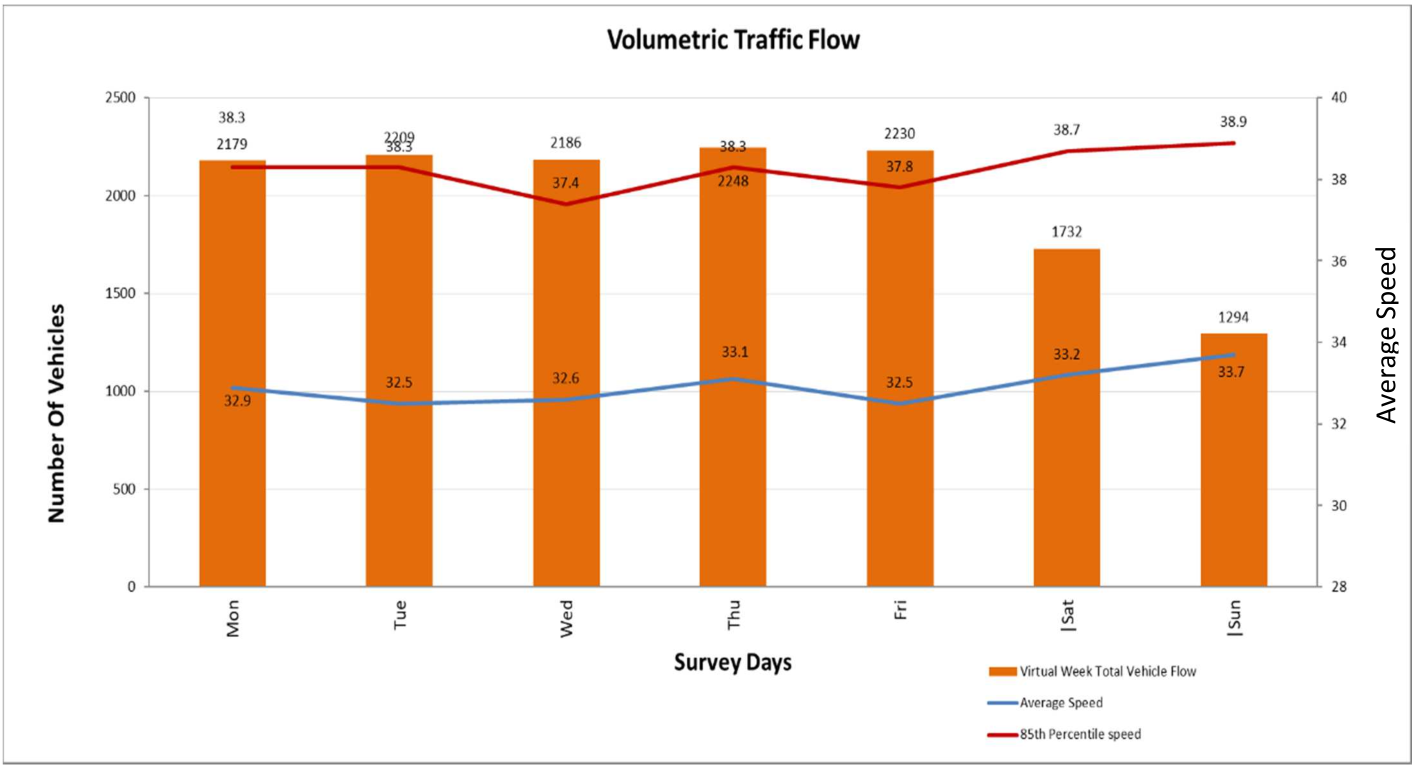


Figure 8 – Graph showing Western ATC traffic volume eastbound (week 1)

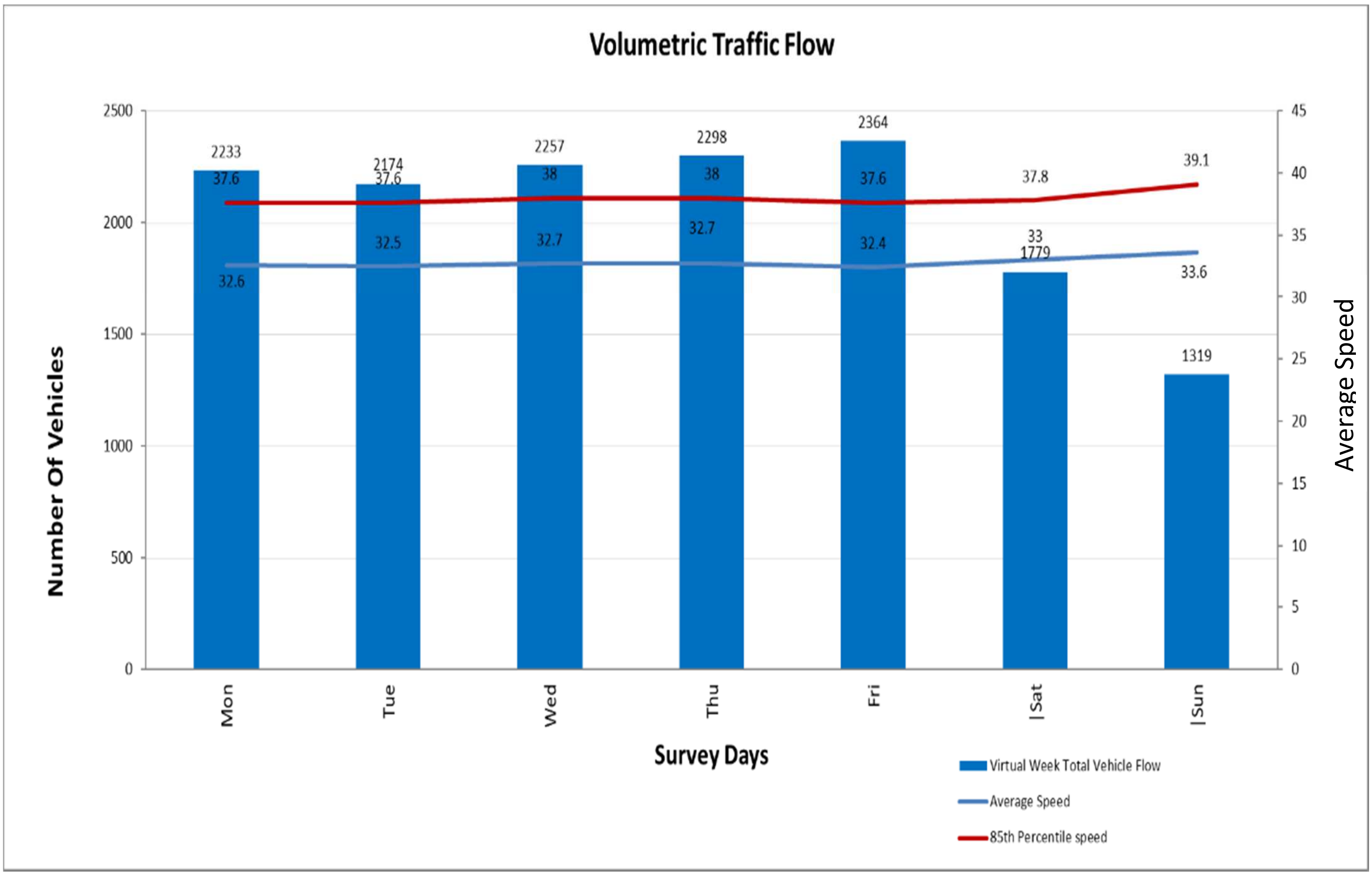


Figure 9 – Graph showing Western ATC traffic volume eastbound (week 2)

Figures 10 and 11 below demonstrate the volume of traffic over each day of the week for week 1 and week 2 in the eastbound direction. As expected traffic flow is consistent over weekdays with a significant reduction over the weekend. This suggests that a large proportion of traffic is commuters using the route as part of their journey to work.

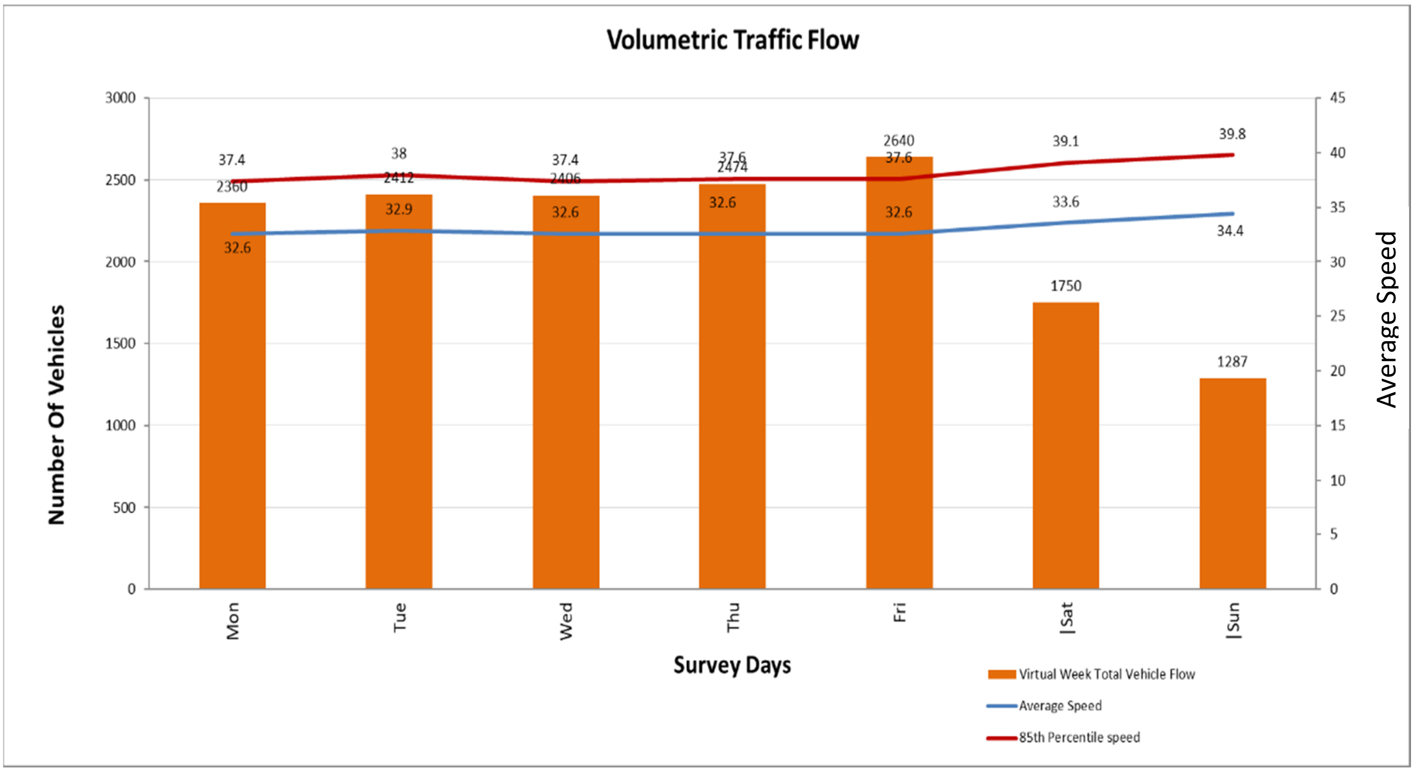


Figure 10 – Graph showing Western ATC traffic volume westbound (week 1)

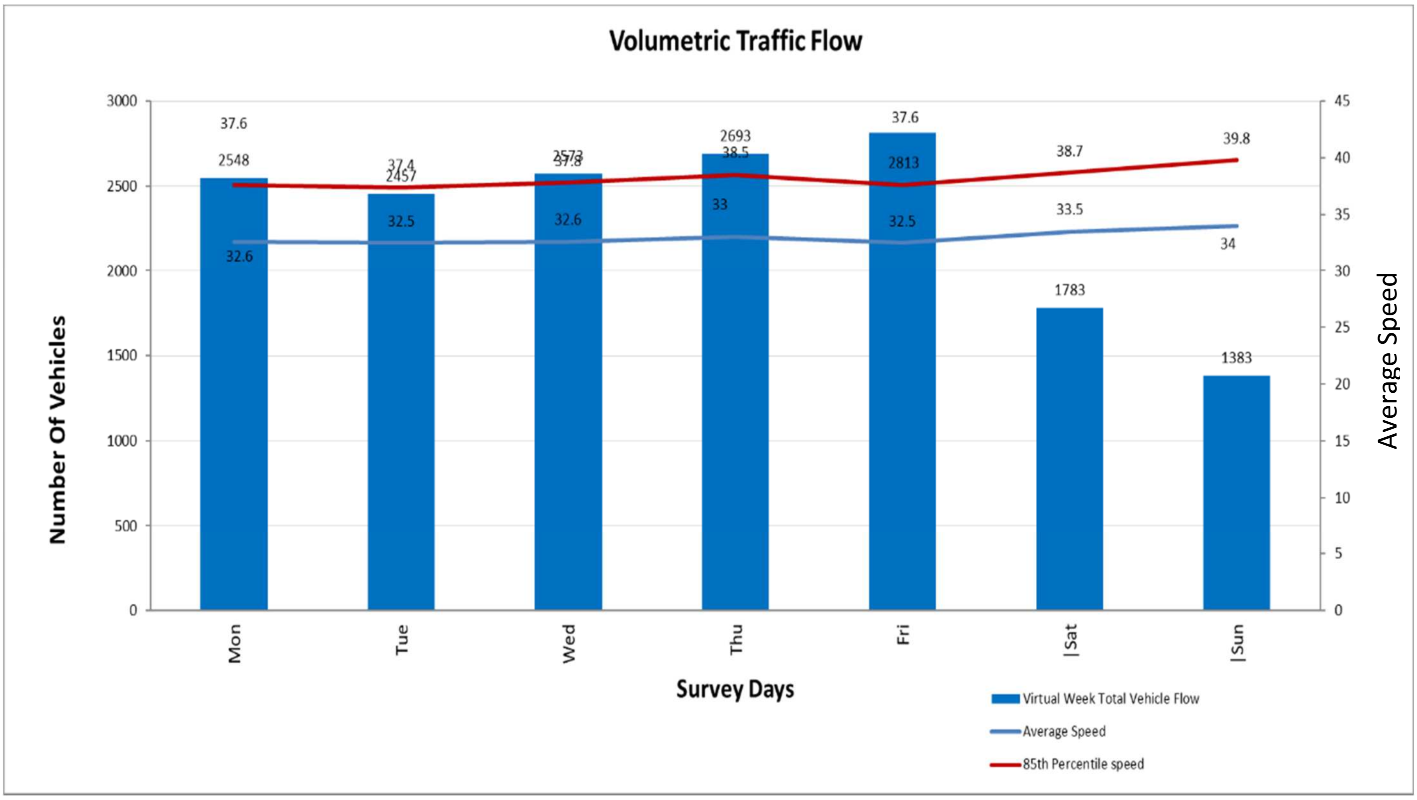


Figure 11 – Graph showing Western ATC traffic volume westbound (week 2)

These results demonstrate that on average there is greater traffic in the westbound direction as oppose to the eastbound direction. There is no obvious reason for this although it's widely acknowledged that drivers are more likely to use alternative routes during their journey after work.

Traffic volume peaked between 7:30am and 8:30am in the morning and 16:00 and 18:00 in the afternoon. This supports the assumption that a large proportion of traffic in the area is using the roads as part of their journey to work.

The ATC surveys also collected information on traffic speed. Mean speed is shown in the figures 8-11.

As expected traffic speed increases at the weekend when there is less traffic on the road network. There doesn't appear to be an issue with traffic speed within the area and the proposals considered within this report are made on the assumption that the speed limit will not be adjusted. However it would be recommended to reduce the speed limit on the approaches to the village if any large scale infrastructure measures were implemented on safety grounds.

3.3 Queue length surveys

Queue length surveys were undertaken at the three level crossings to enable the impact of the existing situation to be calculated. This included timing the barrier downtime over a 12 hour period (7am – 7pm). The results are shown in tables 20-22. These surveys were undertaken on a weekday and Saturday to ensure an appropriate representation of traffic in the area was captured and to gain a better understanding of the current level of train demand in the area.

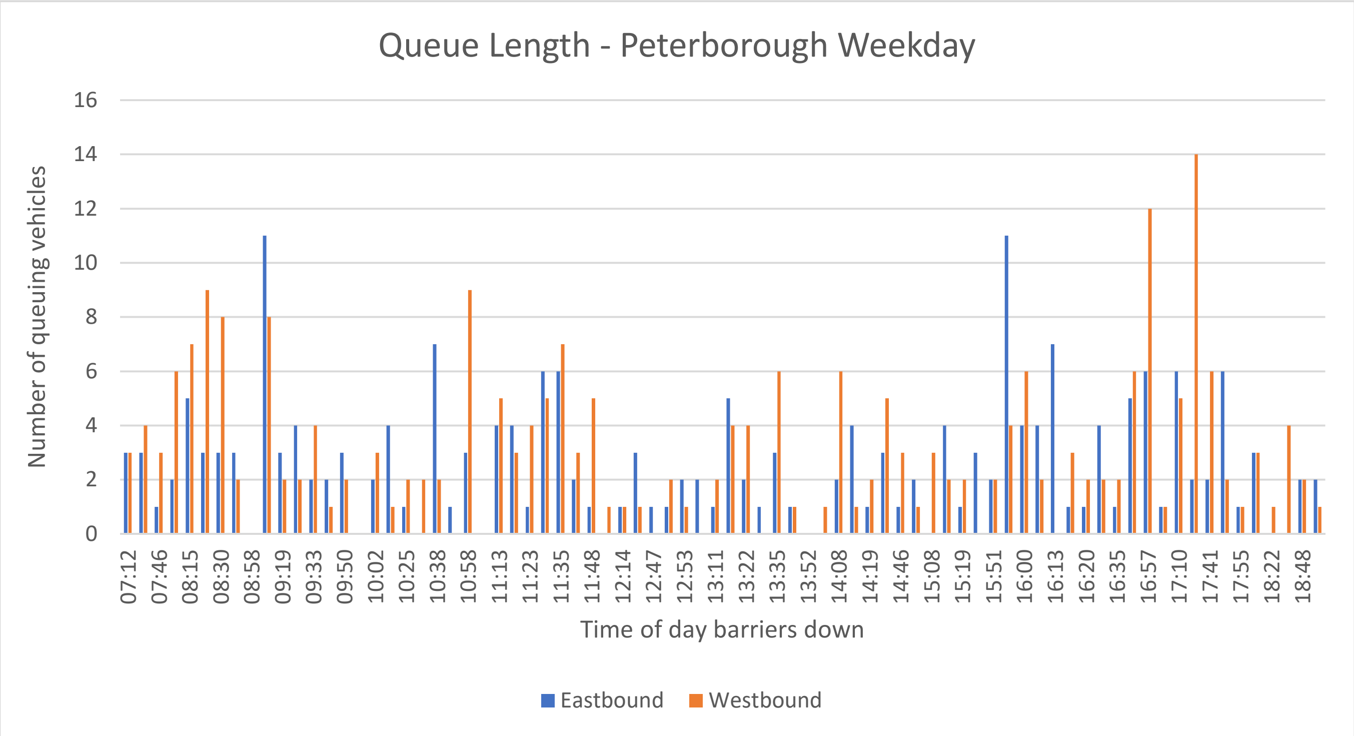


Table 20 – Queue Length – Peterborough Line Weekday

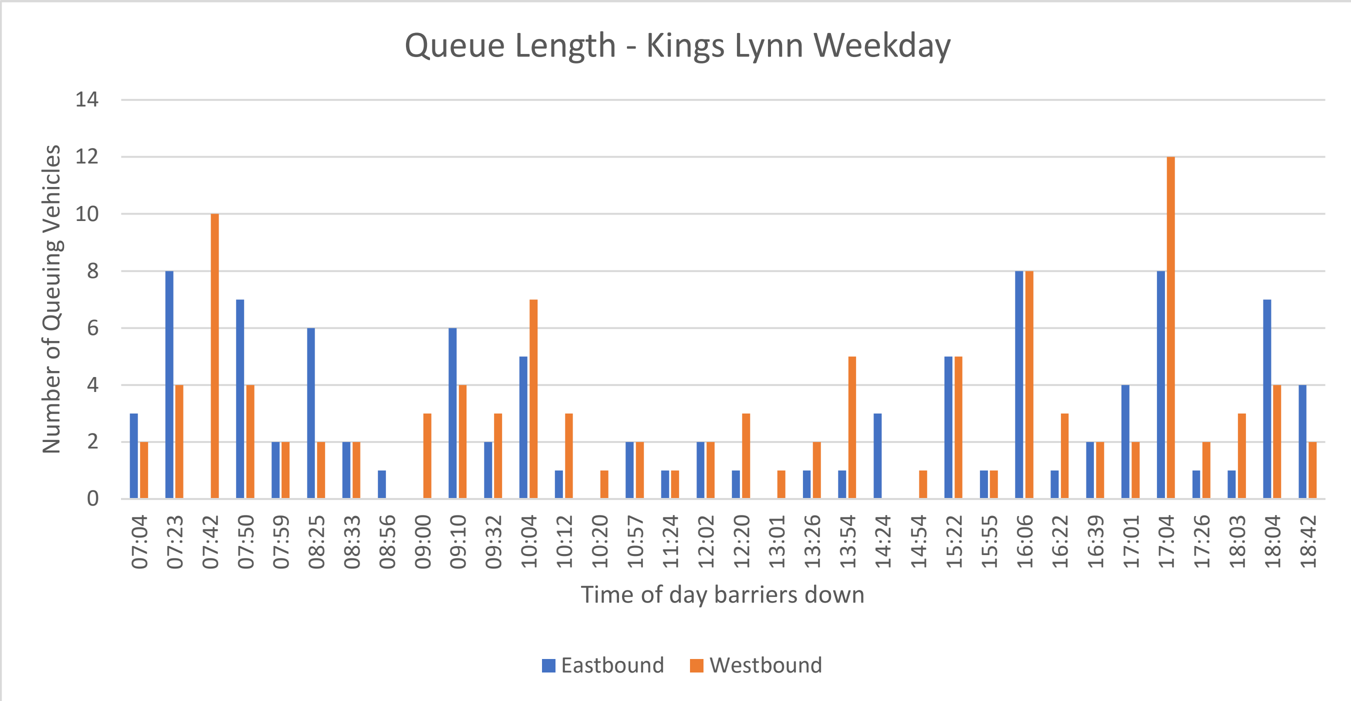


Table 21 – Queue Length – Kings Lynn Line Weekday

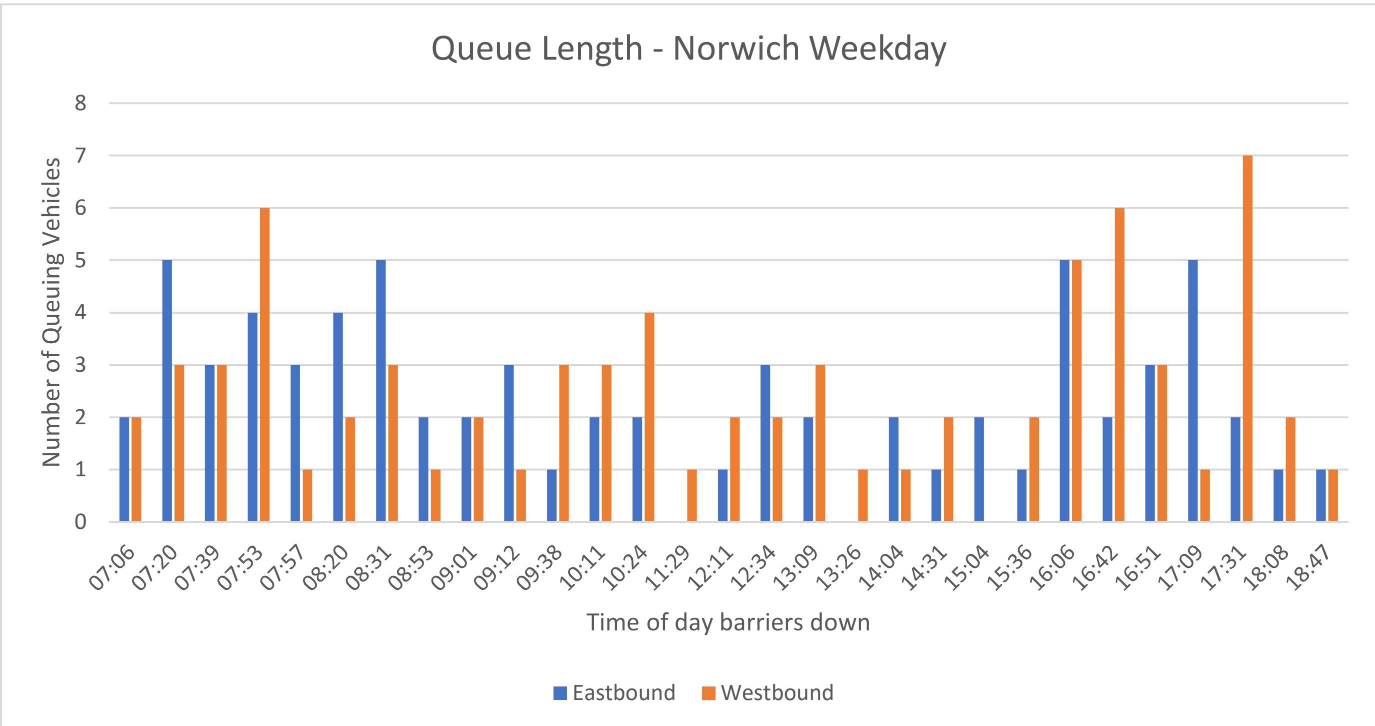


Table 22 – Queue Length – Norwich Line Weekday

The Peterborough line carries the most trains and freight. This means the barrier is down more frequently. There is also more likelihood of more than one train passing, meaning the barrier remains down longer. Therefore the average queue length is longer than the other two lines.

The average queue length on the Peterborough line is 2.9 each time the barriers are down. This increases to 4.9 during the morning peak and 4.3 during the afternoon peak. The average queue length is greater for traffic travelling westbound with a 3.1 average compared to a 2.6 eastbound average.

The average queue length on the Kings Lynn line is 3.0 each time the barriers are down. This increases to 3.6 during the morning peak and 4.4 during the afternoon peak. The average queue length is greater for traffic travelling westbound with a 3.2 average compared to a 2.8 eastbound average.

The average queue length on the Norwich line is 2.7 each time the barriers are down. This increases to 3.3 during the morning peak and 3.6 during the afternoon peak. The average queue length is greater for traffic travelling westbound with a 3.0 average compared to a 2.7 eastbound average.

On average it takes 47 seconds for the first train to pass on the Peterborough line once the barriers have gone down. This compares to 44 seconds for Kings Lynn and 43 seconds for Norwich. This additional time is likely due to the additional trains and freight that pass through.

On average it takes 1 minute 11 seconds for the barriers to raise on the Peterborough line. This compares to 59 seconds on the Kings Lynn line and 57 seconds on the Norwich line. Again, this additional time is likely due to the additional trains and freight that pass through.

3.4 Journey time comparison

As part of the traffic surveys, journey time comparison was carried out from origin’s that can use Queen Adelaide and the three level crossings as part of the journey to destinations as far east as the Cambridgeshire / Norfolk boundary. Journeys were chosen that had an alternative route to demonstrate the impact to traffic if Ely Road in Queen Adelaide was restricted to through traffic.

The results of these comparisons demonstrated that a number of routes are actually quicker when avoiding the Queen Adelaide area. However the majority of these alternative routes did result in slightly greater distances.

Figure 12 – 14 below provides a summary of these routes that was calculated using Google maps.

Figure 12 – Journey Comparison (Ely to east of Queen Adelaide)

Figure 13 - Journey Comparison (Ely to A10 northeast of Littleport)

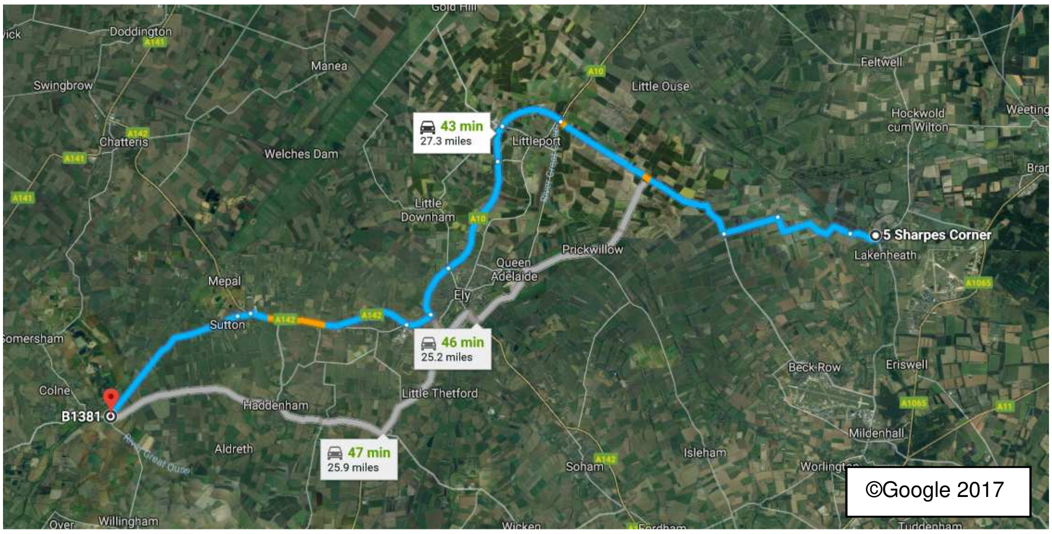


Figure 14 - Journey Comparison (Earith to Lakenheath)

3.4 Road Safety

There has been six recorded Killed or Seriously Injured (KSI) incidents within close proximity of the three level crossings in a five year period. Four of these were classified as slight and two were classified as serious. There was a further two recorded incidents within the proximity of the three level crossings although they have deemed to be outside of the radius of the project extents. One of these was a fatal collision along Queen Adelaide Way and the other was classified as a slight along Ely Road, east of the project extents near the junction with Swasedale Drove.

The six recorded KSI incidents within the extents of the three level crossings are described below.

1. 10/09/16 – Serious involving 2 vehicles, 1 car and 1 cyclist, 1 casualty
   Ely Road at the junction with Branch Bank.

2. 07/09/16 – Slight involving 2 vehicles, 1 car and 1 Two Wheel Motor Vehicle (TWMV), 1 casualty
   Queen Adelaide Way south of junction with Ely Road by the railway bridge.

3. 15/03/16 – Slight involving 1 vehicle, 1 pedestrian, and 1 child, 1 casualty
   Prickwillow Road east of Ely Road

4. 19/01/16 – Slight involving 2 vehicles, 1 car, 1 cyclist, 1 casualty
   Ely Road at the junction with Branch Bank.

5. 09/11/15 – Serious involving 2 vehicles, 2 cars, 1 pedestrian, 1 casualty
   Branch Bank north of junction with Ely Road.

6. 30/06/15 – Slight involving 1 vehicle, 2 casualties one of which was a child
   Branch Bank north of junction with Ely Road.

Please see figure 15 below for a location plan of these KSI incidents.

Figure 15 – Location plan for KSI incidents (5 year period)

4.0 Engagement with Local Residents and Businesses

To inform the more quantitative work that 2020 Consultancy are carried out, the County Council working with Network Rail led an engagement event in September. This work will fed into and informed the consultant's study.

4.1 Methodology

On 14 September 2017 the County Council and Network Rail ran an engagement event in Queen Adelaide Village Hall. The event was open to the public between 18:00 and 20:00. The local MP, Councillors and officers from County Council, District Council and Network Rail were present. The aim of this event was to have a conversation with local residents and businesses to understand more about the way residents and businesses use the roads and the impact three level crossings have now and may have in the future. This event allowed us to try and gain further insight which may not have been picked up from the traffic surveys and modelling work that were carried out.

A week or so before the engagement event all residents in Queen Adelaide and Prickwillow were sent a letter inviting them to the event in the Village Hall. On the day of the event comments cards were delivered to residents along with a freepost envelope. Following the event comments cards and freepost envelopes were posted out to residents. A phone number and email address was also provided so that comments could be sent in via phone or email.

Before the event businesses in Queen Adelaide and Prickwillow were telephoned and told about the event and offered a meeting. A number of meetings took place before the engagement event and notes were made summarising comments from businesses.

Whilst it is understood that people from a wide area use the level crossings the event was focused mainly on residents in Queen Adelaide and Prickwillow. The event was publicised using social media, a press release was issued, posters, comment cards and letters were delivered in the local area. The event was covered by local media, including local newspapers and an interview with BBC Radio Cambridgeshire was carried out on the day of the event. Screenshots below show examples of the above.

Cambridgeshire CC @CambsCC · Sep 14
#QueenAdelaide engagement event has started, come and tell us how you use the roads and what the level crossings mean to you

2

Cambridgeshire CC @CambsCC · Sep 8
Come along to #QueenAdelaide Village Hall next Thurs to discuss traffic & level crossings in the area. More Info -->

Queen Adelaide – have your say
An engagement event is being held to understand more about the way residents and businesses use the roads in and around Queen Adelaide. Cambridgeshire County...
cambridgeshire.gov.uk

Cambridgeshire CC @CambsCC · Sep 12
We are seeking your views... help us understand #QueenAdelaide join in our engagement event on 14 Sept. More info: ow.ly/1bVh30f0vU9

1 2

Some examples of the media coverage:

http://www.elystandard.co.uk/news/a-village-community-would-be-cut-in-half-if-rail-crossings-at-queen-adeliade-are-closed-warn-residents-1-5202827

http://www.elystandard.co.uk/news/how-would-extra-trains-impact-level-crossing-in-the-ely-area-have-your-say-1-5181412

4.2 Results

In total 153 comment cards were sent to properties in Prickwillow and 80 in Queen Adelaide. 51 emails were received, 72 comment cards and five letters were sent back. This is an approximate response rate of 55 per-cent. It should be noted that this does not capture comments that were made to officers at the event, although this has been taken account, and it is also possible that people could have submitted both a comment card and an email.

A large number of comments were made and as a way to summarise these they have been grouped into key themes and topics that emerged as the comments were being analysed. It should be noted that most of the comments received related to the impact that level crossing closures would have.

4.3 Use of the level crossing

The vast majority of people who contacted us use the level crossings regularly, at least once or twice a day. The main reason given for their use of the crossing was access to services and facilities in Ely and places of employment and education. Other reasons that were given include:

- Access to services- (more detail is provided on this topic below)
- Accessing farm land and farm yard- at harvest time this can be at least 30 trips a day
- Customers accessing businesses
- Accessing business location- some businesses with sites in Queen Adelaide and Prickwillow have other locations and use the level crossing to access these
- Ellgia waste transfer access location in Witchford and Prickwillow and also collecting skips and the transfer of waste
- An alternative route to access the A10 for people living further north of Ely e.g. Littleport who want to avoid traffic in Ely
- General deliveries and postal deliveries
- Refuse collection
- Access to employment
- Use the crossing as part of a commuter route- Lakenheath, Mildenhall, Newmarket and access to Ely from Norfolk and other villages close by
- Used as a way to avoid the level crossing at Ely Station which often causes delays

- The internal drainage board have equipment in Prickwillow that is sometimes used in Queen Adelaide and Ely
- Access to customers who are based around the country
- Visiting friends and relations
- Wheelchair user access to Ely
- Providing at home care.

4.4 Services that people access using the crossings

- Mentioned that both Queen Adelaide and Prickwillow have very minimal services so using the level crossing is vital to access almost all services
- Shops in Ely
- Church
- Supermarkets in Ely
- Banks in Ely
- Solicitors
- Land Agent
- Vehicle maintenance
- Agricultural stockist
- Leisure facilities including the new Leisure Village
- Community facilities
- Council Offices in Ely
- Access to health care services including doctors, Princess of Wales Hospital, Dentist, Chiropodist
- Education- schools and colleges- there are no schools in Queen Adelaide or Prickwillow
- Hiam club in Prickwillow- mainly used for dances
- Walks along the river
- Village hall
- Numerous businesses mentioned that if access to their business was affected it would have a major detrimental impact on them
- Visiting friends and relatives
- There is very limited public transport in the area so a heavy reliance on cars and taxis - if crossings are changed access to services will become much harder
- Ely Station
- General access to Ely
- Access to farm yard and land which is either side of the crossings.

4.5 Time

A large number of people who responded to the engagement event mentioned that changes to the level crossings would lead to an impact on their travel time. It was stated that greater barrier downtime would increase the waiting time at the crossings and would increase congestion through Queen Adelaide. It was also mentioned that it would become hard for residents to access their proprieties if there was an increase in the number of vehicles queueing along the road outside properties.

If the level crossings were closed people responded saying that diversion routes were much longer in mileage and therefore would take much longer in journey time, (people stated times of between 10 to 40 minutes). Respondents stated that it could take three times longer than it currently does to access Ely. This is significant given that current journey times are short. Farmers highlighted their slower moving machinery would create additional time and would have a greater impact than on cars.

Some respondents mentioned the impact when the crossings are closed for maintenance and the additional time this adds to their journeys.

4.6 Community and isolation

Due to the locations of the crossings respondents highlight that it would create real isolation for people in Prickwillow which at the moment have easy access to Ely. It was also highlighted that due to the location of the crossings in Queen Adelaide it has the potential to "cut the community in two".

Respondents highlighted that it could have a greater impact on the young and elderly. At the moment access to Ely is fairly easy by bike or walking, if the crossings were closed to pedestrians and cyclists as well as motor vehicles diversions would take much longer. The schools in Ely could no longer be accessed via bike or walking. The impact on the elderly who receive at home help or visitors could be negative as it would become hard to access their homes, they may receive fewer visitors and care costs could increase.

4.7 School transport

A large number of respondents mentioned the impact on school transport. Many spoke about the impact on the time for school buses would be significant. It was also highlighted that school buses could not use the route down Queen Adelaide Way due to the low bridge under the Norwich line. A similar impact on school taxi transport was mentioned. Some respondents suggested that long bus journeys may lead to more residents using cars as this could be quicker.

4.8 Cost and potential compensation

Numerous residents mentioned that the increased distance travelled would increase fuel use and lead to increased costs for both personal mileage and business trips. Increases in taxi fare were also highlighted- it was mentioned that a lot of people use taxis in this area due to limited public transport.

Business owners in the area highlighted that anything that makes it hard for people to access their business premises will have a negative impact on their income and has the potential to make their business unviable. Many customers travel from Ely it was stated that if it became hard to get to their business they would become a lot less competitive. Residents were also concerned about the potential impact on business. Compensation for the negative impacts on businesses were mentioned by several respondents.

The potential impact on house prices were mentioned by several respondents and fears that house prices would be negatively impacted due to additional journey time to access Ely. A couple of people mentioned more trains would reduce house prices.

4.9 Environment

Many respondents mentioned the negative impact on the environment closing the level crossings may have. It was stated that increased vehicle mileage would increase vehicle emission, fuel usage and have a detrimental impact on air quality. It was also mentioned that alternative routes could potentially lead to more traffic through Ely resulting in a negative environmental impact on this area.

It was highlighted that if the crossings were closed the alternative routes are a lot less attractive for sustainable modes of transport so there use might decrease. Examples of no pavement and lighting along Queen Adelaide Way were highlighted.

Residents also warned of the potential impact on wildlife.

Another comment mentioned by a smaller number of respondents was the potential environmental impact of additional trains through the area- mainly these were related to noise and vibration, but emissions from diesel trains were also mentioned.

4.10 Alternative routes/impact on other areas

Numerous comments were made regarding the impact on alternative routes:

- Re-routing farm machinery on alternative routes potentially through Ely would not be practical particularly with large harvesting equipment
- A large number of people commented on the A142/Queen Adelaide Way junction being congested and difficulties turning right from Queen Adelaide Way on to the A142 towards Ely
- Congestion around Ely station area was highlighted and it was stated that this was particularly bad when there was a problem at the level crossing or a bridge strike (both this point and the above will be resolved with the opening of Ely Southern Bypass in 2018)
- The poor condition of Queen Adelaide way and Branch Bank was highlighted including the lack of pedestrian and cycling facilities, street lighting, poor road surface condition and narrow carriageway width
- Alternative routes would be much worse for walkers and cyclists

- Farmers mentioned that as undulating fen roads would be used as alternative routes crops they are moving would be more likely spilt
- The staggered junction of Branch Bank, Ely Road, Queen Adelaide Way was mentioned as having poor visibility
- People commented on the high number of accidents on the alternative routes in particular the junction of Queen Adelaide Way and the A142 and Branch Bank Road
- Respondents highlighted that Ely centre could become a lot more congested, areas of highest concern were Broad Street, Lisle Lane and Kings Avenue.

4.11 Emergency services

A large number of respondents highlighted their concerns around emergency vehicle access to Queen Adelaide and Prickwillow. Concerns were around longer call out times for the emergency services to reach people. There are a number of higher risk jobs in the area and longer response times were of concern to them. Respondents stated that longer response times could 'cost lives'.

4.12 Potential solutions

A number of respondents mentioned potential solutions:

- Potential for a traffic regulation order to restrict traffic to local access only
- Improve options for walking and cycling to reduce the need to travel by car
- Provide a cycling and pedestrian route from Prickwillow to Ely
- A better option to increase the number of trains would be to increase the number of carriages/wagons and increase capacity this way rather than with additional train services
- A bridge over the railway could be a solution
- A tunnel/underpass for the road
- A tunnel for the railway
- Potential to upgrade other roads/tracks beside the B1382 in the area to provide alternative routes such as Dairy Farm track, Low Road, Barn Farm Track, Willow/Waterden Farm and link to the new housing development
- New route that bypasses two of the three rail lines as an upgrade to the old Clayway track / Second Drove with a new bridge over the Ouse to the north
- Potential route through the Potters group site on to Kiln Lane to the south
- Use the loop line that goes under the bridge to a greater extent
- Potential for a rail flyover
- Improve Queen Adelaide Way including the junction with the A142 Stuntney Causeway
- Join the Peterborough and Kings Lynn lines together

- Leave the level crossings as they currently are, it is not that bad and longer wait times would be less inconvenient than alternative routes. There are not any current issues
- Warning signs to stop blocking, people won't mind waiting longer
- Look into re-routing trains
- Divert the Peterborough line onto the Ely West Curve meaning a change at Ely North Junction and the doubling of the track to the Ely West Junction, this would have the benefit of reducing the amount of time road traffic is stopped at the busiest of the three crossings
- Investigate a fully gated crossing rather than the cheaper option of closing the road
- Average speed cameras are required to stop people speeding to "catch up" after being stopped at the crossing
- Trial the additional usage of the crossings first without closing the crossings
- Run freight trains at off peak times so they do not cause problems.

4.13 Rail services

Several respondents mentioned that they were against any rail services improvement. A few said they were for improved services and some caveated this by saying only if it does not impact on the level crossings.

4.14 Objections to level crossing closures

The majority of respondents highlighted they were against any level crossing closures and several wanted their formal objections to be noted.

4.15 Comments regarding engagement process

A number of respondents had comments on how the engagement event was run a summary of these are below:

- Concerns that decisions had already been made and this was a formal consultation event rather than an informal discussion
- People felt the event should have been published more widely and not just focused on Queen Adelaide and Prickwillow
- If the event had been promoted more widely more people would have attended
- Suggested that other estates in Ely should have received information about the event
- It was felt that posters or signs at the level crossings would have been useful
- A letter sent out by a local resident approximately six months before the event saying the level crossings were going to be closed caused a lot of confusion and raised anxiety amongst residents

- People wanted more information about what was planned for the level crossings
- The timing of the event 18:00 to 20:00 was not convenient for some people.

4.16 Conclusion

It is clear from the above that residents and businesses in Queen Adelaide and Prickwillow and further afield have concerns regarding any changes to the level crossings on the B1382. This road provides a vital link to Ely for a variety of key services, employment and education. The road also provides access for customers to businesses in the area and provides farms access to fields and farm yards.

The B1382 is also used by a wider population than just those who live in the villages of Queen Adelaide and Prickwillow as part of a wider commuter route both into and out of Ely. There was a fear that Queen Adelaide and Prickwillow could be isolated from Ely which could result in house prices decreasing and businesses would find it harder to operate.

5.0 Potential Options for Consideration

As part of this study eight potential options have been considered and reported upon to enable a greater understanding of the impact closing or restricting traffic through the Queen Adelaide area will have on the local and wider road network. These options have been summarised below including the justification for their inclusion.

The options that have been considered involve either a physical intervention or a restriction that requires infrastructure but no physical restriction. Physical intervention are the large scale infrastructure works, in this case either a bridge over the railway line or the construction of a northern by-pass as shown below.

5.1 Traffic Regulation Order

Any restriction will require the implementation of a Traffic Regulation Order. Highway authorities can place temporary, experimental or permanent restrictions on traffic within their areas by way of a Traffic Regulation Order (TRO). A TRO is carried out under Parts I, II and IV of the Road Traffic Regulation Act 1984, as amended. Section 1(1) states that permanent orders may be made for the following purposes:

(a) for avoiding danger to persons or other traffic using the road or any other road or for preventing the likelihood of any such danger arising, or

(b) for preventing damage to the road or to any building on or near the road, or

(c) for facilitating the passage on the road or any other road of any class of traffic (including pedestrians), or

(d) for preventing the use of the road by vehicular traffic of a kind which, or its use by vehicular traffic in a manner which, is unsuitable having regard to the existing character of the road or adjoining property, or

(e) (without prejudice to the generality of paragraph (d) above) for preserving the character of the road in a case where it is specially suitable for use by persons on horseback or on foot, or

(f) for preserving or improving the amenities of the area through which the road runs.

A TRO can be implemented using a number of techniques. Regardless of what measures are implemented it requires a legal order that is subject to statutory consultation and signed off by a suitable officer within Cambridgeshire County Council. During statutory advertisement members of public have the right to provide a formal objection to the order which has to be done in writing or by email during the appropriate time period, which is usually 21 days.

To restrict traffic on a particular route the highway through a TRO, the traditional method is to install a bollard or gate at the restriction. Traffic that has the authority to pass through the restricted zone will have some device or sensor that will trigger the release of the feature. This is common for routes that is only accessible for public transport such as buses and taxis. However bollards are no longer used in Cambridge. Therefore the TRO would work independently without any physical measures protecting the route. Drivers are unlikely to risk passing through the restriction as enforcement will be carried out.

Figure 16 below provides an example of a typical independent TRO gateway.

Figure 16 – Example of typical independent TRO

An alternative to a physical restriction is to utilise modern technology and ANPR cameras. Cameras are installed at the restriction and identify any vehicles that are in contravention of the TRO through number plate recognition. This then results in a Penalty Charge Notice issued. It is possible to have exemptions to a TRO to permit certain traffic to continue to use the route. This is usually public transport, and deliveries. However it is possible to permit local residents and business owners to continue to use the route.

There is a requirement for local residents to supply a list of registration plate details to the local authority who will create a spreadsheet that is cross referenced for each contravention. Visitor details can be provided although this can become time consuming. It isn’t very common and further investigation is recommended if this option is progressed.

Figure 17 provides an example of a TRO restriction utilising ANPR cameras and the type of signage required.

Figure 17 – Example of ANPR TRO Restriction

As part of the options considered as part of this study, we have explored a TRO restriction for one direction. This would restrict traffic in one direction, creating a one-way system. This would result in considerably less traffic on the road network. This option has benefits and drawbacks that are described below.

One-Way TROs are common across the country in residential and rural areas. There isn't usually an ongoing enforcement commitment although few motorists take the risk of travelling through a one-way system in the wrong direction for the fear of consequences such as being caught or causing a collision.

Figure 18 provides an example of a one-way TRO restriction.

Figure 18 – Example of a One-Way TRO restriction

Please find the options considered as part of this study below.

5.1 Option 1 - Restricting ALL traffic through the Peterborough and Kings Lynn level crossings

The most western and the central lines are the two busiest routes and it would be Network Rails priority to restrict traffic through these two crossings. Due to the close proximity and existing road layout it isn't possible to restrict traffic at only one of these crossings. Restricting all traffic through these two crossings would enable Network Rail to increase the passenger services and freight as much as desired as the road would be stopped up. However the Peterborough or Kings Lynn level crossing would be required to allow local residents and businesses that are located between the two crossings the ability to access their properties. There would be a need for pedestrians and cyclists to pass through the other crossings so some infrastructure improvements would be necessary. This is likely to cost in the region of £100,000 which involves removing existing infrastructure and replacing with new. This cost is based on previous work that has been identified across the country.

Benefits

Network Rail could use both the Peterborough and Kings Lynn routes to maximum capacity which would benefit the regions and improve the rail links from London. The only cost outlay would be some infrastructure to enable pedestrians and cyclists to cross the rail lines safely. As all traffic would be restricted there would be no ongoing costs involved relating to the enforcement of the crossings. There would also be no Network Rail level crossing maintenance or operational costs involved along with no level crossing risk, which are all benefits to Network Rail.

Issues

Local traffic would be impacted the most as there would be an increase in journey time of potentially 7-14 minutes each journey. This could mean an extra 14-28 minutes a day. This would also result in additional fuel use. The village would feel very isolated and cut off from the wider community. Local businesses that rely on passing trade or from customers that can access their sites easily will see a sharp reduction of turnover. For some businesses this may result in them going out of business altogether. The local authority and Network Rail may be subject to compensation claims as a result of this. There will be greater traffic on the wider road network which already experiences congestion at peak times. Traffic from further afield that uses this route on a regular basis would be impacted with higher journey times.

5.2 Option 2 - Allow local traffic through the Peterborough and Kings Lynn level crossings

An alternative to restricting the Peterborough and Kings Lynn to all traffic is to allow local traffic to by-pass any restriction. This can be done either by using a physical barrier system or using ANPR cameras that will determine if a car registration plate is permitted through the restriction. There are a number of ways this can be done including one site being the restriction such as the Kings Lynn line or two sites such as west of the Peterborough line and east of the Kings Lynn line. Restricting traffic to only allow local traffic to pass through the crossings will result in significantly lower traffic passing the lines. This means that queue lengths will not become a concern as a result of full barrier systems as oppose to the half barrier systems currently in operation. Network Rail would be able to increase the passenger lines and freight as required without the negative impact for residents. Pedestrian and cycle access over the level crossings could remain which is a sustainable travel benefit. The cost of this option is low initially as the cost of the ANPR equipment is likely to be in the region of £100,000. The legal aspect is likely to cost approximately £20,000. However there will be a requirement for commuted sums to cover the maintenance of the equipment. These costs are based on previous work undertaken on ANPR systems.

Benefits

Network Rail could use both the Peterborough and Kings Lynn routes to maximum capacity which would benefit the regions and improve the rail links from London. Local traffic wouldn't be affected and wouldn't require to make considerable detours as part of their journey. This would also see minor capacity benefits on the wider road network. Local businesses would be able to keep the majority of their trade as it would only be passing trade that would diminish although this will still be a concern for business owners. This option wouldn't involve any major infrastructure investment meaning the cost of implementation will be low.

Issues

Local businesses would still see a reduction in trade as passing trade would diminish. There is also a concern that due to the requirements involved for local businesses to register customer vehicles the businesses will become less attractive and customers would look elsewhere. Local residents may feel slightly cut off with their area becoming a no through road. Some residents may feel visitors will be less inclined to visit. Whilst the cost of implementation will be low there will be an ongoing commitment to fund the enforcement method such as physical barrier or ANPR camera. Cambridgeshire County Council would be required to gain approval from the Police for any enforcement solution. The logistics of the enforcement may be difficult. If local traffic is permitted entry through the crossings, difficulties will arise with visitors and deliveries and how that will be enforced. It is unlikely residents will want to register visitors or deliveries in advance. It may be difficult to classify local traffic resulting in high numbers of PCNs issued and subsequent appeals which will require time and resource.

5.3 Option 3 - Implementation of a One-Way system with no exemptions

It is possible to virtually half the amount of traffic through the Queen Adelaide area by creating a Traffic Regulation Order (TRO) to create a section of one-way between the three crossings such as between the Peterborough and Kings Lynn lines. This can either be east to west or west to east, a decision that would be worth consulting with local residents on. The benefit of this option is the little impact on the wider road network and allowing through traffic to continue to use the area for their morning or afternoon journey. This is a low cost option with very little physical works required. The signage and road marking would cost in the region of £20,000 along with a further £20,000 for the legal work involved in the TRO.

Benefits

Network Rail can increase the passenger services and freight through all three lines as and when required without a big impact on traffic as the impact will only be approximately 50%. Local residents can travel as existing for half their journey meaning the impact will be reduced. Local businesses will still receive passing trade. This option wouldn't involve any major infrastructure investment meaning the cost of implementation will be low. Contra flow cycle lanes along with footways will ensure pedestrian and cycle access can remain in both directions.

Issues

Local residents and businesses will still be negatively impacted each journey as their opposing journey will require a lengthy detour. Local businesses will still miss out on the level of trade opportunities currently experienced. Businesses could become less attractive to customers as a result of this. As a rural area this option may also impact local farms. Whilst no major infrastructure will be required there will be an ongoing commitment to enforce the TRO as without enforcement there is a high likelihood vehicles will abuse the TRO. Alternatively the TRO can be enforced through a physical barrier or ANPR camera. Cambridgeshire County Council would be required to gain approval from the Police for any enforcement solution. The logistics of the enforcement may be difficult. This option may not be accepted as a viable solution as issues surrounding blocking back will still occur. It will also result in uneven trip distribution as only one direction will be subject to a reduction.

5.4 Option 4 - Implementation of a One-Way system with exemption for local traffic

An alternative to having a one-way system is to create a one-way system with an exemption to allow local traffic to utilise their existing journeys. The TRO can be located in the same location as the above option suggests and the only obvious difference would be a need for an exemption plate to advise drivers who is permitted to travel and who isn't permitted to travel. The benefit of this option is local residents are no impacted at all as it's only through traffic that will be restricted. However local businesses will see a reduction in passing trade. There will be a greater impact on the wider road network although far less than a permanent restriction for both directions. This is a low cost option with very little physical works required. The signage and road marking would cost in the region of £20,000 along with a further £20,000 for the legal work involved in the TRO.

Benefits

Network Rail can increase the passenger services and freight through all three lines as and when required without a big impact on traffic as the impact will only be approximately 50%. Local residents will not be adversely affected at all as they will be able to travel in both directions with no restrictions. Local businesses will still receive passing trade. This option wouldn't involve any major infrastructure investment meaning the cost of implementation will be low.

Issues

Local businesses will still be negatively impacted as they will miss out on the level of trade opportunities currently experienced. Businesses could become less attractive to customers as a result of this. It is also possible that some traffic will avoid the area altogether. Whilst no major infrastructure will be required there will be an ongoing commitment to enforce the TRO as without enforcement there is a high likelihood vehicles will abuse the TRO. Alternatively the TRO can be enforced through a physical barrier or ANPR camera. Cambridgeshire County Council would be required to gain approval from the Police for any enforcement solution. The logistics of the enforcement may be difficult. If local traffic is permitted entry through the crossings, difficulties will arise with visitors and deliveries and how that will be enforced. It is unlikely residents will want to register visitors or deliveries in advance. Road safety will also need to be considered as drivers may not expect to see oncoming traffic and the signage may be confusing. Early engagement with Road Safety Auditors is recommended.

5.5 Option 5 - Restricting ALL traffic through the Norwich line

Due to the location of the Norwich line it is possible to restrict traffic through this line without disrupting traffic in Queen Adelaide. However it will have a major impact for traffic travelling from Prickwillow to Ely with significant journey time increases. As highlighted in the ANPR surveys only 11% of traffic pass through the Norwich line and therefore the impact on the wider road network will be minimal. Restricting all traffic through this crossing would enable Network Rail to increase the passenger services and freight as much as desired as the road would be stopped up meaning no crossings would be required. There would be a need for pedestrians and cyclists to pass through the crossing so some infrastructure improvements would be necessary. However it is worth remembering that this is the lowest priority line out of the three crossings. Therefore Network Rail would need to revisit their ambitions to determine how to achieve their requirements for the Peterborough and Kings Lynn lines. This is a low cost option that is likely to cost in the region of £100,000 for the ANPR equipment and a further £20,000 for the legal costs involved in the TRO.

Benefits

As shown in the ANPR surveys the impact on closing this crossing is minimal and this option will result in the lowest disruption of all potential options that consider all traffic. The only cost outlay would be some infrastructure to enable pedestrians and cyclists to cross the rail lines safely. As all traffic would be restricted there would be no ongoing costs involved relating to the enforcement of the crossings.

Issues

Local traffic would be impacted the most as there would be an increase in journey time. This would also result in additional fuel use. Local businesses that rely on passing trade or from customers that can access their sites easily may see a reduction of trade. There would also be a significant impact on Prickwillow and surrounding villages. The benefits that Network Rail could gain with the Peterborough or Kings Lynn lines may not be possible with the closure of the Norwich Line as it's the lowest priority of the three crossings. For this option to be worthwhile to Network Rail they may need to adjust the track alignment and routes which could become extremely costly.

5.6 Option 6 - Allow local traffic through the Norwich line

An alternative to restricting the Norwich line to all traffic is to allow local traffic to by-pass any restriction. This can be done either by using a physical barrier system or using ANPR cameras that will determine if a car registration plate is permitted through the restriction. The restriction would only be required at one location as only one crossing is impacted. Restricting traffic to only allow local traffic to pass through the crossings will result in significantly lower traffic passing through the line. This means that queue lengths will not become a concern as a result of a full barrier system as oppose to the half barrier system currently in operation.

Benefits

Network Rail could use the Norwich line to maximum capacity which would benefit the region and improve the rail links. Local traffic wouldn't be affected and wouldn't require to make considerable detours as part of their journey. This would also see minor capacity benefits on the wider road network. Local businesses would be able to keep the majority of their trade as it would only be passing trade that would diminish although this will still be a concern for business owners as administration of the TRO would be a disincentive. This option wouldn't involve any major infrastructure investment meaning the cost of implementation will be low.

Issues

Local businesses would still see a reduction in trade as passing trade would reduce slightly. Local residents may feel slightly cut off with their area becoming a no through road. Some residents may feel visitors will be less inclined to visit. Whilst the cost of implementation will be low there will be an ongoing commitment to fund the enforcement method such as physical barrier or ANPR camera. Cambridgeshire County Council would be required to gain approval from the Police for any enforcement solution. The logistics of the enforcement may be difficult. If local traffic is permitted entry through the crossing, difficulties will arise with visitors and deliveries and how that will be enforced. It is unlikely residents will want to register visitors or deliveries in advance. Due to the wider reaching impact of closing the Norwich line it may be difficult to determine the area of local traffic such as Prickwillow. Network Rail may prefer to see the Peterborough and Kings Lynn lines restricted as the logistics to increase passenger lines and freight through the Norwich line may be too great or costly.

5.7 Option 7 - Implementing a Bridge over the Peterborough line

Implementing a bridge over the Peterborough line would result in the least impact on the road network whilst allowing as much passenger services and freight along the line as Network Rail require. However this option will be extremely costly and is likely to cost at least £40 million. Due to the layout of the Peterborough and Kings Lynn lines it will not be possible to have a bridge over both lines. However with the complete removal of the Peterborough level crossing it isn't envisaged a problem occurring with Kings Lynn becoming full barrier as the queue lengths will not be great enough. However this option would need further investigation as the available room is tight and there may be insufficient room to construct a bridge.

Benefits

Constructing a bridge over the Peterborough line will allow all traffic to continue using the area without impacting Network Rail's desire to increase usage along this line. As the level crossing will be removed there will actually be a reduction in journey time. Local businesses wouldn't loose any passing trade. There would be no impact on the wider road network as no traffic will be diverted. This option doesn't require any TRO or restriction meaning there are no enforcement issues to consider. This option also removes all level crossing risks resulting in greater safety benefits and removes maintenance and operation cost involved in level crossings.

Issues

This option will be expensive to implement with a cost at least £20 million+. A Benefit Cost Ratio (BCR) assessment may result in this option not delivering the results expected with the capital outlay required. There may be a need for compulsory purchases of properties within close proximity of the line which may be extremely upsetting for the property owners and may create disharmony in the village. This option will only allow for the Peterborough line to be increased without the need to restrict traffic. There will also be an ongoing maintenance requirement and whilst this will almost certainly be in the long term only, this will need consideration. Any necessary maintenance will require traffic management. Road safety would need consideration as queuing traffic may not be seen due to the bridge.

5.8 Option 8 - Constructing a Ely Northern By-Pass north of Queen Adelaide

Along with the implementation of a bridge over the Peterborough line, the construction of a Ely northern by-pass north of Queen Adelaide will result in the least impact on the road network whilst allowing as much passenger services and freight along the line as Network Rail require. However this option will be by far the most costly and is likely to cost at least £100 million depending on the nature of structures used for the bridges. Due to the Peterborough and Kings Lynn lines merging shortly after Ely Road it may be possible to construct one bridge to cover the span of the Peterborough and Norwich lines. However this is considered an extreme option due to the large costs involved. This highlights that more detail investigation into this option is required.

Benefits

Constructing Ely northern by-pass will allow all traffic to continue using the area with minimal journey time disruption without impacting Network Rail's desire to increase usage along this line. Network Rail would be able to increase passenger services and freight through all three crossings as much as necessary. This option doesn't require any TRO or restriction meaning there are no enforcement issues to consider. This option also removes all level crossing risks resulting in greater safety benefits and removes maintenance and operation cost involved in level crossings. There would be no level crossing risk or operational and maintenance costs which would be a positive for Network Rail.

Issues

This option will be by far the most expensive to implement with a cost in the region of £100 million. The high costs of this scheme highlight the need for further investigation. There will be an ongoing maintenance requirement and whilst this will almost certainly be in the long term only, this will need consideration.

5.9 Consideration of all Proposals

Table 23 below provides a list of all eight proposals discussed above along with the Network Rail impact, and a summary of the pro's and con's.

Table 23 – Summary of traffic study proposals

Proposal	Rail impact	Benefits	Issues
Option 1 - Restricting ALL traffic through PBO & KLN	PBO & KLN lines increased capacity 100%	PBO & KLN lines increased capacity, low cost, no enforcement	Local traffic impacted, increased journey times, negative impact on businesses, extra traffic on wider road network
Option 2 - Local traffic only through PBO & KLN	PBO & KLN lines increased capacity from existing	PBO & KLN lines increased capacity, low cost, local traffic not impacted	Increased journey times, negative impact on businesses, extra traffic on wider road network, enforcement required
Option 3 - Implementation of a One-Way system with no exemptions	PBO & KLN lines increased capacity from existing	PBO & KLN lines increased capacity, low cost, local businesses still receive passing trade	Local traffic impacted on return journey, increased journey times, extra traffic on wider road network, enforcement required
Option 4 - Implementation of a One-Way system with exemption for local traffic	PBO & KLN lines increased capacity from existing	PBO & KLN lines increased capacity, low cost, local businesses still receive passing trade, local traffic not impacted	Increased journey times, extra traffic on wider road network, enforcement required, uncertainty over TRO
Option 5 - Restricting ALL traffic through Norwich line	NRW line increased capacity 100%	NRW line increased capacity, low cost, no enforcement	Local traffic impacted, particularly Prickwillow, Increased journey times, negative impact on businesses, extra traffic on wider road network
Option 6 - Allow local traffic through Norwich line	NRW line increased capacity from existing	NRW line increased capacity, low cost, local traffic not impacted	Increased journey times, negative impact on businesses, extra traffic on wider road network, no benefit to PBO or KLN line, enforcement required
Option 7 - Implementing Bridge over PBO	PBO & KLN lines increased capacity 100%	PBO & KLN lines increased capacity, no impact to any traffic, local businesses not impacted, no TRO	High cost, possible need for compulsory purchase of property, potentially poor BCR score, maintenance
Option 8 - Constructing a Queen Adelaide Northern By-Pass	PBO, KLN & NRW lines increased capacity 100%	All lines increased capacity, minor impact for local traffic, no TRO	High cost, negative impact businesses, poor BCR score, maintenance

6.0 Modelling Methodology

6.1 Introduction

This document covers the development of the Queen Adelaide Highway assignment model developed for 2020 Consultancy from April-December 2017.

6.2 Model Inputs

The traffic modelling was based upon survey data and readily available electronic data sources that included:

- One-day MCC count data from 2015/2016 provided by Cambridgeshire County Council (see Figure 15 and Table 5);
- TEMPRO demand estimates for the base year (2016) and forecast year (2036);
- OpenStreetMap network data used as the basis for highway network development
- Middle Layer Super Output Areas (MSOAs) zoning, consistent with the smallest level of detail output by TEMPRO, used as the start point for the model zoning system.

Figure 19 Queen Adelaide Count locations

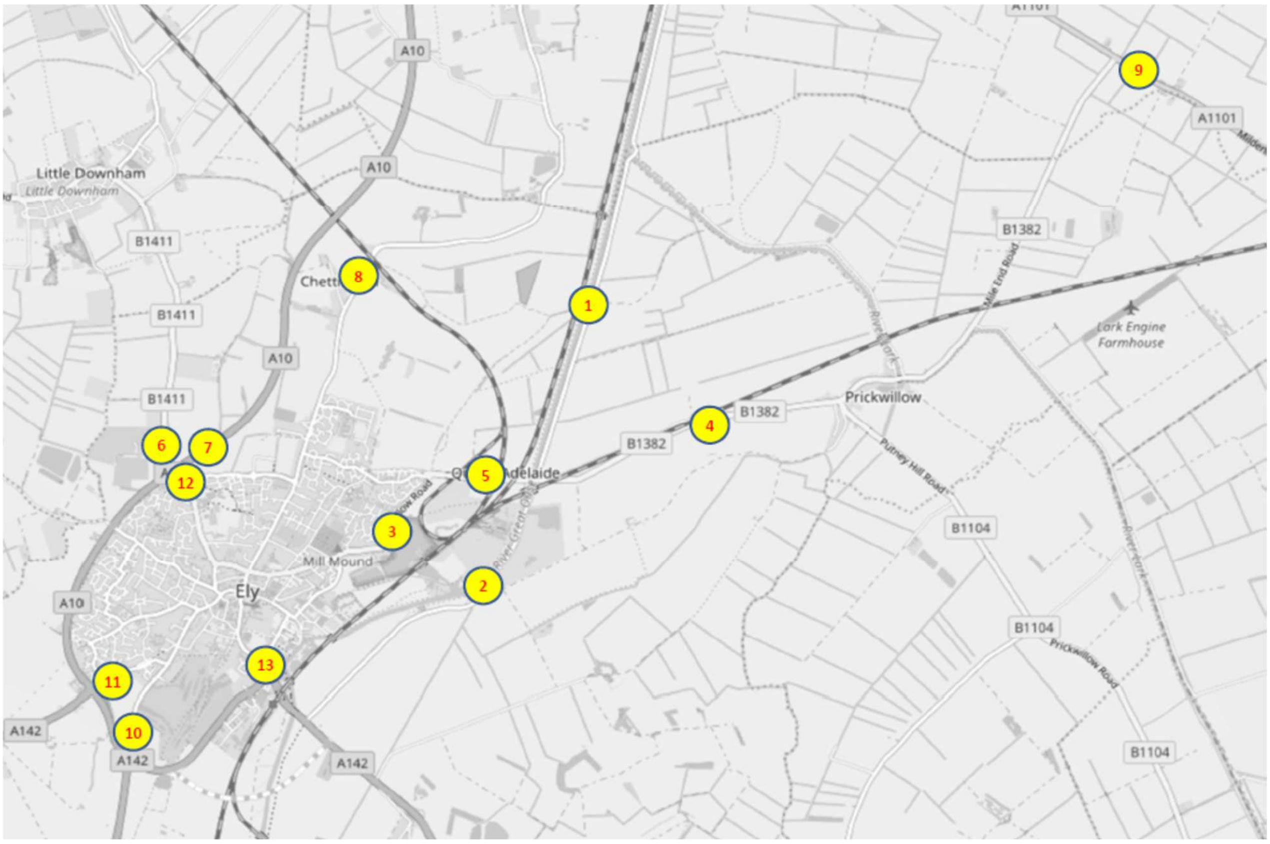


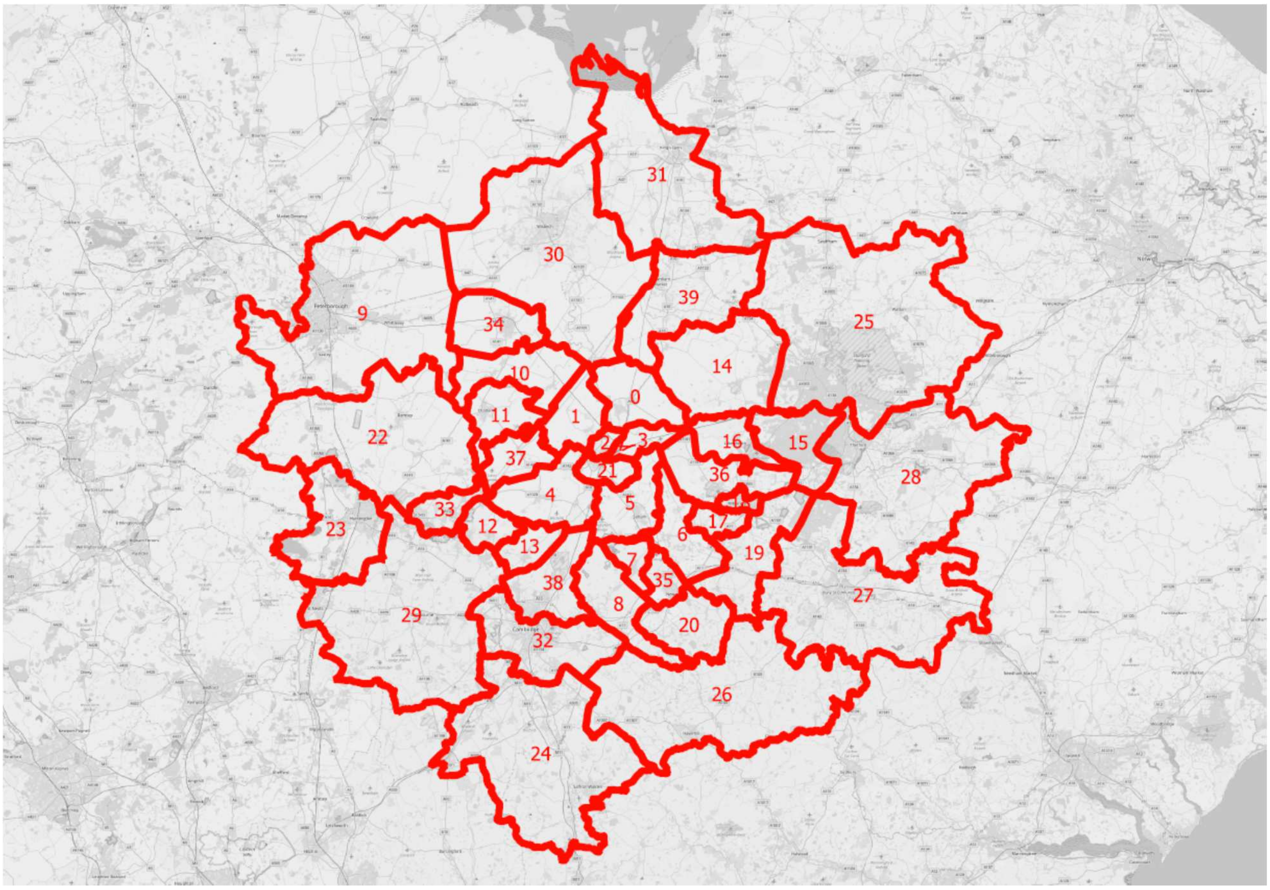
Table 24 Queen Adelaide Highway Model Calibration/Validation counts

No	Type	Start date	Location	Number
1	QA MCC	29/11/2016	Branch Bank	-
2	QA MCC	29/11/2016	Queen Adelaide Way	-
3	QA MCC	29/11/2016	Prickwillow Road	B1382
4	QA 2-week ATC	29/11/2016	Ely Road, E of Railway	B1382
5	QA 2-week ATC	29/11/2016	Ely Road W of Railway	B1382
6	County Screenline	06/05/2015	Ely - Little Downham	B1411
7	County Screenline	06/05/2015	Ely Littleport Bypass	A10
8	County Screenline	06/05/2015	Chettisham	C315
9	County Screenline	06/05/2015	East of Littleport	A1101
10	Ely Annual Monitoring	20/10/2016	Cambridge Road	C315
11	Ely Annual Monitoring	20/10/2016	Witchford Road	C316
12	Ely Annual Monitoring	20/10/2016	Downham Road	B1411
13	Ely Annual Monitoring	20/10/2016	Station Road	C318

6.3 Study area

The extent of the Queen Adelaide modelled region was initially defined as an area up to King's Lynn in the North, Thetford in the East, Peterborough in the West and Cambridge in the South. An initial 144-zone model zoning system, based on the Middle Layer Super Output Areas (MSOAs) zoning was aggregated to 40 final model zones. The final highway model zoning is shown in figure 20.

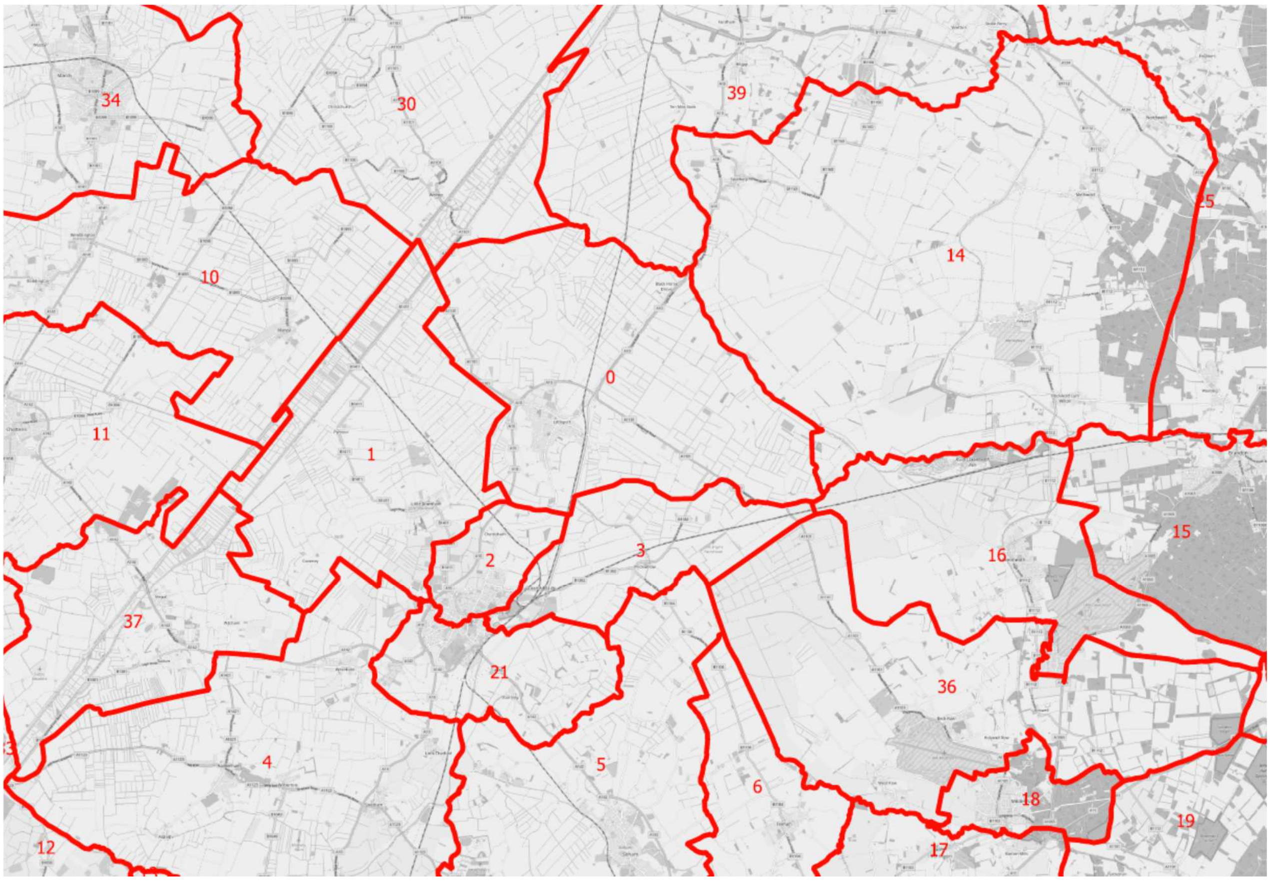
Figure 20 Zone System – Full extent



The core area of zoning detail covers the vicinity of Queen Adelaide and Ely with a few larger external zones around the periphery of the model. The smaller more detailed zoning within the city centre is shown in Figure . To achieve this zoning hierarchy, MSOAs were aggregated in the outer zones as shown in

Figure . 3 MSOAs were also disaggregated in the inner region of the model as the zones were deemed too large and irregular for the detailed study area as shown in Figure . In order to disaggregate these zones, the smaller Lower Layer Super Output Areas (LSOAs) administrative boundaries that are subsets of the MSOA layer. Rather than using the area to disaggregate the model data, population data at the LSOA level was used to give a more representative split.

Figure 21 Zone System – Ely and Queen Adelaide centre



The network extent is smaller than the zone extent reflecting that the external areas are not modelled in detail and are present to provide a representation of longer distance travel.

Figure 22 NTEM zone Aggregations (green) to QA model zones (red)

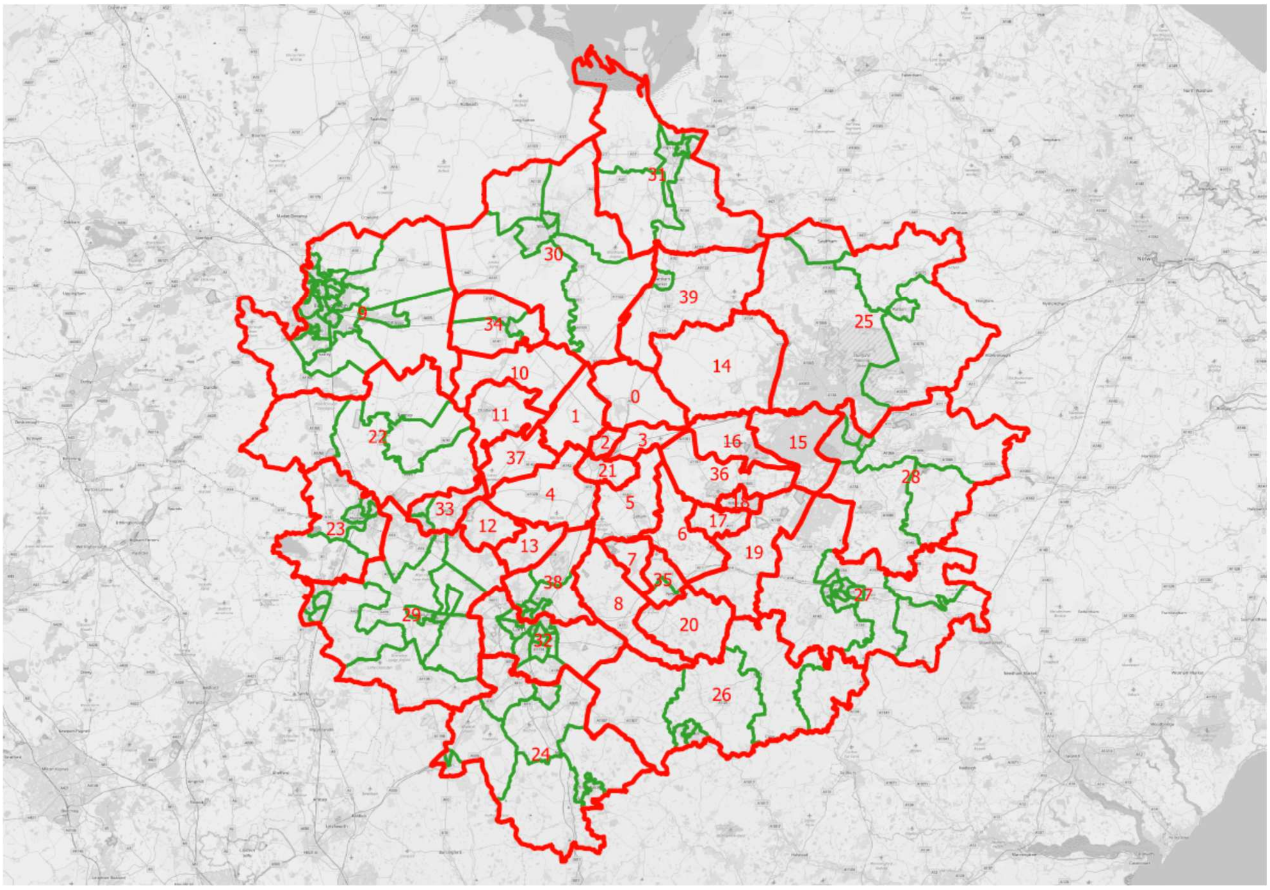
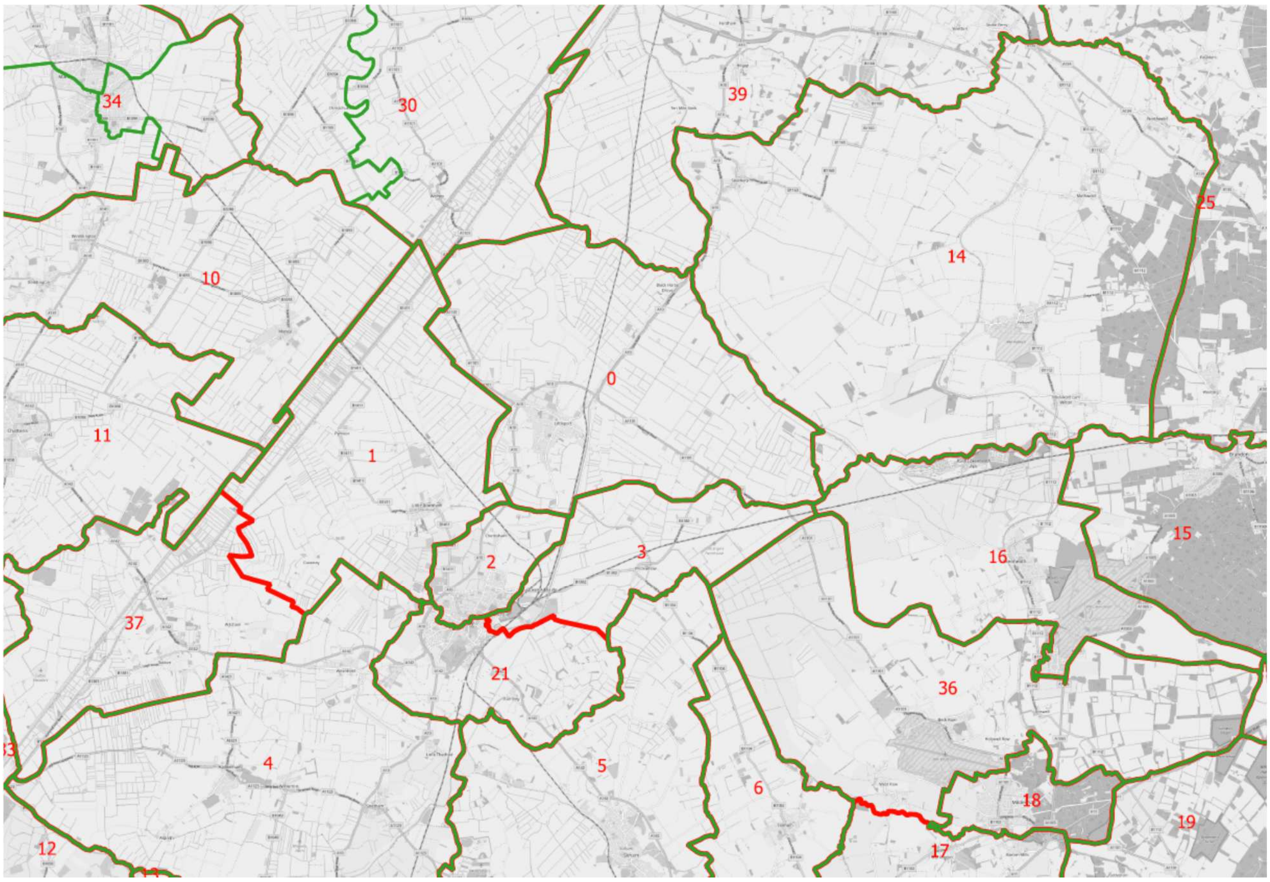


Figure 23 QA model zone disaggregation (red) from NTEM zones (green)



6.4 Model Variables

The model was built to a 2016 base year for three time periods; morning peak (AM), average inter-peak hour 1000-1600 (IP) and evening peak (PM). The ATC count data at the two locations in the vicinity of Queen Adelaide (counts 4 and 5 in 4 and 6) were analysed to identify the busiest hour within each time period based on 30-minute time slices. Based on this analysis 0730—0830 was chosen as the AM peak hour and 1630-1730 as the PM peak hour.

6.4 Base Year Traffic Model development

The traffic model development followed the principles of well-established four stage modelling process

- Trip Generation, estimates the level of transportation demand within each zone based upon land use and socio-economic factors;
- Trip Distribution, allocates the end point for the demand calculated in the trip generation model by a gravity function;
- Mode Choice, calculates the mode of travel for each trip; and
- Assignment, allocates the demand to the highway network with routings determined by costs such as time and distance.

6.5 Trip Generation Model

The trip generation process for the base year demand used the DfT's TEMPRO 7 software with NTEM Planning data v7.2. For simplicity, this provided a ready-made start point for the base demand creation and subsequently the forecasting process. TEMPRO is a modelling tool designed to allow users to look at the growth in trip ends, using actual and forecast data supplied by the Department for Transport, but also provides estimates that are suitable for use in the 2016 base year of the model. As the TEMPRO software provides outputs at the MSOA level, this data would be readily compatible with the model zoning. The correspondence between the model zoning and the MSOAs is shown in Table .

In order to extract the necessary trip end data that would underpin the model matrix data, the following options were selected from TEMPRO:

- Data Selections
    - Select Dataset version: 72
    - Result type: Trip ends by time period
    - Set Area definition: The 144 MSOA zones in Table were selected
    - Enter base year: 2016
    - Enter future year: 2036
- Trip end selections
    - Trip purpose definition: All purposes – individually
    - Transport mode: Car driver
- Trip end by time period selections
    - Select time period: (in turn)
        - Weekday AM peak period (0730 – 0830)
        - Weekday Inter peak period (1000 – 1559)

    - Weekday PM peak period (1630 – 1730)
  - Trip end type: Origin/Destination

Data from the 2 ATC locations in proximity to Queen Adelaide (counts 4 and 5 in Figure 1 and Table) were analysed to derive the conversion from AM/PM peak period to peak hour, resulting in the factors shown in Table . The IP factor was just taken as one sixth to represent a flat profile, and the counts were processed accordingly. The factors were applied to the TEMPRO outputs to convert them from period to hour.

Table 25 Peak period to peak hour conversion factors

Purpose	Peak period to peak hour		
	AM	IP	PM
All purpose	0.415	0.167	0.401

6.6 Trip Distribution Model

The trip ends (origins/destination row/column totals) for each zone were allocated to origin-destination pairs based upon a gravity model with a curve fitted to the trip length distribution derived from the survey data and readily available DfT statistics. These allowed gravity model curve parameters to be derived for two purposes: Commuting and Non-commuting.

For the commuting data, census journey to work data was downloaded from the Nomis website (https://www.nomisweb.co.uk/census/2011/wp702ew) from Table ID WP702EW - Distance travelled to work (Workplace population). This dataset provides 2011 Census estimates that classify the workplace population in England and Wales by distance travelled to work. The estimates are as at census day, 27 March 2011. As this data is provided nationally at the MSOA level, the subset of the 144 MSOAs that underpin the model zoning were isolated as the basis for the data from which to derive the commuting gravity model curve. The columns included in the data table are as follows (those of interest highlighted in red):

- 2011 super output area - middle layer
- All categories: Distance travelled to work (total)
- Less than 2km
- 2km to less than 5km
- 5km to less than 10km
- 10km to less than 20km
- 20km to less than 30km
- 30km to less than 40km
- 40km to less than 60km
- 60km and over
- Work mainly at or from home
- No fixed place
- Total distance (km)
- Average distance (km)

The data was aggregated across all the MSOAs, and using a suitable mid-point for each distance range a distance-weight profile was created.

For the non-commuting data information was taken from the National Travel Survey (NTS) data table NTS0308 from its website (https://www.gov.uk/government/statistical-data-sets/nts03-modal-comparisons) for the average number of trips by trip length and main mode in England. The most up-to-date year at the time of download (2015) was used and the cumulative percentages by distance for the "car/van driver" were used to derive a distance-weight profile that would be applicable for non-commuting purposes.

In order to fit a gravity model curve to the trip length distribution the total demand was factored down until it represented a probability distribution. Once this was achieved, a Tanner function was fitted to the trip length distribution by using a Gamma distribution (the same functional form as a Tanner function). In order to find the parameters for which the curve fitted the distribution best, an Excel macro was developed to iteratively calculate the overall error for each curve with the best curve minimising it. After several iterations refining the numerical ranges for the alpha and beta parameters the curves illustrated in Figure and Figure were derived. The functional for of the Tanner function is:

$$x^{\alpha} e^{\beta x}$$

Where:

$$\propto = 0.65, \;\; \beta = 0.065 \; for \; Commuting$$

$$\propto = 1.2183, \;\; \beta = 0.1801 \; for \; Non - commuting$$

Figure 24 Tanner function fitted to observed trip length (Commuting)

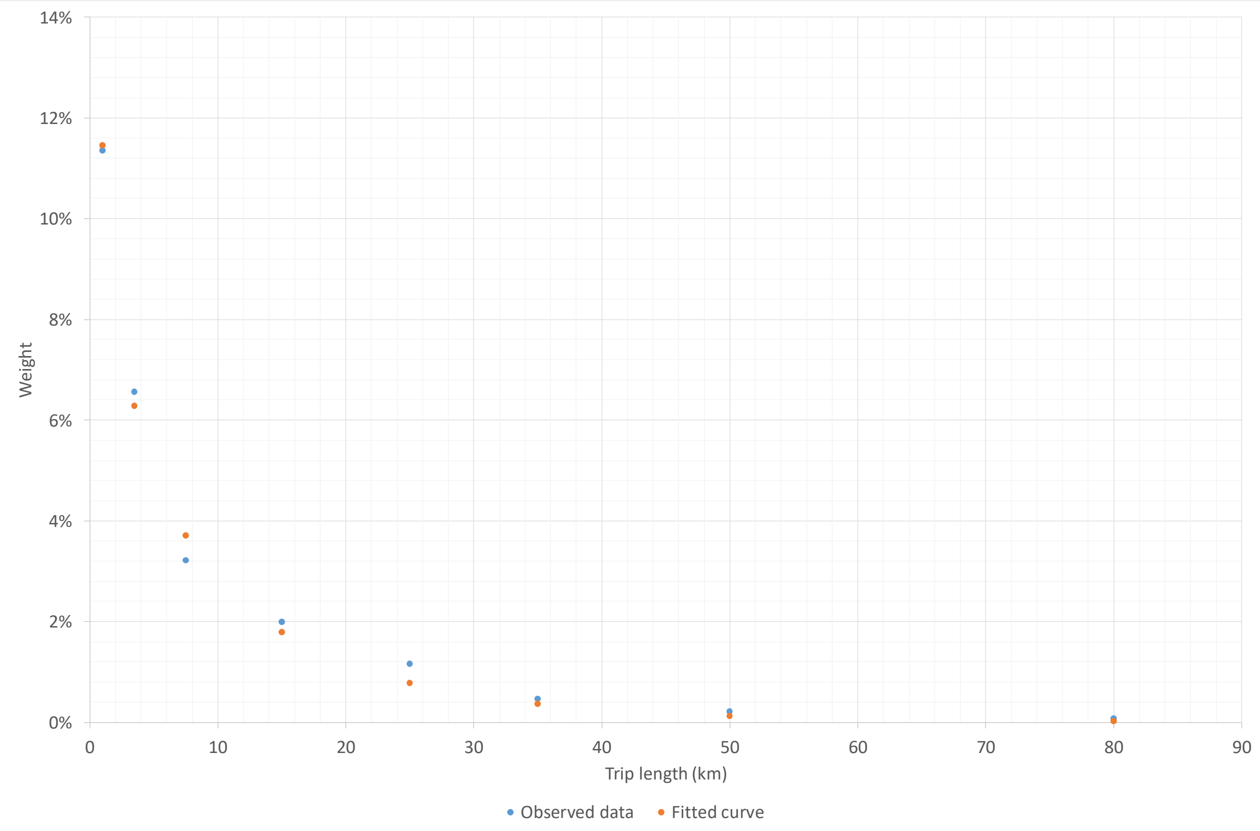
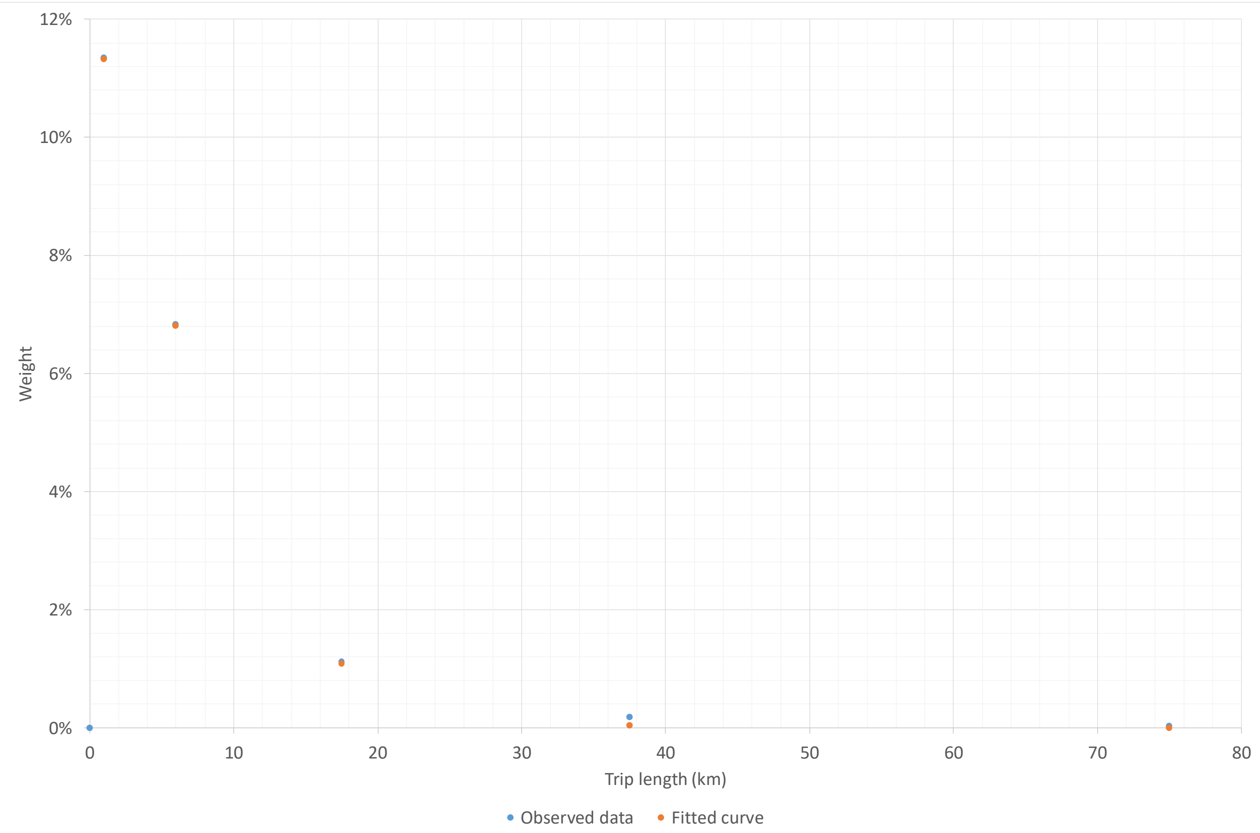


Figure 25 Tanner function fitted to observed trip length (Non-commuting)



Distance skims with the path choice dependent on impedance (the linear combination of value of time and the value of distance components) were extracted from the model for each mode so that the gravity model curve could be applied to these representative OD distances to get the relative zone to zone weights (attractiveness based on distances).

The final stage of the trip distribution process was to apply the fitted gravity model curve to the weighted distance matrix and balance to the AM / PM peak hour production and attraction trip ends totals using a Furness.

6.7 Mode Choice and vehicle composition

The TEMPRO NTEM outputs were aggregated into 3 separate Car user classes using the correspondence shown in Table .

Table 26 TEMPRO purpose to Model User class correspondence

Model User Class	TEMPRO purpose
Commuting	HB Work
Employers' business	HB Employers Business
Commuting	HB Education
Other	HB Shopping
Other	HB Personal Business
Other	HB Recreation/Social
Other	HB Visiting Friends and Relatives
Other	HB Holiday/Day Trip
Commuting	NHB Work
Employers' business	NHB Employers Business
Commuting	NHB Education
Other	NHB Shopping
Other	NHB Personal Business
Other	NHB Recreation/Social
Other	NHB Holiday/Day Trip

As LGV and HGV estimates are not produced by TEMPRO, estimates were derived using the same non-commuting gravity model parameters and derived from a proportion of the Other and Employers' business trip ends derived from the MCC count data collected for Queen Adelaide. For LGV, a weight of 88% and 12% of Other and Employers' business trip ends was used reflecting the observed LGV trip purpose composition. For HGV a weight of 100% of Employers' business was used. As the overall level of LGV and HGV was relatively small compared to car in the MCC counts in the vicinity it was not deemed necessary to provide a more complex approach and the level of LGV and HGV would be representative for the Queen Adelaide area.

The following user classes were therefore used in the assignment model:

- Car (Employers' business);
- Car (Commuting);
- Car (Other);

- Light Goods Vehicles (LGV);
- Heavy Goods Vehicles (HGV);

These user classes represented the demand segments within the demand matrix. A factor of 2 was applied to the HGV matrix to convert it from vehicles to PCU.

6.8 Traffic Assignment

The assignment model was built within a spreadsheet so that it could be self-contained easily and avoid excessive amounts of data processing from/to proprietary software. In order to create the assignment model in a spreadsheet the links, nodes, link types, matrices and parameters needed to be stored within the spreadsheet. As the assignment process requires numerous iterations it was only viable to undertake this in Visual Basic for Applications (VBA) in a similar fashion to other software's processing.

The implementation of the assignment in the spreadsheet was comparable to a "buffer" assignment in SATURN or VISUM. Therefore, without representation of node delays and turns such as at signals or roundabouts. Despite this limitation, a few limited nodes were modelled at roundabouts experiencing significant observed delays, and at the level crossing nodes at Queen Adelaide that required special consideration.

In order to create the assignment model, the Frank-Wolfe algorithm was implemented, as it is one of the most widely used and well understood. The algorithm is as follows:

1. Assign all demand to OD paths to produce an initial set of link flows $V_a^{(n)}$ where n=1 is the iteration number and a is the link number. Usually the first assignment is an all-or-nothing assignment with the link times set to their "free-flow" values.
2. Calculate link times based on the current flows $V_a^{(n)}$; i.e., set: $T_a^{(n)} = T_a(V_a^{(n)})$.
3. Build a new set of shortest paths based on $T_a^{(n)}$ and assign all demand D_{ij} to them to produce a set of "auxiliary" all-or-nothing flows $F_a^{(n)}$.
4. Generate the next iteration's set of link flows $V_a^{(n+1)}$ as a linear combination of the old and the auxiliary flows (where $0 < \lambda < 1$ is chosen so that the "new" flows $V_a^{(n+1)}$ minimise the objective function):

$$V_a^{(n+1)} = (1-\lambda)\, V_a^{(n)} + \lambda\, F_a^{(n)}$$

5. Return to step 2 and keep looping until the convergence criteria are satisfied.

To implement this within VBA, arrays were used to store all the model inputs and outputs were written to output worksheets within the spreadsheet. To implement the Frank Wolfe algorithm, other complementary algorithms were also required including the Dijkstra algorithm to calculate the shortest paths between each OD pair and the Secant Method to find the value of λ that minimised the objective function. Once the Frank Wolfe algorithms had been implemented it was tested using known networks and demand against known optimal solutions. To similar convergence levels, the spreadsheet returned comparable results to software such as SATURN or VISUM.

In order to bring the AM / PM OD matrices in line with the volume of observed traffic, global demand factors were used to factor the demand matrices to reflect the level of trip making within the modelled area. To achieve this the set of counts were considered in full and the demand was adjusted so that the total modelled demand was equivalent to the total observed demand. The global factors are shown in Table . This could reflect trip rates being slowly low within the TEMPRO software, which has been identified in other studies.

Table 27 Global Demand uplifts by time period

Purpose	Demand uplift factor		
	AM	IP	PM
All purposes	1.1000	1.5000	1.1935

No matrix estimation was undertaken as the majority of the counts were only 1 day MCC counts, and therefore it was not considered appropriate to rely on them for matrix adjustment, but to use them solely to inform the model validation instead. Although matrix estimation was not undertaken, one count was used to help calibrate the model. Count 9 (as shown in Figure 1 and Table) was analysed and it showed significantly higher modelled flow than its corresponding counts. This could have been caused by the trip distribution process predicting demand between zone pairs based on their proximity. In reality although the zones are nearby this demand does not appear to exist. In order to correct for this demand (that would otherwise result in too much traffic on the A10 and A1101 north of Ely and Queen Adelaide) the zone pairs using the specific links were identified and adjusted. The factors are shown in Table . This could be perceived as a single link matrix estimation or a sector to sector matrix reduction.

Table 28 OD pairs (all combinations of AB and BA) with global calibration factor of 0.25 applied

OD	Zones		
A	2	10	11
	31	35	40
B	16	17	18
	19	20	26
	28	29	37

7.0 Network Model Development

The base and forecast models consists of approximately 730 links, 240 nodes (including 40 zones) and 8 modelled junctions (3 level crossings and 5 congested roundabouts)

7.1 Link representation

The highway network was developed using a GIS link vector dataset obtained from OpenStreetMap (https://www.openstreetmap.org/copyright). Other Sources such as Google Maps were used in order to classify the links into types based on visual inspection from aerial photography and based on the estimated journey times. The base year network coverage is shown in Figure 4. The characteristics of each of these link types, as used ifor the assignment, are detailed in Table .

In order to convert the speed flow characteristics as used in software such as VISUM and SATURN, the functional form of VISUM's "BPR3" speed flow curve was transferred to the spreadsheet assignment model so that SATURN/VISUM speed flow curves could be fully replicated. VISUM's "BPR3" speed flow curve has the following functional form:

$$t_{cur} = t_0.\left(1 + a.S^b\right) \quad when\ V \leq C$$

$$t_{cur} = t_0.\left(1 + a.C^b\right) + (V - C).d \quad when\ V > C$$

Where:

t_{cur} = link travel time

t_0 = link free flow travel time

V = link volume

C = link capacity

S = saturation (V / C)

a,b,c,d = parameters of the link type

The link characteristics in Table were converted into the parameters required in the spreadsheet for the BPR3 speed flow curve with units of seconds and metres. The derived parameters used for the base model network link types are shown in Table . Buffer links were introduced to handle excessive levels of demand loading onto a single point on the network for large external zones. The buffer network was designed to permit demand to dissipate to the wider network where more routing options were available. Figure and Figure show the link types applied to each link within the model.

Table 29 Spreadsheet assignment model link types and their characteristics

Link type	Capacity	Speed (kph)		Power
		Free flow	At capacity	
Dual 2 lanes (Trunk)	4520	100	40	3.66
Dual 2 lanes	4360	98	40	3.68
Single 2 lanes (Good A road)	3280	80	40	2.16
Single 1 lane (Good A road)	1640	78	40	2.16
Single 1 lane (Average A road)	1380	70	35	2.07
Village S1 40 mph (Low dev)	1300	56	24	3
Village S1 30 mph (High dev)	880	42	20	2.09
Village S1 20 mph (High dev)	450	32	15	1.87
Buffer	8000	72	72	0
Village S1 50 mph (Low dev)	1300	70	30	2.07

Table 30 Base model BPR3 parameters by link type

Link type	a	b	C	d
Dual 2 lanes (Trunk)	1.500	3.66	1	0.7965
Dual 2 lanes	1.450	3.68	1	0.826
Single 2 lanes (Good A road)	1.000	2.16	1	1.098
Single 1 lane (Good A road)	0.950	2.16	1	2.195
Single 1 lane (Average A road)	1.000	2.07	1	2.609
Village S1 40 mph (Low dev)	1.333	3.00	1	2.769
Village S1 30 mph (High dev)	1.100	2.09	1	4.091
Village S1 20 mph (High dev)	1.133	1.87	1	8.000
Buffer	0	1.00	1	0.000
Village S1 50 mph (Low dev)	1.333	2.07	1	2.769

Figure 26 Base Year (2016) Network (outer view)

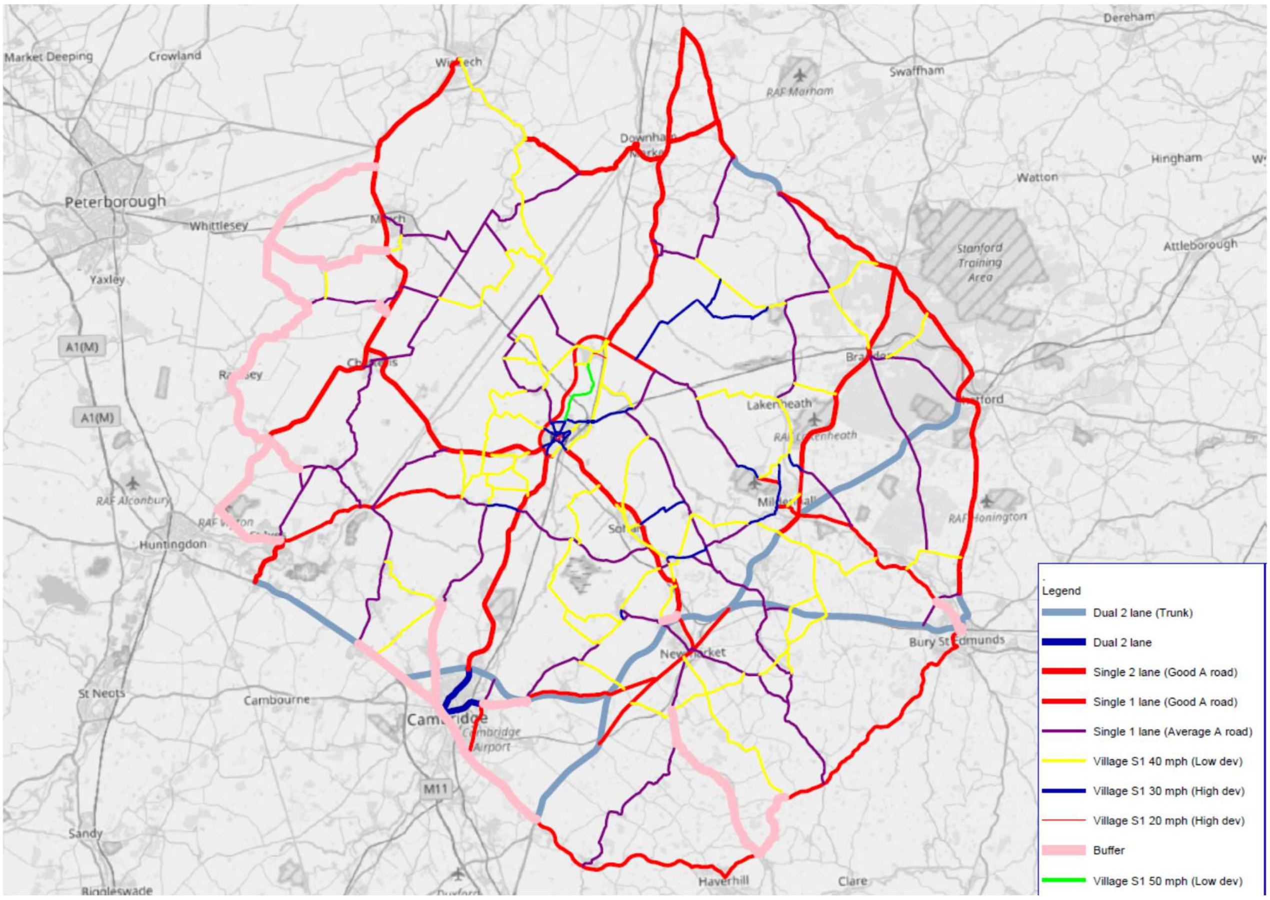
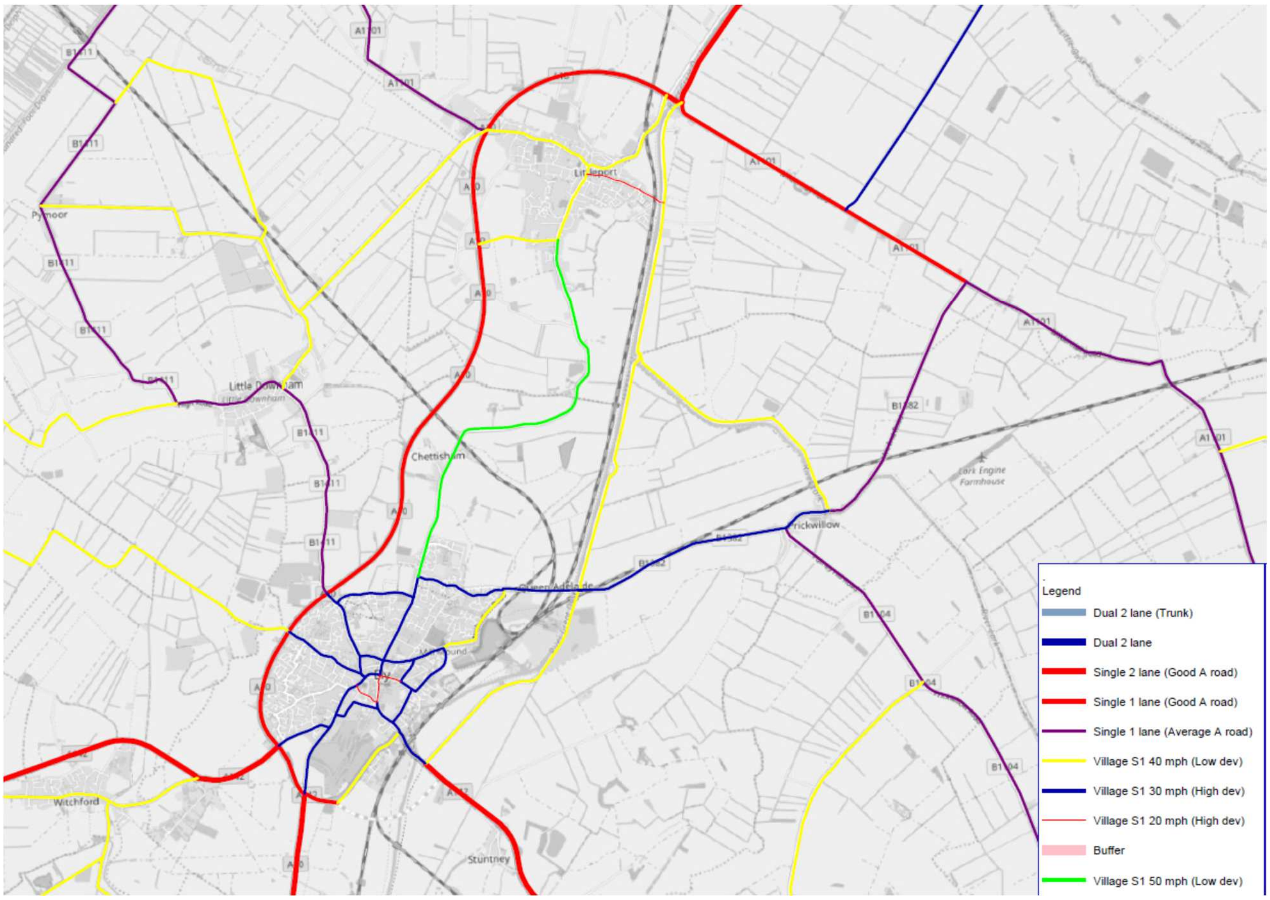


Figure 27 Base Year (2016) Network (inner view)



In addition to link speed flow curves an impedance function was applied that considered the relative weight of distance and time for each vehicle type for the choice of their shortest overall path through the network. The assignment would then consider the shortest path between origin and destination based on impedance. The general form of the impedance function was:

$$\text{Impedance} = \text{VoT} * \text{Time} + \text{VoD} * \text{Length}$$

Where:

VoT= Value of Time in Pounds (GBP) per second

T_{cur} = Link travel time in seconds

VoD = Value of Distance in Pounds (GBP) per metre

Length = Link length in metres

Table illustrates the base year VoT and VoD implemented in the assignment for each of the separate vehicle types modelled separately in the assignment. These values were derived using standard values taken from the WebTAG TAG databook. In addition to these assumptions it was also assumed that the HGV fleet was composed of 40% OGV1 and 60% OGV2 and an HGV Operator VoT multiplier of 2.3

in line with standard Highways England modelling practice. Due to slight variation in inputs, the VoTs varied by time period, however the VoD remained constant (for all time periods within each year).

Table 31 Base model VoT and VoD for impedance calculations by vehicle type in Pounds (GBP)

User Class	GBP per second			GBP per metre
	AM	IP	PM	All time periods
Car (EB)	0.5033	0.5157	0.5105	0.0122
Car (Commuting)	0.3375	0.343	0.3387	0.0056
Car (Other)	0.2328	0.248	0.2438	0.0056
LGV	0.3557	0.3557	0.3557	0.0127
HGV	0.8307	0.8307	0.8307	0.0469

In order to model the Option tests within the assignment model it was necessary to add additional functionality to deal with local traffic; such as where local vehicles movements are allowed to use the level crossings but other longer distance trips are not. Without creating additional user classes and network subsets, it was considered pragmatic to run separate assignments with local vehicle subsets only (with level crossing open for example) and then “preload” these flows on the network with another matrix subset excluding the local trip (and with the appropriate level crossings then closed for the other vehicles). This preloaded demand would then be static within the assignment but the volumes would make an impact on the speed flow curves and the journey times of the local traffic would also be representative.

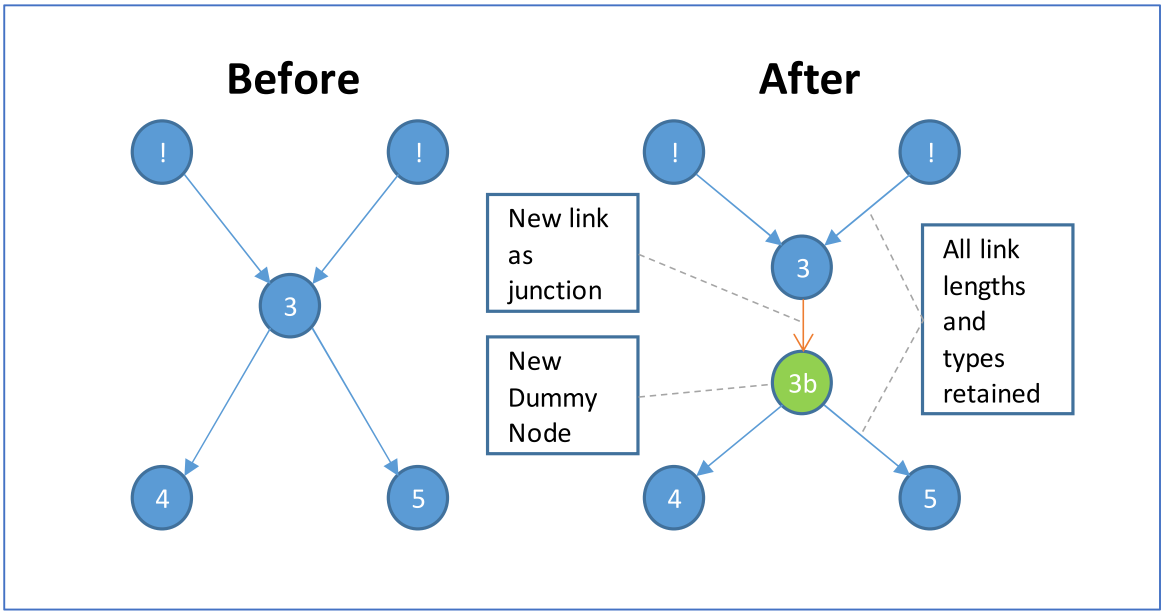
7.2 Node representation

8 junctions were identified that were significant for the model validation and scenario testing. Figure 21 illustrates the locations of the 3 level crossings at Queen Adelaide and 5 roundabouts where significant delay was identified by the journey time validation.

Modelling junctions within the spreadsheet model was challenging as there was no representation of turns for modelling simplicity and to improve runtimes. In order to circumvent this limitation, it was assumed that the junctions would be represented by links instead. The one issue with this assumption however, was that the same junction delay would apply to all turning movements. This assumption would be appropriate for a level crossing, though for roundabouts the assumption is less appropriate.

As the delays at the identified roundabouts seemed to occur predominantly on the major flows, it was deemed the “lesser of two evils” that the minor arms would also experience a similar delay. To model this within the spreadsheet, additional dummy junction nodes were added on top of the existing node and links were used to connect the original node to the new node. The links from the original nodes were then transferred to the new dummy junction nodes but their other characteristics such as link type and length were left unchanged. The links between the original node and the new dummy junction nodes did not have an actual physical length associated with them; the link type was to reflect the average junction delay. The modification made to the modelled junctions is illustrated in Figure .

Figure 28 Visual representation of node delay implementation



For the level crossing nodes, the junction delay link type was designed to include an estimate of the average delay experienced by each vehicle (PCU) during the modelled hour, taking into account the average random delay of being caught by the barriers being down and also the likelihood or the queue not clearing between consecutive train passes and the corresponding delay incurred by the average vehicle. The equation takes the following functional form:

$$t_{cur} = INT\left(\frac{Vol}{Cap\left(1-\frac{W}{Y}\right)}\right).Y + (W^2)/(2.Y)$$

Where:

INT() = Integer part of the resultant value (rounded down)

Vol = Link Volume in PCU

Cap = turn capacity (assumed to be 1800 PCU)

Y= Barrier downtime in seconds

W=Total cycle length (intergreen + barrier downtime) = 3600* H / T

H= Total hours of operation

T= Trains per day

For the roundabouts, an exponential turn delay function was implemented that used the properties of a representative and medium sized roundabout's effective capacity. The parameters were calibrated to reflect a similar level of delay as observed in the journey time analysis. The equation takes the following functional form:

$$t_{cur} = t_0 + \exp[(a.S)]\,/b \quad when\ V \le C$$

$$t_{cur} = t_0 + \exp[(a.C)]\,/b + (V - C).d \quad when\ V > C$$

Where:

t_{cur} = link travel time

t_0 = link free flow travel time

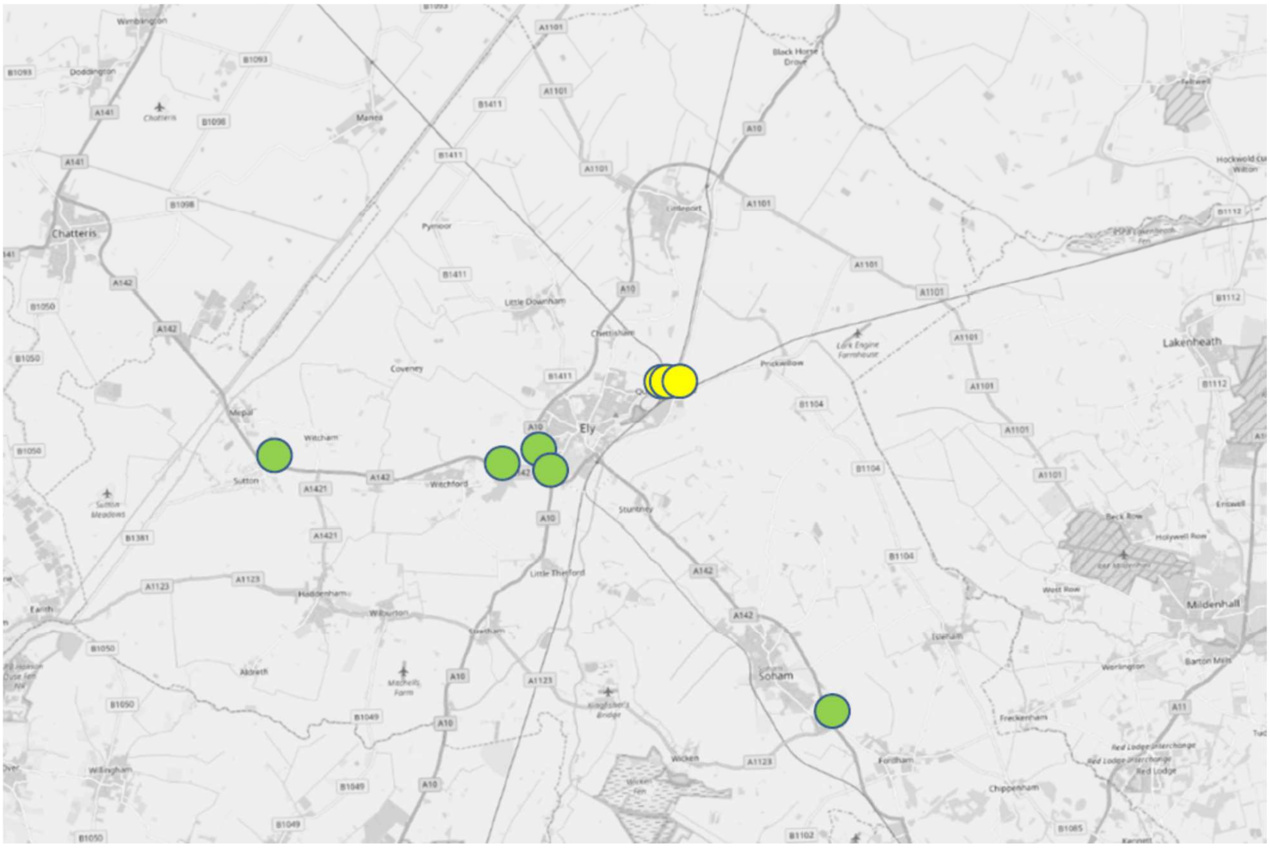
V = link volume

C = roundabout effective capacity (assumed to be 2657 PCU)

S = saturation (V / C)

a,b,d = 4.8, 4, 0.06 are parameters

Figure 29 Locations of junction roundabout (green) and level crossing (yellow) representations



7.3 Base Model Validation – Link validation

The base year model was validated against the traffic counts shown in Figure 1 and Table . Without the use of matrix estimation, in excess of eighty percent of the traffic flows were within fifty percent of the observed flows (85%, 88% and 81% for the AM, IP, and PM respectively). Given that the majority of the counts used were one day MCC counts with a lower than usual numbers of PCUs compared to typical strategic models, these results, although less stringent that WebTAG guidance, were deemed suitable. The cumulative differences between observed and modelled links is shown in more detail in Table . Figure , Figure and Figure show scatter plots of the observed and modelled PCU values where a noticeable correlation can be seen without any significant outliers.

Table 32 Cumulative distribution of observed vs modelled flow percentage differences

Difference observed vs modelled	% of modelled flows meeting criterion		
	AM	IP	PM
15%	23%	46%	31%
25%	42%	58%	54%
50%	85%	88%	81%
75%	96%	96%	96%
100%	100%	100%	96%

Figure 30 Scatterplot Observed vs. Modelled link volumes AM peak hour

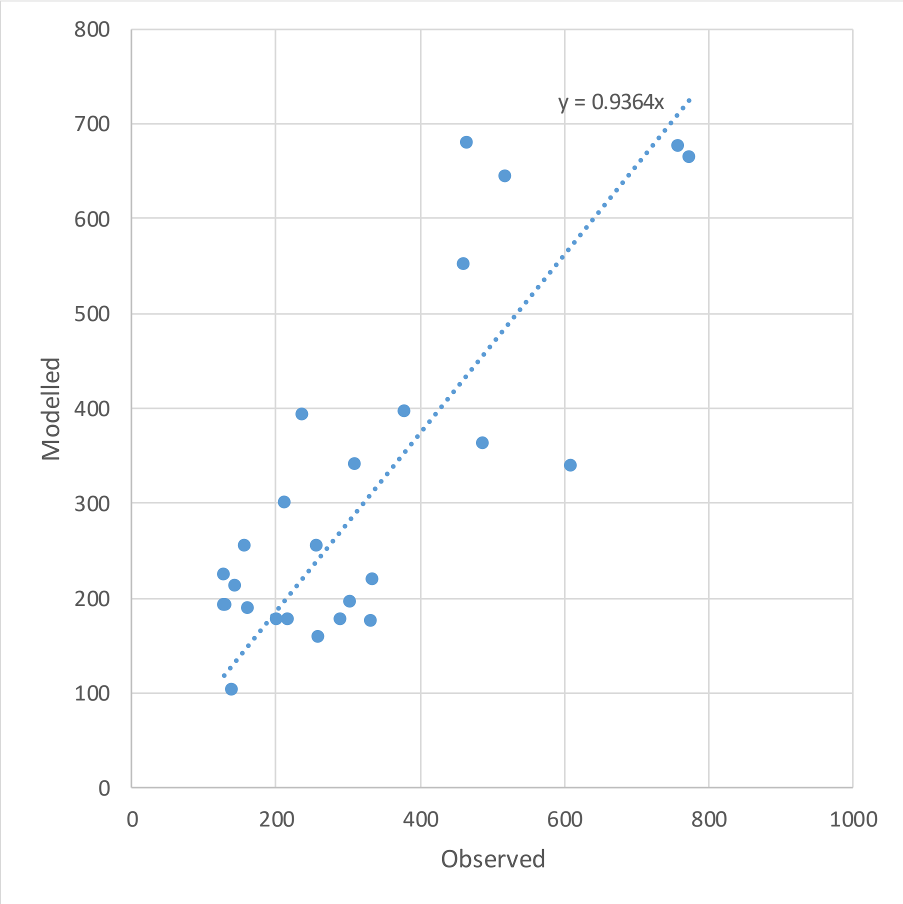


Figure 31 Scatterplot Observed vs. Modelled link volumes Inter peak hour

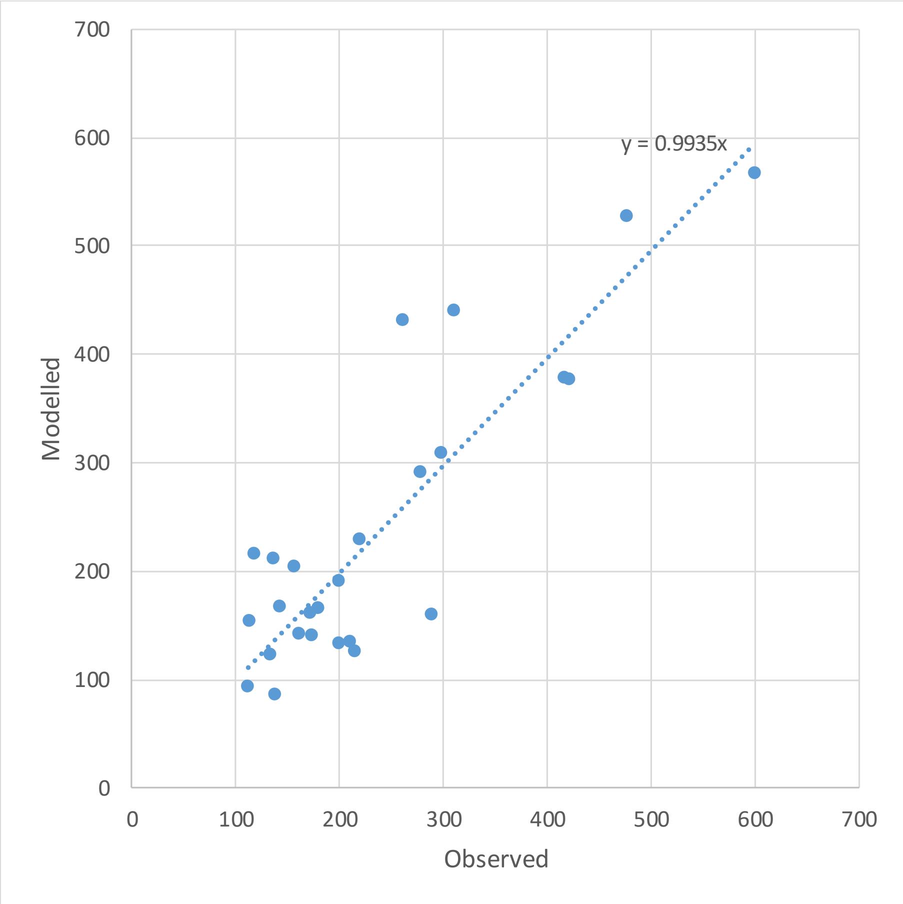
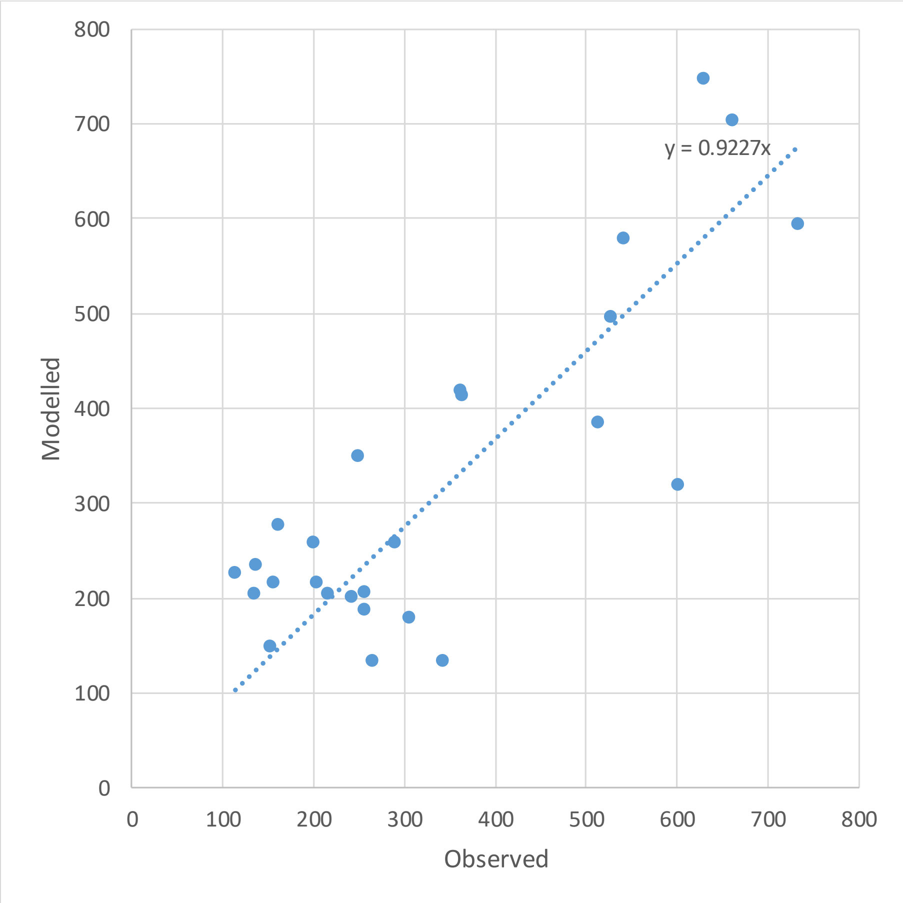


Figure 32 Scatterplot Observed vs. Modelled link volumes PM peak hour



7.4 Journey time validation

Google Maps was used as the basis for the journey time validation. Using the date selection, equivalent time periods were selected to the modelled time periods. The start/end points were matched to the models zones and the searches returned either ranges of expected journey times (from min to max), or a typical value. Where a range of values was given the average was taken. Free flow journey times were analysed using 2am as the representative time, to check the robustness of the model's uncongested journey times.

In total 13 journey time routes were analysed for each direction (26 routes in total). These routes traversed the vicinity of Ely and Queen Adelaide and also adjacent routes were also reviewed. Figure illustrates a selection of the Google Maps journey times used for the AM peak with a corresponding set for the other time periods.

The comparison of modelled and observed journey times overall saw a general trend of modelled journey times being slightly quicker than the observed data, suggesting a slight bias in the model towards faster journeys. However, in aggregate, in excess of three quarters the journey times were within 15% of the observed totals (81%, 85% and 77% for the AM, IP and PM respectively) and in excess of 95% within 25% of the observed totals (96%, 100% and 96% for the AM, IP and PM respectively).

This level of journey time validation was considered appropriate to form the basis of the forecasting; given the simplified node representation and the average values chosen within the output range values. Table illustrates the cumulative distribution of modelled journey times against observed journey times.

Table 33 Cumulative distribution of observed vs modelled journey time differences

Difference observed vs modelled	% of journey times less than or equal to criterion		
	AM	IP	PM
7.5%	35%	35%	35%
15%	81%	85%	77%
25%	96%	100%	96%
40%	100%	100%	100%

8.0 Model Forecasting

8.1 Introduction

The 2036 forecast model was derived directly from the 2016 model with updated impedance parameters and a limited number of forecast year network changes.

8.2 Forecast Demand

In an identical fashion to the 2016 base matrices, TEMPRO demand was used to create the Origin and Destination trip ends. For simplicity this was processed in an identical fashion to the 2016 demand with the same gravity model curve applied.

8.3 Forecast Network

The only highway schemes added to the 2036 model to create the Do-Minimum (DM) network were the Ely Southern Bypass shown in red in Figure . Another link representing the Ely Northern bypass was also added to the modelling for the representation of Option 8, as shown in blue in Figure .The link types used in the 2036 forecast model were also unchanged from 2016. No changes were made either to the node representation of node (delays) in the forecast model.

For the 2036 forecast year impedances, the 2016 base year values were updated to values appropriate for the 2036 model. The standard WebTAG approach of updating the Values of time (VoT) was applied. For the Value of Distance, the normal considerations are the change in the cost of fuel combined with the improvements in vehicle efficiency, reflected in the changes from the corresponding 2016 values.

Table 34 2036 Forecast model VoT and VoD for impedance calculations by vehicle type in Pounds (GBP)

User Class	GBP per second			GBP per metre
	AM	IP	PM	All time periods
Car (EB)	0.7263	0.7443	0.7368	0.0115
Car (Commuting)	0.4872	0.495	0.4888	0.005
Car (Other)	0.336	0.358	0.352	0.005
LGV	0.5133	0.5133	0.5133	0.0128
HGV	1.1986	1.1986	1.1986	0.0556

Figure 33 Additional highway network in 2036

Table 35 Middle Layer Super Output Areas (MSOAs) to Model Zone correspondence with split factors

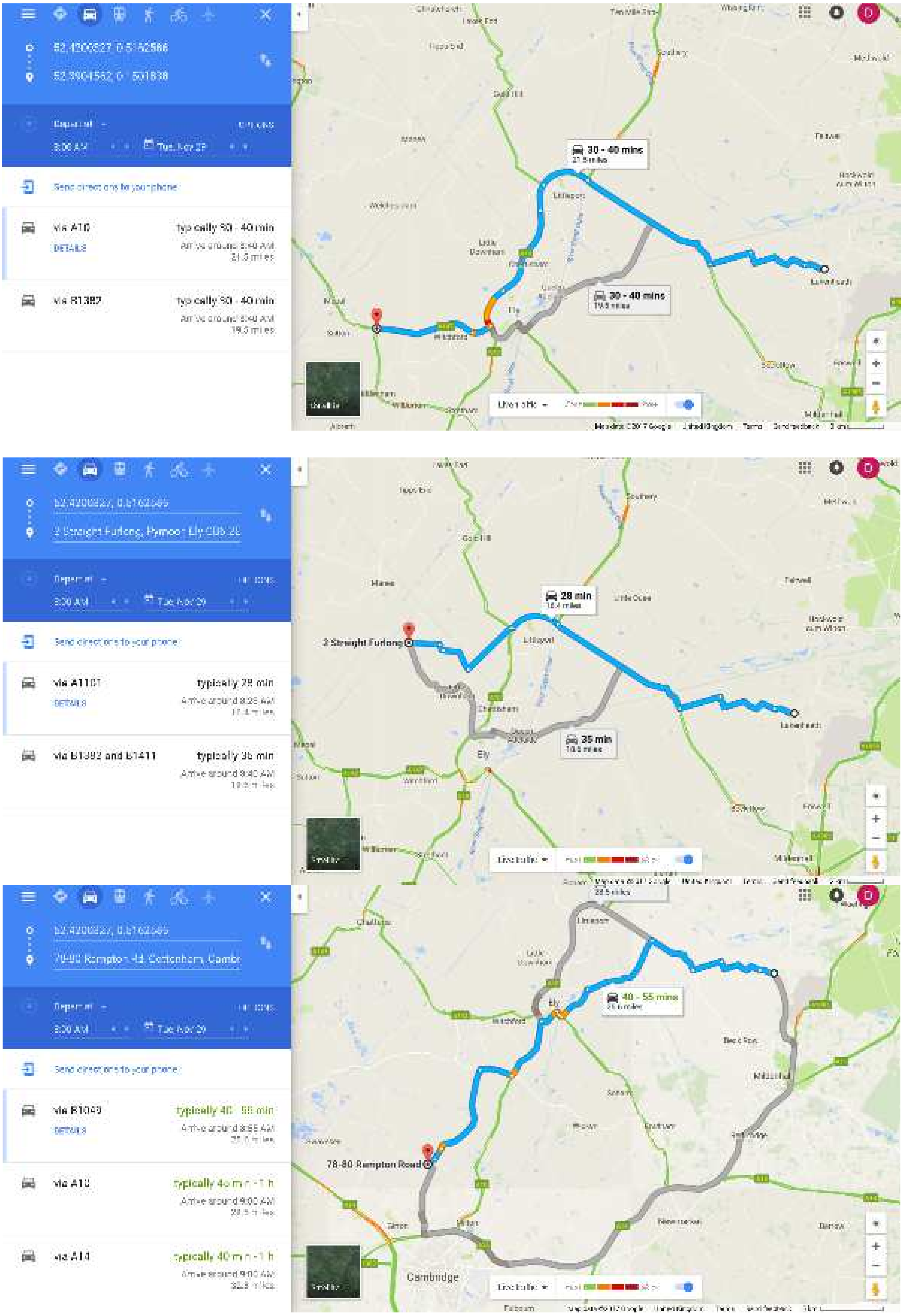
MSOA	Name	Local Authority	Model Zone	Split Proportion
E02003732	East Cambridgeshire 001	East Cambridgeshire	0	100%
E02003733	East Cambridgeshire 002	East Cambridgeshire	1	36%
E02003734	East Cambridgeshire 003	East Cambridgeshire	2	100%
E02003735	East Cambridgeshire 004	East Cambridgeshire	3	13%
E02003736	East Cambridgeshire 005	East Cambridgeshire	4	100%
E02003737	East Cambridgeshire 006	East Cambridgeshire	5	100%
E02003738	East Cambridgeshire 007	East Cambridgeshire	6	100%
E02003739	East Cambridgeshire 008	East Cambridgeshire	7	100%
E02003740	East Cambridgeshire 009	East Cambridgeshire	8	100%
E02003238	Peterborough 002	Peterborough	9	100%
E02003239	Peterborough 003	Peterborough	9	100%
E02003241	Peterborough 005	Peterborough	9	100%
E02003242	Peterborough 006	Peterborough	9	100%
E02003243	Peterborough 007	Peterborough	9	100%
E02003244	Peterborough 008	Peterborough	9	100%
E02003245	Peterborough 009	Peterborough	9	100%
E02003246	Peterborough 010	Peterborough	9	100%
E02003247	Peterborough 011	Peterborough	9	100%

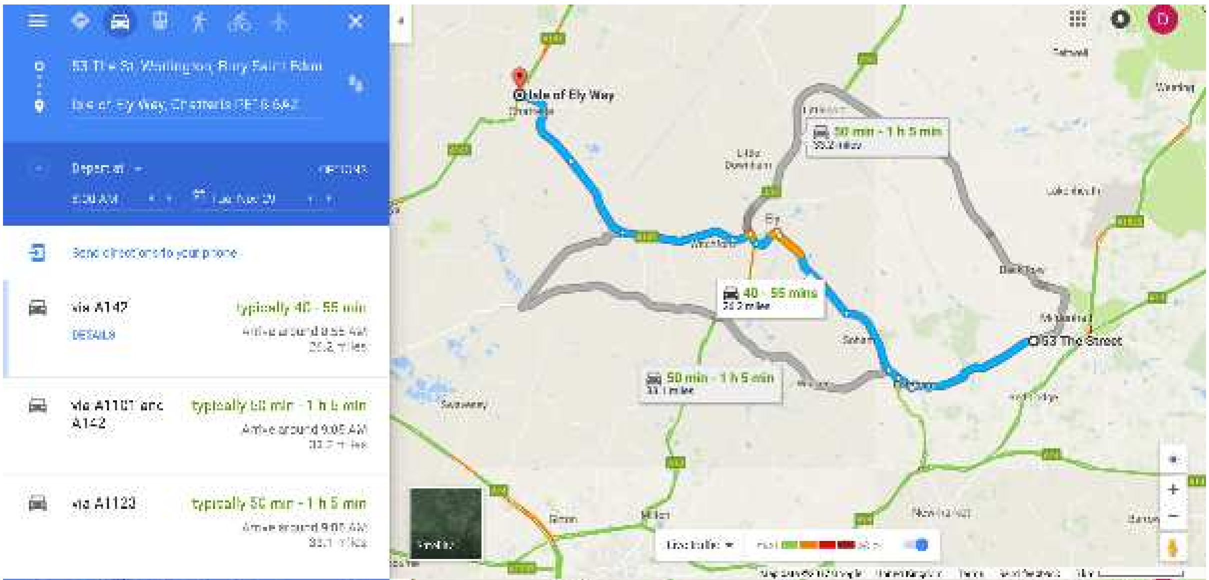
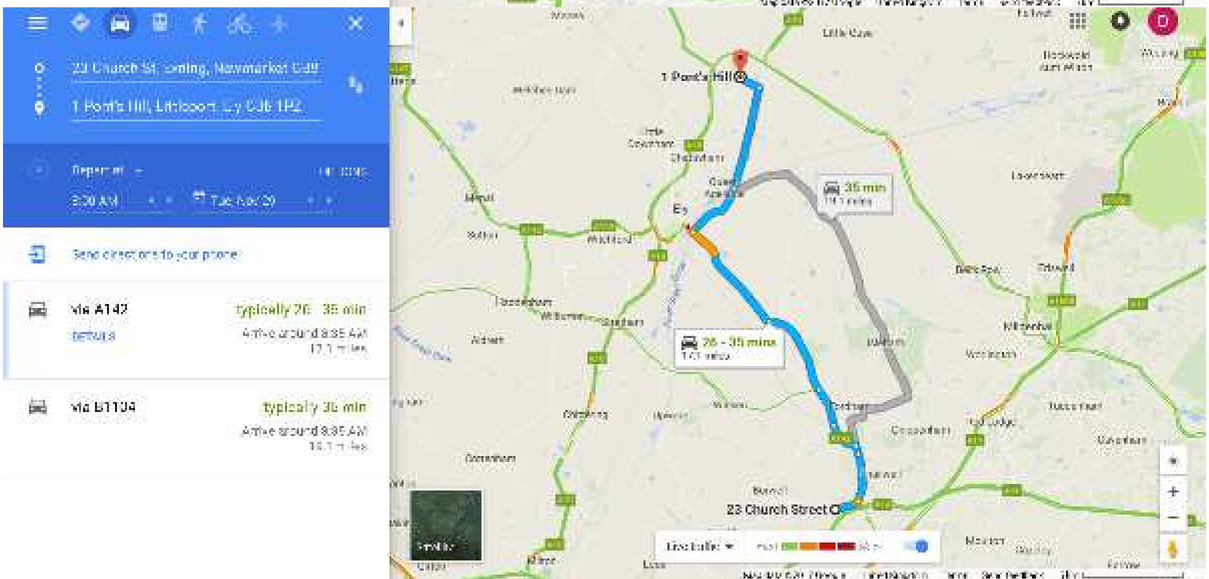
E02003248	Peterborough 012	Peterborough	9	100%
E02003249	Peterborough 013	Peterborough	9	100%
E02003250	Peterborough 014	Peterborough	9	100%
E02003251	Peterborough 015	Peterborough	9	100%
E02003252	Peterborough 016	Peterborough	9	100%
E02003253	Peterborough 017	Peterborough	9	100%
E02003255	Peterborough 019	Peterborough	9	100%
E02003257	Peterborough 021	Peterborough	9	100%
E02003747	Fenland 006	Fenland	9	100%
E02003749	Fenland 008	Fenland	9	100%
E02003753	Huntingdonshire 001	Huntingdonshire	9	100%
E02003754	Huntingdonshire 002	Huntingdonshire	9	100%
E02006877	Peterborough 022	Peterborough	9	100%
E02006878	Peterborough 023	Peterborough	9	100%
E02003751	Fenland 010	Fenland	10	100%
E02003752	Fenland 011	Fenland	11	100%
E02003775	South Cambridgeshire 001	South Cambridgeshire	12	100%
E02003776	South Cambridgeshire 002	South Cambridgeshire	13	100%
E02005569	King's Lynn and West Norfolk 019	King's Lynn and West Norfolk	14	100%
E02006238	Forest Heath 001	Forest Heath	15	100%
E02006239	Forest Heath 002	Forest Heath	16	100%
E02006240	Forest Heath 003	Forest Heath	17	22%
E02006241	Forest Heath 004	Forest Heath	18	100%
E02006242	Forest Heath 005	Forest Heath	19	100%
E02006825	East Cambridgeshire 011	East Cambridgeshire	20	100%
E02003735	East Cambridgeshire 004	East Cambridgeshire	21	87%
E02003755	Huntingdonshire 003	Huntingdonshire	22	100%
E02003756	Huntingdonshire 004	Huntingdonshire	22	100%
E02003757	Huntingdonshire 005	Huntingdonshire	22	100%
E02003758	Huntingdonshire 006	Huntingdonshire	22	100%
E02003760	Huntingdonshire 008	Huntingdonshire	23	100%
E02003761	Huntingdonshire 009	Huntingdonshire	23	100%
E02003762	Huntingdonshire 010	Huntingdonshire	23	100%
E02003764	Huntingdonshire 012	Huntingdonshire	23	100%
E02003766	Huntingdonshire 014	Huntingdonshire	23	100%
E02003769	Huntingdonshire 017	Huntingdonshire	23	100%
E02003788	South Cambridgeshire 014	South Cambridgeshire	24	100%
E02003789	South Cambridgeshire 015	South Cambridgeshire	24	100%
E02003791	South Cambridgeshire 017	South Cambridgeshire	24	100%
E02003792	South Cambridgeshire 018	South Cambridgeshire	24	100%
E02004591	Uttlesford 001	Uttlesford	24	100%
E02004592	Uttlesford 002	Uttlesford	24	100%
E02004593	Uttlesford 003	Uttlesford	24	100%
E02004909	North Hertfordshire 001	North Hertfordshire	24	100%
E02004910	North Hertfordshire 002	North Hertfordshire	24	100%
E02005509	Breckland 007	Breckland	25	100%
E02005510	Breckland 008	Breckland	25	100%
E02005511	Breckland 009	Breckland	25	100%
E02005512	Breckland 010	Breckland	25	100%

E02005514	Breckland 012	Breckland	25	100%
E02003790	South Cambridgeshire 016	South Cambridgeshire	26	100%
E02006228	Babergh 002	Babergh	26	100%
E02006282	St Edmundsbury 010	St Edmundsbury	26	100%
E02006283	St Edmundsbury 011	St Edmundsbury	26	100%
E02006284	St Edmundsbury 012	St Edmundsbury	26	100%
E02006285	St Edmundsbury 013	St Edmundsbury	26	100%
E02006286	St Edmundsbury 014	St Edmundsbury	26	100%
E02006264	Mid Suffolk 004	Mid Suffolk	27	100%
E02006266	Mid Suffolk 006	Mid Suffolk	27	100%
E02006275	St Edmundsbury 003	St Edmundsbury	27	100%
E02006276	St Edmundsbury 004	St Edmundsbury	27	100%
E02006277	St Edmundsbury 005	St Edmundsbury	27	100%
E02006278	St Edmundsbury 006	St Edmundsbury	27	100%
E02006279	St Edmundsbury 007	St Edmundsbury	27	100%
E02006280	St Edmundsbury 008	St Edmundsbury	27	100%
E02006281	St Edmundsbury 009	St Edmundsbury	27	100%
E02005516	Breckland 014	Breckland	28	100%
E02005517	Breckland 015	Breckland	28	100%
E02005518	Breckland 016	Breckland	28	100%
E02005519	Breckland 017	Breckland	28	100%
E02006273	St Edmundsbury 001	St Edmundsbury	28	100%
E02006274	St Edmundsbury 002	St Edmundsbury	28	100%
E02003768	Huntingdonshire 016	Huntingdonshire	29	100%
E02003770	Huntingdonshire 018	Huntingdonshire	29	100%
E02003771	Huntingdonshire 019	Huntingdonshire	29	100%
E02003772	Huntingdonshire 020	Huntingdonshire	29	100%
E02003773	Huntingdonshire 021	Huntingdonshire	29	100%
E02003774	Huntingdonshire 022	Huntingdonshire	29	100%
E02003777	South Cambridgeshire 003	South Cambridgeshire	29	100%
E02003779	South Cambridgeshire 005	South Cambridgeshire	29	100%
E02003784	South Cambridgeshire 010	South Cambridgeshire	29	100%
E02003787	South Cambridgeshire 013	South Cambridgeshire	29	100%
E02006873	South Cambridgeshire 020	South Cambridgeshire	29	100%
E02006874	South Cambridgeshire 021	South Cambridgeshire	29	100%
E02003742	Fenland 001	Fenland	30	100%
E02003743	Fenland 002	Fenland	30	100%
E02003744	Fenland 003	Fenland	30	100%
E02003745	Fenland 004	Fenland	30	100%
E02005563	King's Lynn and West Norfolk 013	King's Lynn and West Norfolk	30	100%
E02005566	King's Lynn and West Norfolk 016	King's Lynn and West Norfolk	30	100%
E02005556	King's Lynn and West Norfolk 006	King's Lynn and West Norfolk	31	100%
E02005557	King's Lynn and West Norfolk 007	King's Lynn and West Norfolk	31	100%
E02005558	King's Lynn and West Norfolk 008	King's Lynn and West Norfolk	31	100%

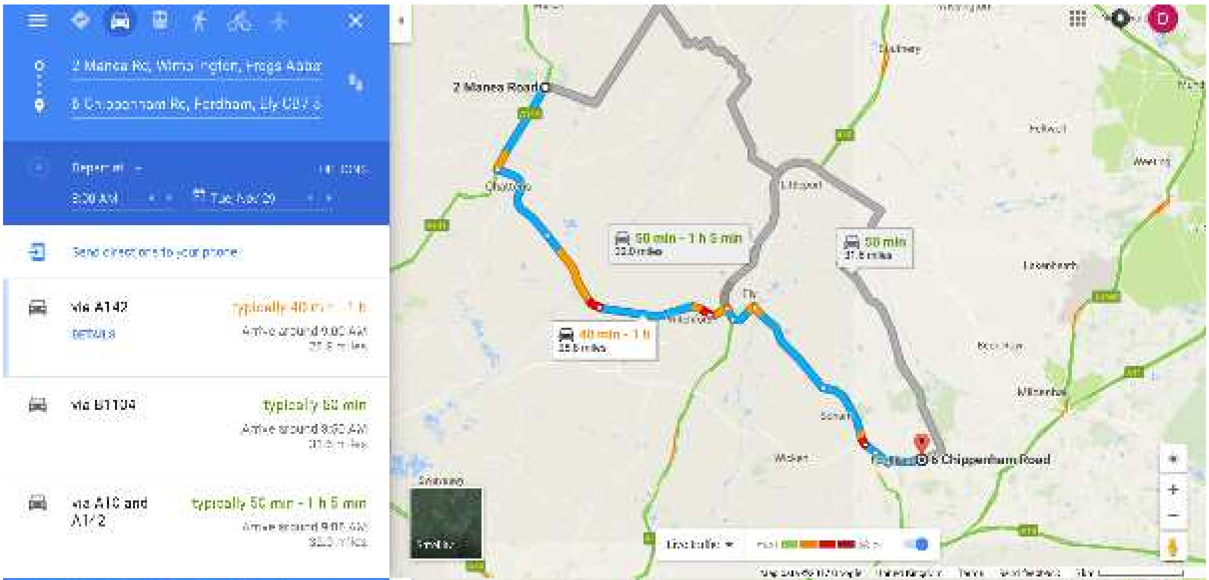
E02005559	King's Lynn and West Norfolk 009	King's Lynn and West Norfolk	31	100%
E02005560	King's Lynn and West Norfolk 010	King's Lynn and West Norfolk	31	100%
E02005561	King's Lynn and West Norfolk 011	King's Lynn and West Norfolk	31	100%
E02005564	King's Lynn and West Norfolk 014	King's Lynn and West Norfolk	31	100%
E02005565	King's Lynn and West Norfolk 015	King's Lynn and West Norfolk	31	100%
E02003723	Cambridge 005	Cambridge	32	100%
E02003724	Cambridge 006	Cambridge	32	100%
E02003725	Cambridge 007	Cambridge	32	100%
E02003726	Cambridge 008	Cambridge	32	100%
E02003727	Cambridge 009	Cambridge	32	100%
E02003728	Cambridge 010	Cambridge	32	100%
E02003729	Cambridge 011	Cambridge	32	100%
E02003730	Cambridge 012	Cambridge	32	100%
E02003731	Cambridge 013	Cambridge	32	100%
E02003783	South Cambridgeshire 009	South Cambridgeshire	32	100%
E02003785	South Cambridgeshire 011	South Cambridgeshire	32	100%
E02003786	South Cambridgeshire 012	South Cambridgeshire	32	100%
E02003759	Huntingdonshire 007	Huntingdonshire	33	100%
E02003763	Huntingdonshire 011	Huntingdonshire	33	100%
E02003765	Huntingdonshire 013	Huntingdonshire	33	100%
E02003746	Fenland 005	Fenland	34	100%
E02003748	Fenland 007	Fenland	34	100%
E02003750	Fenland 009	Fenland	34	100%
E02006243	Forest Heath 006	Forest Heath	35	100%
E02006826	Forest Heath 008	Forest Heath	35	100%
E02006240	Forest Heath 003	Forest Heath	36	78%
E02003733	East Cambridgeshire 002	East Cambridgeshire	37	64%
E02003719	Cambridge 001	Cambridge	38	100%
E02003720	Cambridge 002	Cambridge	38	100%
E02003721	Cambridge 003	Cambridge	38	100%
E02003722	Cambridge 004	Cambridge	38	100%
E02003778	South Cambridgeshire 004	South Cambridgeshire	38	100%
E02003780	South Cambridgeshire 006	South Cambridgeshire	38	100%
E02003781	South Cambridgeshire 007	South Cambridgeshire	38	100%
E02005567	King's Lynn and West Norfolk 017	King's Lynn and West Norfolk	39	100%
E02005568	King's Lynn and West Norfolk 018	King's Lynn and West Norfolk	39	100%

Figure 34 Selection of AM peak hour Google Map journey times used for validation



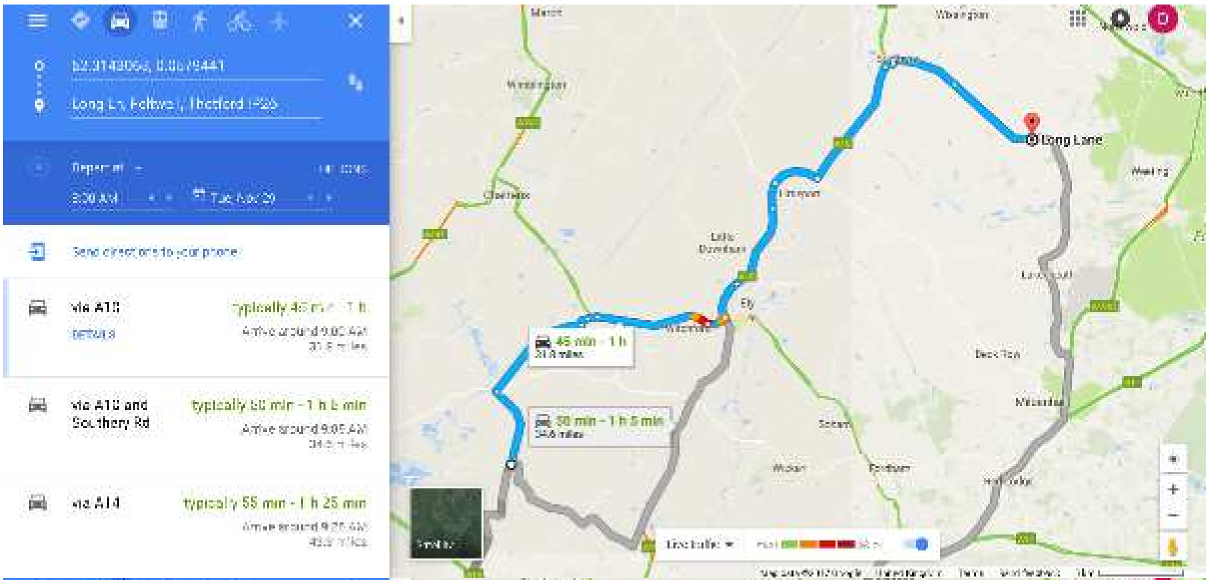

Send directions to your phone
via A142
typically 40 - 55 min
DETAILS
via A1101 and A142
typically 50 min - 1 h 5 min
via A1123
typically 50 min - 1 h 5 min
Isle of Ely Way
53 The Street
50 min - 1 h 5 min
40 - 55 mins
Ely

23 Church St, Exning, Newmarket CB8
1 Pont's Hill, Littleport, Ely CB6 1PZ
Send directions to your phone
via A142
typically 25 - 35 min
DETAILS
via B1104
typically 35 min
1 Pont's Hill
23 Church Street
35 min
25 - 35 mins
Ely

A10, Downham Market PE38
Send directions to your phone
via A10
typically 40 - 50 min
DETAILS
via A14 and A10
typically 50 min - 1 h 5 min
via B1090 and A10
typically 55 min - 1 h 10 min
A10
94 A10
55 min - 1 h 10 min
40 - 50 mins
Cambridge
Thetford Forest Park
Bury St Edmunds


2 Manea Road
6 Chippenham Road
via A142
typically 40 min - 1 h
via B1104
via A10 and A142
50 min - 1 h 5 min
50 min
40 min - 1 h
Ely
Soham
Littleport
Mildenhall
Send directions to your phone

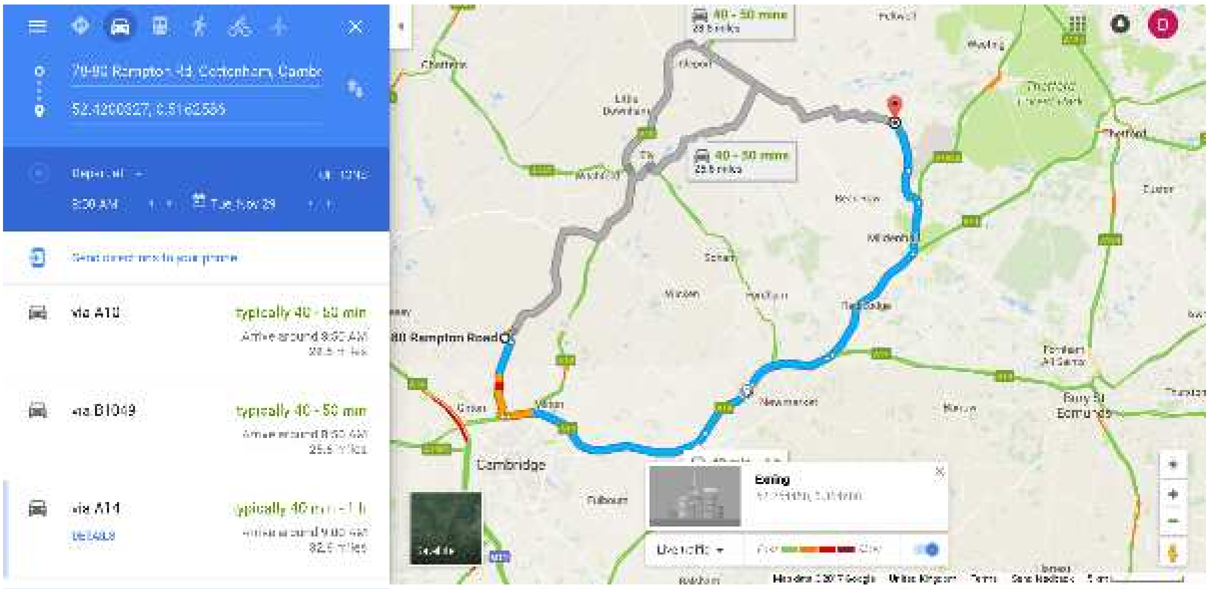

Pools Rd, Wilburton, Ely CB6 3PZ
4 Eriswell Rd, Bury Saint Edmunds
Pools Road
4 Eriswell Road
via A10 and A1101
typically 35 - 45 min
via A1123 and B1102
via A1101
35 - 45 mins
Ely
Littleport
Send directions to your phone


The Toll House
via B1102
typically 24 - 28 min
via B1102 and B1104
typically 30 min
via A142
typically 28 - 35 min
28 - 35 mins
24 - 28 mins
30 min
Soham
Send directions to your phone

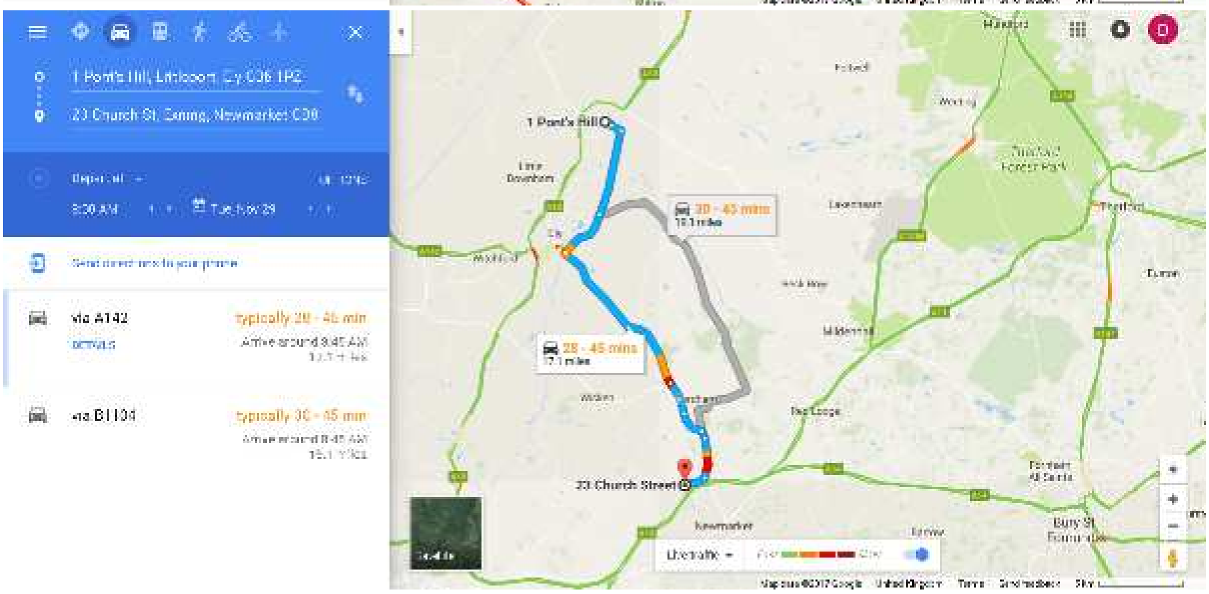

Long Ln, Feltwell, Thetford IP26
Send directions to your phone
via A10
DETAILS
via A10 and Southery Rd
via A14
typically 55 min - 1 h 25 min
45 min - 1 h
50 min - 1 h 5 min
Long Lane
Ely

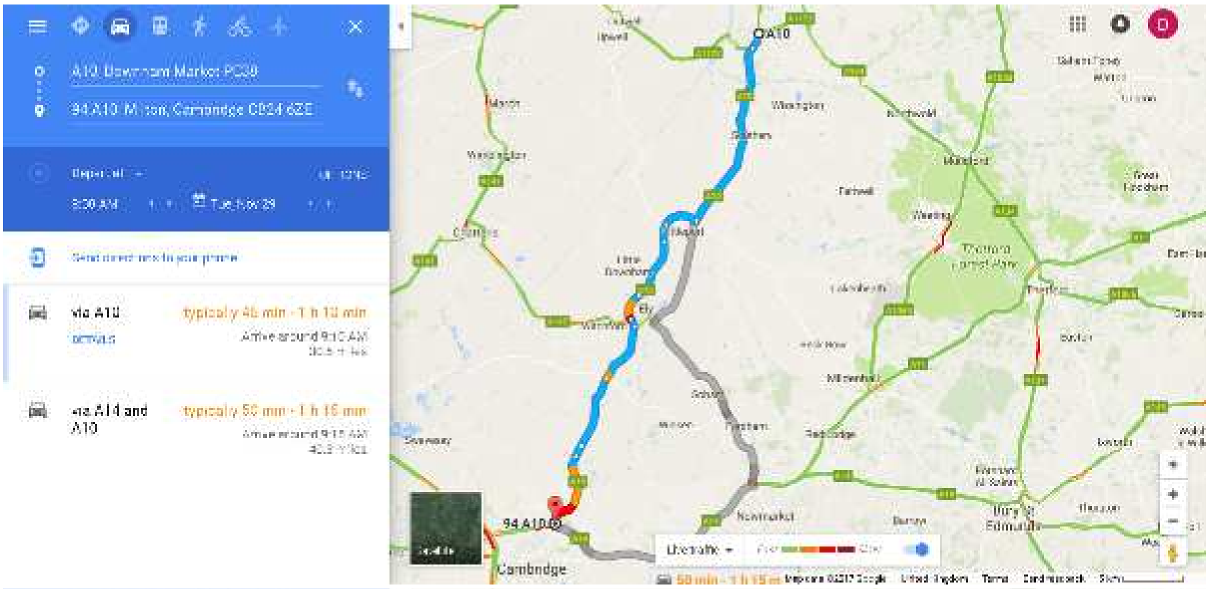
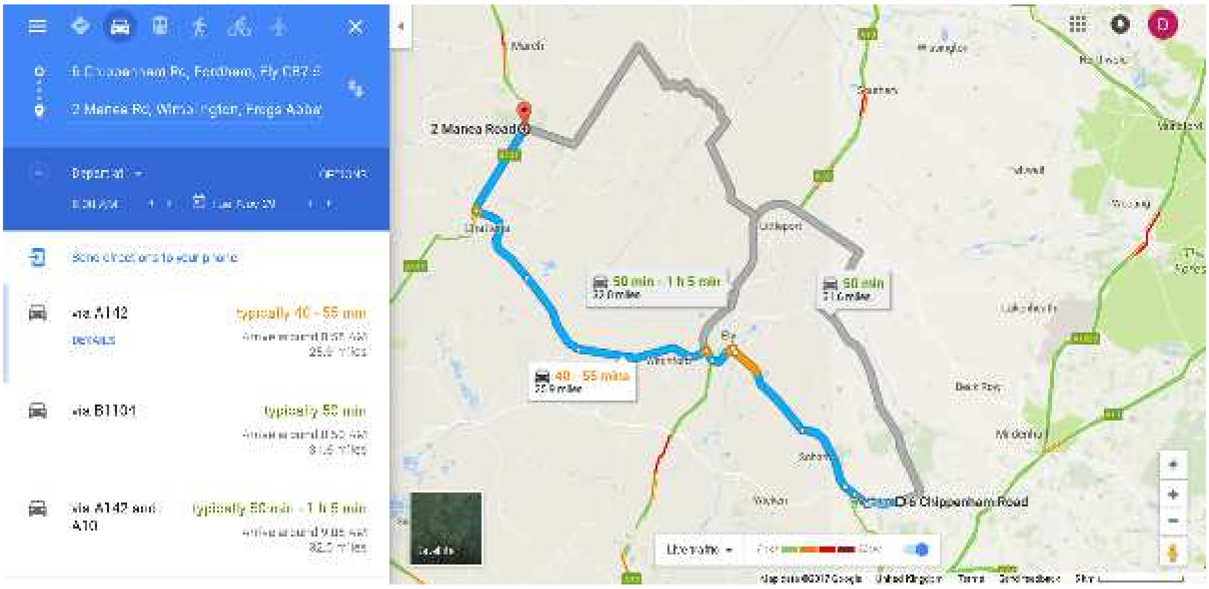
Send directions to your phone
via A10
typically 30 - 40 min
DETAILS
via B1382
typically 30 - 40 min
via A142
typically 45 min - 1 h
30 - 40 mins
30 - 40 mins
45 min - 1 h
Ely

2 Straight Furlong, Pymoor, Ely CB6 2E
Send directions to your phone
via A1101
typically 28 min
DETAILS
via B1411 and B1382
typically 35 min
28 min
35 min
2 Straight Furlong
Ely

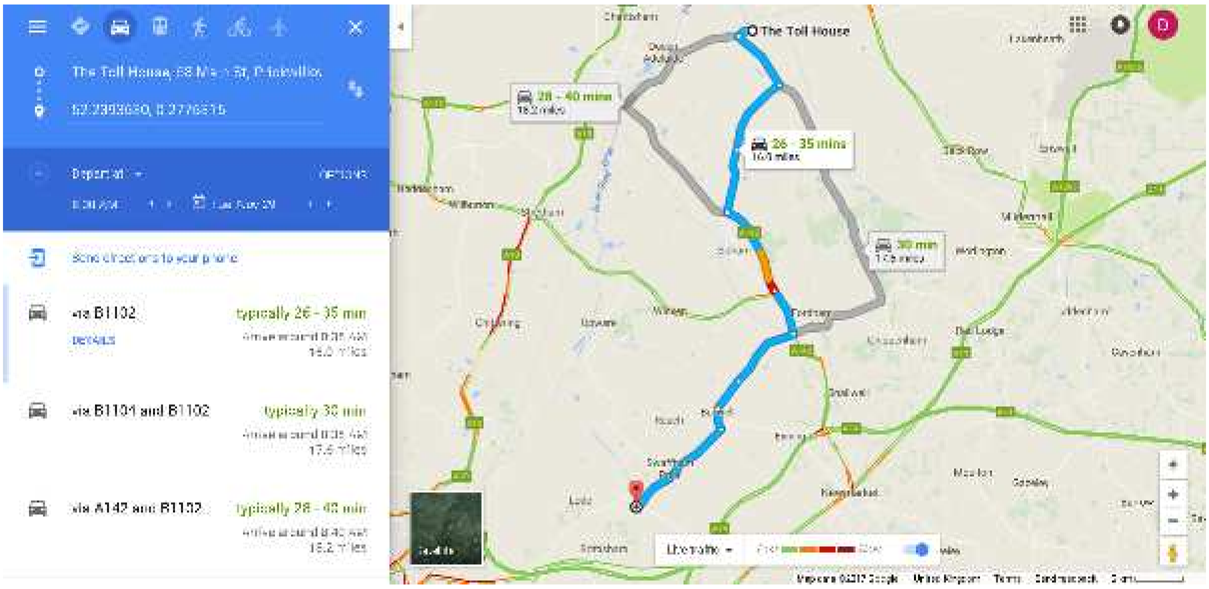

via A10
typically 40 - 50 min
via B1049
typically 40 - 50 min
25.5 miles
via A14
typically 40 min - 1 h
DETAILS
32.9 miles
40 - 50 mins
28 miles
40 - 50 mins
25.5 miles
80 Rampton Road
Cambridge
Newmarket
Bury St Edmunds
Exning
Live traffic

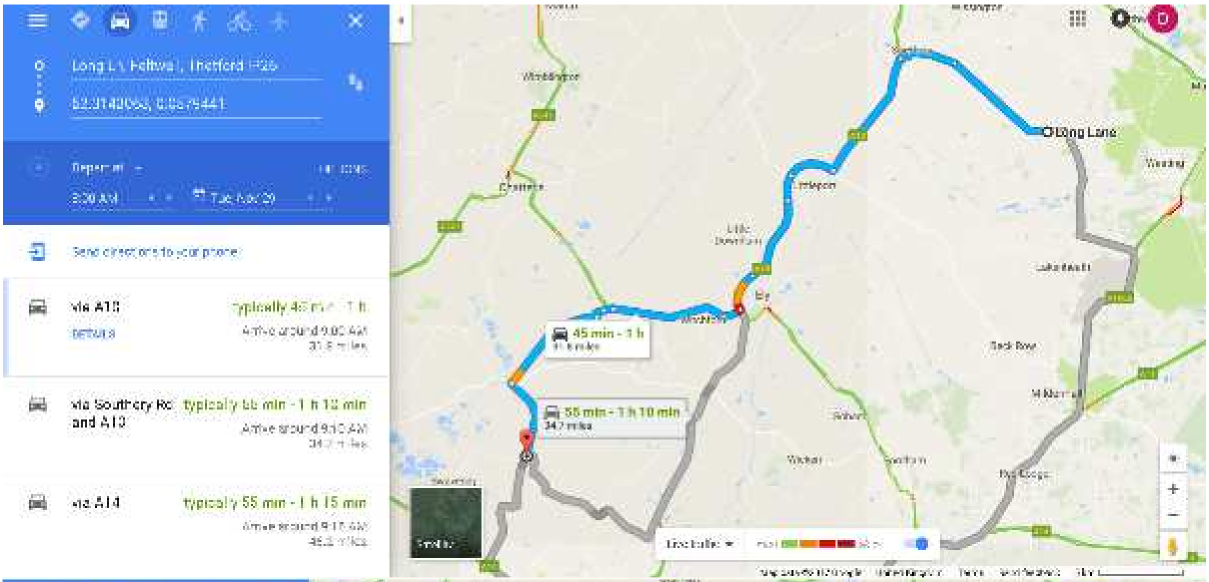

via A142
typically 40 min - 1 h 5 min
DETAILS
via A142 and A1101
typically 50 min - 1 h 10 min
via A1123
typically 55 min - 1 h 15 min
Isle of Ely Way
53 The Street
50 min - 1 h 10 min
40 min - 1 h 5 min
55 min - 1 h 15 min
Live traffic


1 Pont's Hill, Littleport, Ely CB6 1PZ
23 Church St, Exning, Newmarket CB8
Send directions to your phone
via A142
typically 28 - 45 min
DETAILS
via B1104
typically 30 - 45 min
1 Pont's Hill
30 - 45 mins
28 - 45 mins
23 Church Street
Newmarket
Live traffic


A10, Downham Market PE38
94 A10, Milton, Cambridge CB24 6ZE
Send directions to your phone
via A10
typically 45 min - 1 h 10 min
DETAILS
via A14 and A10
typically 50 min - 1 h 15 min
A10
94 A10
Cambridge
Ely
Newmarket

2 Manea Rd, Wimblington, March
Send directions to your phone
via A142
typically 40 - 55 min
DETAILS
via B1101
typically 50 min
via A142 and A10
typically 50 min - 1 h 5 min
2 Manea Road
6 Chippenham Road
50 min - 1 h 5 min
50 min
40 - 55 mins
Ely

4 Eriswell Rd, Bury Saint Edmunds
Pools Rd, Wilburton, Ely CB6 3RE
Send directions to your phone
via A1101 and A10
typically 35 - 50 min
via B1102 and A1123
typically 35 - 45 min
DETAILS
via A1101
typically 35 - 45 min
Pools Road
4 Eriswell Road
35 - 50 mins
35 - 45 mins
35 - 45 mins


The Toll House
Send directions to your phone
via B1102
typically 26 - 35 min
DETAILS
via B1104 and B1102
typically 30 min
via A142 and B1102
typically 28 - 40 min
28 - 40 mins
26 - 35 mins
30 min
Live traffic


Long Ln, Feltwell, Thetford IP26
Send directions to your phone
via A10
DETAILS
via Southery Rd and A10
via A14
typically 55 min - 1 h 15 min
45 min - 1 h
55 min - 1 h 10 min
Long Lane
Live traffic


2 Manea Road
4 Friswell Road
45 - 50 mins
50 min - 1 h 10 min


18 Churchill Road
50 min - 1 h 5 min
6 Chippenham Road


2 Manor Road
14 Eriswell Road


18 Churchill Road
50 min - 1 h 5 min
6 Chippenham Road

9.0 Traffic Modelling Output

Table 36 below provides the summary of the traffic modelling output for each of the eight options that have been considered as part of this study. This is the change in PCU hours and kilometres compared to the base figures.

Table 37 provides the summary of the traffic modelling output for each of the eight options for the change in PCU hours and kilometres compared to the demand matrix.

Figure 35 and figure 36 provides graphs to represent the summary of the traffic modelling output for each of the eight options that have been considered as part of this study. This is the change in PCU hours and kilometres compared to the base figures.

Figure 37 and figure 38 provides graphs to represent the summary of the traffic modelling output for each of the eight options for the change in PCU hours and kilometres compared to the demand matrix.

Appendix C provides all the maps that relate to the table.

				Change PCU hours vs Base			Change PCU kilometres vs Base		
Year	**Option**	**Time period**	**Demand Case**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**
2016	Option 1	AM	Central	32	14	70	1206	443	1407
2016	Option 2	AM	Central	20	6	28	951	285	1006
2016	Option 3a	AM	Central	23	8	46	706	204	630
2016	Option 3b	AM	Central	9	7	27	517	235	793
2016	Option 4a	AM	Central						
2016	Option 4b	AM	Central						
2016	Option 5	AM	Central	23	10	28	1449	1314	1673
2016	Option 6	AM	Central						
2016	Option 7	AM	Central	-1	0	-1	-14	4	2
2016	Option 8	AM	Central	0	0	-3	545	442	495

Table 36 – Summary output for change in PCU hours and Kilometres vs base

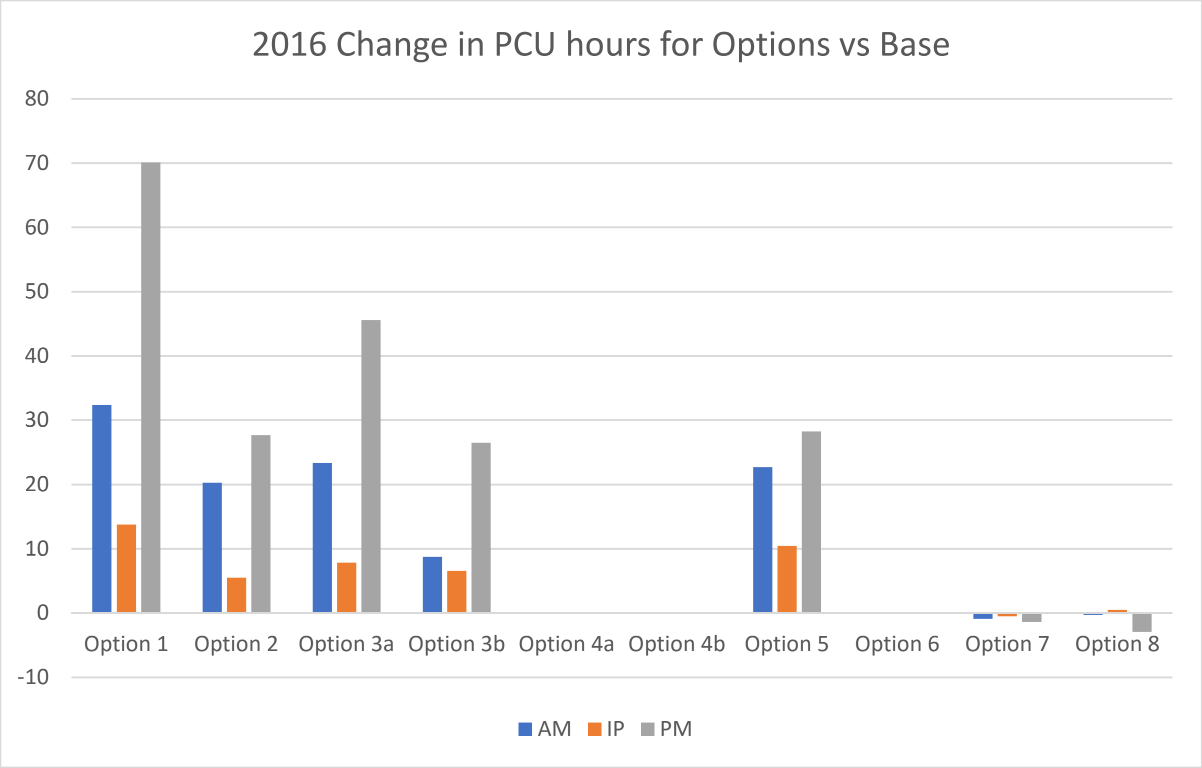


Figure 35 – Summary output for change in PCU hours vs base

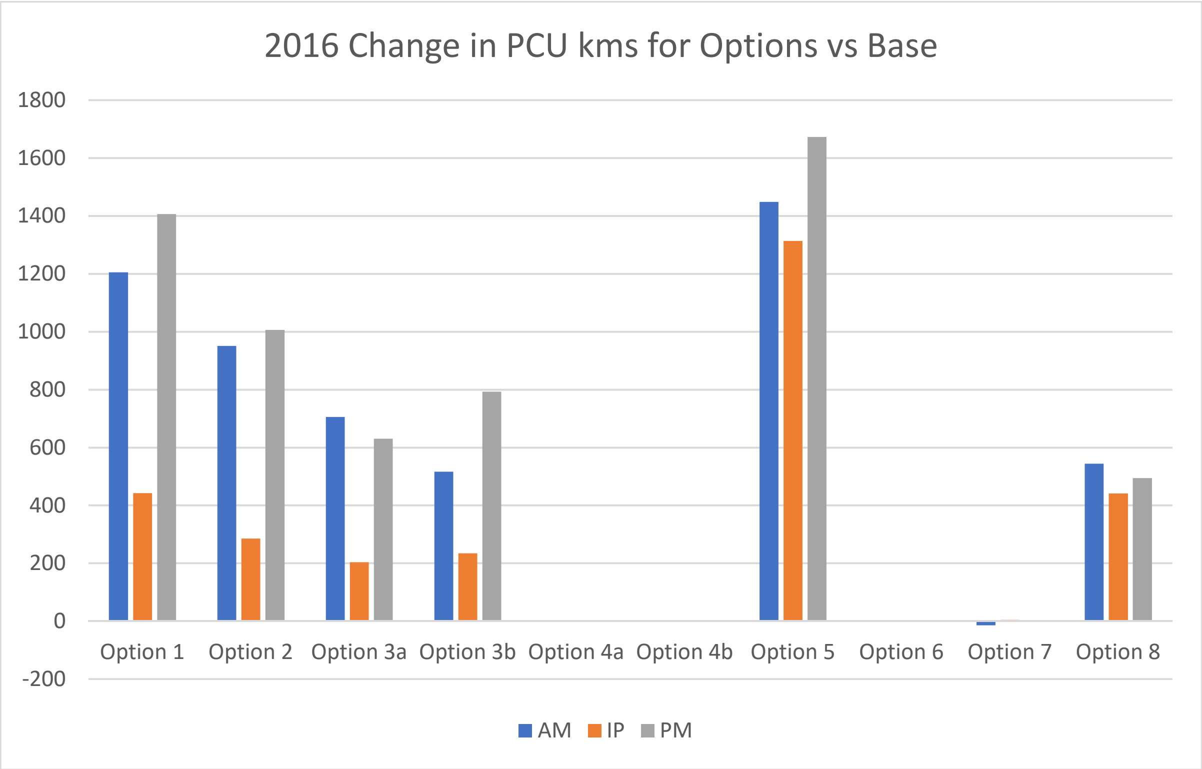


Figure 36 – Summary output for change in PCU Kilometres vs base

				Change PCU hours vs DM			Change PCU kilometres vs DM		
Year	**Option**	**Time period**	**Demand Case**	**AM**	**IP**	**PM**	**AM**	**IP**	**PM**
2036	Option 1	AM	Central	44	15	61	1170	712	1313
2036	Option 2	AM	Central	22	6	31	743	406	823
2036	Option 3a	AM	Central	25	7	21	705	433	517
2036	Option 3b	AM	Central	20	9	43	452	329	847
2036	Option 4a	AM	Central						
2036	Option 4b	AM	Central						
2036	Option 5	AM	Central	28	13	36	2177	1770	2215
2036	Option 6	AM	Central						
2036	Option 7	AM	Central	-2	0		-1	4	
2036	Option 8	AM	Central	1	2	2	844	629	617

Table 37 – Summary output for change in PCU hours and Kilometres vs DM

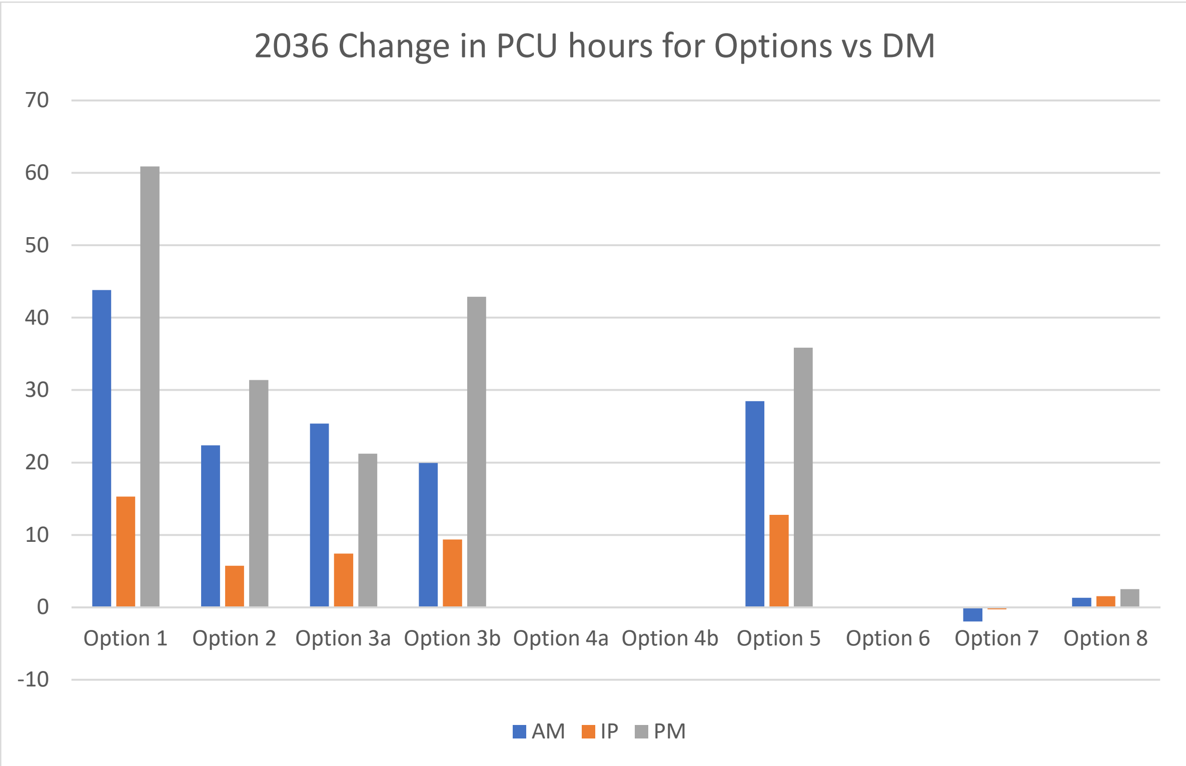


Figure 37 – Summary output for change in PCU hours for options vs base

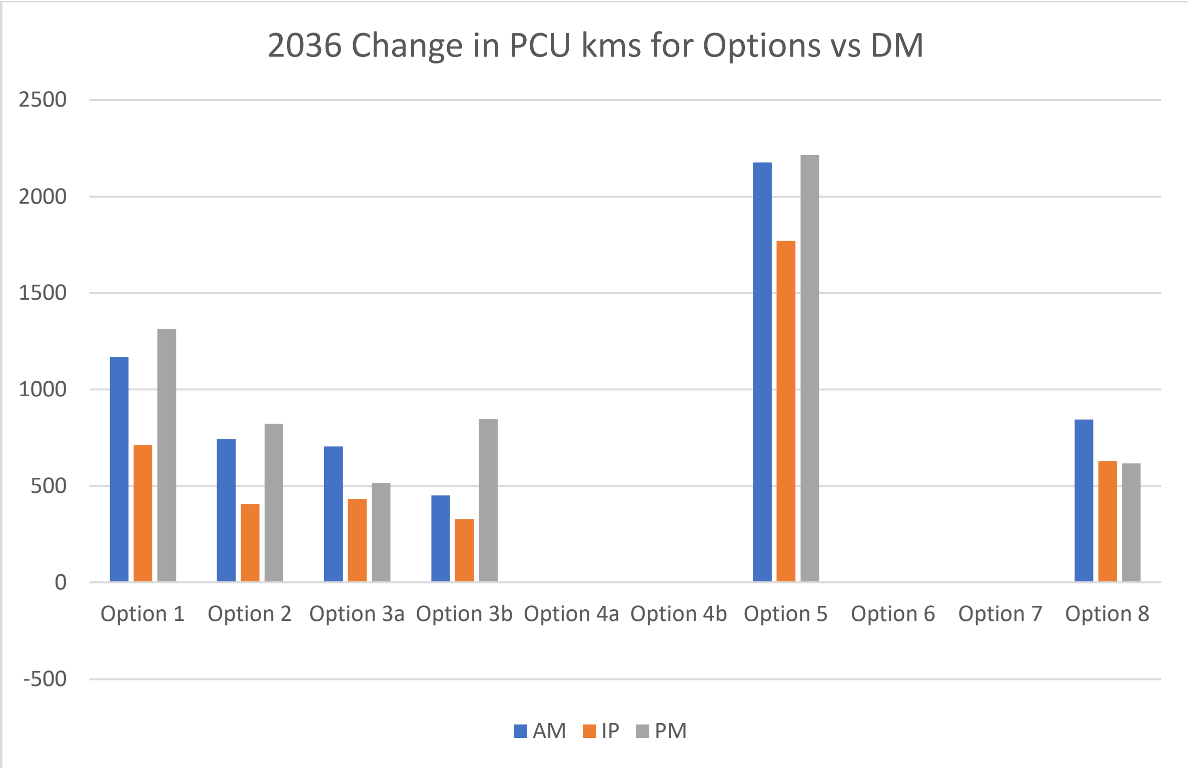


Figure 38 – Summary output for change in PCU Kms for options vs base

10.0 Recommendations

Having analysed all the data collected on the existing situation along with the comments received during the stakeholder engagement task, it is our opinion that any option taken forward by Cambridgeshire County Council and Network Rail requires a provision for local residents and businesses. This is due to the location of the area and the increase in journey time for any option outlined in this report that doesn't provide an exemption.

It isn't viable to introduce full barrier level crossings at this location without restricting traffic in some capacity due to the close proximity of the three level crossings and the increase in barrier down time. Therefore it is our recommendation that either Option 2 - Allow local traffic through the Peterborough and Kings Lynn level crossings, Option 7 - Implementing a Bridge over the Peterborough line, or Option 8 - Constructing a Ely Northern By-Pass north of Queen Adelaide is implemented prior to any adjustments to the existing level crossing arrangements at the Peterborough, Kings Lynn, or Norwich lines.

The results of the strategic road modelling demonstrate that the impact on the wider road network with the additional vehicles as a result of implementing option 2 is negligible. Due to the contrast in cost of implementation option 2 appears to be more favourable. However this option requires the implementation of a TRO which requires ongoing enforcement and also work to determine what might be classied as local traffic which could be problematic. This highlights the need for further investigation.

Whilst there are a number of examples where local authorities have successfully implemented TRO's restricting traffic through a road or route, the examples found have all been the responsibility of the local authority to enforce. It is possible to tie this enforcement into ongoing enforcement strategies such as Yellow Box Junctions and bus lane enforcement.

It appears that under the existing Traffic Management Act in Cambridgeshire the responsibility of enforcing any TRO along Ely Road in Queen Adelaide would be the responsibility of the Police.

Therefore it is vital that consultation with the Police is undertaken on any proposal to implement a TRO at a very early stage.

It is worth noting that option 2 may result in local businesses losing trade as passing trade is likely to diminish as a result of the restriction along Ely Road. This is reinforced by comments provided during the stakeholder engagement task.

Results of the queue length surveys demonstrate that restricting traffic through the level crossings to only local traffic will not impact the level crossings. It is likely that no more than three of four vehicles will be queuing at any given time based on the existing queue length surveys providing an average of only three vehicles queueing at the Peterborough and Kings Lynn crossing, and between two and three vehicles queuing at the Norwich crossing.

Appendices

Appendix A- ATC Data

Appendix B- Queue Length Tables

Appendix C- Traffic Modelling Outputs

Appendices are available on request by emailing:
Transport.Plan@Cambridgeshire.gov.uk

Or available to view in Shire Hall Room 301 by appointment.