MOTT MACDONALD

Ely to Cambridge Transport Study

Strand 2 New Town North of Waterbeach Transport Report

1 February 2018

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1 Introduction

1.1 Study Background

Mott MacDonald has been commissioned by Cambridgeshire County Council (CCC) to deliver the Ely to Cambridge Transport Study. The indicative study area includes the rail route and the A10 route between Cambridge and Ely, the B1049 between Wilburton and the A14 at Histon Interchange, and the B1047 though Horningsea and Clayhithe to the A14.

As specified in the study brief, the outputs of the study will be:

- Strand 1 – An Options Study and Strategic Outline Business Case for the overall package of interventions in the Ely to Cambridge study area, including development of principles/mechanisms for securing appropriate developer contributions.
- Strand 2 – A Transport Study to identify the specific transport requirements, access options and measures, their costs, acceptability and any implications for the phasing of development of a new town north of Waterbeach.
- Strand 3 – A Transport Study to identify the specific transport requirements, access options and measures, their costs, acceptability and any implications for the levels of development and phasing of, a significant parcel of land in the north-east of Cambridge, known as Cambridge Northern Fringe East (CNFE) and Cambridge Science Park (CSP).

In accordance with the above study scope, this report identifies an infrastructure package – and the phasing of that package – to provide for the transport demand of the development of a new town north of Waterbeach.

The new town north of Waterbeach site comprises 558 hectares of brownfield and agricultural land on the site of the former Waterbeach Barracks and Airfield, before it was closed in 2013. The new town north of Waterbeach is identified as a Strategic Site in the South Cambridgeshire Emerging Local Plan[1].

1.2 Report Structure

The report is structured as follows:

- The existing conditions are outlined in Section 2
- The development proposals are outlined in Section 3
- The future conditions are described in Section 4
- The proposed interventions are identified in Section 5
- Implementation considerations are discussed in Section 6
- The report is summarised in Section 7

[1] South Cambridgeshire Local Plan, Proposed Submission, July 2013

2 Existing Conditions

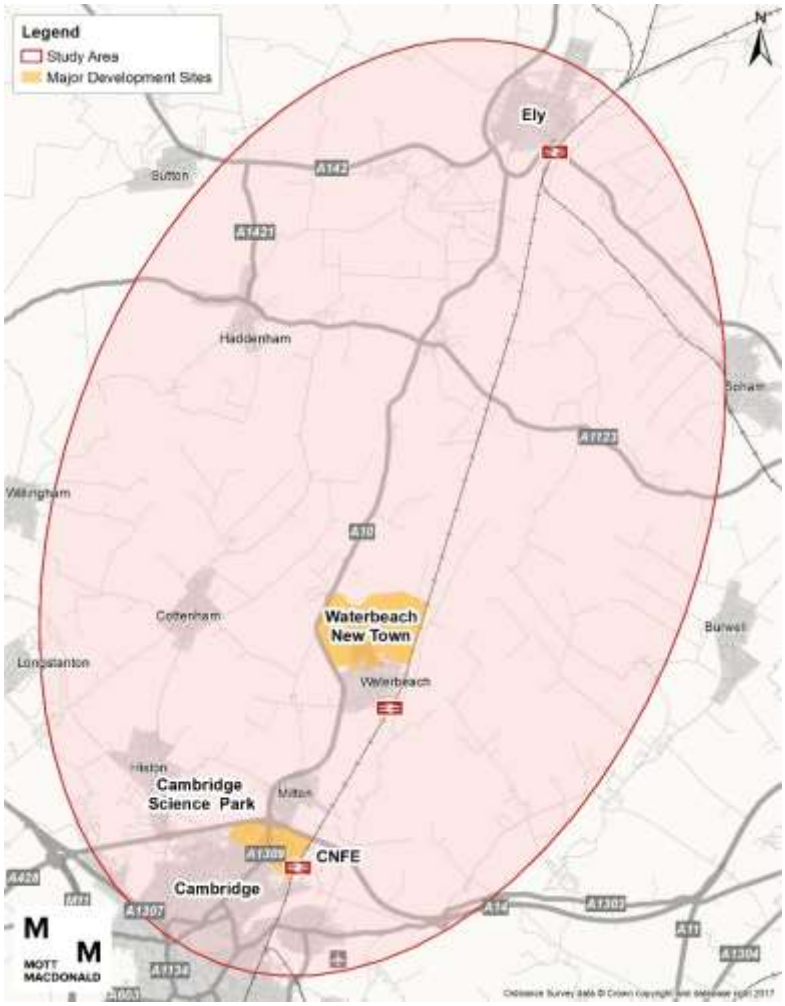
The purpose of this section is to provide a summary of the existing status of the development site, the travel demand they generate and the performance of the surrounding transport network.

2.1 Development Site Status

Waterbeach is one of the main settlements within the A10 study area, located around five miles north of Cambridge and ten miles south of Ely. The village has a population of around 4,200 people[2]. Land use is primarily residential with some office and industrial employment, focussed mainly at the two cluster locations of Cambridge Research Park and Denny End Industrial Estate.

The subject development site is the former Waterbeach Barracks and Airfield, closed in 2013, which is located directly north of Waterbeach village.

Figure 1: Indicative Ely to Cambridge Transport Study Area



Source: MM

[2] ONS mid-year estimates 2014

The site is around 558 hectares in size and is currently minimally developed, with only the existing buildings and infrastructure required to support the former Barracks and Airfield.

2.2 Development Travel Demand

Following the closure of the Waterbeach Barracks and Airfield, the site has provided sports facilities for the local community, while the control tower has been converted into an office and meeting space. These uses generate only a relatively modest number of trips with little impact on the external network.

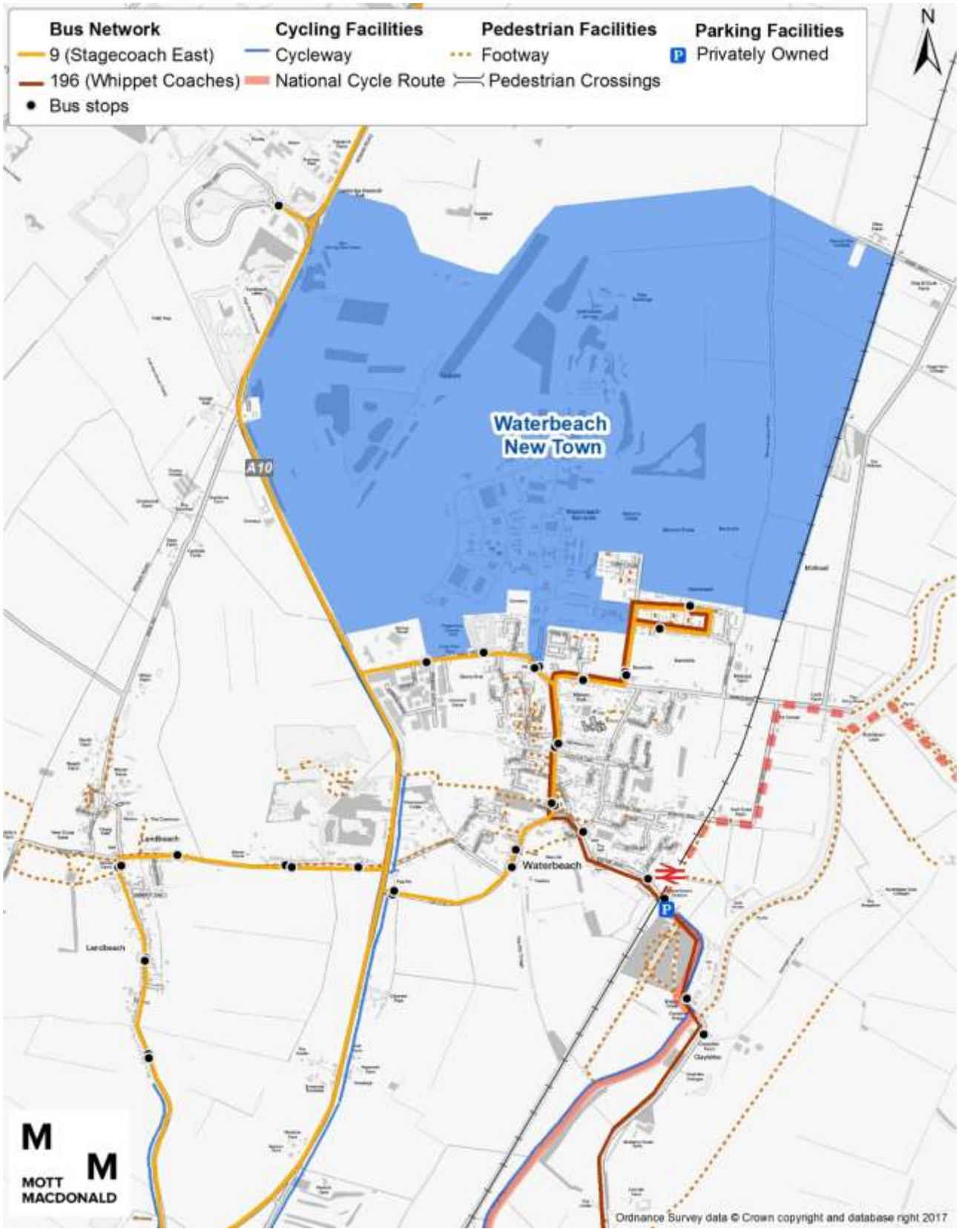
A number of buildings are currently being converted into residential accommodation for Papworth hospital staff, which will hold 235 bed spaces.

2.3 Transport Network Performance

2.3.1 Summary of Transport Provision

Figure 2 illustrates the main transport networks which serve the Waterbeach Barracks site. Each element is discussed in more detail in the following sections.

Figure 2: Waterbeach transport network



Source: OpenStreetMap & TRACC

2.3.2 Highway Network

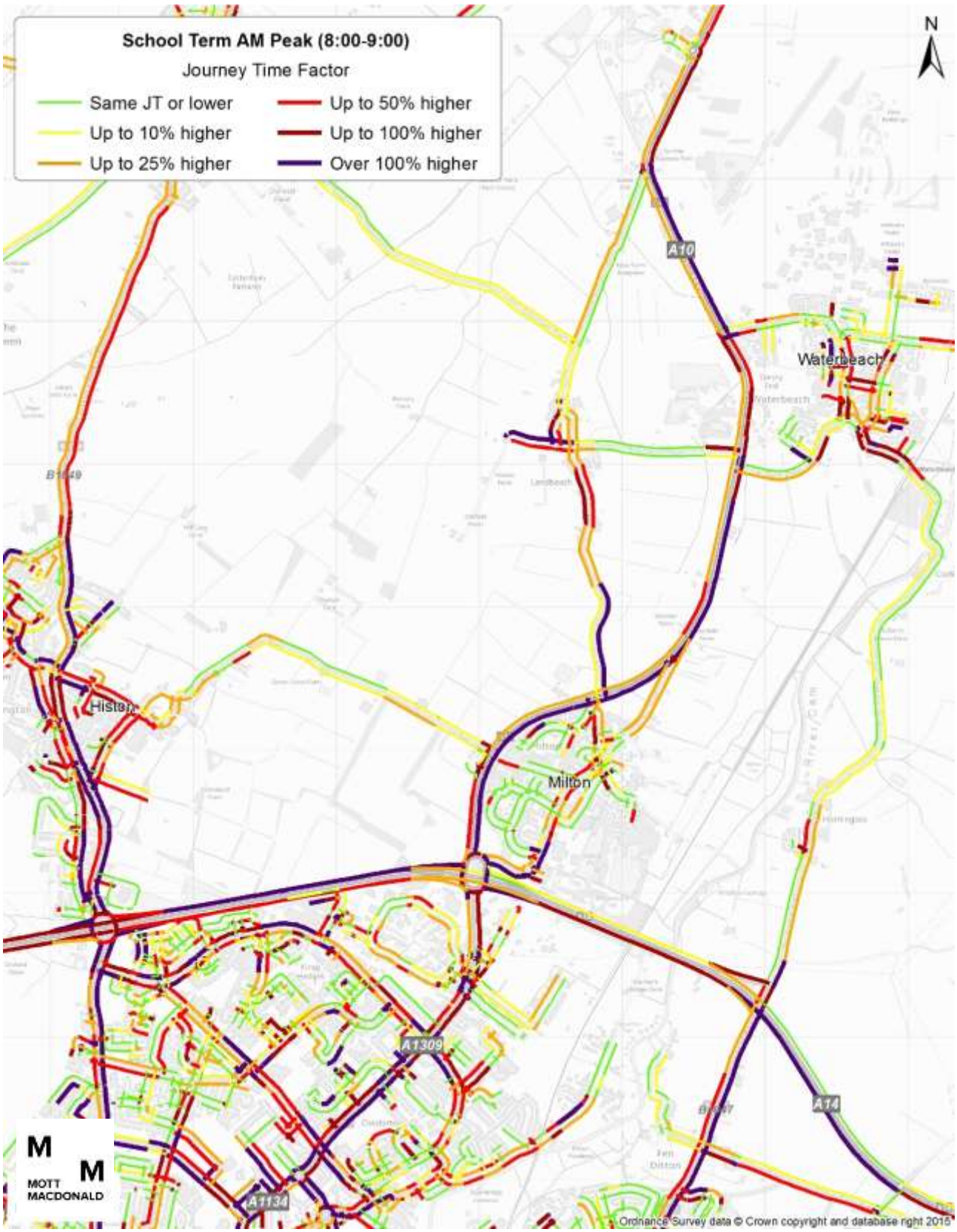
As outlined previously, the new town north of Waterbeach site is well located with respect to the strategic network and to nearby Cambridge. The site has good access to the strategic road network in the form of the A10 which runs directly adjacent to the west of the site. The closest access is available at the priority junction at Denny End Road which is directly to the south of the site. However, access is also available on the southern side of Waterbeach at the Car Dyke Road priority junction. In addition, Clayhithe Road provides a secondary access route to Cambridge and to the A14(W).

A full journey time assessment of the existing road network is provided within the Baseline Report, and the Trafficmaster 2013/14 journey time results are repeated in Figure 3 and Figure 4 below to illustrate peak hour congestion conditions in the vicinity of the two sites.

These show:

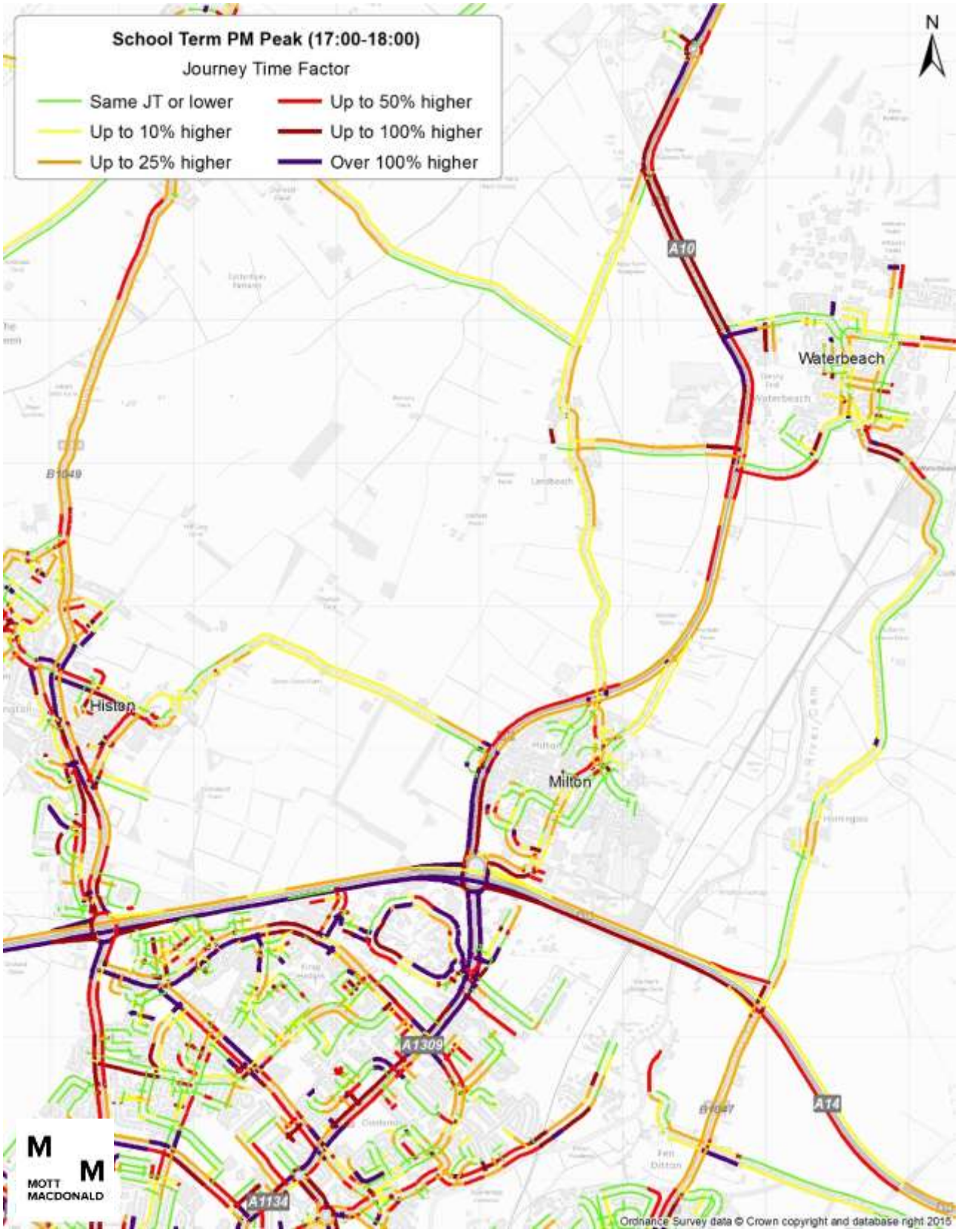
- Significant southbound AM peak delay on the A10 from north of Waterbeach into Cambridge city centre
- Significant southbound AM peak delay on Horningsea Rd from the junction with the A14 onwards
- Significant AM peak delays on all approach arms to the Interchange at Milton
- Significant northbound PM peak delay on the A10 from Waterbeach northwards. Also congestion on links between Waterbeach and the A10
- Significant PM peak delays either side of Milton Interchange on the A10 and the A1309

Figure 3: School term-time AM Peak journey times as factor of free-flow journey times



Source: Trafficmaster 2013/14 averages

Figure 4: School term-time PM Peak journey times as factor of free-flow journey times



Source: Trafficmaster 2013/14 averages

2.3.3 Rail Network

Waterbeach benefits from a mainline rail station providing fast links to Cambridge, Ely and the East Coast Mainline, with connections to London and other regional centres. Table 1 lists a selection of destinations, journey times and service frequencies from the Waterbeach station, listed in ascending order of journey time.

Table 1: Train services from Waterbeach

Destination	Duration	Weekday Frequency
Cambridge	7 minutes	15-30 mins
Ely	10 minutes	30-60 mins
Kings Lynn	40 minutes	30-60 mins
London Kings Cross	60 minutes	30-60 mins

We do not have access to station-level rail punctuality data so cannot comment on the existing performance of the rail network in this area. However, as outlined in the Baseline report, the journey times compare favourably to the highway peak period journey times to the same locations. Passenger numbers at the station have grown consistently since 1997/98 at above the average East region and England growth levels.

Whilst access to the rail network is available, the rail station is located to the south east of the existing Waterbeach village centre, resulting in the station being located around 1.3 miles from the southern extent of the development site and around 2 miles from the northern extent, which equates to about a 25 to 39 minute walk respectively[3]. This makes the existing rail station relatively remote from the development site, though the journey by cycle would take a more accessible 8 to 13 minutes[4].

2.3.4 Bus Network

As illustrated in Figure 2, the Waterbeach area is currently served by two bus services. Table 2 outlines the frequencies of these services, which is low for the 196 service, but every 30 minutes for the number 9 service. Travel time by bus between Waterbeach and Elizabeth Way in Cambridge is around 30 minutes during the peak periods, compared to around 20 minutes for cars[5].

Table 2: Bus frequencies serving Waterbeach

Service	Destination (from Cambridge)	Day Frequency	Evening Frequency	Weekend Frequency
9	Chatteris, via Waterbeach	30 mins	30 mins until 19.15	Sat only, 30 mins
196	Waterbeach via Horningsea	12.15, 14.15, 17.45	-	-

Currently neither of the bus services run through the former Waterbeach Barracks site. Figure 2.5 illustrates the 400m catchments of bus stops around the Waterbeach area. Whist nearly all of the existing Waterbeach settlement falls within 400m of a bus stop, only the southern extent of the Barracks site falls within 400m of a bus stop. Whilst the bus stop within the Cambridge Research Park is technically within 400m of the site, the A10 results in a significant barrier to accessing this service.

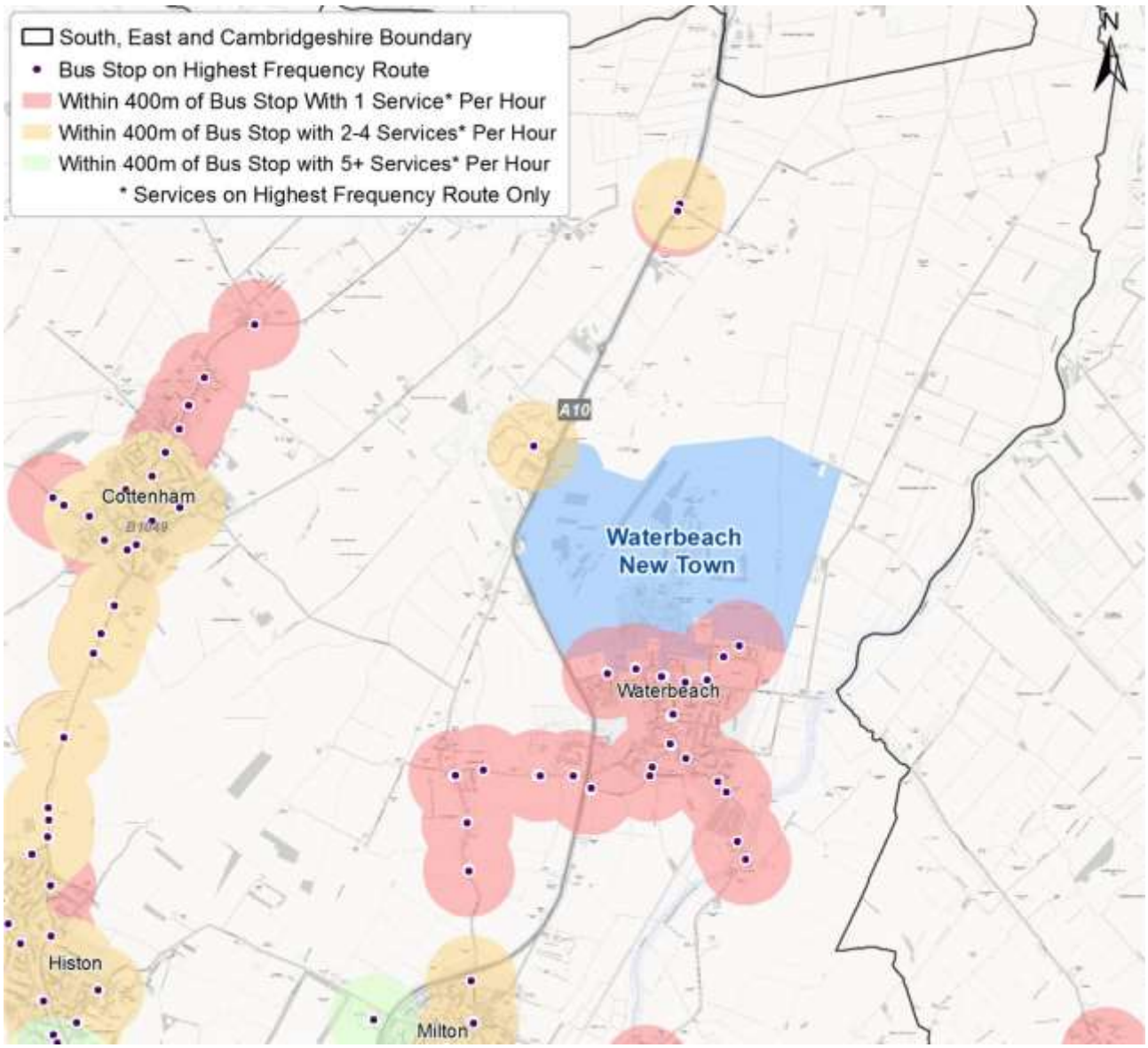
Based on Census Travel-to-Work data, the study Baseline Report shows that the majority of Waterbeach residents work in Cambridge, Milton, Histon or Cambourne. These can be accessed either directly or through a connecting service via the above service provision.

[3] Based on a standard average walking speed of 3.1 mph

[4] Based on a standard average cycling speed of 9.6 mph

[5] Based on 2013-14 Trafficmaster journey time data

Figure 2.5: 400m catchment areas for bus stops of different service frequencies



Source: TRACC and 2011 Census

2.3.5 Active Mode Network

As illustrated in Figure 2, there are two cycleways connecting the Waterbeach settlement to destinations to the south. To the east of the railway line, there is the national cycle route 11. This is part of a longer route stretching from Harlow to Kings Lynn which, when complete, will be 91 miles long. The route is currently incomplete between Waterbeach and Wicken Fen, although it provides a good connection between Waterbeach and Cambridge.

The second route is the existing pedestrian/cycleway which runs along the A10 between Waterbeach and Cambridge, although the route does not stretch as far north as the Waterbeach barracks site. The pedestrian/cycleway is segregated from traffic.

It is noted that Milton is just within the 2.4-mile average utility cycling distance defined by DfT[6], but that Cambridge is over twice this distance. However, the DfT acknowledge that commute distances by cycle can be three times greater than this average.

There is a pedestrian network of footpaths located within the existing settlement, although this does not extend to within the development site itself. Most notably, pedestrian footway provision along the A10 is discontinuous and there are no crossing facilities.

2.4 Summary

In summary:

- Now that the former barracks and airfield uses have ceased, the development site is host to a minor level of development and generates few trips on the external network.
- The development site has good access to the strategic road network in the form of the A10 which runs directly adjacent to the west of the site. In addition, Clayhithe Road provides a secondary access route to Cambridge and to the A14(W). However, this advantage is constrained at peak times by significant levels of delay on these routes.
- There is a mainline rail station located on the south eastern side of the existing Waterbeach settlement, though it is around 1.3 miles from the southern extent of the development site and around 2 miles from the northern extent, which equates to about a 25 to 39 minute walk respectively[7]. This makes the existing rail station relatively remote from the development site, though the journey by cycle would take a more accessible 8 to 13 minutes[8]..
- The existing village of Waterbeach is served by two bus services. Stagecoach service 9 connects Waterbeach to Cambridge and Ely and runs every 30 minutes. There is also an infrequent service (196) which runs between Waterbeach and west Cambridge via Clayhithe Rd. Currently, however, no bus services penetrate the development site due to lack of demand. Bus journey times to Cambridge take about 50% longer than equivalent car journey times.
- Cycle links are present between Waterbeach village and Cambridge to the south, both via a cycleway along the A10 and a national cycle route parallel to the railway. However, areas other than Cambridge and Milton are harder to access by cycle.
- A network of pedestrian routes exists within the village and there is a pedestrian footway on the west side of the A10 between the village and Cambridge, and along the river Cam. The main walkable destination for which there is no pedestrian route is the Cambridge Research Park on the other side of the A10. There are also no pedestrian crossings across the A10 at this location.

[6] LTN 1/04 - Policy, Planning and Design for Walking and Cycling

[7] Based on a standard average walking speed of 3.1 mph

[8] Based on a standard average cycling speed of 9.6 mph

3 Development Proposals

The purpose of this section is to define the level and type of development proposed for the Waterbeach New Town site and assumed by this study to be in place by 2031.

3.1 Land Use Proposals

The new town north of Waterbeach site is 558 hectares of brownfield and agricultural land which was formerly used as the Waterbeach Barracks and Airfield, before it was closed in 2013. The site is identified in the South Cambridgeshire Emerging Local Plan[9] as a strategic site for development. The Plan envisages a new town encompassing approximately 8,000 to 9,000 dwellings to north of the existing village.

Based on feedback from the site's prospective developers, the full build-out aspirations are as illustrated in described in Table 3 below. In agreement with the developers and the client group, this scenario assumes this level of full build-out by 2031. Though the South Cambridgeshire Local Plan assumes that only 1,500 homes will be built by then, the faster build-out scenario has been assumed for modelling purposes in order to ensure a robust assessment of the full development.

Table 3: New town north of Waterbeach Proposals

Description	Development Class	Quantity	Profile Through Time				Units	Jobs
		Total	2016	2021	2026	2031		
Dwellings	Houses	10,000		2,100	2,500	5,400	Houses	
	Apartments						Apartments	
Retail (including food and drink)	Convenience	15,000		3,150	3,750	8,100	GFA sqm	750
	Comparison / Service						GFA sqm	
Industrial	Light Industrial						GFA sqm	
Other: Leisure and Health	Hotel(s)	6,000			6,000		GFA sqm	450
	Health / Fitness Centre						GFA sqm	750
	Place of Worship						GFA sqm	
Office	Commercial	5,000		1,050	1,250	2,700	GFA sqm	320
	Academic Research						GFA sqm	
Pre-School							Pupils	800
Primary School		2,160		454	540	1166	Pupils	
Secondary School		1,800		378	450	972	Pupils	
Sixth Form		360		76	90	194	Students	
Adult Education							Students	
Other Uses / General / Sui Generis							GFA sqm	400
On Site Job Estimates								3,470
Homeworking								2,573
Cambridge Research Park								2,507
Cambridge Research Park Hotel								56
Jobs Estimate Total (including home working and CRP buildout)								**8,606**

Source: Peter Brett Associates on behalf of Urban & Civic and RLW

[9] South Cambridgeshire Local Plan, Proposed Submission, July 2013

3.2 Transport Proposals

The developers propose a range of transport measures to enable this development to be delivered sustainably and with the least negative impact on the surrounding transport networks. As part of the full development, these measures include:

- The main access to the site will be via the A10. Two vehicle access points are proposed: one via a fourth arm off the existing Cambridge Research Park roundabout; and another to the north of the A10/Denny End Road junction (arrangement and scale to be agreed and determined).
- Direct links will be provided for buses, cycles and pedestrians between the development and the adjacent village to encourage interaction by these modes, but no direct links will be provided for private vehicles in order to minimise development-related vehicular traffic impacts through the village and on the Horningsea Road route to the A14 and Cambridge.
- Public transport will be given priority through the provision of bus priority measures within the site, along the A10 and along adjacent routes to the A10. Improvements to the rail station will initially take place in the current location, and ultimately by relocating it to a new position immediately to the east of the site.
- Internal spatial layout and design will encourage use of non-car modes for internalised trips.
- Car parking within the development will be provided to meet relevant policy at the time of the relevant reserved matters application, but will aim to provide a balance between providing for car users and encouraging non- car modes.

3.3 Summary

In summary, full build-out of the development by 2031 is proposed to comprise 10,000 houses and over 3,000 on-site jobs. The site is proposed by the developers to be accessed directly from the A10 via a north and south access, while provision for non-car modes is proposed to be enhanced and prioritised in order to minimise the impact of private-vehicle trips on the external network.

4 Future Conditions

The purpose of this section is to describe the future transport conditions predicted by modelling to result from the implementation of the full development proposals without development-specific mitigation in place.

4.1 Modelling Method

Modelling of future transport conditions in Cambridgeshire has been carried out using Cambridgeshire County Council's updated Cambridge Sub-Regional Model (CSRM2). CSRM2 is a WebTAG-compliant strategic model which uses base data from 2015, including:

- Validation against recently collected traffic and transportation counts
- All networks (highway, PT, walk, cycle)
- Representation of parking and Park & Ride
- Base transport movement data
- Base land use data
- Matrices derived using a mix of RSI and mobile phone data

Investigations undertaken on behalf of CCC of model performance and journey times in the study area confirm that the model is fit for use in the assessment of this phase of the project.

CSRM2 comprises a highway model, which uses SATURN software, and a multi-modal demand model. This combination allows CSRM2 to simulate the following transport user choices in response to a change in supply and/or demand:

- Change of travel route
- Change of travel time
- Change of travel mode
- Change of travel destination

The modelling work is based on two future modelling scenarios as follows:

- The Future-Base Scenario, which represents the hypothetical future situation in 2031 where neither the new town north of Waterbeach, CNFE nor CSP intensification developments take place
- The Combined Scenario, which represents the future situation in 2031 where both the new town north of Waterbeach and CNFE/CSP developments take place

Both scenarios have been tested against a 'Do Minimum' transport network in order to identify the unmitigated transport impacts of the above developments through comparing one scenario with the other. The Do Minimum network includes all planned transport schemes in the modelled area with a likelihood status of 'certain' or 'near certain' (see Do Minimum Modelling report for more details).

It is also noted that all modelling results presented below are for the AM and PM weekday peak hours, which are:

- AM peak: 08:00-09:00
- PM peak: 17:00-18:00

4.2 Development Trip Details

In this section, the impacts of the new town north of Waterbeach in the Combined Scenario Do Minimum CSRM model is considered in terms of the transport parameters of total person trip generation, mode share, site internalisation levels and external trip generation and distributions. The level of development modelled at the site is set out in Table 3, at 10,000 homes and 3,470 jobs.

4.2.1 Trip Levels

In order to understand how travel demand for the new town north of Waterbeach has been represented in the CSRM2 model, outputs from the CSRM2 demand model have been interrogated. The peak periods used in the demand model are as follows:

- AM Peak (07:00-10:00)
- PM Peak (16:00-19:00)

Conversion factors provided by Atkins have been applied to convert the 3-hour peaks to 1-hour peaks to keep the results consistent with the highway model outputs. Therefore, as outlined above, the peaks investigated are:

- AM Peak (08:00-09:00)
- PM Peak (17:00-18:00)

The level of all-mode person-trip generation calculated by the CSRM demand model for the new town north of Waterbeach is shown in Table 4 below.

Table 4: Development person trip generation

Parameter	AM (08:00-09:00)			PM (17:00-18:00)		
	Departures	Arrivals	Total Trips	Departures	Arrivals	Total Trips
External trips	3,509	1,195	4,704	2,113	3,612	5,725
Internal trips	1,980	1,980	1,980	1,305	1,305	1,305
All	**5,489**	**3,176**	**6,684**	**3,418**	**4,917**	**7.030**

Source: CSRM

The table shows that a higher number of person trips are expected to depart the development in the AM peak rather than arrive, with the opposite being true in the PM peak. This tidal pattern is consistent with the predominantly residential development mix proposed, but can lead to acute pressures on the surrounding network during peak times.

Based on the above 'Total Trips' data in Table 4, Table 5 shows the overall level of trip internalisation at the new town north of Waterbeach calculated by the CSRM2.

Table 5: Level of development trip internalisation

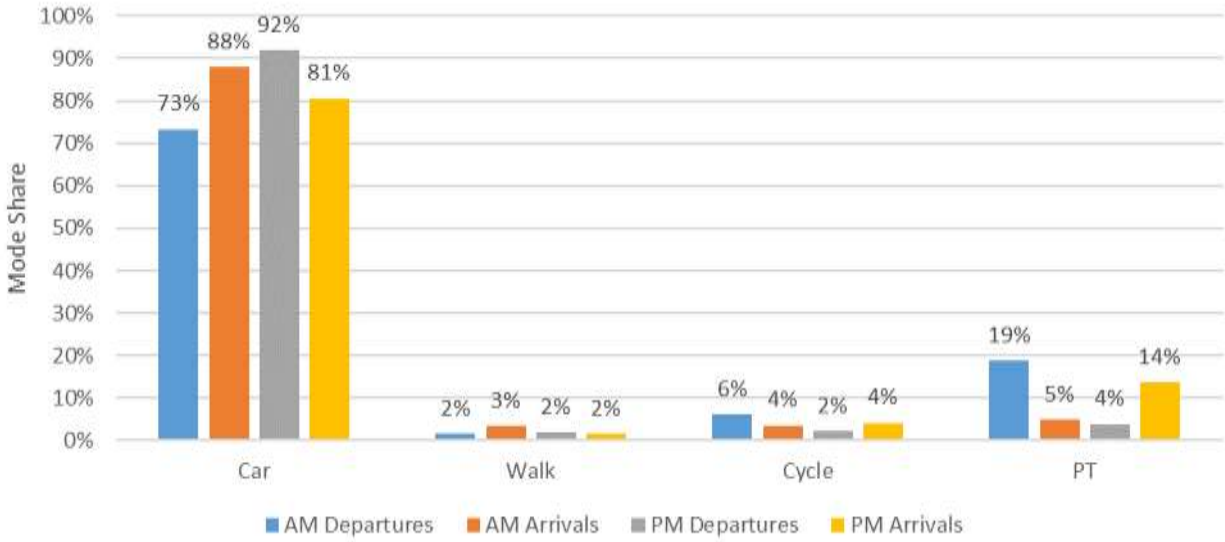
Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Proportion of trips	30%	70%	19%	81%

Source: CSRM

4.2.2 Mode Share

Figure 6 below shows the mode share for the new town north of Waterbeach external trips calculated by CSRM2. These are the trips which generate impact on the external transport network.

Figure 6: Forecast mode share for external development trips



Source: CSRM

This chart shows that the model forecasts a lower car mode share for trips produced by the site in the morning and returning in the evening than for trips attracted to the site in the morning and leaving in the evening. This is because more of the trips produced by the site are attracted to nearby Cambridge, for which there are a range of non-car travel options, whereas there are more trips attracted to the site being drawn from areas where travel by car is the main option.

4.2.3 Car Trips

Table 6 outlines how the above analysis translates into car trips and actual vehicles using the external network. It is noted that all these vehicles must use the A10 for at least part of their trip.

Table 6: External car trip generation

Parameter	AM Peak (08:00-09:00)			PM Peak (17:00-18:00)		
	Departures	Arrivals	Total Trips	Departures	Arrivals	Total Trips
Person trips by car	2,409	1,086	3,495	1,922	2,784	4,706
Number of cars	1,733	791	2,524	1,266	1,990	3,256

Source: CSRM

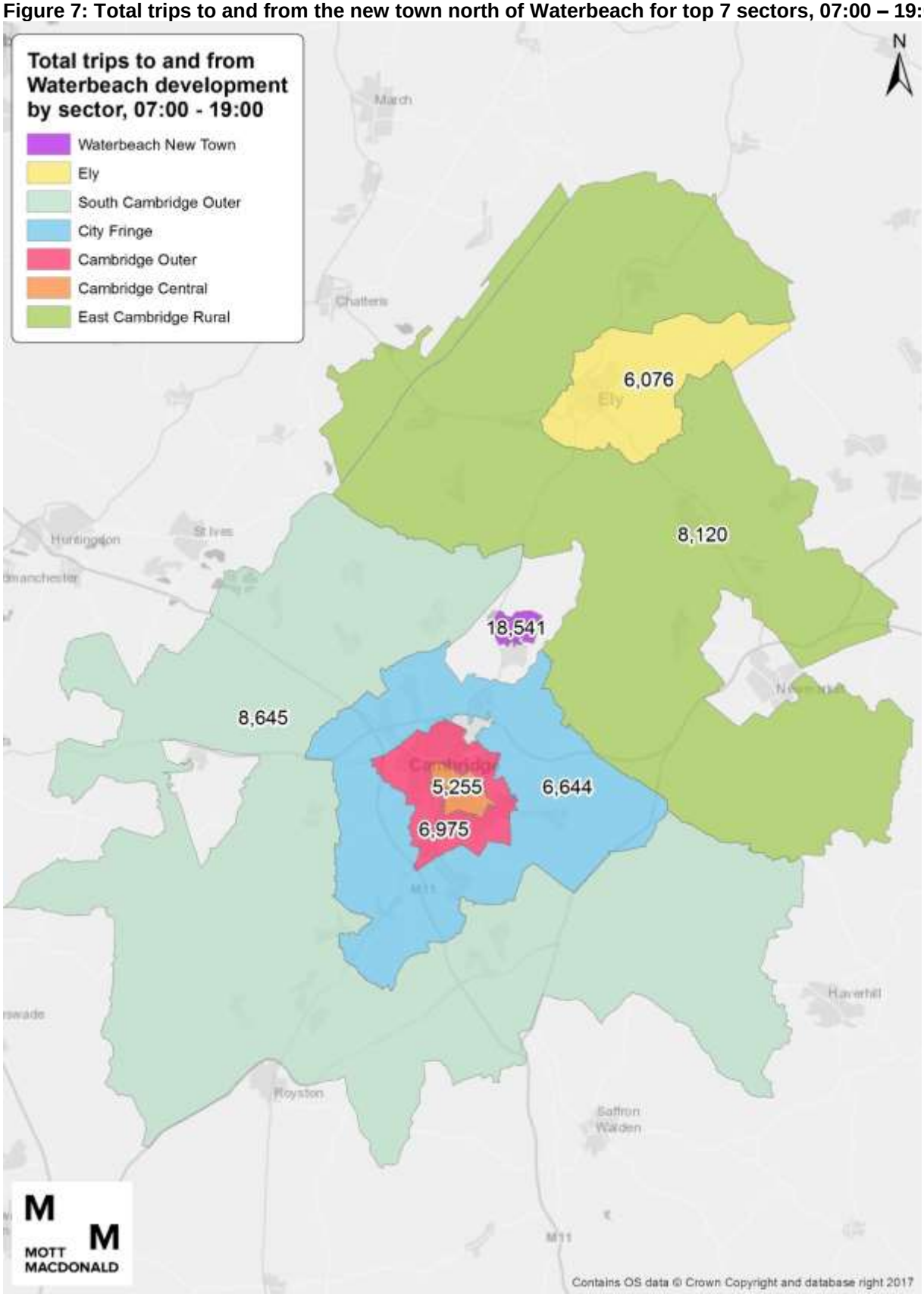
This table shows that the development is predicted to generate a total of about 2,500 car trips in the AM peak hour and about 3,250 car trips in the PM peak hour. As noted above, all these trips must use the A10 at some point in order to access or leave the development.

4.2.4 Highway Trip Distribution

Table 7 shows the top 7 sectors between which trips are generated by the proposed development at Waterbeach, and lists the actual 12-hour trip levels predicted to be undertaken by mode. Only the top 7 have been shown due to these sectors having over 5,000 total trips during the time period, whilst the remaining sectors have a far lower number.

These top 7 sectors are shown in Figure 7, and are derived from the CSRM model. A map showing all of the sectors can be found in Appendix A.

Figure 7: Total trips to and from the new town north of Waterbeach for top 7 sectors, 07:00 – 19:00



Source: Atkins

Table 7: Total trips to and from the new town north of Waterbeach by sector, 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	2,871	14,811	858	0	0	0	0	18,541
South Cambs Outer	8,416	23	74	30	68	34	0	8,645
East Cambs Rural	7,911	5	29	100	74	0	0	8,120
Cambridge Outer	5,078	40	676	275	738	1	168	6,975
City Fringe	6,131	133	168	167	43	0	0	6,644
Ely	5,680	0	17	321	59	0	0	6,076
Cambridge Central	2,395	29	669	135	1596	0	431	5,255

Source: CSRM

This table shows that, after the development itself, the sectors generating most external development trips are South Cambridgeshire and East Cambridgeshire, followed by Cambridge areas and Ely. It is noted, however, that summing the three Cambridge sectors would make the city the greatest single external origin/destination for development related trips.

Table 8 below presents the above information in terms of mode share by sector.

Table 8: Total trips to and from the new town north of Waterbeach sector (%), 07:00 – 19:00

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R
Waterbeach new town	15%	80%	5%	0%	0%	0%	0%
South Cambs Outer	97%	0%	1%	0%	1%	0%	0%
East Cambs Rural	97%	0%	0%	1%	1%	0%	0%
Cambridge Outer	73%	1%	10%	4%	11%	0%	2%
City Fringe	92%	2%	3%	3%	1%	0%	0%
Ely	93%	0%	0%	5%	1%	0%	0%
Cambridge Central	46%	1%	13%	3%	30%	0%	8%

Source: CSRM

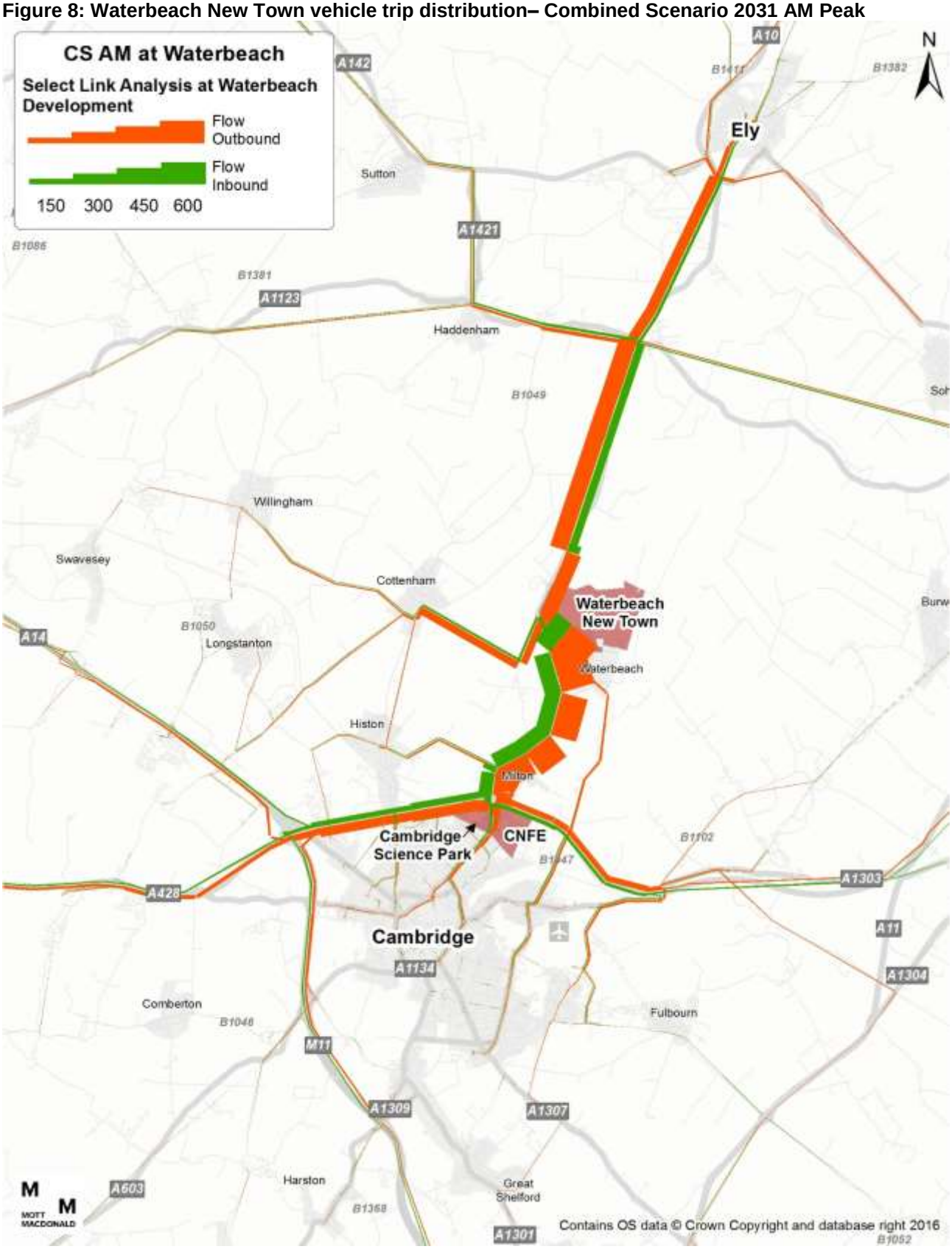
This shows clear distinction in mode share depending on which sector is being travelled to/from by development related trips. Trips to South and East Cambridgeshire show the highest car mode share, closely followed by trips to Ely. Conversely, trips to Cambridge Central, for which there are other modal options, show the lowest car mode share for external trips. This applies less to Cambridge Outer, however, and hardly at all to the City Fringe, highlighting the challenges of serving non-central Cambridge trips by other modes.

Figure 8 and Figure 9 show how the above distribution of car trips to and from the new town north of Waterbeach site impacts the 2031 highway network in terms of development flow distribution during both the AM and PM peak periods respectively.

These figures show:

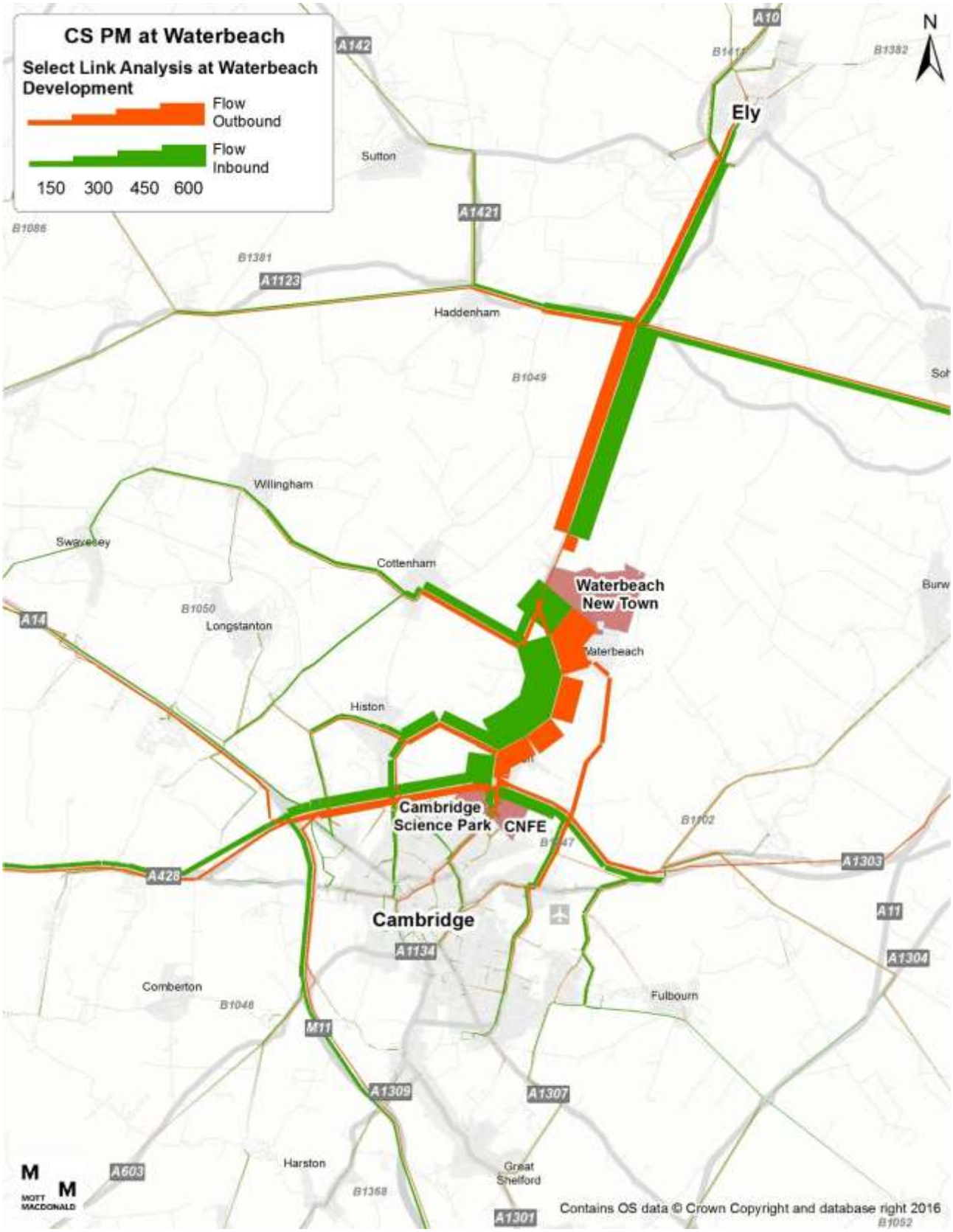
- Highest level of flow impact on A10 between the site and Milton Interchange
- Next highest level of flow impact on A10 between the site and Stretham roundabout, followed by the A10 to Ely and also on the A14
- Flow increases on Cottenham Road as far as Cottenham in both peaks, and on Milton Road / Butt Lane in the PM peak
- By contrast, relatively low levels of development flow on the Clayhithe Road route into Cambridge

Figure 8: Waterbeach New Town vehicle trip distribution– Combined Scenario 2031 AM Peak



Source: CSRM

Figure 9: Waterbeach New Town vehicle trip distribution – Combined Scenario 2031 PM Peak



Source: CSRM

4.3 Network Performance

4.3.1 Traffic Flows and Delay

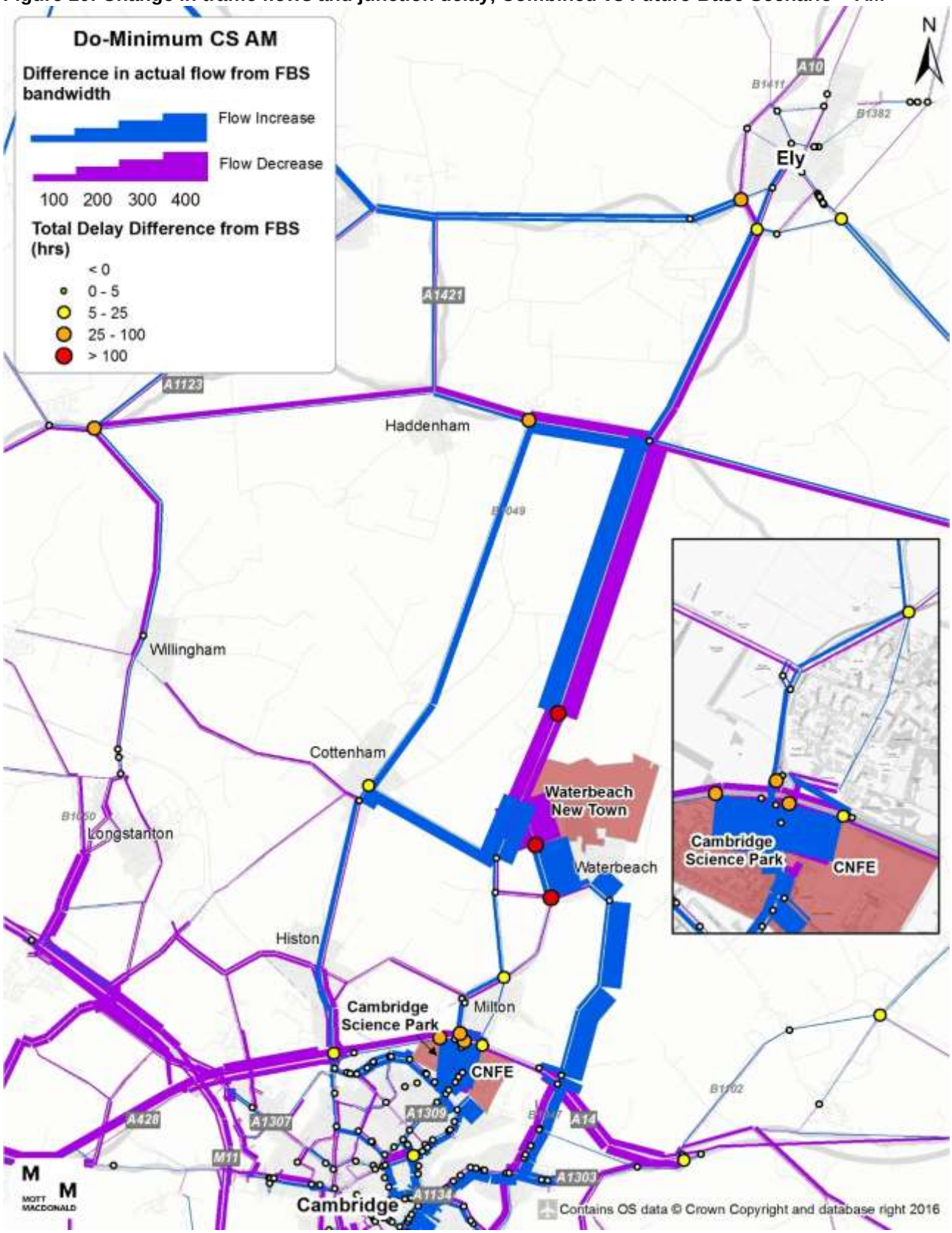
In order to estimate how proposed development is predicted to impact the performance of the highway network, the following figures show the change in traffic flow and total junction delay between the 2031 Combined Scenario Do Minimum case (ie, the 'with-development- without-mitigation' scenario) and the 2031 Future-Base Do Minimum case (ie, the 'without-development-without-mitigation' scenario). This allows the changes resulting from the new development to be observed. In order to identify junctions which are impacted by the developments, only delay *increases* are shown, and only for junctions with a V/C[10] ratio in the Combined Scenario case over 85%.

These figures show:

- In the AM peak, the main increases in flow and junction delay are on the A10/A1309 route between Ely and Cambridge. Particular junction delay impacts are seen near the new town north of Waterbeach and at Milton Interchange. As a result, there is also an increase in flow on alternative routes, including the B1049 leading to King Hedges Road and impacting Histon Interchange, and on the B1047 leading to Newmarket Road.
- In the PM peak, substantial flow and delay increases are similarly evident on the A10/A1309 route between Ely and Cambridge and on the parallel B1047, but now also on parallel routes north of the A14 between Girton, Histon and Milton. This increase is both related and contributory to delays at Histon Interchange and Milton Interchange. Flow and delay increases are also seen on Kings Hedges Road and within central Cambridge, which are also partly a result of traffic seeking to avoid the delays at the A14 interchanges.

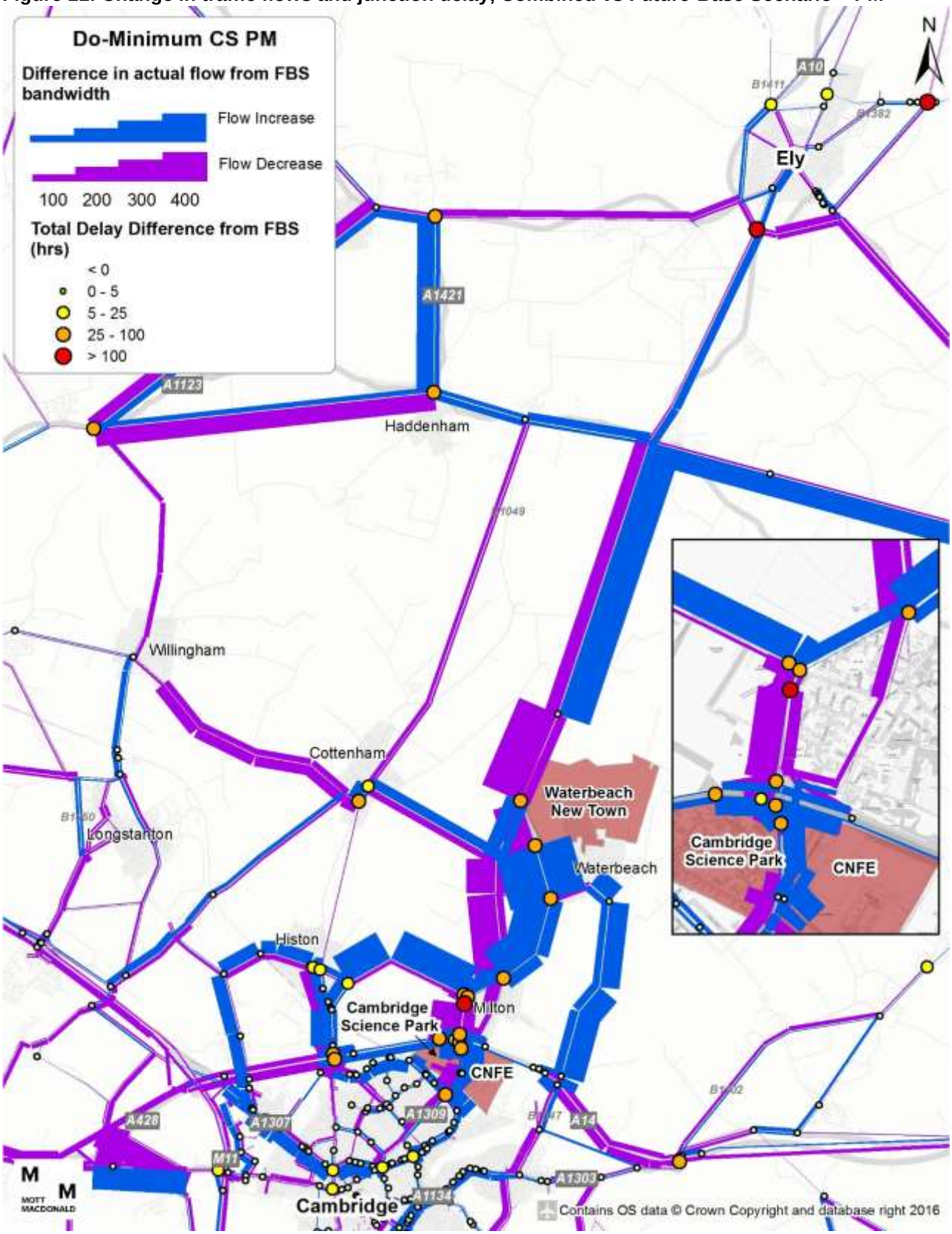
[10] V/C = ratio of traffic volume to junction capacity. This is a standard modelling measure of the operating level of a junction, where a V/C level above 85% is considered to mean a junction is operating above its effective capacity, and a level above 100% means it is operating above its absolute capacity.

Figure 10: Change in traffic flows and junction delay, Combined vs Future-Base Scenario – AM



Source: CSRM

Figure 11: Change in traffic flows and junction delay, Combined vs Future-Base Scenario – PM



Source: CSRM

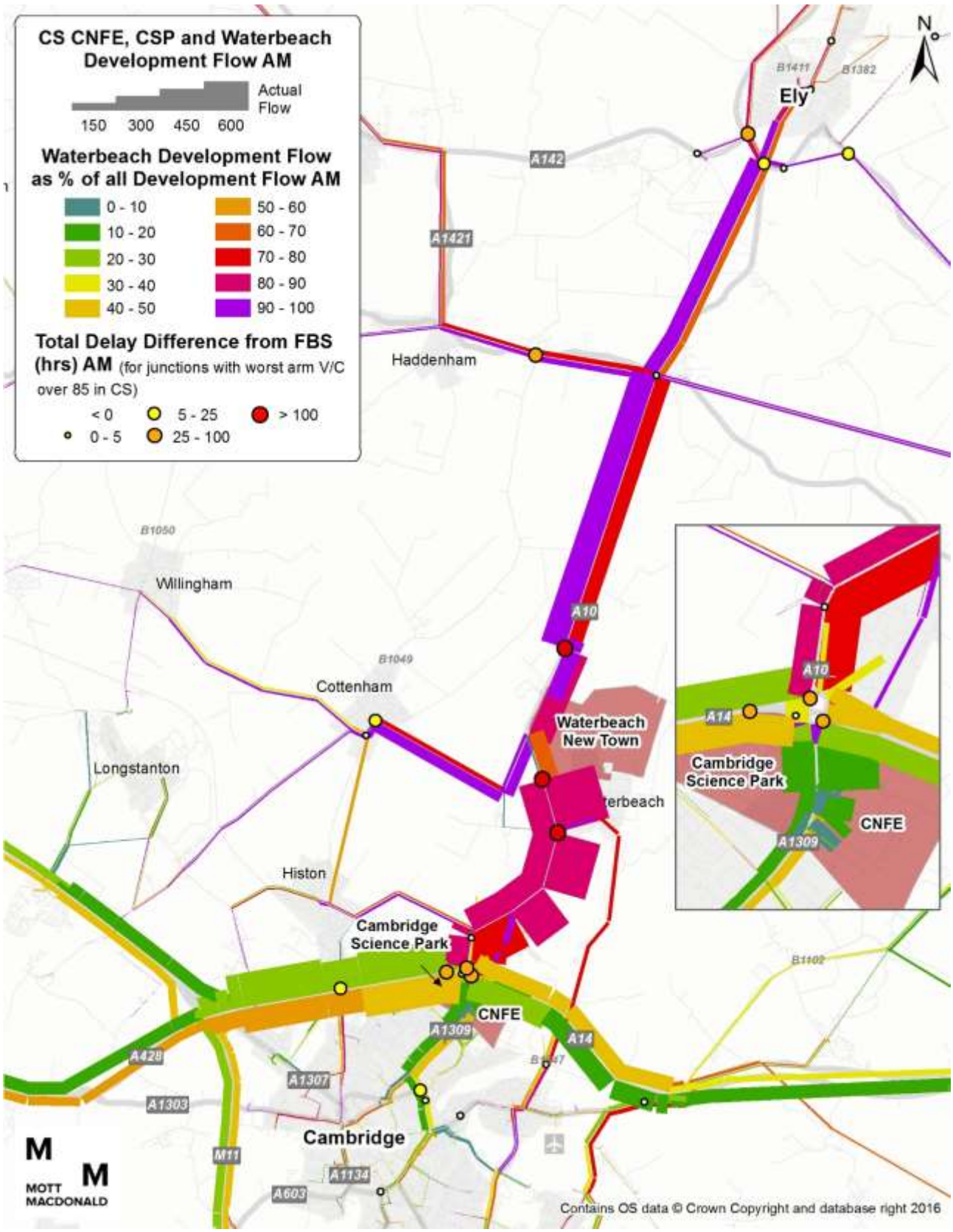
As noted, the above plots show flow changes and junction delay impacts as a result of the addition of new development traffic from both the new town north of Waterbeach and the CNFE and CSP sites. In order to help identify to what degree the above junction impacts are attributable to the new town north of Waterbeach only, the following two figures show for the AM and PM peak periods:

- The impacted junctions from the above figures
- The distribution of total new development flows in the Combined Scenario Do Minimum case
- The proportion of those flows which are generated by new town north of Waterbeach (with the remaining proportion therefore being attributable to the CNFE and CSP sites combined)

These figures show:

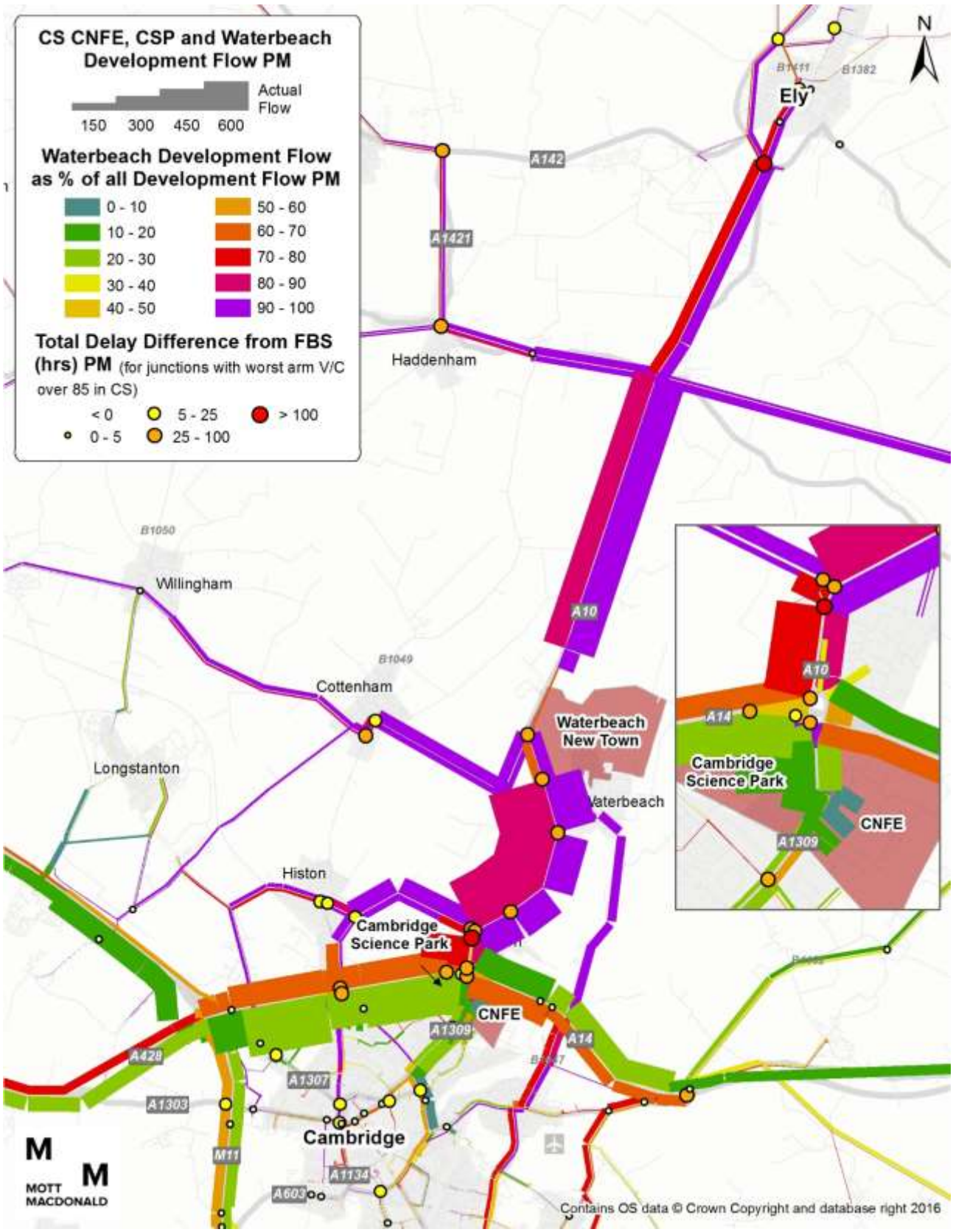
- In both peaks, a clear delineation between development flow contributions, with the new town north of Waterbeach representing the majority development flow contribution on the A10 and connecting routes to the north, and the CNFE and CSP flows representing the majority development flow contribution on the A14 and M11 and mostly within Cambridge. The connecting point between the two areas of impact is Milton Interchange which combines impacts from both developments.
- In the AM, junctions impacted by majority new town north of Waterbeach flows are Milton Interchange, Car Dyke Road/A10, the development accesses, the B1049 in Cottenham, the A1123 in Wilburton and junctions on the Ely Bypass.
- In the PM, the same junctions are impacted by majority new town north of Waterbeach flows, but with the addition of Quy Interchange, Histon Interchange, B1049 junctions in Histon, Haddenham and with the A142, and A10 junctions around Milton.

Figure 12: WB Dev % of Combined Scenario DM total development flow and impacted junctions, AM



Source: CSRM2

Figure 13: WB Dev % of Combined Scenario DM total development flow and impacted junctions, PM



Source: CSRM2

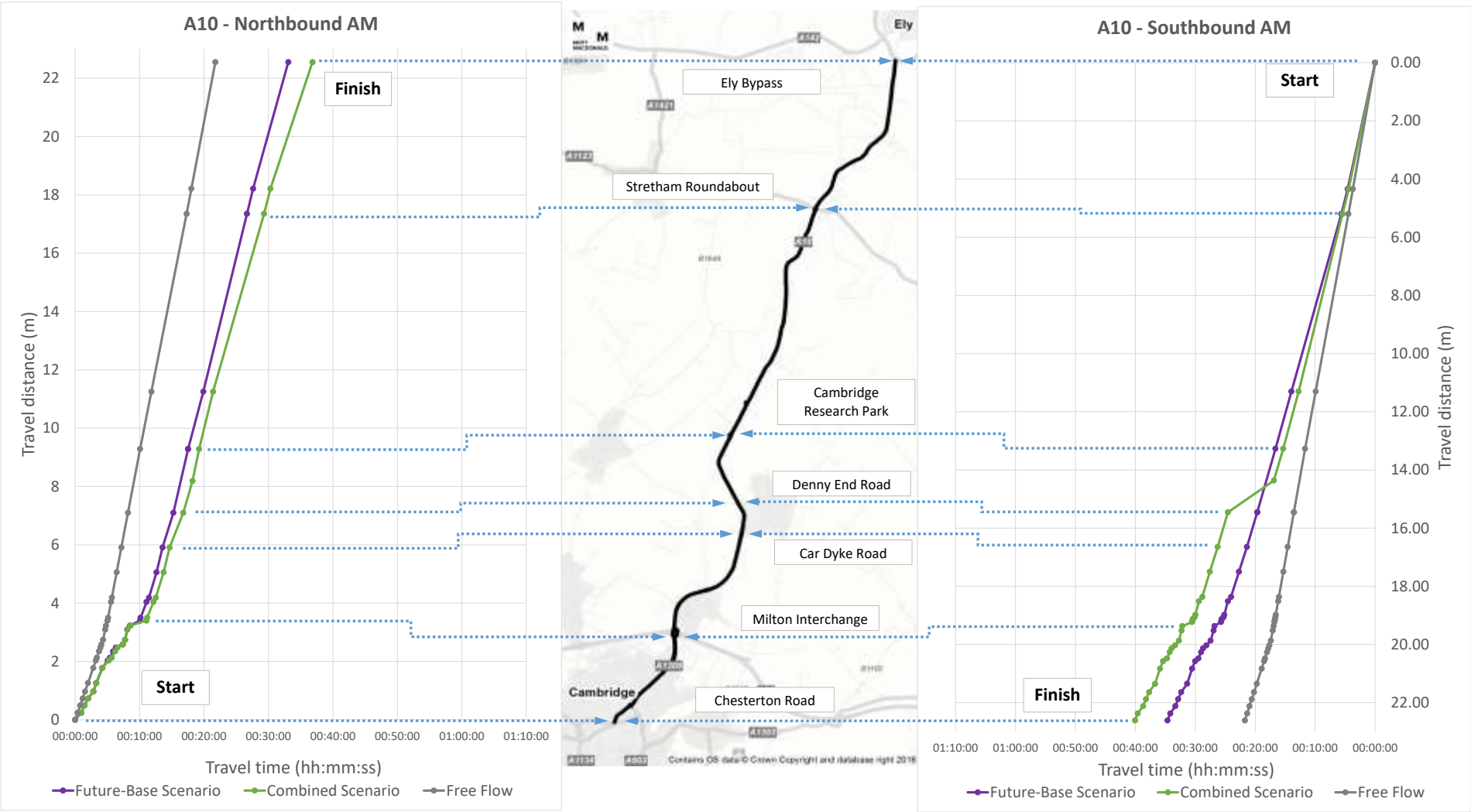
4.3.2 A10 Journey Times

Figure 14 and Figure 15 below show modelled northbound and southbound journey times along the A10 between Chesterton Road in Central Cambridge and Ely during the AM and PM peaks. Results are illustrated for both the Future-Base and Combined Scenarios, with free flow time (taken from each link's 'Free Flow Time' parameter in the CSRM model) included for further comparison.

With particular focus on the impacts of the new town north of Waterbeach, these results show:

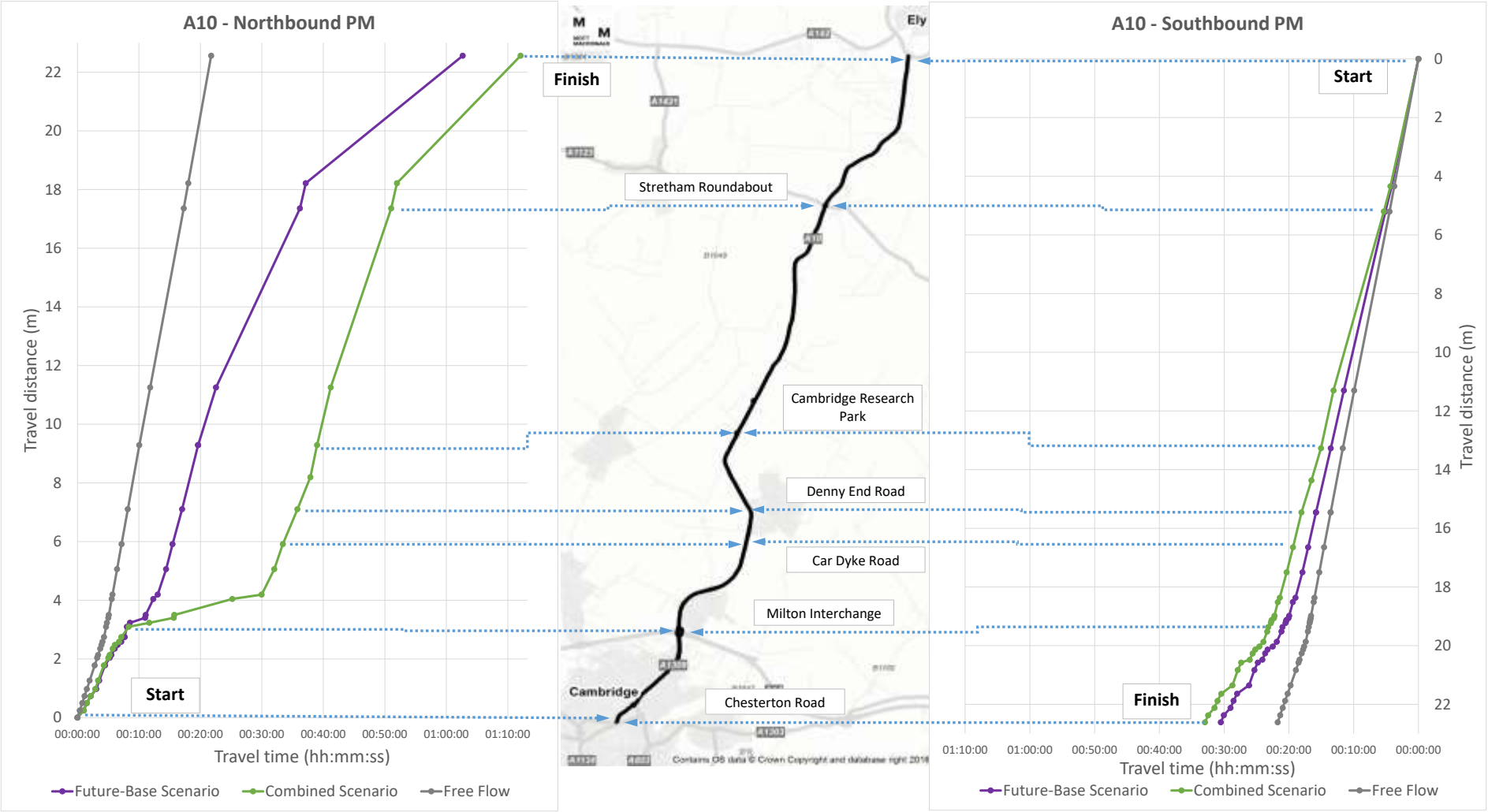
- Combined Scenario southbound delays in the AM peak in the vicinity of the development, corresponding with high levels of development demand accessing the A10 at this point.
- Combined Scenario northbound delays in the PM peak between Milton Interchange and Landbeach Road, corresponding to high levels of demand attracted to the development from Cambridge and the A14.

Figure 14: Journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

Figure 15: Journey time on the A10 between Ely and Cambridge – PM



Source: CSRM

4.4 Summary

An assessment of future transport conditions with full build-out of development in 2031 but no transport mitigation measures has been carried out using the CSRM2 model. The purpose of this 'Do Minimum' assessment is to identify future development transport impacts which would require mitigation.

Based on this assessment, the proposed development at Waterbeach is predicted to generate between 6,000 and 7,000 person trips during each weekday peak hour. The proportion of these trips which are predicted to be internal to the site is between 19% and 30%, meaning that between 70% and 81% of development trips would use external transport networks.

For the external trips, demand is predicted to be generated to and from a number of locations, some of which are served by viable alternative modes of travel, such as rail and bus, but many of which are not. The car mode share for development trips in the Do Minimum situation is therefore predicted to be relatively high, at between 73% and 92% depending on the peak period and direction of travel. The corresponding public transport mode share is predicted to be between 4% and 19%, and walking and cycling mode shares between 2% and 6%. The resulting car trip generation in the Do Minimum case would be around 2,500 external car trips in the AM peak hour, and about 3,250 in the PM peak hour. At some point in their journeys, all these trips will use at least part of the A10.

The modelling results indicate that the primary flow impact of the new town north of Waterbeach on the surrounding highway network is predicted to be along the A10, the parallel B1047 route, and on the east-west A1123, A142 and Cottenham Road/Rampton Road routes. In terms of the delay impacts arising as a result of these predicted flows being added without mitigation, the modelling results for both peak hours show junction impacts at Milton Interchange, Car Dyke Road/A10, the development accesses, the B1049 in Cottenham, the A1123 in Wilburton and junctions on the Ely Bypass, and further impacts in the PM peak at Quy Interchange, Histon Interchange, B1049 junctions in Histon, Haddenham and with the A142, and A10 junctions around Milton.

The Do Minimum modelling therefore predicts that there would be significant increases in travel time on the A10 due to this unmitigated growth in vehicle trips. In the AM peak, southbound delays would arise in the vicinity of the development, where the new demand is accessing the A10 while, in the PM peak, northbound delays between Milton Interchange and Landbeach Road are predicted, corresponding to high levels of demand attracted to the development from Cambridge and the A14.

Further details on these modelling results can be found in the Do Minimum Modelling Report, but the overall conclusion for the proposed new town north of Waterbeach is that some significant mitigation measures will be required to enable the development to function effectively without causing undue impact on surrounding transport networks.

5 Proposed Interventions

The purpose of this section is to review the transport interventions proposed to address the impact of the development proposals on the study area, and to review measures potentially required to address impacts on the wider network.

5.1 On-Site Measures

5.1.1 Site Access

As outlined in Section 3, two vehicle access points to the new town north of Waterbeach are proposed: one via a fourth arm off the existing Cambridge Research Park roundabout; and another to the north of the A10/Denny End Road junction (arrangement and scale to be determined). Direct links will be provided for buses, cycles and pedestrians between the development and the adjacent village to encourage interaction by these modes, but no direct links will be provided for private vehicles in order to minimise development-related vehicular traffic impacts through the village and on the Horningsea Road route to the A14 and Cambridge

For the purposes of the unmitigated development modelling described above, the southern and northern accesses were assumed to be roundabouts with three arms, each with two lanes. In the mitigated development modelling described below, the southern access increases to 3 lanes on the southern A10 arm and from the site. The northern access increases to three lanes from the site, but no other changes.

5.1.2 Trip Internalisation Measures

The development is proposed to include a number of measures to maximise the internalisation of trips and to encourage those trips by non-car modes, including complementary land uses, an appropriate car parking strategy, travel planning and high quality, direct walking/cycle routes.

5.2 Study Area Measures

5.2.1 Outline of Package

In order to address the development-related highway impacts predicted and described in Section 4 above, a number of potential mitigation packages have been tested using the CSRM2 model. These range from the non-highway intervention approach only to packages with an increasing level of complementary highway intervention. This range of packages is fully described in the accompanying Strand 1 Options Modelling report, but is also summarised in the following table.

Table 9: Core mitigation packages tested

Package	Description	Rationale
Mode-shift	Do Minimum highway network, but new measures to encourage mode shift	To test the impact of non-highway interventions only
Junction+	Mode-shift option measures, but with additional junction improvements to A10	To test the impact of adding a first level of highway improvements
North-dual	Junction+ option, but with the A10 dualled from the north access of the new town north of Waterbeach to Ely	To test the impact of a further highway upgrade, which encourages use of Waterbeach P&R to Cambs
South-dual	Junction+ option, but with the A10 dualled from the south access of the new town Waterbeach to the A14	To test the impact of upgrading capacity on the south half of the A10, where it is most needed
Full-dual	Junction+ option, but with the A10 dualled from the A14 to Ely	To test the impact of a full A10 upgrade

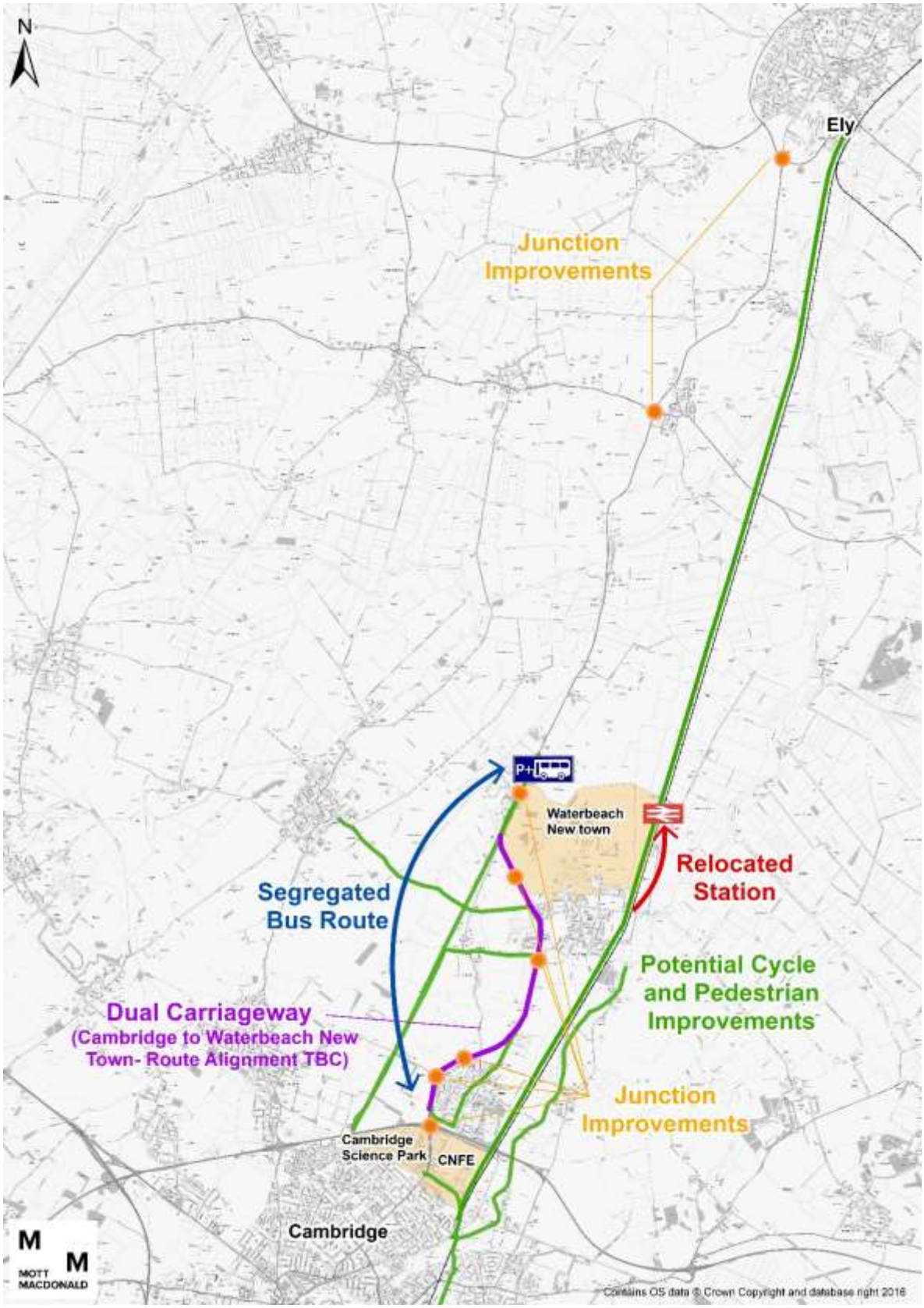
Source: MM

In addition, the implications for these mitigation packages of a potential new link between the A47 and the M11 were also assessed through sensitivity testing.

Full appraisal of these packages against the specific objectives of this study, wider policy objectives and considerations of value is described in the Strand 1 Preliminary Strategic Outline Business Case report. Though no single package is recommended as a preferred scheme at this stage, the INSET appraisal process scored the above ‘South-Dual’ package highest in terms of its overall balance of benefits and costs. For the purpose of assessing the impact of the new town north of Waterbeach on the study area in the context of a proportionate and effective package of mitigation measures, the modelling results for this package are considered in this report.

The measures included in this package are summarised in the following figure and described in more detail in the following sub-sections.

Figure 16: South-Dual package measures



Source: MM

5.2.2 Active Mode Improvements

New or improved walking/cycling routes are proposed between Ely, Waterbeach and Cambridge including:

- A new route between the Waterbeach Park and Ride and the western end of the Cambridge Science Park located away from the A10, utilising Green End Road and the local road and walkway network
- Improvements to the existing off road walkway/cycleway adjacent to the A10
- New cross connections between the two routes described above and connecting to Cottenham
- A new cycleway adjacent to the rail route between Cambridge and Ely
- Improvements to the existing National Cycle Route between the existing Waterbeach Rail Station and Cambridge

5.2.3 Bus Mode Improvements

A new segregated busway is proposed between the new town north of Waterbeach and Cambridge. This will include the provision of a Park and Ride facility adjacent to the A10 within the site.

The route is yet to be determined, but the intention is to improve the attractiveness of bus travel by shortening the journey time through separating buses from general vehicle congestion.

5.2.4 Rail Mode Improvements

As outlined previously, the existing Waterbeach rail station is located to the south east of the existing Waterbeach village. It is proposed to relocate the rail station closer to the new town north of Waterbeach and to provide an additional Park & Rail parking facility, separate to the bus based Park & Ride.

5.2.5 Highway Improvements

The ‘South-Dual’ mitigation package option comprises dualling of the southern and busiest section of the A10 between the southern access of the new town north of Waterbeach and Milton Interchange, and to upgrade the junctions within that section accordingly. The exact alignment of the dualling will be determined at the next stage of scheme development.

For the remainder of the study route to the north as far as Ely, moderate capacity improvements are also proposed at junctions where the modelling shows such measures would be beneficial. The proposed junction improvements, for modelling purposes, are at the following junctions:

- A10 / Green End
- Northern access of the new town north of Waterbeach
- Stretham Roundabout
- A10 / A142 / Cambridge Road

5.3 Potential Wider Network Measures

It is noted that potential wider network improvements in future could generate positive impacts for the study area. Such measures could include a new link between the A47 and M11, which early modelling analysis suggests could reduce the full level of highway intervention required in the study area, though the mode-shift and junction improvement measures are still likely to be required (see Strand 1 Options Modelling Report for full details). Though such a scheme is only at a very early stage of development and its feasibility and viability is yet to be determined, its potential impact on the A10 and on the mitigation package required for this development should be taken into account should it come forward.

5.4 Summary

To address the predicted external transport network impacts of the proposed new town north of Waterbeach, a package of mitigation measures will be required. The package tested for this study includes a number of measures to maximise internalisation of trips and to encourage those external trips to be made by non-car modes, including:

- Complementary land uses
- An appropriate car parking strategy
- Travel planning
- High quality, direct walking/cycle routes
- Improvements to public transport, including a new segregated busway to Cambridge
- A relocated railway station

Highway improvements will also be required, as outlined in the Strand 1 Preliminary Strategic Outline Business Case report. Though no single package is recommended in that report as a preferred scheme at this stage, the INSET appraisal process scored the above 'South-Dual' package highest in terms of its overall balance of benefits and costs. For the purpose of assessing the impact of the new town north of Waterbeach on the study area in the context of a proportionate and effective package of mitigation measures, the modelling results for this package are considered in this report. The package includes the dualling of the southern and busiest section of the A10 between the southern access of the new town north of Waterbeach and Milton Interchange, as well as capacity improvements at key junctions on the remainder of the route to Ely.

6 Impact of Interventions

The purpose of this section is to review the predicted impact of the proposed interventions on development travel behaviour and surrounding network performance.

6.1 Modelling Method

Using the same method as described above in Section 4.1, the interventions outlined in Section 5 have been modelled by adding them to the Combined Scenario Do Minimum network to create a Combined Scenario 'Do Something' case. The results of this assessment are then compared with the equivalent Combined Scenario Do Minimum case ('Do Minimum') in order to establish the impacts of the interventions.

6.2 Development Trip Details

6.2.1 Trip Levels

As with the above Do Minimum assessment, the impacts of the new town north of Waterbeach on the proposed transport network in the CSRM model is considered in terms of the transport parameters of total person trip generation, mode share, site internalisation levels and external trip distributions.

The level of all-mode person trip generation calculated by the CSRM demand model for the new town north of Waterbeach is shown in Table 10. The table also shows the % difference between the results of the Proposed Intervention and Do Minimum Scenario described in Section 4 of this report.

Table 10: Development person trip generation following interventions vs the Do Minimum

Parameter	AM (08:00-09:00)			PM (17:00-18:00)		
	Departures	Arrivals	Total Trips	Departures	Arrivals	Total Trips
External	3,767	1,312	5,079	2,298	3,947	6,145
% Diff vs Do Minimum	+7.4%	+9.8%	+7.9%	+8.8%	+9.3%	+7.3%
Internal	1,808	1,808	1,800	1,178	1,178	1,178
% Diff vs Do Minimum	-8.7%	-8.7%	-8.7%	-9.7%	-9.7%	-9.7%
All	**5,575**	**3,120**	**6,879**	**3,477**	**5,125**	**7,323**
% Diff vs CS	**+1.6%**	**-1.8%**	**+2.9%**	**+1.7%**	**+4.2%**	**+4.2%**

Source: CSRM2

The table shows that overall, there is predicted to be a slight increase in person trips during the peak periods as a result of the proposed interventions. This change is due to the interventions having an impact on the times at which people travel, as more external network capacity is released to allow travel during the peak hours. The proportion of external trips is predicted to increase for the same reason, as shown in the following table.

Table 11: Level of development trip internalisation vs the Do Minimum

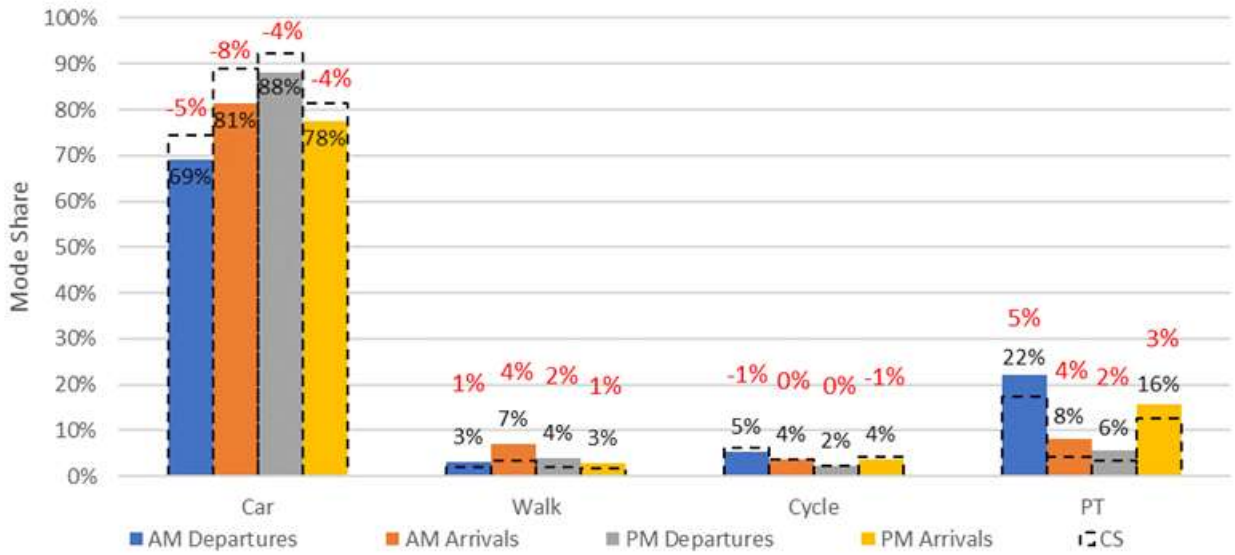
Parameter	AM Peak (08:00-09:00)		PM Peak (17:00-18:00)	
	Internal	External	Internal	External
Proportion of trips	26%	74%	16%	84%
% Diff vs Do Minimum	-4%	+4%	-3%	+3%

Source: CSRM2

6.2.2 Mode Share

Figure 17 below shows the mode share for the new town north of Waterbeach external trips calculated by the CSRM for the Do Something case. The equivalent Do Minimum result is also shown for reference.

Figure 17: Forecast Mode Share for External Development Trips – Do Something versus Do Minimum



Source: CSRM2

The results show that the proposed interventions are predicted to result in a drop in car mode share and increase in walking and PT mode share for external trips across both the AM and PM time periods. There is not predicted to be any significant change to cycle mode share as a result of the proposed interventions.

6.2.3 Car Trips

Table 12 outlines how the above analysis translates into car trips and actual vehicles and compares the results to the Do Minimum scenario.

Table 12: External car trip generation – Do Something vs Do Minimum Scenario

Parameter	AM Peak (08:00-09:00)			PM Peak (17:00-18:00)		
	Departures	Arrivals	Total Trips	Departures	Arrivals	Total Trips
Person trips by car	2,534	1,040	3,574	2,026	3,070	5,096
% Diff vs Do Minimum	+5.2%	-4.2%	+2.3%	+5.4%	+10.3%	+8.3%
Number of cars	1,829	761	2,590	1,327	2,178	3,505
% Diff vs Do Minimum	+5.5%	-3.8%	+2.6%	+4.8%	+9.4%	+7.6%

Source: CSRM2

Due to the increase in total person trips during the peak hours noted in Table 10 above, this table shows that external car trips are also predicted to increase. However, because the interventions result in a decrease in the mode share of development travel by car, this increase is not as great as it otherwise would be. This underlines the importance that the interventions package for Waterbeach should include a strong suite of non-car measures.

6.2.4 Highway Trip Distribution

In Section 4.2.4 above, trip levels by mode between the new town north of Waterbeach and the top 7 trip generating sectors are tabulated for the Combined-Scenario Do Minimum case. The following table shows how these trip levels are predicted to change as a result of the Do Something package of interventions.

Table 13: Change in total trips to and from the new town north of Waterbeach by sector, 07:00 – 19:00, Do Something vs Do Minimum

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R	Total
Waterbeach new town	-348	-1,210	-106	0	0	0	0	-1,664
South Cambs Outer	-153	51	30	-25	17	165	0	86
East Cambs Rural	-935	0	0	-80	104	90	0	-822
Cambridge Outer	651	9	5	-234	164	422	42	1,059
City Fringe	647	10	-4	-73	12	45	0	638
Ely	-658	0	-1	-251	83	179	0	-648
Cambridge Central	153	-5	-50	-131	-345	979	338	940

Source: CSRM2

As outlined in the table, the modelling predicts an overall reduction in internal trips at the new town north of Waterbeach, due to the proposed interventions increasing network capacity and so making external trips relatively more attractive. These results also predict an increase in car trips to the south where the greatest highway capacity is added, but also strong increases in the use of guided busway, P&R and rail, which more than compensates for the reduction in bus use. There are decreases in trips to East Cambs Rural and Ely, which is the result of the model changing trip destinations based on capacity changes to the network.

In Section 4.2.4 above, the mode share for trips by sector is also tabulated for the Combined-Scenario Do Minimum case. The following table shows how these mode shares are predicted to change as a result of the Do Something package of interventions.

Table 14: Change in mode shares to and from the new town north of Waterbeach by sector, 07:00 – 19:00, Do Something vs Do Minimum

Destination	Car	Walk	Cycle	Bus	Rail	GBus	P&R
Waterbeach new town	-1%	1%	0%	0%	0%	0%	0%
South Cambs Outer	-3%	1%	0%	0%	0%	2%	0%
East Cambs Rural	-2%	0%	0%	-1%	2%	1%	0%
Cambridge Outer	-1%	0%	-1%	-3%	1%	5%	0%
City Fringe	1%	0%	0%	-1%	0%	1%	0%
Ely	-1%	0%	0%	-4%	2%	3%	0%
Cambridge Central	-4%	0%	-3%	-3%	-10%	16%	4%

Source: CSRM2

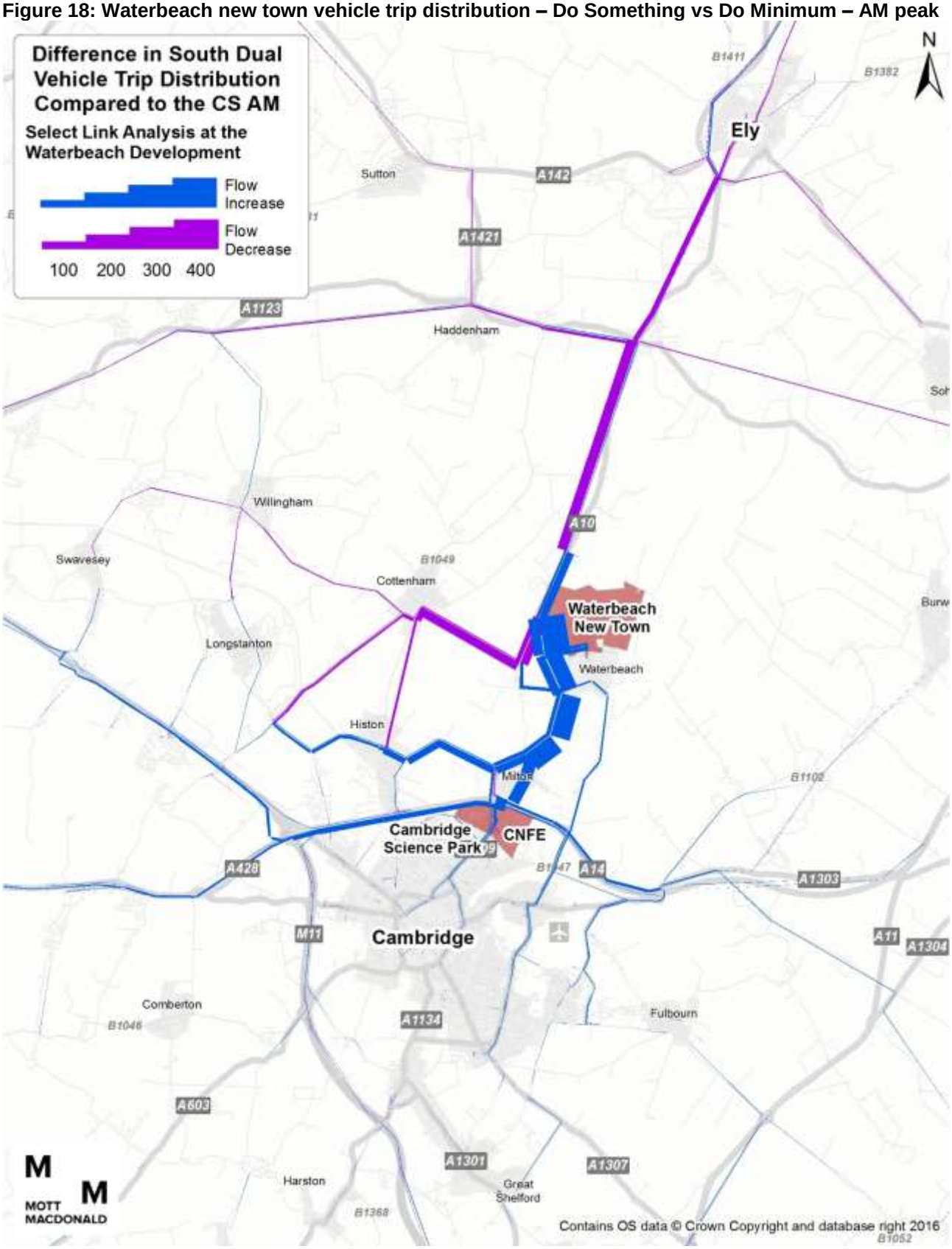
The results reveal that even though overall person trips are predicted to increase, all car mode shares are predicted to decrease apart from to the City Fringe. There is a decrease in the bus mode share, but an increase in the guided bus mode share, as would be expected since access to the guided busway wasn't provided previously and now offers an offline route. The rail mode share increases for all top 7 sectors except for trips to and from Cambridge Central, with trips shifting to the guided bus instead. It is possible that this is happening because access to the guided bus is available within the development, whereas the new rail station will be on the edge of the development, but further work will be required to refine and optimise how the public transport package elements will operate most effectively together.

Section 4.2.4 above shows the highway network distribution of car trips to and from the new town north of Waterbeach site for both the AM and PM peak periods in the Combined-Scenario Do Minimum case. The following figures show how these distributions change as a result of the Do Something package of interventions.

The main change in modelled trip distribution between the two scenarios is a predicted increase in vehicle trips between Waterbeach and Cambridge and a subsequent reduction between Waterbeach and Ely. This includes greater use of the A14 instead of the A1123 for trips to the east and west.

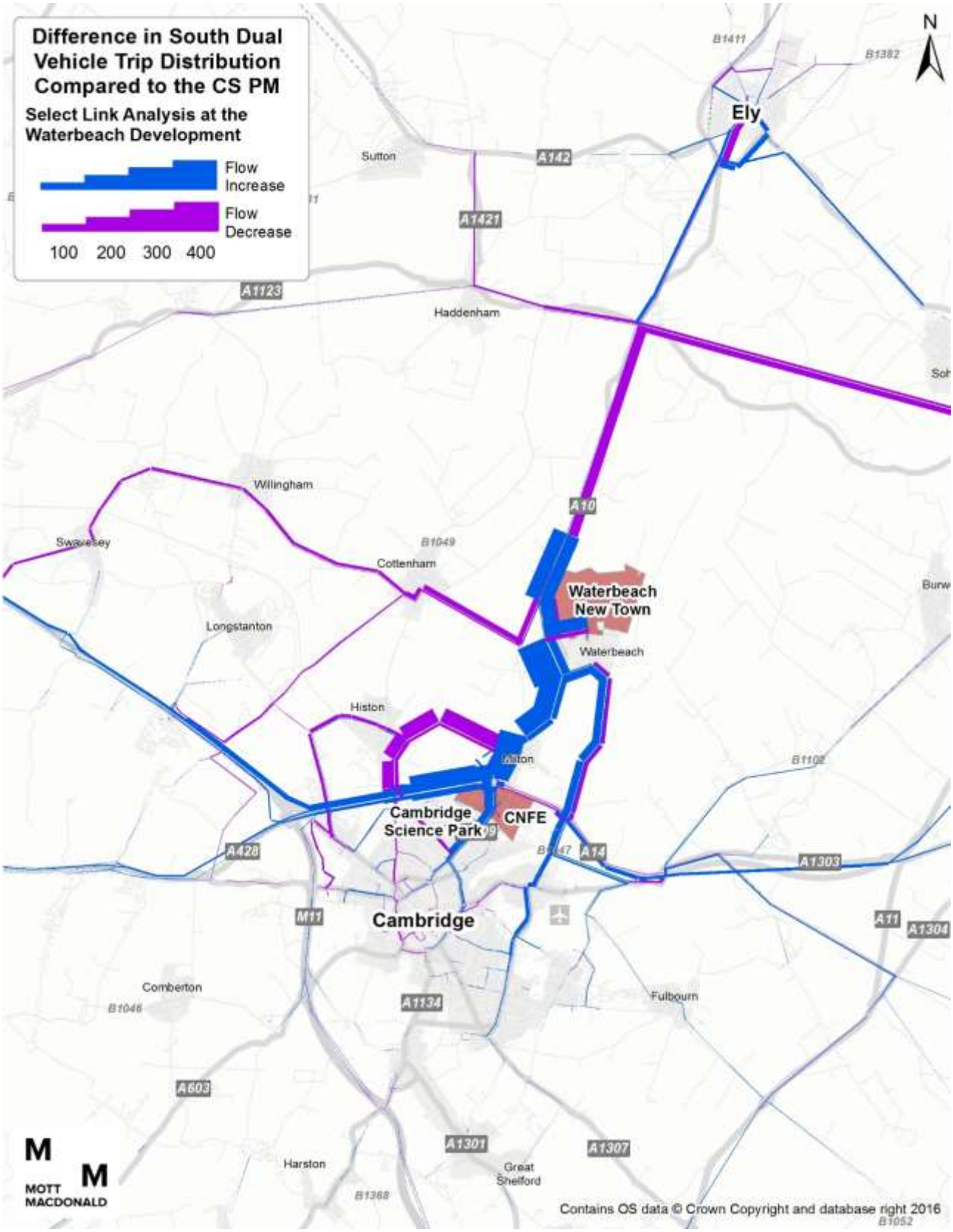
These changes are a result of the southern dualling of the A10 and improvements to Milton Interchange making this route more attractive (though it should be noted from the above results that the development car mode share to southern destinations actually decreases in nearly all cases). Since the model allows the destinations for trips to change depending on alterations to the network's capacity, there are increases and decreases in trip distribution compared to the Future-Base Scenario. Some of these changes will be for work-related trips, but many will be for the more flexible trip purposes, such as for shopping or personal business.

Figure 18: Waterbeach new town vehicle trip distribution – Do Something vs Do Minimum – AM peak



Source: CSRM

Figure 19: Waterbeach New Town vehicle trip distribution following distributions PM Peak



Source: CSRM

6.3 Network Performance

6.3.1 Traffic Flows and Delay

In order to show how the mitigation package is predicted to impact the performance of the highway network, the following figures show the change in traffic flow and total junction delay between the 2031 Combined Scenario South-Dual Do Something case (ie, the 'with-development-with-mitigation' scenario) and the 2031 Combined Scenario Do Minimum case (ie, the 'with-development-without-mitigation' scenario). This allows the changes resulting from the mitigation measures to be observed.

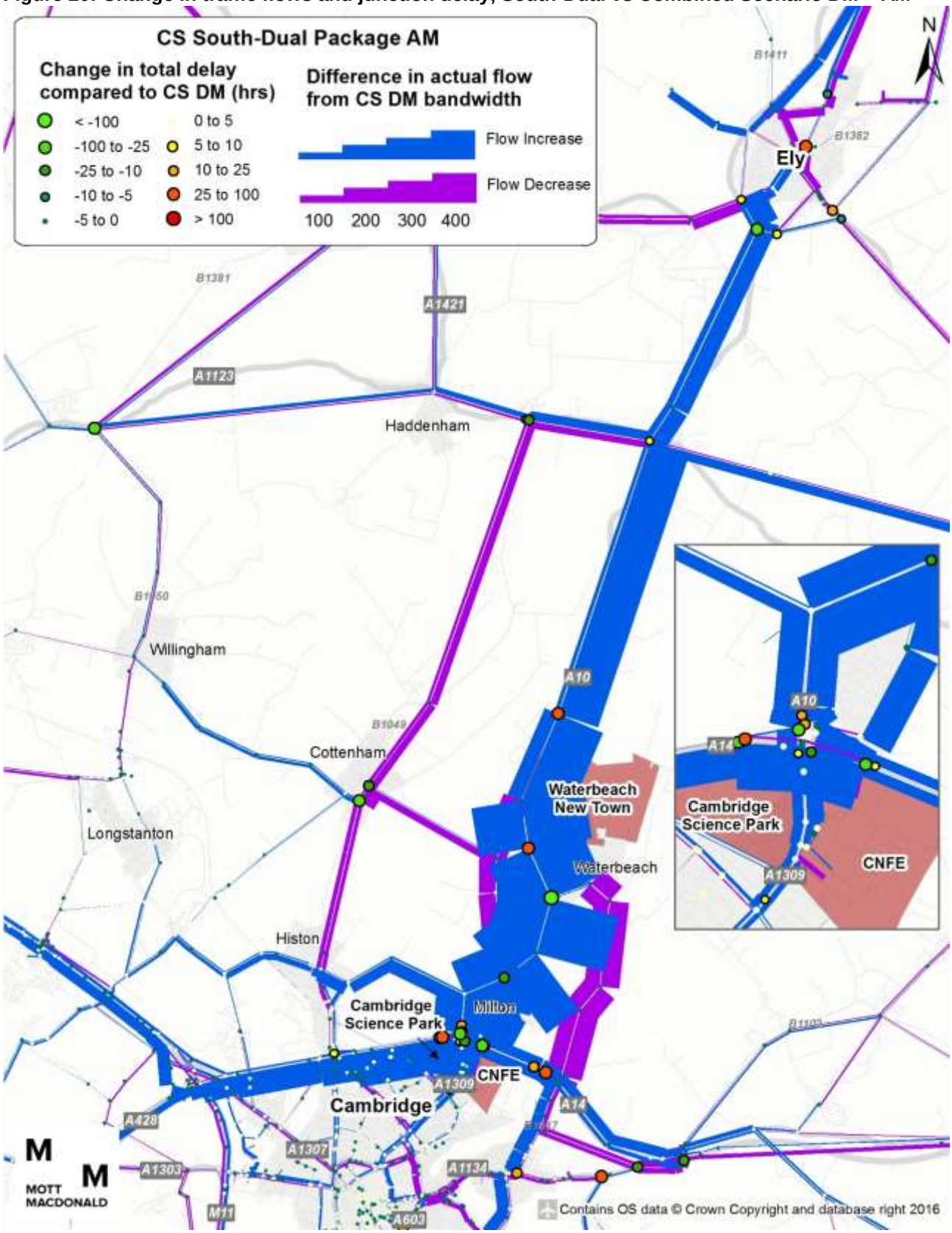
It is noted in Section 4.3.1 above that the main impacts generated by the new town north of Waterbeach traffic in the Do Minimum are along the A10, followed by Milton Interchange. Lesser impacts are also observed at Histon, Cottenham, Ely and on the A1123.

Taking this context into consideration, therefore, the following figures show:

- Delay improvements at certain junctions along the A10 and at Milton Interchange in both time periods. This yields improvements on parallel routes to the A10 through Horningsea and Cottenham, with addition benefits around Histon. The decrease in traffic on these routes is due to traffic being drawn to the A10 as a result of the increased capacity.
- Delay increases at different junctions along the A10 however. To the north of the new town at Waterbeach there are increases in delay at Stretham roundabout due to the increase in flow on the A10 to join the southern dualled section. The accesses of the new town north of Waterbeach have increases in delay, though in reality these would be designed to function within capacity. Additionally, there is a delay increase on the A10 at its junction with Humphries Way as a result of increased flow through Milton. However, in reality measures would be put in place to prevent this.

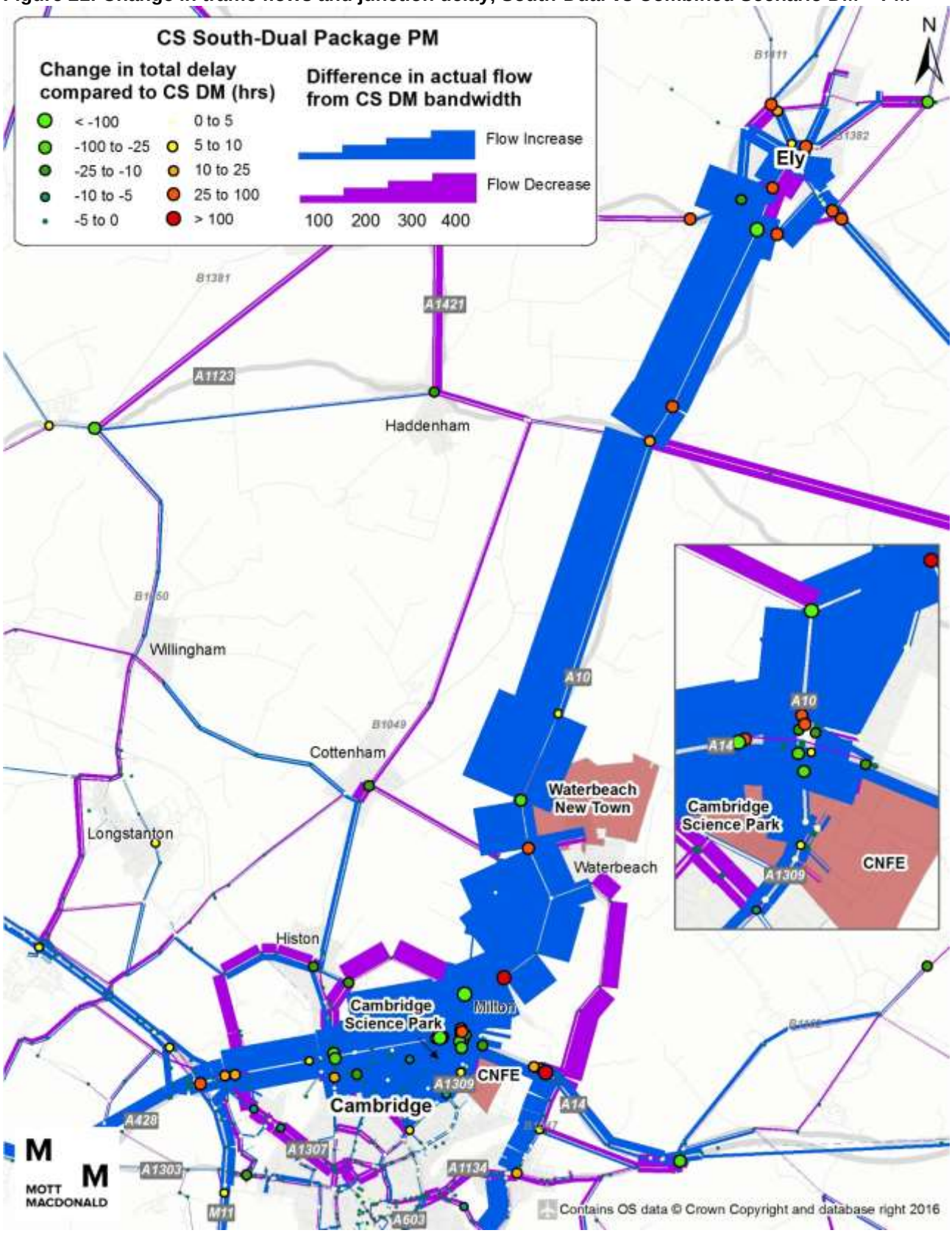
Overall, the results suggest that the tested Do Something package of interventions will help to mitigate the main local impacts of increased development at the new town north of Waterbeach. The greatest benefits for the development are seen in the upgrading of the A10 and Milton Interchange, which helps to reduce pressure on parallel routes and on the A10 itself.

Figure 20: Change in traffic flows and junction delay, South-Dual vs Combined Scenario DM – AM



Source: CSRM

Figure 21: Change in traffic flows and junction delay, South-Dual vs Combined Scenario DM – PM



Source: CSRM

6.3.2 A10 Journey Times

Figure 22 and Figure 23 show modelled northbound and southbound journey times along the A10 between Chesterton Road in Central Cambridge and Ely during the AM and PM peaks. Results are illustrated for the:

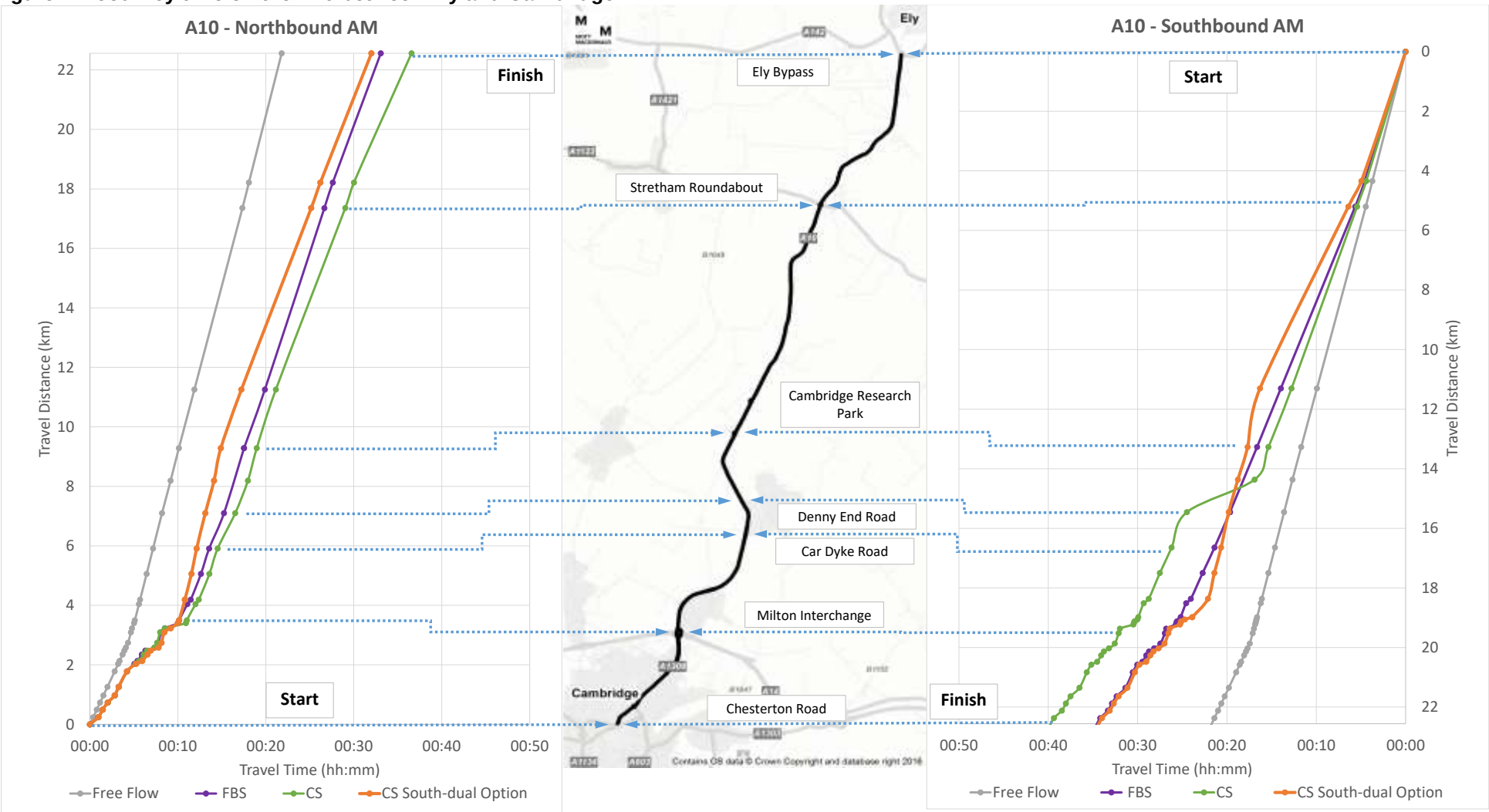
- Combined-Scenario Do Something case (ie mitigated with-development case)
- Combined-Scenario Do Minimum case (ie unmitigated with-development case)
- Future-Base Do Minimum case (ie without-development case)
- Free-flow case (taken from each link's 'Free Flow Time' parameter in the CSRM model)

With particular focus on the impacts of the new town north of Waterbeach with mitigation in place, the results show:

- In the less busy northbound direction in the AM peak, an improvement in journey times over both the Combined-Scenario and Future-Base Do Minimum cases along the full route. Most of the gain is seen on the southern dualled section. Progress on the northern undualled section is then a little slower than in the Future-Base Do Minimum due to a higher level of traffic attracted by the dualled southern section. However, this is outweighed by the southern section gains to generate an improved journey time overall.
- In the busier southbound direction in the AM peak, the Combined-Scenario Do Something journey time is slightly improved over the Future-Base Do Minimum case when measured across the full route, and substantially better than Combined-Scenario Do-Minimum. Due to increased traffic attracted by the dualled section, journey times of the northern undualled section are slower than in both Do Minimum cases, but the dualled section then delivers sufficient improvement to result in a net gain over the whole route. In particular, it can be seen that the South-Dual mitigation package resolves the delays adjacent to the new development which are evident in the unmitigated case.
- In the busiest northbound direction in the PM peak, the Combined-Scenario Do Something journey time is improved over the Future-Base Do Minimum case when measured across the full route, and also substantially better than Combined-Scenario Do-Minimum. The results show that most of the gains for this scenario are on the northern section.
- In the less busy southbound direction in the PM peak, increased traffic on the northern undualled section in the Do Something case results in journey time losses which are not fully recovered on the southern dualled section. The overall journey time, however, is of a similar order to the Do Minimum cases, and delay levels in all cases are relatively moderate.

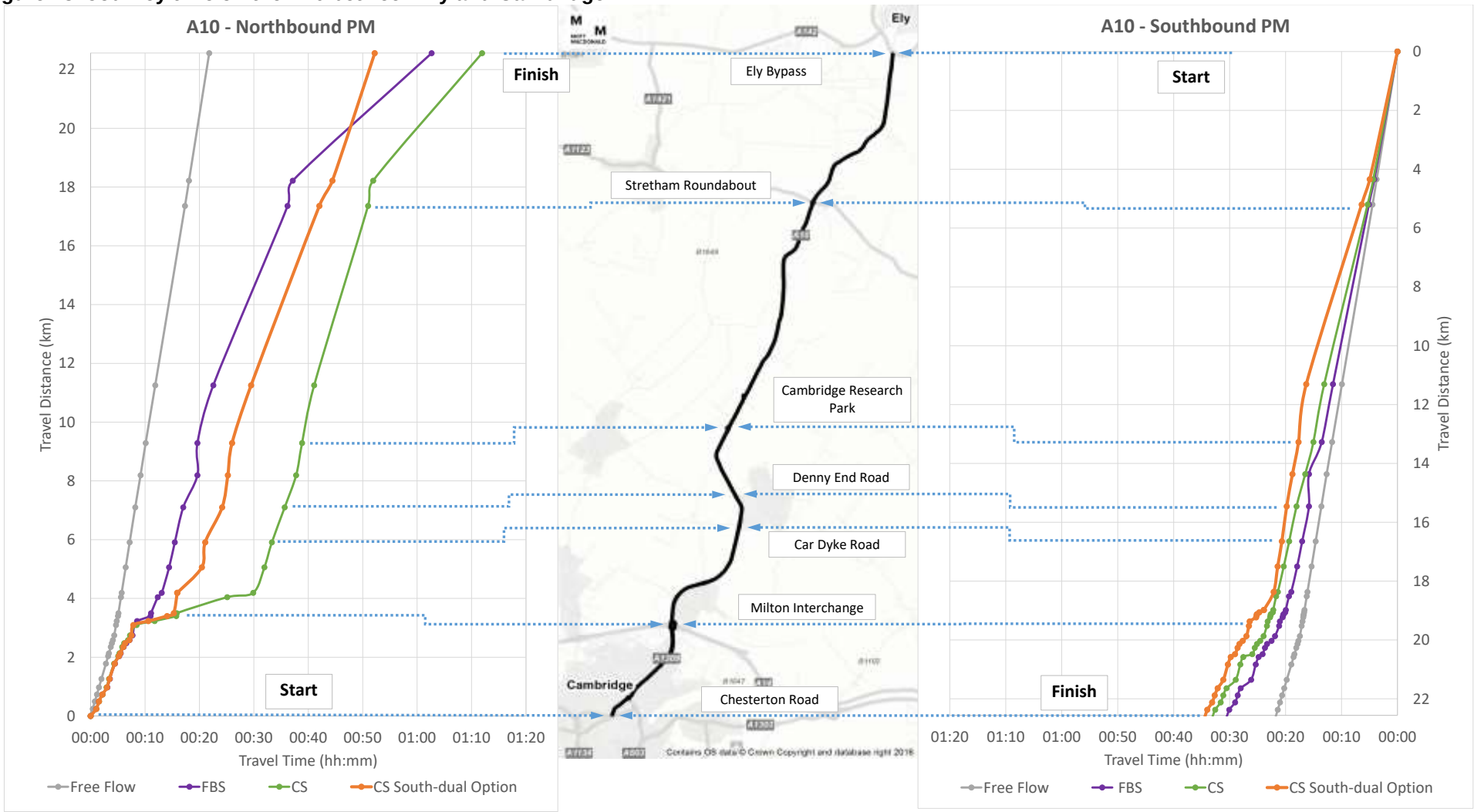
Overall, it can be seen from these results that the package of transport interventions proposed for the study area to facilitate the Waterbeach new town development is predicted to deliver A10 journey time performance which is generally better than the equivalent 'without development' case. The measures are therefore predicted to provide effective development impact mitigation on A10 performance.

Figure 22: Journey time on the A10 between Ely and Cambridge – AM



Source: CSRM

Figure 23: Journey time on the A10 between Ely and Cambridge – PM



Source: CSRM

6.4 Summary

The assessment of the tested mitigation package for the new town north of Waterbeach first reveals that the increase in capacity to the external network results in an overall increase in person trips in the peak hours and hence an increase in the level of trip externalisation. This shows that, when external capacity restraints are reduced for the development, one of the responses is an increase in the choice to travel externally at peak times. This results in an increase in external travel to and from the development by most modes, including by car.

However, the results also show that the increase in car trips would be substantially greater were it not that the mitigation package results in an overall drop in the development car mode share of between 4% and 8%, to between 69% and 88% depending on peak hour and direction of travel. This highlights the requirement for the mitigation package to include a strong suite of non-car improvement measures, which the results show generate particular mode share increases for walking, rail, guided bus and P&R modes.

In terms of the distribution of highway trips, the model predicts that the proposed interventions will result in an increase in vehicle trips between Waterbeach and Cambridge and a subsequent reduction between Waterbeach and Ely. This includes greater use of the A14 instead of the A1123 for trips to the east and west. These changes are a result of the southern dualling of the A10 and improvements to Milton Interchange making this route more attractive, since the model allows the destinations for trips to change depending on alterations to the network's capacity. Some of these changes will be for work-related trips, but many will be for the more flexible trip purposes, such as for shopping or personal business.

The modelling predicts improved journey times along the A10 as a result of the interventions. As expected, most of the gain is seen on the southern dualled section.

Overall, these results show that the package of transport interventions tested for the study area to facilitate the new town north of Waterbeach is predicted to deliver A10 journey time performance which is generally better than the equivalent 'without development' case. The measures are therefore predicted to provide effective development impact mitigation on study area highway performance, while also reducing the development's overall car mode share and significantly increasing the use of non-car modes.

7 Implementation Considerations

The purpose of this section is to review issues relating to development implementation.

7.1 Costs and Funding

7.1.1 Scheme Costs

An outline cost estimate for the 'South-Dual' package of interventions is outlined in Table 15 below.

Table 15: South-Dual package estimated costs

Intervention	Estimated Cost (£million)
Guided Busway	£90m
Waterbeach Park and Ride	£10m
New Waterbeach Station	£30m
Pedestrian and Cycle Improvements	£20m
Milton Road Improvements	£5m
Highway Works (dualling and junction improvements)	£155m
Total	**£310m**

Source: MM

This estimate is based on the following assumptions and exclusions:

- General assumptions**:**
  - The estimate is based at 4Q17 (no inflation has been allowed for beyond this time)
  - Works can be carried out under half road closure wherever possible
  - Existing ground level approximately same as finished construction levels
  - The A10 is not a Highways England maintained asset therefore no allowances have been included for roadside technology signs for NRTS
  - All signage to be unlit
  - All street lighting for the (non-rail) dedicated public transport route, ped/cycle and junction improvements is at 20m intervals
  - New Waterbeach Park and Ride site allowance for 1,000 spaces as per the Waterbeach Transport Assessment document
  - The generic layout of the relocated railway station platform uses assumptions taken from the Waterbeach Transport Assessment which is considered a reasonable basis for estimates at the early stage in the process
  - If existing lane configurations not clear then a minimum of 100m allowed on the approach to major junctions where the lane configuration changes
  - Roundabout inscribed circle diameter assumed as 30m unless existing roundabout is larger
  - Assume (non-rail) dedicated public transport route is through a greenfield site
  - Assume cycle/ped way is through a greenfield site
  - The crossing over the River Great Ouse will be widened, not demolished and rebuilt
  - Replacement of pedestrian bridge for Milton Park and Ride for the South and Full Dual Options

  - Site compounds included in the prelims except for the Guided Busway which needs site compound for a batching plant
  - Where possible, budget quotations have been used from specialist subcontractors
- Exclusions**:**
  - VAT
  - 3rd party compensation costs
  - Planning and approval charges
  - Costs associated with Statutory Fees (e.g. HMRI, Local Authority, etc.)
  - Costs associated with taxes, levies and licences
  - Costs associated with changes in legislation and any form of applicable standards
  - Christmas, Easter and Bank Holiday working
  - Environmental mitigation works
  - Archaeological digs
  - Inflation beyond the base date
  - Land deemed relatively flat - minimising the use of safety barrier in the verges allowed for 50% barrier
  - Re-location of affected businesses
  - Road diversions
  - Landscaping
  - Retaining walls
  - Footpaths for the full length of the dual carriageway
  - Any works to the existing A14
  - Tactile paving
  - Procurement of new vehicles for the (non-rail) dedicated public transport route
  - New depot for vehicles for the (non-rail) dedicated public transport route

It is common practice when schemes and measures are in the early stages of their assessment for there to be a number of exclusions such as those noted above. For the purposes of assessing the economic performance of the package in the Strand 1 Preliminary Strategic Outline Business Case report, however, factors reflecting optimism bias, risk and other elements, including an assumed uplift for land costs, have been applied in addition to the above inclusions.

7.1.2 Funding Considerations

This study is not a substitute for detailed development-related transport assessments (TAs) which will need to accompany planning applications for development at Waterbeach. These TAs will be expected to consider the transport implications of the development proposals, to set out measures to address the transport needs of development, and to mitigate severe impacts. The TAs, and any accompanying transport proposals, will need to be agreed with the transport authorities in the usual way.

This study has, however, identified a number of potential strategic interventions for the study aera which are either directly related to development, or from which development will benefit, and therefore should be funded – at least in part – by development.

At the time of writing, any cost-sharing mechanism seeking to secure funds via Planning Obligations (‘Section 106’) would need to comply with Regulation 122 of the Community Infrastructure Levy Regulations which state that an obligation should be:

- Necessary to make the development acceptable in planning terms

- Directly related to the development
- Fairly and reasonably related in scale and kind to the development

In the case of the bus and rail-based measures, these are directly related to the new developments and there is an expectation that these would therefore be funded in full by development. Where multiple developments benefit from such investments, then a cost-sharing arrangement should be explored. This should be based on the relative levels of demand from each development predicted to make use of that investment and will need to be subject to further, more detailed, assessment work.

In the case of strategic highway schemes, there will be multiple beneficiaries including specific developments, but also general background growth. Should these be taken forward by the relevant delivery bodies then it is recommended that, as a start-point for discussions, the transport authorities undertake further, more detailed, model-based assessment work to:

- Finalise the package of measures proposed
- Determine more refined cost estimates for each element
- Assess the relative use made of each element for each strategic development site (Waterbeach, CNFE, CSP, and others identified as relevant), together with background growth
- Calculate appropriate developer contributions based on those proportions
- Assume that the residual funding requirement (ie, that related to general background growth that is less easily attributed to specific sites) is met from public sector funding sources. These might include from the GCP, from the CA, from DfT, and from other opportunistic public funding opportunities should these materialise (historic examples include Growth Area Funding and the Community Infrastructure Fund)

Such an approach would be in line with the requirement for obligations to be fair and reasonable.

Specifically for the development considered by this report, it is noted from the analysis in Section 4.3.1 above that trips generated by the new town north of Waterbeach are predicted to generate delay impacts at Milton Interchange, Histon Interchange, Quy Interchange, and at junctions along the A10, the Ely Bypass and the A1049. Section 6.3.1 above shows that the tested improvements to the A10 are predicted to resolve many of these wider impacts. This development will therefore be required to contribute to the cost of upgrading that junction, and to resolving the wider residual highway impacts noted in the previous chapter.

In further developing the details of funding packages, the planning and transport authorities will also need to be mindful of restrictions on the number of developer contributions that can be pooled (currently limited to five) towards any single project. This will need to be borne in mind as details – based on the above principles if they are adopted – are developed.

If, of course, the strategic highway measures identified are not taken forward by the public bodies, then development would be expected to mitigate its highway impact directly. Similarly, highway impacts away from the study area but directly attributable to development at Waterbeach would also need to be identified and addressed independent of any A10-related measures.

7.2 Development and Scheme Phasing

A full scheme phasing plan is recommended at a following stage of works. However, at this stage, we recommend the following:

- As part of this study, an assessment was undertaken to provide an initial indication of what mitigation would be required to deliver the first phase of approximately 1,500 dwellings at Waterbeach. This indicated that implementing the various non-car mode improvements in tandem with this level of development would result in approximately as many existing car trips being removed from the network as being added. Providing these interventions at an early stage of development will also encourage use of non-car modes from the beginning before trip behaviours are set. With the exception of road

improvements required to enable the development (such as site access) and potential local off-site highway works to mitigate residual impacts that would need to be identified via the Transport Assessment process, these short term measures include:

  - Works associated with encouraging non-vehicle travel, including walking and cycling improvements. This included providing high quality and high capacity cycle routes that would link Waterbeach to the north of Cambridge and the wider cycle network
  - Other public transport measures including linking Waterbeach and the study area by high quality public transport to the existing busway network (and thus providing linkages to CSP and CNFE, as well as Cambridge City Centre). As part of these proposals, a park and ride facility would also be provided at Waterbeach, and potentially
  - Rail station improvements/relocation, including relocating the rail station to the new development site and the provision of park and ride facilities at the rail station
- Medium term improvements should include single carriageway junction improvements
- The proposals for A10 dualling should continue to be developed but are likely to be the last intervention implemented

It is noted that the sensitivity test described in Section 5.2.1 above established that the introduction of a new link between the A47 and the M11 would potentially reduce the level of highway intervention required in the study area, though the non-car mode and junction improvements would likely remain necessary to deliver development. The implications of such a scheme for the phasing and delivery of study area schemes should be considered should the scheme come forward.

7.3 Delivery Risks

The following provides a list of potential risks to the delivery of the proposed interventions which should be considered:

- The need for consents. We anticipate that the proposed interventions – in particular the guided busway and the dualling of the A10 – are likely to require planning consent as a major project, together with supporting environmental studies. This will need to be factored into the programme and increases the risk of delay.
- Potential environmental effects which could affect the ability to obtain consents are ecology, landscape, air quality, noise and vibration, historic environment, flood risk. A high-level review of government environmental data (www.magic.defra.gov.uk) does not reveal any major designations in the area of the proposed interventions, although a thorough assessment will be required. This can affect the cost of the project, particularly if significant potential effects are envisaged.
- Land-take requirements are predicted to be required for the guided busway and dualling elements. This will require consultation with landowners which can result in increased timeframes and costs.
- Objections from local interest groups or communities. Statutory public consultation is required as part of a major application, which can impact on timeframes and costs.
- Funding risks (as outlined above), where the failure to secure sufficient funding from relevant sources could either delay, or ultimately prevent, scheme delivery.
- Cost risks, where the cost of scheme delivery increases due to unforeseen circumstances such as ground conditions, archaeological issues etc.

The management and effective mitigation of these risks will need to be built into the delivery programme for all schemes to maximise the chances of effective delivery.

7.4 Summary

The outline cost estimate for the 'South-Dual' package of interventions is around £310m at present values. However, it should be noted that this is an indicative cost at this stage, and is not based on either specific or detailed scheme designs.

With regards the funding of this package, this study has identified a number of potential strategic interventions for the study area which are either directly related to development, or from which development will benefit, and therefore should be funded – at least in part – by development. In the case of the bus and rail-based measures, these are directly related to the new developments and there is an expectation that these would therefore be funded in full by the developments. In the case of strategic highway schemes, however, there will be multiple beneficiaries including specific developments, but also general background growth, so transport authorities will need to identify the degree to which the different implicated parties contribute to the funding of these measures.

Specifically for the development considered by this report, it is noted from the analysis in Section 4.3.1 above that trips generated by the new town north of Waterbeach are predicted to generate delay impacts at Milton Interchange, Histon Interchange, Quy Interchange, and at junctions along the A10, the Ely Bypass and the A1049. Section 6.3.1 above shows that the tested improvements to the A10 are predicted to resolve many of these wider impacts. This development will therefore be required to contribute to the cost of upgrading that junction, and to resolving the wider residual highway impacts noted in the previous chapter.

With regards to package phasing, a full scheme phasing plan is recommended at a following stage of works. However, at this stage, we recommend the following:

- With the exception of road improvements required to enable the development (such as site access), short term measures should include works associated with encouraging non-vehicle travel, which could support a development level up to about 1,500 houses
- Medium term improvements should include single carriageway junction improvements
- The A10 Dualling should be the last intervention implemented.

Finally, it is noted that there are many potential risks to the delivery of the proposed interventions, including the need for consents, environmental issues, land-take requirements, funding, objections from interest groups or communities and cost increases due to unforeseen circumstances. The management and effective mitigation of these risks will need to be built into the delivery programme for all schemes to maximise the chances of effective delivery.

8 Summary and Conclusions

8.1 Study Background and Report Purpose

Mott MacDonald has been commissioned by Cambridgeshire County Council (CCC) to deliver the Ely to Cambridge Transport Study. The indicative study area includes the rail route and the A10 route between Cambridge and Ely, the B1049 between Wilburton and the A14 at Histon Interchange, and the B1047 though Horningsea and Clayhithe to the A14.

As specified in the study brief, the outputs of the study are:

- Strand 1 – An Options Study and Strategic Outline Business Case for the overall package of interventions in the Ely to Cambridge study area, including development of principles/mechanisms for securing appropriate developer contributions.
- Strand 2 – A Transport Study, supported by modelling, that identifies the infrastructure package and phasing of that package to provide for the transport demand of the development of a new town north of Waterbeach.
- Strand 3 – A Transport Study, supported by modelling, which provides evidence for the level of development which could be supported in the CNFE and CSP areas and their phasing, in transport terms. This report outlines the findings of the Transport Study for the development of a new town north of Waterbeach.

In accordance with the above study scope, this report identifies an infrastructure package – and the phasing of that package – to provide for the transport demand of the development of a new town north of Waterbeach.

The new town north of Waterbeach site is 558 hectares of brownfield and agricultural land which was formerly used as the Waterbeach Barracks and Airfield, before it was closed in 2013. The new town north of Waterbeach is identified as a Strategic Site in the South Cambridgeshire Emerging Local Plan[11].

8.2 Existing Conditions

A review of existing transport conditions relating to the development site shows that:

- Now that the former barracks and airfield uses have ceased, the development site is host to a minor level of development and generates few trips on the external network.
- The development site has good access to the strategic road network in the form of the A10 which runs directly adjacent to the west of the site. In addition, Clayhithe Road provides a secondary access route to Cambridge and to the A14(W). However, this advantage is constrained at peak times by significant levels of delay on these routes.
- There is a mainline rail station located on the south eastern side of the existing Waterbeach village, though it is around 1.3 miles from the southern extent of the development site and around 2 miles from the northern extent, which equates to about a 25 to 39 minute walk respectively[12]. This makes the existing rail station relatively remote from the development site, though the journey by cycle would take a more accessible 8 to 13 minutes[13].
- The existing village is served by two bus services. Stagecoach service 9 connects Waterbeach to Cambridge and Ely and runs every 30 minutes. There is also an infrequent service (196) which runs

[11] South Cambridgeshire Local Plan, Proposed Submission, July 2013

[12] Based on a standard average walking speed of 3.1 mph

[13] Based on a standard average cycling speed of 9.6 mph

between Waterbeach and west Cambridge via Clayhithe Rd. Currently, however, no bus services penetrate the development site due to lack of demand. Bus journey times to Cambridge take about 50% longer than equivalent car journey times.

- Cycle links are present between Waterbeach village and Cambridge to the south, both via a cycleway along the A10 and a national cycle route parallel to the railway. However, areas other than Cambridge and Milton are harder to access by cycle.
- A network of pedestrian routes exists within the village and there is a pedestrian footway on the west side of the A10 between the village and Cambridge, and along the river Cam. The main walkable destination for which there is no pedestrian route is the Cambridge Research Park on the other side of the A10. There are also no pedestrian crossings across the A10 at this location.

8.3 Development Proposals

Full build-out of the development by 2031 is proposed to comprise 10,000 houses and over 3,000 on-site jobs. The site is proposed by the developers to be accessed directly from the A10 via a north and south access, while provision for non-car modes is proposed to be enhanced and prioritised in order to minimise the impact of private-vehicle trips on the external network.

8.4 Future Conditions

An assessment of future transport conditions with full build-out of development in 2031 but no transport mitigation measures has been carried out using the CSRM2 model. The purpose of this ‘Do Minimum’ assessment is to identify future development transport impacts which would require mitigation.

Based on this assessment, the proposed development at Waterbeach is predicted to generate between 6,000 and 7,000 person trips during each weekday peak hour. The proportion of these trips which are predicted would be internal to the site is between 19% and 30%, meaning that between 70% and 81% of development trips would use external transport networks.

For the external trips, demand is predicted to be generated to and from a number of locations, some of which are served by viable alternative modes to the car, such as rail and bus, but many of which are not. The car mode share for development trips in the Do Minimum situation is therefore predicted to be relatively high, at between 73% and 92% depending on the peak period and direction of travel. The corresponding public transport mode share is predicted to be between 4% and 19%, and walking and cycling mode shares between 2% and 6%. The resulting car trip generation in the Do Minimum case would be around 2,500 external car trips in the AM peak hour, and about 3,250 in the PM peak hour. At some point in their journeys, all these trips will use at least part of the A10.

The modelling results indicate that the primary flow impact of the new town north of Waterbeach on the surrounding highway network is predicted to be along the A10, the parallel B1047 route, and on the east-west A1123, A142 and Cottenham Road/Rampton Road routes. In terms of the delay impacts arising as a result of these predicted flows being added without mitigation, the modelling results for both peak hours show junction impacts at Milton Interchange, Car Dyke Road/A10, the development accesses, the B1049 in Cottenham, the A1123 in Wilburton and junctions on the Ely Bypass, and further impacts in the PM peak at Quy Interchange, Histon Interchange, B1049 junctions in Histon, Haddenham and with the A142, and A10 junctions around Milton.

The Do Minimum modelling therefore predicts that there would be significant increases in travel time on the A10 due to this unmitigated growth in vehicle trips. In the AM peak, southbound delays would arise in the vicinity of the development, where the new demand is accessing the A10 while, in the PM peak, northbound delays between Milton Interchange and Landbeach Road are predicted, corresponding to high levels of demand attracted to the development from Cambridge and the A14.

Further details on these modelling results can be found in the Do Minimum Modelling Report, but the overall conclusion for the proposed new town north of Waterbeach is that some significant mitigation measures will be required to enable the development to function effectively without causing undue impact on surrounding transport networks.

8.5 Proposed Interventions

To address the predicted external transport network impacts of the proposed new town north of Waterbeach, the package of interventions tested for this study includes a number of measures to maximise internalisation of trips and to encourage those external trips to be made by non-car modes, including:

- Complementary land uses
- An appropriate car parking strategy
- Travel planning
- High quality, direct walking/cycle routes
- Improvements to public transport, including a new segregated busway to Cambridge
- A relocated railway station

Highway improvements will also be required, as outlined in the Strand 1 Preliminary Strategic Outline Business Case report. Though no single package is recommended in that report as a preferred scheme at this stage, the INSET appraisal process scored the 'South-Dual' mitigation package highest in terms of its overall balance of benefits and costs. For the purpose of assessing the impact of the new town north of Waterbeach on the study area in the context of a proportionate and effective package of mitigation measures, the modelling results for this package are considered in this report. In addition to the above non-car mode improvements, the package includes the dualling of the southern and busiest section of the A10 between the southern access of the new town north of Waterbeach and Milton Interchange, as well as capacity improvements at key junctions on the remainder of the route to Ely.

8.6 Impact of Interventions

The assessment of the tested mitigation package for the new town north of Waterbeach first reveals that the increase in capacity to the external network results in an overall increase in person trips in the peak hours and hence an increase in the level of trip externalisation. This shows that, when external capacity restraints are reduced for the development, one of the responses is an increase in the choice to travel externally at peak times. This results in an increase in external travel to and from the development by most modes, including by car.

However, the results also show that the increase in car trips would be substantially greater were it not that the mitigation package results in an overall drop in the development car mode share of between 4% and 8%, to between 69% and 88% depending on peak hour and direction of travel. This highlights the requirement for the mitigation package to include a strong suite of non-car improvement measures, which the results show generate particular mode share increases for walking, rail, guided bus and P&R modes.

In terms of the distribution of highway trips, the model predicts that the proposed interventions will result in an increase in vehicle trips between Waterbeach and Cambridge and a subsequent reduction between Waterbeach and Ely. This includes greater use of the A14 instead of the A1123 for trips to the east and west. These changes are a result of the southern dualling of the A10 and improvements to Milton Interchange making this route more attractive, since the model allows the destinations for trips to change depending on alterations to the network's capacity. Some of these changes will be for work-related trips, but many will be for the more flexible trip purposes, such as for shopping or personal business.

The modelling predicts improved journey times along the A10 as a result of the interventions. As expected, most of the gain is seen on the southern dualled section.

Overall, these results show that the package of transport interventions tested for the study area to facilitate the new town north of Waterbeach is predicted to deliver A10 journey time performance which is generally better than the equivalent 'without development' case. The measures are therefore predicted to provide effective development impact mitigation on study area highway performance, while also reducing the development's overall car mode share and significantly increasing the use of non-car modes.

8.7 Implementation Considerations

The outline cost estimate for the 'South-Dual' package of interventions is around £310m at present values. However, it should be noted that this is an indicative cost at this stage, and is not based on either specific or detailed scheme designs.

With regards the funding of this package, this study has identified a number of potential strategic interventions for the study area which are either directly related to development, or from which development will benefit, and therefore should be funded – at least in part – by development. In the case of the bus and rail-based measures, these are directly related to the new developments and there is an expectation that these would therefore be funded in full by the developments. In the case of strategic highway schemes, however, there will be multiple beneficiaries including specific developments, but also general background growth, so transport authorities will need to identify the degree to which the different implicated parties contribute to the funding of these measures.

Specifically for the development considered by this report, it is noted from the analysis in Section 4.3.1 above that trips generated by the new town north of Waterbeach are predicted to generate delay impacts at Milton Interchange, Histon Interchange, Quy Interchange, and at junctions along the A10, the Ely Bypass and the A1049. Section 6.3.1 above shows that the tested improvements to the A10 are predicted to resolve many of these wider impacts. This development will therefore be required to contribute to the cost of upgrading that junction, and to resolving the wider residual highway impacts noted in the previous chapter.

With regards to package phasing, a full scheme phasing plan is recommended at a following stage of works. However, at this stage, we recommend the following:

- With the exception of road improvements required to enable the development (such as site access), short term measures should include works associated with encouraging non-vehicle travel, which could support a development level up to about 1,500 houses
- Medium term improvements should include single carriageway junction improvements
- The A10 Dualling should be the last intervention implemented

It is noted that the sensitivity test described in Section 5.2.1 above established that the introduction of a new link between the A47 and the M11 would potentially reduce the level of highway intervention required in the study area, though the non-car mode and junction improvements would likely remain necessary to deliver development. The implications of such a scheme for the phasing and delivery of study area schemes should be considered should the scheme come forward.

Finally, it is noted that there are many potential risks to the delivery of the proposed interventions, including the need for consents, environmental issues, land-take requirements, funding, objections from interest groups or communities and cost increases due to unforeseen circumstances. The management and effective mitigation of these risks will need to be built into the delivery programme for all schemes to maximise the chances of effective delivery.

8.8 Study Conclusions

Given its proximity to the economically strong centre of Cambridge, the proposed new town north of Waterbeach provides opportunity for many new trips to be made in the area by non-car modes. However, with already congested A10 being the only means of accessing the development by highway, it is

nonetheless predicted that 10,000 new homes plus ancillary development in this location will generate substantial flow and performance impacts on this key route. The study therefore shows that the non-car mode improvement options considered for the study area are essential for the sustainable delivery of this development and that they should be implemented from the outset of development construction and completed before more than 1,500 homes are built. It is proposed that these measures should be funded by the new developments which necessitate and benefit from them.

However, the study also shows that these measures will not be sufficient in themselves to mitigate the full development's impact on the A10 and on parallel routes and that potentially significant highway intervention will also be required. This, as a minimum, should comprise improvements to existing junctions along the routes, including at Milton interchange, but in the longer term is likely to also involve dualling at least the southern section of the A10, while locking in traffic flow reductions on parallel routes. The funding for these measures will be drawn from multiple sources according to the range of beneficiaries, including new developments and wider public funding streams.

Lastly, it is noted that these findings should be reviewed in the event that other schemes come forward that are not within the study area but which could affect it, such as a new highway link between the A47 and the M11. Testing shows that such schemes could potentially reduce the highway intervention requirement within the study area.

Appendices

A. CSRM Sector System 59

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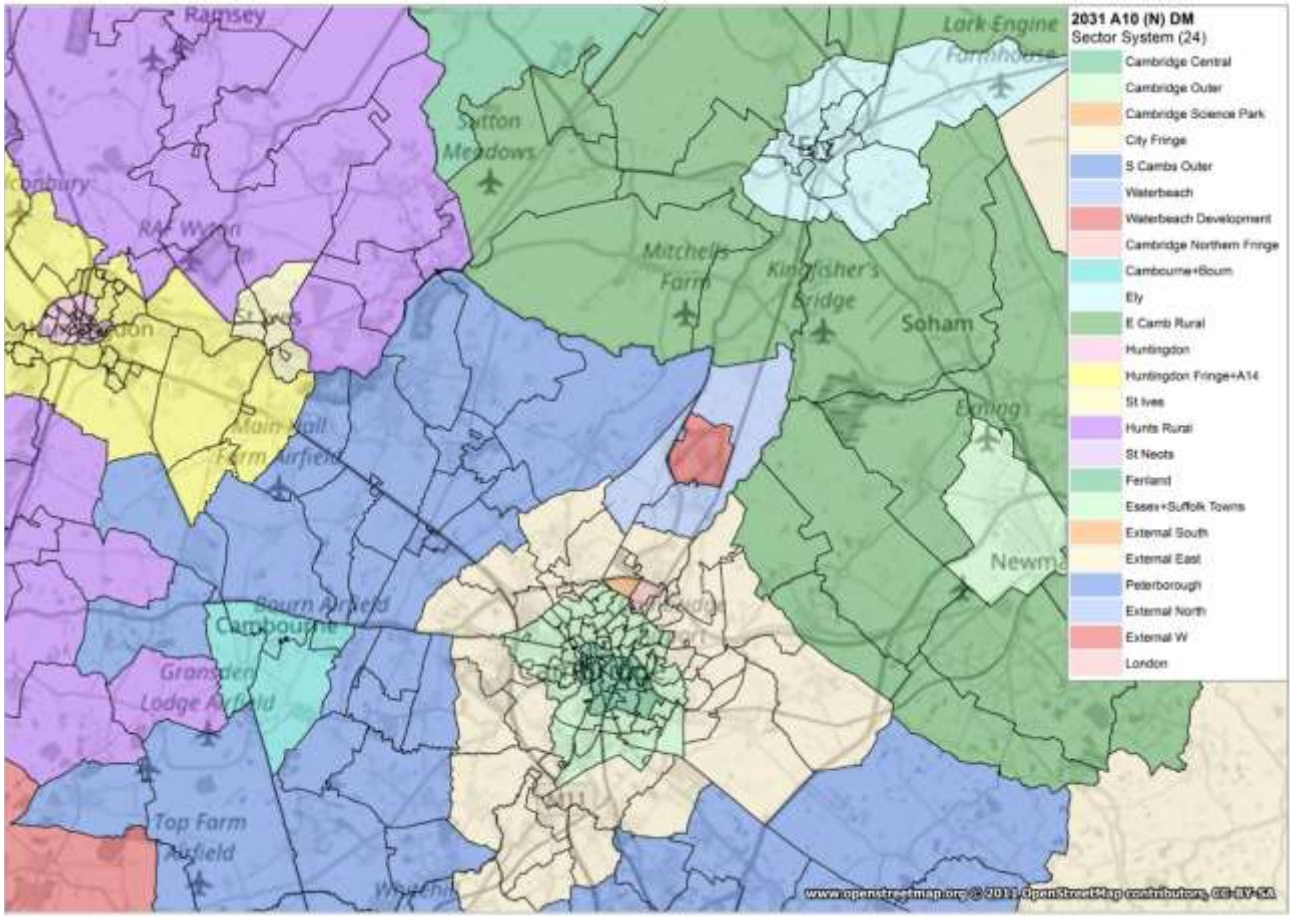
Figure 24: CSRM Sector System for Cambridgeshire



Source: Atkins

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