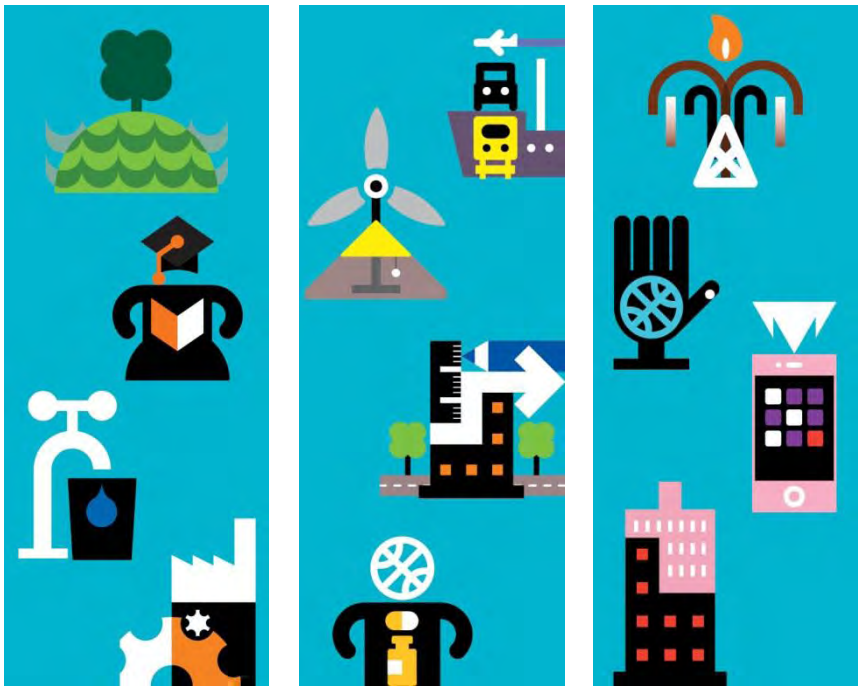

Longwater - Easton Transport Strategy

Further Assessment

October 2015

Norfolk County Council

Mott MacDonald

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Contents

1 Introduction

1.1 Brief

The Joint Core Strategy (JCS) for the Norwich area has identified significant development in the vicinity of Longwater and Easton, to the west of the city. This report summarises the output of modelling assessment work, carried out in response to a brief issued by Norfolk County Council (NCC) in early 2015. This required use of the latest NATS traffic model to assess the performance of three options for a major improvement scheme in this area. These are:

- **DS1** – A new link from the Longwater Employment Area, through the existing Costessey landfill site, to the A1074 east of Longwater Interchange;
- **DS2** – A new bridge over the A47 at Longwater Interchange to allow a larger signalised gyratory layout; and
- **DS3** – A new link, running parallel to and north of the A47, connecting the A47 Easton roundabout to the Longwater Employment Area.

The brief also requires consideration of a potential implementation programme for recommended strategy options.

1.2 Structure of Report

The structure of this report is as follows:

- **Background and Study Area** – describes the background to this work and the study area;
- **Modelling Scenarios** – describes the modelling scenarios considered and the associated measures incorporated;
- **Network Forecast Flows** – presents the results of the SATURN strategic modelling work for 2017 and 2032 scenarios, in the form of daily, morning and evening peak hour flows;
- **Junction Performance** - presents the results of LINSIG assessments of four key junctions for 2017 and 2032 scenarios;
- **Implementation** – discusses potential deliverability issues associated with the DS1 and DS2 improvement options; and
- **Conclusions** – summarises the main findings of the study.

2 Background and Study Area

2.1 Background

In 2014, NCC commissioned a feasibility study which considered potential improvement strategies to address:

- existing peak hour traffic congestion at the A47/A1074 Longwater Interchange, on the A1074 Dereham Road and at the A47 Easton roundabout; and
- additional traffic demands arising from committed and planned land use development in the Longwater and Easton area, as set out in the adopted JCS.

The outcome of that study is summarised in the 'Longwater and Easton Transport Strategy – Final Report' dated May 2014 (the 2014 Strategy report). Two alternative strategies were developed which contained a common series of smaller scale measures, with the key difference being in the treatment of Longwater Interchange itself. These are:

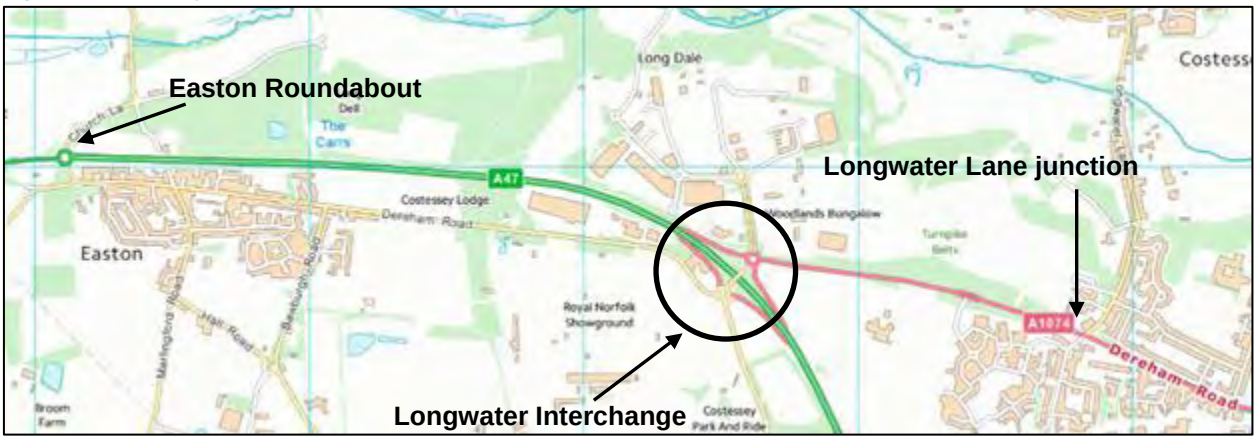
- Strategy 1 - reduces traffic demand at Longwater Interchange through creation of an alternative access to the Longwater Employment Area (Longwater Link Road). A double 'tear drop' arrangement would be provided at Longwater Interchange itself;
- Strategy 2 - increases the capacity of Longwater Interchange through provision of a second bridge and a large signalised gyratory system

2.2 Study Area

The study area under consideration is shown in **Figure 2.1** and covers:

- the A47 between the Longwater Interchange and the Easton Roundabout;
- Dereham Road from its junction with Longwater Lane to the east and the Easton roundabout to the west; and
- local access roads to the Longwater Employment Area and Queens Hills.

Figure 2.1: Study Area



Source: Contains Ordnance Survey data © Crown copyright and database right [2014]

3 Modelling Scenarios

The three scenarios for improvements at Longwater were modelled with the strategic traffic model that was developed and used for the assessment of the Norwich Northern Distributor Road. For the purpose of this assessment, the matrices from the recent Norwich City Centre Measures study were used for running the models. DIADEM model runs were undertaken but no changes were required to be made to the VISUM public transport component of the overall model and the relevant files from the DCO model runs were used. DIADEM is used to model the potential wider impacts on traffic demand of changes to the transport system, such as re-timings of trips or induced traffic.

In carrying out this work, the SATURN coding of the Longwater Interchange, the two signalised junctions to the east and one signalised junction to the west of this junction were fined-tuned with the geometric parameters extracted from the latest engineering drawings. The signal timings were then optimised for all of these junctions during the morning peak, evening peak and inter peak periods..

Using the highway trip matrices from the Norwich City Centre Measures work as a starting point, DIADEM runs were carried out for the Do Minimum and three Do Something scenarios. Post-DIADEM park and ride adjustments to the model networks were carried out to ensure the correct number of trips are allocated to the 6 park and ride links.

3.1 Do Nothing

The Do Nothing scenario is based on a network which contains the Northern Distributor Road together with a series of Norwich City Centre Measures, developed in recent work and described in the 'NATS City Centre Measures Report', dated April 2015. The Do Nothing for this assessment is the Do-Something scenario from the City Centre Measures work.

3.2 Do Minimum

The starting point for this scenario is the Do Nothing network, described above. With reference to the 2014 Strategy report, new Do Minimum networks were created by adding measures (shown in **Table 3.1**) to the Do Nothing networks. All of these measures are included in each of the Strategy scenarios. Separate networks were created for 2017 and 2032 forecasting years.

Table 3.1: Do Minimum Measures

Measure	Description	Year	SATURN Nodes
11	Free-flow left turn from Longwater to EB Dereham Road	2017 & 2032	2038-5131 & 9202-9210
21	Longwater Lane Traffic Signals improvement	2017 & 2032	2035
12	Free-flow left turn from Dereham Road to A47 EB on-slip	2032	9205-9203
18	Longwater 'Tear drop' at South roundabout	2032	3007, 5126, 5128 & 5129
23	A1074 Dereham Road widening (west section)	2017 & 2032	5132-9202 & 9202-9210
14	A47 EB off-slip 2 lanes to Dereham Road	2032	3009-5130
4	Easton village Public Transport Corridor (mid-section)	Not included	Not included
9	Improvements to Easton Roundabout	2032	2096, 5094, 5095, 5096 & 5097

Measure	Description	Year	SATURN Nodes
23	A1074 Dereham Road widening (mid-section)	2017 & 2032	9210-2035

In accordance with NCC's delivery programme, measures 11, 21 and 23 were included in both the 2017 and 2032 network files, whilst measures 12, 18, 14 and 9 were only incorporated in the 2032 networks. Measure 4 was not included in any of the network files.

A 2017 Do-Minimum network for Longwater Interchange is shown in **Appendix A** which includes measures 11 and 18. Measure 9 (shown in Figure A.2 of the 2014 Strategy report), takes the form of a 'throughabout' layout for the Easton roundabout in 2032, with signalisation of the A47 approaches.

3.3 Do-Something Scenarios

DS1 – New Link from Dereham Road to Longwater Employment Area, together with a Double 'Tear Drop' Roundabout at Longwater Interchange.

This scenario would reduce peak hour demand at Longwater Interchange through creation of an alternative access to the Longwater Employment Area, in the form of Longwater Link Road, and a double 'tear drop' arrangement at Longwater Interchange itself (see Appendices A.1 and A.4 in the 2014 Strategy report). For the purpose of the modelling the Link Road has been assumed to be in place by 2017 and the double 'tear drop' on the northern part of Longwater interchange will be in place by 2032.

DS2 - New bridge over the A47 at Longwater Interchange

This scenario would increase the capacity of Longwater Interchange through construction of a second bridge over the A47 providing a larger signalised gyratory layout (see Appendix A.3 in the 2014 Strategy report).

DS3 – New Link from Easton Roundabout to Longwater Employment Area

This scenario consists of a new two-way link road from the A47 Easton roundabout tying into the Sir Alfred Munnings Road roundabout in the Longwater Employment Area (shown in principle as option 7 on Figure 4.1 in the 2014 Strategy report).

3.4 Review of Junction Coding

Within the DCO models, saturation flows for signalised junctions were derived from the values shown in the Local Model Validation Report (Table 4.6, ref 5.6). These values are based on TRRL Report RR67 and assume standard values for lane width, entry width, turning proportion and turning radii to establish a generic set of junction parameters that represent saturation flows at an average signalised junction. For this work, saturation flows used in LINSIG runs in the 2014 Strategy report were extracted and input to SATURN network files, together with signal timings adopted in the DCO models. Table 4.7 of the DCO

LMVR shows the saturation flows adopted at all non-signalised roundabouts. For the two non-signalised junctions in this study, i.e. Longwater Interchange and Easton roundabouts which are coded as a series of priority junctions, saturation flows were calculated using TRRL Report LR942.

4 Network Forecast Flows

Forecast traffic flows for each Do-Something scenario have been presented in a series of diagrams, for the Longwater Interchange itself and the wider road network. These are shown, together with Do-Minimum values, in the following Appendices:

- **Appendix B.1** to **B.6** – two-way Annual Average Daily Traffic (AADT) (vehicles/day);
- **Appendix C.1** to **C.6** – one-way morning peak flows (PCUs/hour); and
- **Appendix D.1** to **D.6** – one-way evening peak flows (PCUs/hour).

4.1 DS1 - Link Road and Double 'Tear Drop' at Longwater Interchange

The traffic flow impacts of DS1 in 2017 and 2032 are summarised in **Table 4.1** and **Table 4.2** respectively.

DS1 has little effect on the traffic to the west or the south of Longwater Interchange in terms of daily, morning peak or evening peak flows. On the new link itself, daily traffic flows are forecast at 3,700 vehicles in 2017 and 5,500 vehicles in 2032 with corresponding reductions on William Frost Way. On Dereham Road immediately to the east of the Interchange, the reductions in daily flows are 4,000 vehicles in 2017 and 6,200 vehicles in 2032. On Longwater Bridge, there are reductions in daily flow of 100 vehicles in 2017 and 900 vehicles in 2032.

Across the wider network, there are only small differences between the Do Minimum and DS1 daily flows for both of the forecasting years. During the morning peak the only noticeable change in flows is 60 PCUs in the southbound direction on Ringland Road in 2032. In the evening peak there are no significant changes in traffic flow as a result of the scheme.

Overall, DS1 attracts a significant number of traffic movements between William Frost Way and Dereham Road to the east of the Longwater Interchange but has only minor impacts on the wider road network.

Table 4.1: DS1 Traffic Flow Summary 2017

		AADT (Vehicles)			AM Peak (PCUs)			PM Peak (PCUs)		
Link		DM	DS	Change	DM	DS	Change	DM	DS	Change
A1074 to Longwater Link	nb	0	3,700	+3,700	0	130	+130	0	170	+170
	sb				0	220	+220	0	200	+200
William Frost Way	nb	12,800	9,100	-3,700	560	420	-130	740	570	-170
	sb				780	550	-220	550	350	-200
Dereham Road (east)	wb	20,300	16,300	-4,000	1,260	1,160	-100	890	720	-180
	eb				800	560	-240	1,060	840	-230
Longwater Bridge	nb	13,800	13,700	-100	640	610	-20	1,040	1,020	-20
	sb				810	840	+30	370	370	0
Ringland Road	nb	3,100	3,100	0	120	130	0	240	240	0
	sb				200	190	-10	130	130	0
A47 (west)	wb	13,500	13,500	0	1,140	1,150	+10	1,500	1,510	0
	eb	14,600	14,500	-100	1,700	1,700	0	1,290	1,280	-10

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
Dereham Road (west)	wb	2,300	2,300	0	80	80	0	140	150	0
	eb				110	110	0	90	90	0
Longwater Lane	nb	8,100	7,900	-200	380	360	-20	490	470	-20
	sb				600	590	-10	380	380	0
Marlingford Road	nb	7,100	7,100	0	300	300	0	350	350	0
	sb				320	310	0	320	320	0
The Street	nb	4,300	4,200	-100	250	240	-10	240	230	0
	sb				250	260	+10	210	210	0
West End	nb	5,200	5,100	-100	180	180	0	310	300	-10
	sb				370	370	-10	200	200	0
Dog Lane	nb	2,800	2,700	-100	110	120	0	240	240	0
	sb				160	150	-10	140	130	0

Table 4.2: DS1 Traffic Flow Summary 2032

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
A1074 to Longwater Link	nb	0	5,500	+5,500	0	310	+310	0	270	+270
	sb				0	250	+250	0	260	+260
William Frost Way	nb	15,300	9,700	-5,600	770	450	-320	790	510	-270
	sb				830	580	-250	740	470	-270
Dereham Road (east)	wb	24,100	17,900	-6,200	1,380	1,140	-250	1,150	880	-260
	eb				940	650	-290	1,210	920	-290
Longwater Bridge	nb	18,300	17,400	-900	1,030	930	-100	1,160	1,070	-100
	sb				920	950	+30	520	530	+10
Ringland Road	nb	4,600	4,600	0	260	280	+10	340	340	0
	sb				390	330	-60	220	210	-10
A47 (west)	wb	16,100	16,200	+100	1,230	1,240	+10	1,820	1,830	0
	eb	15,900	15,900	0	1,870	1,860	-10	1,350	1,420	+70
Dereham Road (west)	wb	4,500	4,200	-300	80	90	+10	200	200	0
	eb				360	310	-50	190	120	-80
Longwater Lane	nb	9,300	9,100	-200	410	380	-30	500	490	-20
	sb				580	600	+20	460	450	-10
Marlingford Road	nb	10,100	10,000	-100	510	500	-10	470	460	-10
	sb				400	390	-20	540	540	0
The Street	nb	5,400	5,200	-200	260	250	-20	250	250	-10
	sb				310	320	+10	300	290	-10
West End	nb	5,100	5,100	0	170	160	-10	290	290	-10
	sb				300	310	+10	190	190	0

		AADT (Vehicles)			AM Peak (PCUs)			PM Peak (PCUs)		
Link		DM	DS	Change	DM	DS	Change	DM	DS	Change
Dog Lane	nb	4,100	4,000	-100	190	200	+10	320	310	-10
	sb				390	320	-80	220	200	-10

4.2 DS2 - New Bridge over the A47 at Longwater Interchange

The traffic flow impacts of DS2 in 2017 and 2032 are summarised in **Table 4.3** and **Table 4.4** respectively.

DS2 has little effect on traffic to the north or east of Longwater Interchange in terms of daily traffic flows, in the morning peak or in the evening peak. On the A47 to the west of the Interchange, in the eastbound direction, there is an increase in 2032 flows of 1,200 vehicles per day, whilst on Dereham Road to the west of the Interchange there is a decrease in 2032 flows of 1,300 vehicles per day in the eastbound direction. Overall, there is minimal change in total traffic demand to the west, with some traffic diverting from Dereham Road onto the A47. On Longwater Bridge, there are only small changes in daily and peak hour flows, despite the increase in capacity that the DS2 scheme provides.

Across the wider network, DS2 has little impact on daily flows in either of the forecasting years and changes in the peak hour are limited. During the morning peak, DS2 reduces southbound flows in 2032 on both Ringland Road and Dog Lane. During the evening peak the only appreciable change in 2032 flows is in both directions on Longwater Lane and in the southbound direction on Marlingford Road.

Overall DS2 reduces eastbound flows passing through Longwater Interchange but has limited impact on the wider network, reflecting its aim of increasing capacity at a single point on the network rather than a redirection of traffic flows.

Table 4.3: DS2 Traffic Flow Summary 2017

		AADT (Vehicles)			AM Peak (PCUs)			PM Peak (PCUs)		
Link		DM	DS	Change	DM	DS	Change	DM	DS	Change
William Frost Way	nb	12,800	12,700	-100	560	550	-10	740	750	0
	sb				780	770	0	550	550	0
Dereham Road (east)	wb	20,300	19,900	-400	1,260	1,270	+10	890	870	-20
	eb				800	780	-20	1,060	1,070	+10
Longwater Bridge	nb	13,800	13,900	100	640	630	-10	1,040	1,060	+20
	sb				810	880	+70	370	370	0
Ringland Road	nb	3,100	3,100	0	130	130	0	240	240	0
	sb				200	190	-10	130	130	-10
A47 (west)	wb	13,500	13,600	+100	1,140	1,140	0	1,500	1,560	+60
	eb	14,600	14,800	+200	1,700	1,720	+20	1,290	1,290	0
Dereham Road (west)	wb	2,300	1,800	-500	80	80	0	140	120	-30
	eb				110	80	-30	90	70	-20

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
Longwater Lane	nb	8,100	7,900	-200	380	360	-10	490	470	-10
	sb				600	590	-10	380	370	-10
Marlingford Road	nb	7,100	7,000	-100	300	290	-10	350	340	-10
	Sb				320	310	0	320	340	+20
The Street	nb	4,300	4,200	-100	250	250	0	240	230	0
	sb				250	250	0	210	210	0
West End	nb	5,200	5,100	-100	180	180	0	310	300	-10
	sb				370	360	-10	200	200	0
Dog Lane	nb	2,800	2,800	0	110	110	0	240	250	10
	sb				160	150	-10	140	130	-10

Table 4.4: DS2 Traffic Flow Summary 2032

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
William Frost Way	nb	15,300	15,200	-100	770	760	-10	790	790	0
	sb				830	830	0	740	730	-10
Dereham Road (east)	wb	24,100	23,500	-600	1,380	1,380	0	1,150	1,090	-60
	eb				940	910	-20	1,210	1,200	-10
Longwater Bridge	nb	18,300	17,000	-1,300	1,030	840	-190	1,160	1,080	-80
	sb				920	940	+20	520	490	-30
Ringland Road	nb	4,600	4,500	-100	260	260	0	340	340	-10
	sb				390	340	-50	220	220	-10
A47 (west)	wb	16,100	16,000	-100	1,230	1,220	-10	1,820	1,810	-10
	eb	15,900	17,100	+1,200	1,870	1,990	120	1,350	1,440	+80
Dereham Road (west)	wb	4,500	3,200	-1,300	80	90	+10	200	220	+20
	eb				360	210	-160	190	100	-90
Longwater Lane	nb	9,300	9,000	-300	410	390	-20	500	490	-10
	sb				580	570	-10	460	440	-30
Marlingford Road	nb	10,100	10,000	-100	510	510	0	470	460	-10
	sb				400	390	-20	540	550	+10
The Street	nb	5,400	5,300	-100	260	250	-10	250	250	-10
	sb				310	300	-10	300	280	-20
West End	nb	5,100	5,000	-100	170	160	-10	290	290	-10
	sb				300	300	0	190	190	0
Dog Lane	nb	4,100	4,000	-100	190	190	0	320	310	-10
	sb				390	360	-30	220	210	-10

4.3 DS3 – New Link from Easton Roundabout to Longwater Employment Area

The traffic flow impacts of DS3 in 2017 and 2032 are summarised in **Table 4.5** and **Table 4.6** respectively.

DS3 results in little change to traffic flows to the south of the Longwater Interchange, whilst to the east on Dereham Road there is a decrease in daily flow of 600 vehicles in 2017 and 700 vehicles in 2032. On the new link itself, daily traffic flows are forecast at 700 vehicles in 2017 and 1,100 vehicles in 2032 with corresponding reductions on William Frost Way and smaller reductions on the A47 to the west of the Interchange.

Across the wider network, DS3 reduces daily and peak hour traffic flows on The Street, Longwater Lane and West End, whilst increasing flows on Ringland Road and Dog Lane.

Overall DS3 provides only very limited relief to Longwater Interchange, as flows on the new link road are comparatively very low, whilst causing some reassignment of flows on the wider network.

Table 4.5: DS3 Traffic Flow Summary 2017

		AADT (Vehicles)			AM Peak (PCUs)			PM Peak (PCUs)		
Link		DM	DS	Change	DM	DS	Change	DM	DS	Change
William Frost Way	nb	12,800	12,300	-500	560	520	-40	740	710	-40
	sb				780	800	+20	550	520	-30
Dereham Road (east)	wb	20,300	19,700	-600	1,260	1,200	+60	890	860	-30
	eb				800	770	-20	1,060	1,030	-40
Longwater Bridge	nb	13,800	13,700	-100	640	630	-10	1,040	1,030	-10
	sb				810	810	0	370	360	-10
Ringland Road	nb	3,100	3,400	+300	130	140	+10	240	250	+10
	sb				200	260	+60	130	150	+20
A47 (west)	wb	13,500	13,300	-200	1,140	1,120	-20	1,500	1,490	-20
	eb	14,600	14,400	-200	1,700	1,670	-30	1,290	1,260	-20
Dereham Road (west)	wb	2,300	2,200	-100	80	70	-10	140	140	0
	eb				110	110	0	90	90	0
Longwater Lane	nb	8,100	7,600	-500	380	350	-20	490	460	-30
	sb				600	530	-70	380	360	-20
Marlingford Road	nb	7,100	7,100	0	300	300	0	350	350	0
	sb				320	310	0	320	320	0
The Street	nb	4,300	4,100	-200	250	240	-10	240	230	-10
	sb				250	220	-30	210	200	-10
West End	nb	5,200	4,900	-300	180	170	-10	310	300	-20
	sb				370	340	-40	200	200	-10
Dog Lane	nb	2,800	3,300	+500	110	130	+20	240	250	+10
	sb				160	240	+80	140	160	+20

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
Easton to Longwater Link	wb	0	700	+700	0	30	+30	0	30	+30
	eb				0	90	+90	0	40	+40

Table 4.6: DS3 Traffic Flow Summary 2032

Link		AADT (Vehicles) DM	DS	Change	AM Peak (PCUs) DM	DS	Change	PM Peak (PCUs) DM	DS	Change
William Frost Way	nb	15,300	14,200	-1,100	770	670	-100	790	700	-90
	sb				830	810	-30	740	680	-60
Dereham Road (east)	wb	24,100	23,400	-700	1,380	1,360	-20	1,150	1,090	-50
	eb				940	900	-40	1,210	1,180	-30
Longwater Bridge	nb	18,300	18,300	0	1,030	1,020	-10	1,160	1,230	+70
	sb				920	930	+10	520	520	-10
Ringland Road	nb	4,600	4,900	+300	260	290	+30	340	350	+10
	sb				390	380	-10	220	260	+40
A47 (west)	wb	16,100	15,800	-300	1,230	1,210	-20	1,820	1,780	-50
	eb	15,900	15,300	-600	1,870	1,760	-100	1,350	1,270	-80
Dereham Road (west)	wb	4,500	4,600	+100	80	90	+10	200	200	0
	eb				360	370	0	190	240	+40
Longwater Lane	nb	9,300	8,700	-600	410	370	-40	500	480	-20
	sb				580	540	-40	460	410	-60
Marlingford Road	nb	10,100	10,000	-100	510	510	-10	470	460	-10
	sb				400	390	-20	540	530	-10
The Street	nb	5,400	5,100	-300	260	240	-30	250	250	0
	sb				310	280	-30	300	270	-30
West End	nb	5,100	4,900	-200	170	160	-10	290	280	-20
	sb				300	290	-10	190	170	-20
Dog Lane	nb	4,100	4,600	+500	190	230	+40	320	320	0
	sb				390	380	-10	220	270	+50
Easton to Longwater Link	wb	0	1,100	+1,100	0	60	+60	0	60	+60
	eb				0	120	+120	0	90	+90

4.4 Summary

This modelling exercise has demonstrated that the DS1 scenario would reduce traffic volumes passing through Longwater Interchange, providing significant relief to William Frost Way. DS2 achieves some reduction in flow through the Interchange as a result of traffic from Easton diverting off Dereham Road onto the A47 via Easton roundabout to the west. The effectiveness of these scenarios in adding to capacity of the Interchange is considered in section **5.0**.

DS3 provides only very limited relief to traffic flow levels at Longwater Interchange, with the new link forecast to attract only 1,100 vehicles per day in 2032. This reflects the origins and destinations of the majority of traffic using Longwater Interchange, which lie to the east within Norwich itself.

5 Junction Performance

The following four junctions were tested using LINSIG:

- A47 Longwater/William Frost Way Interchange;
- A1074 Dereham Road/Link Road staggered junction (DS1 scenario only);
- A1074 Dereham Road/Longwater Lane; and
- A47 Easton Throughabout.

For each of the above junctions, the traffic turning flows (in PCUs) during the AM peak, Inter Peak and PM peak were extracted from SATURN runs for the following scenarios:

- 2012 DCO Base Year model;
- 2017/ 2032 Do-Nothing (DN);
- 2017/ 2032 Do-Minimum (DM);
- 2017/ 2032 DS1;
- 2017/ 2032 DS2; and
- 2017/ 2032 DS3.

For the purposes of the 2014 Strategy work, NCC commissioned a peak hour traffic survey at Longwater Interchange in April 2013. These observed turning flows were compared to the 2012 modelled turning flows and whilst there was a good match between the observed and modelled total flows on the approaches to the junction on the A47, there were significant differences in the turning flows themselves.

For this reason, it was decided to accept the 2013 turning counts in preference to the 2012 modelled data. In order to derive the future year flows, it was decided to compare the model in 2017 and 2032 for the scenario (DM or one of the DSs) with 2012 model and calculate the flow differences. The future year turning flows were then derived by adding the flow differences from the models to the observed 2013 turning count. For the other three junctions, a similar approach was used i.e. adding increased traffic demand in the future from the SATURN model to the observed counts in 2013 (or 2012)

In the absence of 2013 survey data for the Inter Peak period, traffic turning flows from SATURN runs were used directly in testing junction performance.

5.1 A47/A1074 Longwater Interchange

A summary of the capacity analysis for the junction is shown in **Table 5.1**, in terms of the ratio of flow to capacity (RFC), taking the highest value of all arms feeding into each junction. Signalised junctions are considered to operate adequately if the RFC is 90% or less.

For the DM scenario in 2017, the junction performs satisfactory in all of the AM Inter Peak and PM peak periods. In 2032, despite the introduction of the free-flow left turn from Dereham Road to A47 EB on-slip, the RFC value increases to 100% in the AM peak, and up to 111% in the PM peak which is well above the acceptable level. The DS3 link road attracts very little traffic and as a result, a very similar pattern to the DM scenario is shown for the DS3 scenario, where the junction is over-capacity in the AM peak in both forecasting years.

For both DS1 and DS2, during all peak periods and all forecasting years, the RFC is below the acceptable value of 90%. The turning movement demand derived for this assessment has been compared to that used for the 2014 Strategy work. In the previous work a 'robust' assessment was undertaken, assuming that all potential land plots at Longwater would be developed and that employment designations would be developed as office business parks. Within the SATURN model, it has been assumed that employment at Longwater would be a mix of B1/B2/B8 uses, giving much lower peak hour trip generation levels and traffic demands than used in the 2014 Strategy work. Sensitivity testing has therefore been carried out to assess the impact of higher flows, the results of which show that the Interchange continues to operate adequately with increased traffic demands of up to 10%.

Therefore, it is concluded that DS1 and DS2 improvements would provide sufficient capacity in 2032, whereas with DM and DS3 the junction is over-capacity in both 2017 and 2032.

Table 5.1: Summary of Capacity Analysis for A47/A1074 Longwater Interchange

			Ratio of Flow to Capacity		
Scenario	Description	Year	AM Peak	IP	PM Peak
Do Minimum	Existing with DM Measures	2017	84%	50%	86%
		2032	**100%**	48%	**111%**
DS1	Double 'Tear Drop' with Link Road	2017	88%	30%	79%
		2032	83%	41%	81%
DS2	Longwater Double Bridge	2017	81%	69%	86%
		2032	85%	73%	86%
DS3	Easton to Longwater Link Road	2017	84%	51%	85%
		2032	**102%**	48%	**111%**

5.2 A1074 Dereham Road/Link Road Staggered Junction

This is the staggered junction with the link road in the DS1 scenario.

Table 5.2 shows the result of LINSIG runs, which indicate that the junction performs satisfactory in all peak periods and in both forecasting years.

Table 5.2: Summary of Capacity Analysis for A1074 Dereham Road/ Link Road Staggered Junction

Scenario	Description	Year	Ratio of Flow to Capacity		
			AM Peak	IP	PM Peak
DS1	Double 'Tear Drop' with Link Road	2017	58%	33%	53%
		2032	59%	40%	63%

5.3 A1074 Dereham Road/Longwater Lane Junction

This is the junction on Dereham Road to the east of Longwater Interchange. **Table 5.3** shows a summary of LINSIG runs for the DM and the DS1 scenarios (DS1 having slightly higher demand than DS2 and DS3). The results show that the junction performs satisfactorily in all peak periods and in both forecasting years.

Table 5.3: Summary of Capacity Analysis for A1074 Dereham Road/ Longwater Lane Junction

Scenario	Description	Year	Ratio of Flow to Capacity		
			AM Peak	IP	PM Peak
Do Minimum	Existing with DM Measures	2017	79%	68%	76%
		2032	83%	76%	85%
DS1	Double 'Tear Drop' with Link Road	2017	81%	68%	77%
		2032	84%	76%	84%

5.4 A47 Easton Throughabout

Currently this junction is in the form of a normal roundabout but by 2032 it is proposed to change to a 'throughabout' layout. The performance of the junction was tested with the proposed layout and a summary of LINSIG results in 2032 are shown in **Table 5.4**. The RFCs show the junction performs satisfactory in DM, in DS2 and DS3 in all peak periods (DS1 having lower demand than DS2).

Table 5.4: Summary of Capacity Analysis for A47 Easton Throughabout

Scenario	Description	Year	AM Peak	IP	PM Peak
Do Minimum	Existing with DM Measures	2017	-	-	-
		2032	75%	47%	65%
DS2	Longwater Double Bridge	2017	-	-	-
		2032	77%	50%	68%
DS3	Easton to Longwater Link Road	2017	-	-	-
		2032	72%	47%	62%

6 Implementation

An initial consideration of deliverability issues associated with DS1 and DS2 improvement options is set out below, in respect of:

- the disruption to existing traffic during construction;
- the potential construction period; and
- the estimated cost of construction.

6.1 DS1 - Link Road and Double 'Tear Drop' at Longwater Interchange

6.1.1 New Link Road

The new link road currently being considered from Ernest Gage Way to the Dereham Road is likely to be routed across the existing Costessey Landfill site, operated by NCC. It is understood that the landfill would be remediated (removed) prior to construction of the link road, with the land being engineered to a suitable specification that would allow a standard road construction. The link road will require minor realignment of Ernest Gage Way, which should be easily accommodated with little impact upon the existing commercial businesses during construction.

The link road will require a new junction with the A1074 Dereham Road. Whilst the junction type and location has not yet been determined, it is likely to take the form of a signalised T-junction, similar to that installed earlier this year to access the Lodge Farm residential development, to the south of Dereham Road. Construction impacts for this new junction are likely to be similar to the Lodge Farm junction, which was constructed with periods of single way flow controlled by temporary traffic lights.

The estimated construction duration for the new link road is no more than 12 months, on the assumption that the Costessey Landfill site has been remediated in advance. As the majority of the build is off-line there should be little impact on existing traffic flows during construction.

6.1.2 'Tear Drop' Roundabout

The construction impact of the conversion of the existing northern roundabout at Longwater Interchange into a 'tear drop' configuration would be relatively minor, in that it only requires extension of the splitter island from the existing bridge across the carriageway to the existing roundabout. This work would follow opening of the new link road and have only a minor impact on traffic using the roundabout during construction. No formal diversions are considered likely.

6.2 DS2 - New Bridge over the A47 at Longwater Interchange

6.2.1 New Overbridge

A new overbridge would require at least one weekend (72 hour) closure to effect the placement of bridge beams over the A47. During this time it is envisaged that the A47 would be reduced to one lane in each direction and diverted up and down the existing slip roads. There would be resultant queues on the A47

and through the construction works during this time. On the northern side the resultant queue would make it very difficult for members of the public to exit the Longwater Employment Area and Queen's Hills by car, and could greatly reduce the response times of the ambulances based at the ambulance station (a temporary relocation could be considered). However, if DS1 was already in place it would provide an alternative route for vehicles to access and egress the Longwater Employment Area, and thereby reduce some of the potential impacts during construction of the new overbridge.

6.2.2 Slip Roads

The new roundabout configurations will require alterations to the existing slip roads. The works will necessitate reducing the offslips to one lane for periods of time, which would impact on travel times, access to the Easton and Longwater areas, and could cause queuing back onto the A47 at peak times during construction.

6.2.3 Construction Period

In light of our recent experience in the delivery of a new overbridge at the A47 Postwick Junction, to the east of Norwich, we anticipate that a construction period for DS2 would be a minimum of 18 months.

6.3 Summary

Option	Duration	Ease of Construction	Impact during Construction	Potential Cost (estimate +/- 30%)
DS1	Up to 12 months	Standard construction, majority off-line	Slight	£5m
DS2	18+ months	Relatively standard construction, but constrained by working on/around live carriageways	Severe	£15m

7 Conclusions

This report summarises the results of SATURN strategic modelling and LINSIG junction capacity assessment work carried out to investigate the performance of three options for a major improvement scheme, which aims to enhance the capacity of the Longwater Interchange. This would address existing congestion at the Interchange and enable it to accommodate planned developments in the Longwater and Easton area. These options are:

- **DS1** – A new link from the Longwater Employment Area, through the existing Costessey landfill site, to the A1074 east of Longwater Interchange;
- **DS2** – A new bridge over the A47 at Longwater Interchange to allow a larger signalised gyratory layout; and
- **DS3** – A new link, running parallel to and north of the A47, connecting the A47 Easton roundabout to the Longwater Employment Area.

The strategic modelling work found that a new link road from Dereham Road to Longwater Employment Area (DS1) would carry around 3,700 vehicles per day in 2017 and 5,500 vehicles per day in 2032. These flows would be higher if new employment land at Longwater was based on office development, rather than a mix of B1/B2/B8 uses.

By comparison, a new link road west from Longwater Employment Area to the Easton roundabout (DS3) would attract much lower volumes of traffic, in the order of 700 vehicles per day in 2017 and 1,100 vehicles per day in 2032. This reflects the origins and destinations of the majority of traffic using Longwater Interchange, which lie to the east within Norwich itself.

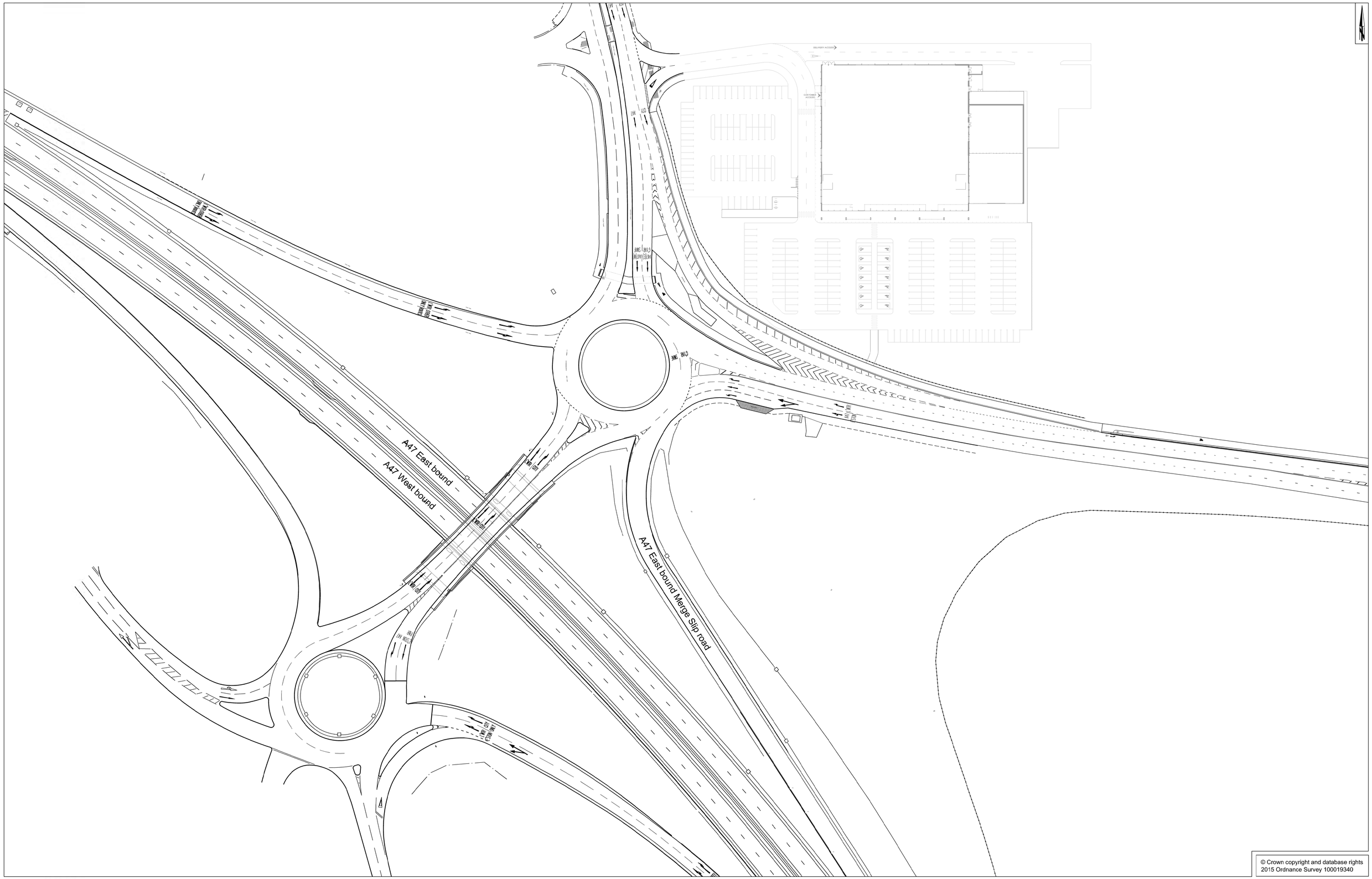
The junction capacity assessments revealed that the Longwater Interchange would be over-capacity in the 2032 Do Minimum scenario, but also under the DS3 scenario, where a new link road to the west would provide only limited relief in the AM and PM peak periods. However, for the DS1 and DS2 scenarios the Interchange performs well in both peak periods for 2017 and 2032. LINSIG results show that the other three signalised junctions considered, perform satisfactorily in both peak periods and in both future years.

The key conclusion from this modelling exercise is that the DS3 improvement is not effective in improving the performance of Longwater Interchange, in comparison with the DS1 and DS2 improvements. Both the DS1 and DS2 improvements would enable Longwater Interchange to operate with reserve capacity in 2032 (able to accommodate 10% more traffic) and the choice of a preferred option will rest on a fuller consideration of their feasibility.

An initial consideration of deliverability issues associated with DS1 and DS2 improvement options indicates that DS1 can be implemented more quickly and with considerably less disruption to existing traffic than DS2. It should be noted, however, that this conclusion does not take account of the timescales and costs required for remediation of Costessey Landfill site to an acceptable engineering specification. This is currently the subject of a separate engineering feasibility study (DMRB Stage 1 Assessment).

Appendices

Appendix A. Do-Minimum Layout



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DRAWING TITLE
Longwater Do Minimum
Appendix A1

REV.	DESCRIPTION	CHECKED	DATE

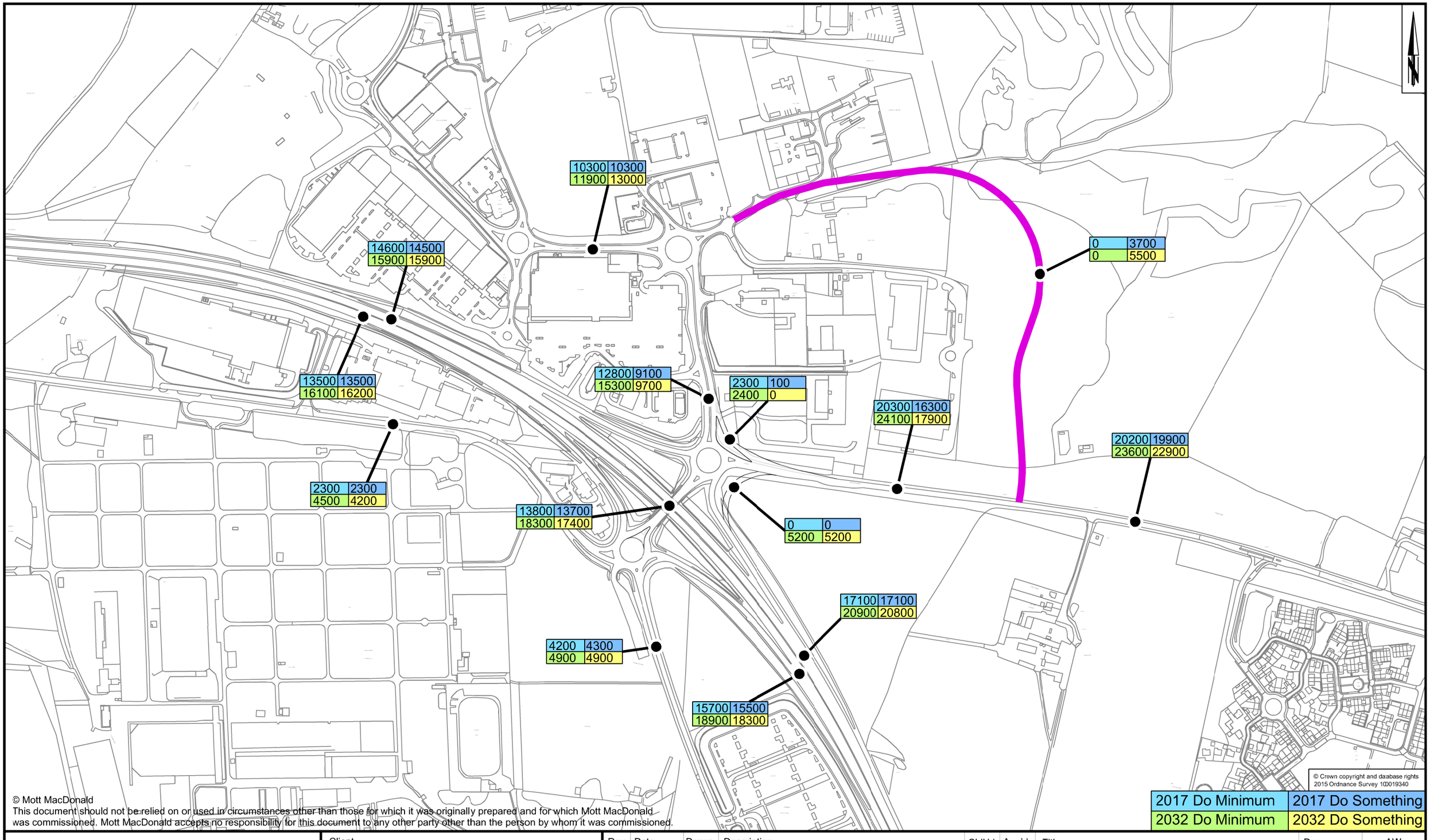
	INIT.	DATE
DESIGNED BY	JR	07/13
DRAWN BY	JR	07/13
CHECKED BY	AH	08/13
APPROVED BY	MMG	08/13

DRAWING No.
MMD-326107-C-DR-00-XX-0001
PROJECT TITLE
Longwater Do Minimum
SCALE AT A1
1:1000
FILE No.
326107

ORIGINAL SIZE: A1

30/06/2009

Appendix B. AADT Traffic Flow Data (Vehicles)



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Title

Longwater and Easton
Transport Strategy
AADT Flows (Vehicles)
DS1
Appendix B1

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0002

Rev: 0

Status: INF

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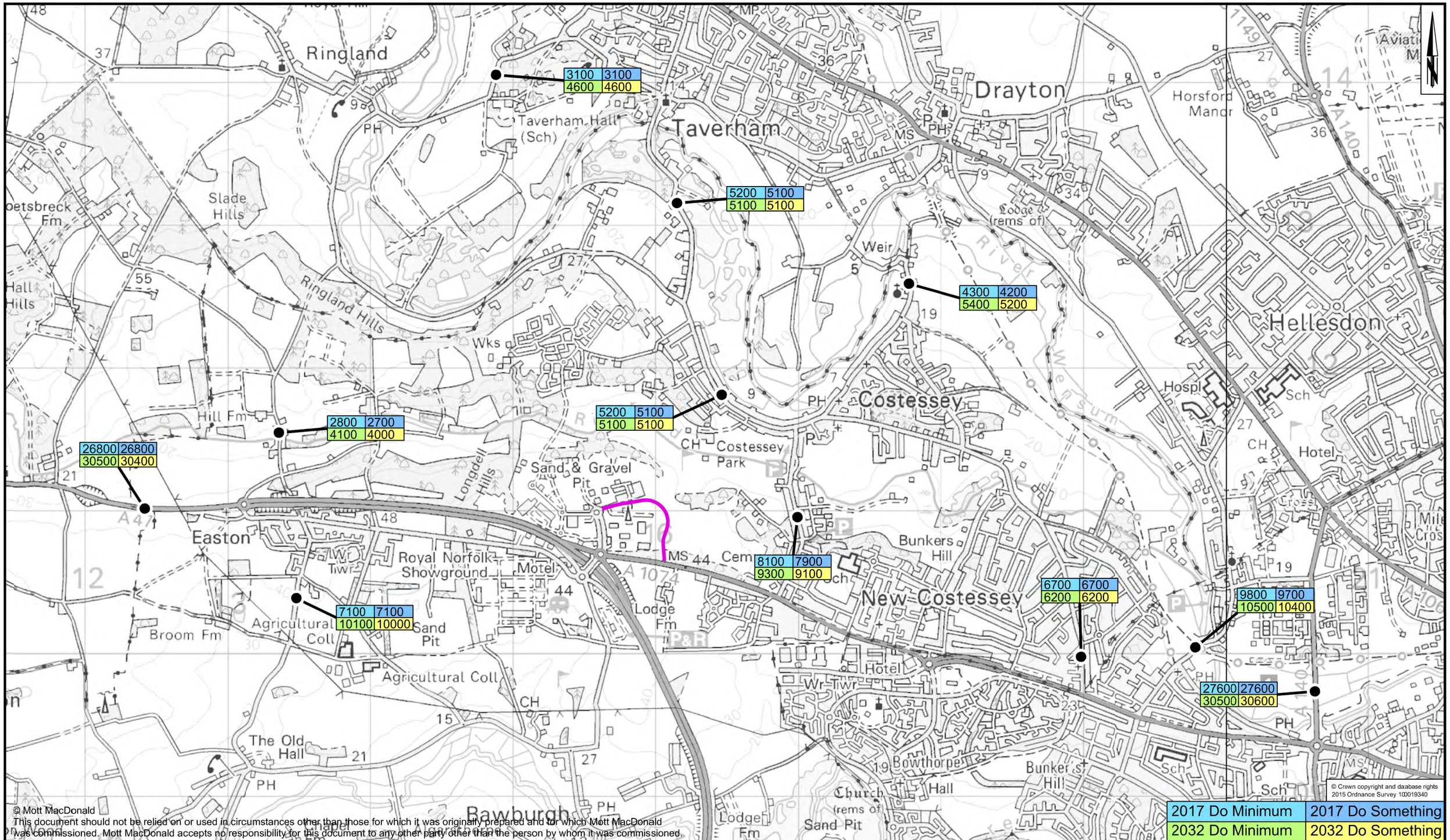

2017 Do Minimum	2017 Do Something
2032 Do Minimum	2032 Do Something

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Longwater and Easton Transport Strategy
AADT Flows (Vehicles)
DS1
Appendix B2

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Rev	Status
0	INF

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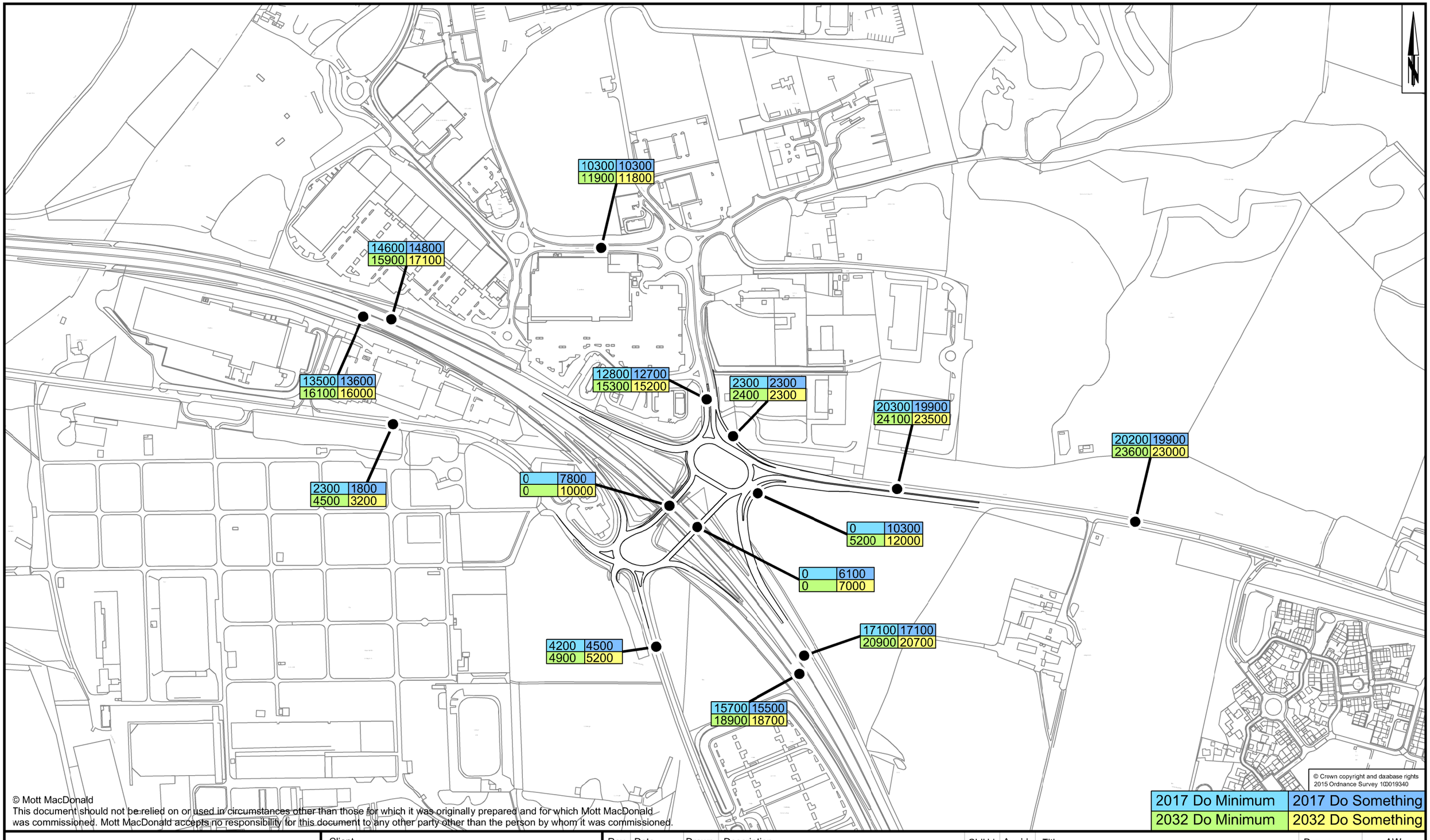

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Longwater and Easton
Transport Strategy
AADT Flows (Vehicles)
DS2
Appendix B3

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Rev: 0

Status: INF

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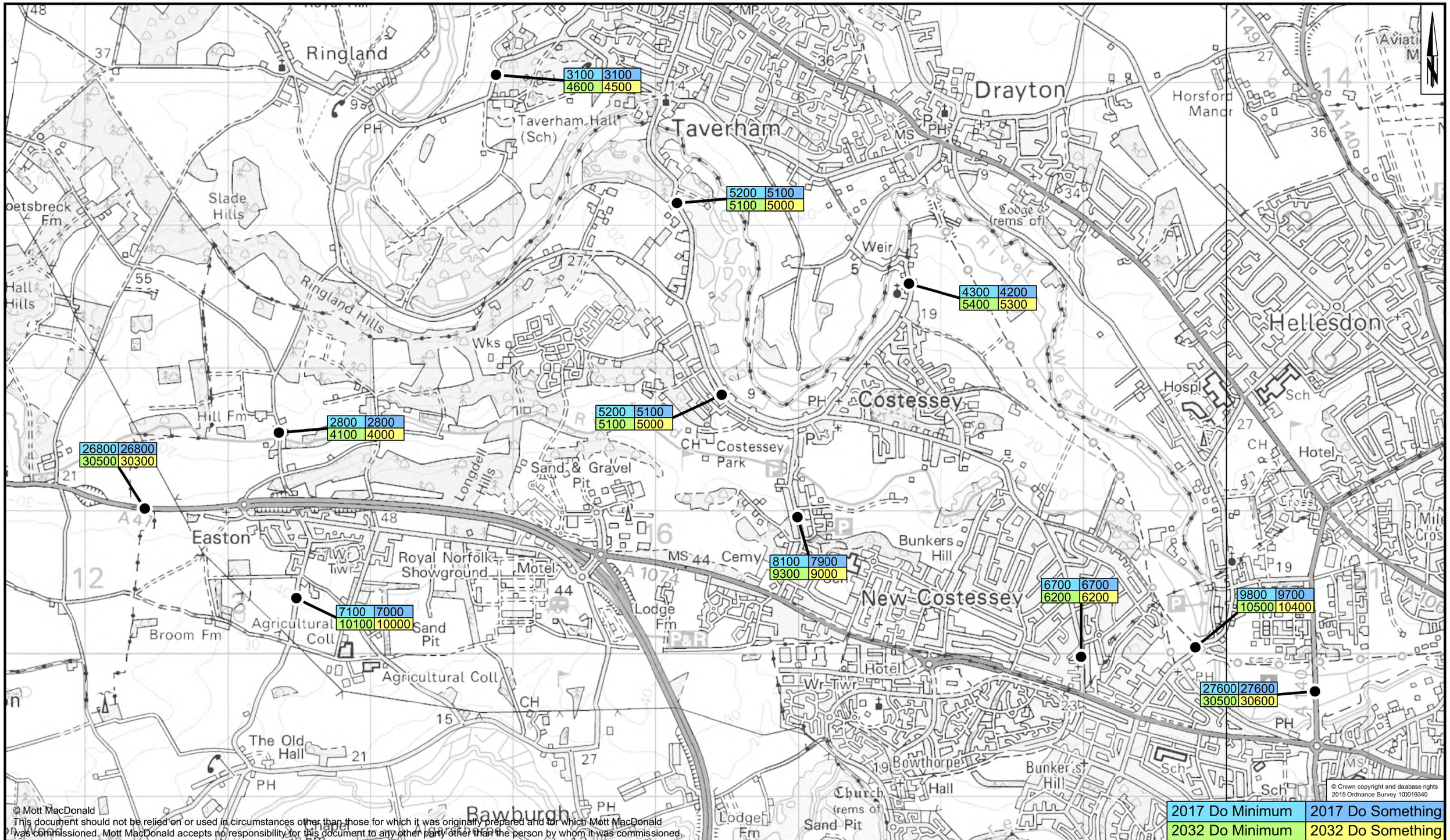

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Title: Longwater and Easton Transport Strategy
AADT Flows (Vehicles)
DS2
Appendix B4

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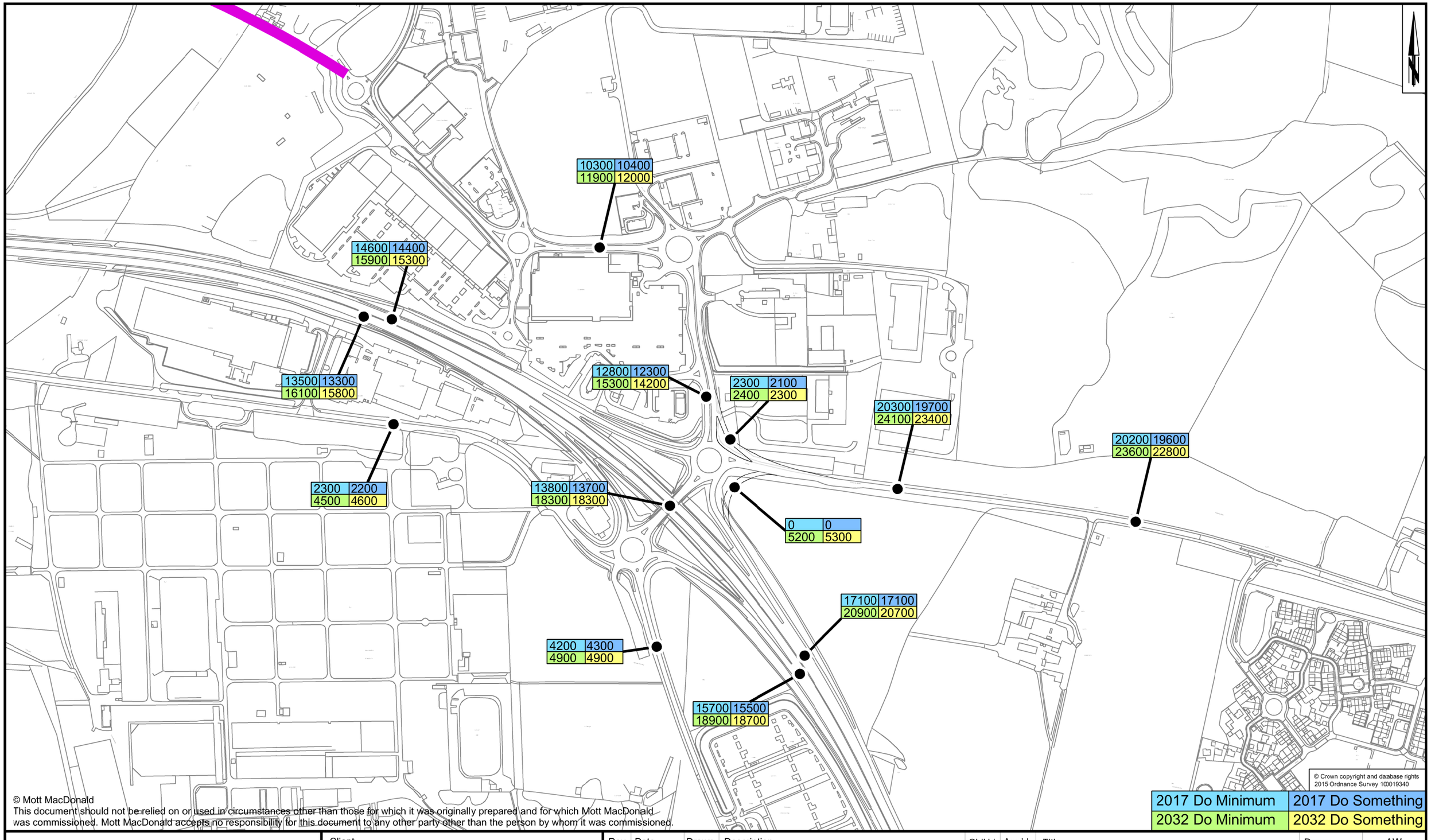

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Longwater and Easton
Transport Strategy
AADT Flows (Vehicles)
DS3
Appendix B5

Drawn	AW
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Approved	CW
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Drawing Number: MMD-326107-C-DR-00-XX-0006

Rev: 0

Status: INF

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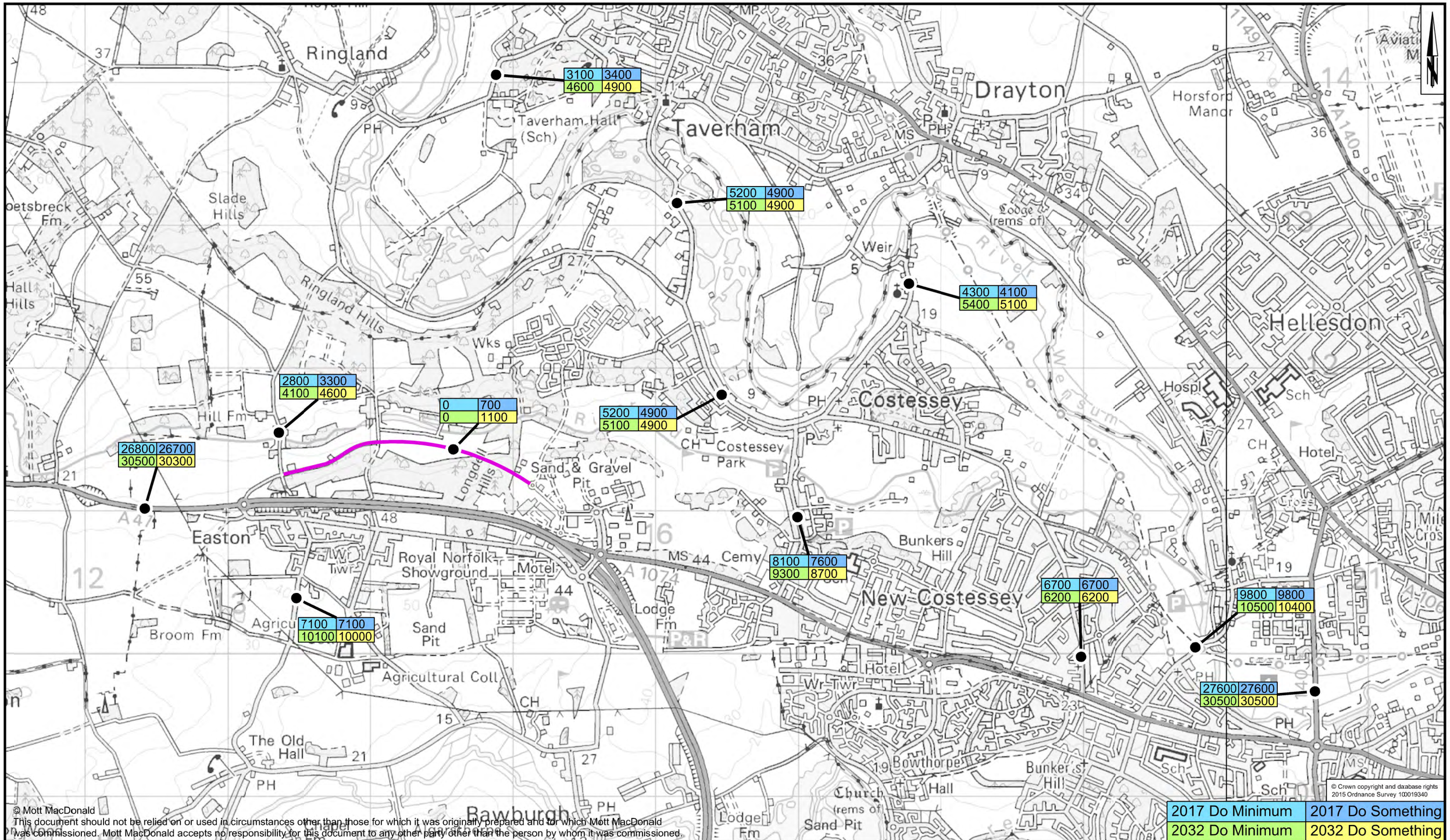

2017 Do Minimum	2017 Do Something
2032 Do Minimum	2032 Do Something

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Longwater and Easton Transport Strategy
AADT Flows (Vehicles)
DS3
Appendix B6

Drawn	AW
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Rev	Status
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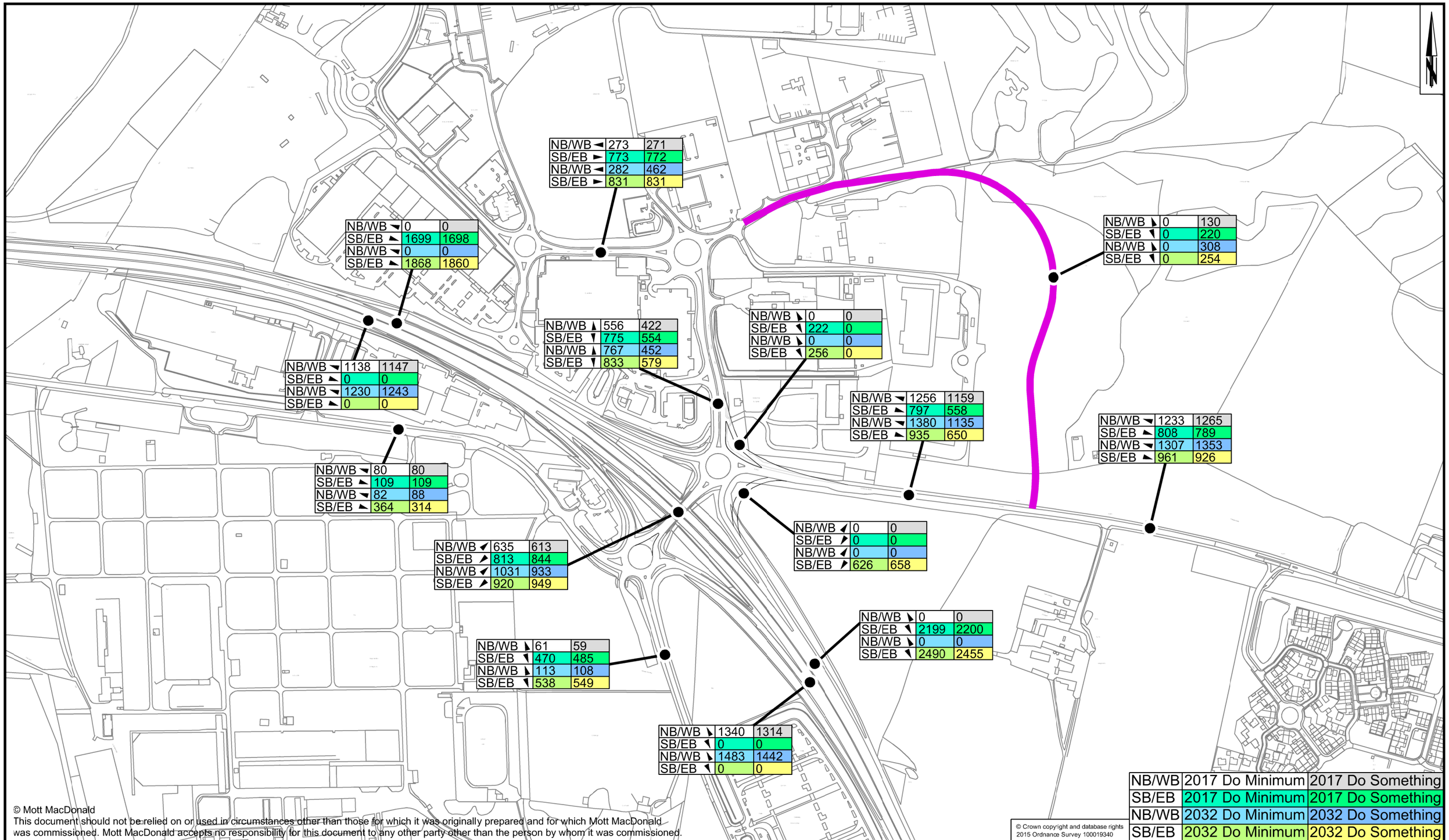
Appendix C. AM Peak Traffic Flow Data (PCUs)



NB/WB	2017 Do Minimum	2017 Do Something
SB/EB	2017 Do Minimum	2017 Do Something
NB/WB	2032 Do Minimum	2032 Do Something
SB/EB	2032 Do Minimum	2032 Do Something

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Longwater and Easton
Transport Strategy
AM Peak (PCUs)
DS1
Appendix C1

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Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0008

Rev	Status
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NB/WB	264	275
SB/EB	391	331

NB/WB	180	176
SB/EB	373	366
NB/WB	167	161
SB/EB	302	311

NB/WB	250	243
SB/EB	249	255
NB/WB	263	245
SB/EB	309	321

NB/WB	180	176
SB/EB	373	366
NB/WB	167	161
SB/EB	302	311

NB/WB	111	115
SB/EB	158	153
NB/WB	190	199
SB/EB	392	319

NB/WB	1056	1062
SB/EB	1620	1622
NB/WB	1104	1110
SB/EB	1712	1721

NB/WB	376	361
SB/EB	599	594
NB/WB	410	382
SB/EB	583	600

NB/WB	193	193
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SB/EB	341	341

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SB/EB	624	623

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NB/WB	514	501
SB/EB	404	389

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SB/EB	1014	1009
NB/WB	1083	1091
SB/EB	1009	1014

NB/WB	2017 Do Minimum	2017 Do Something
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Longwater and Easton
Transport Strategy
AM Peak (PCUs)
DS1
Appendix C2

Drawn	AW
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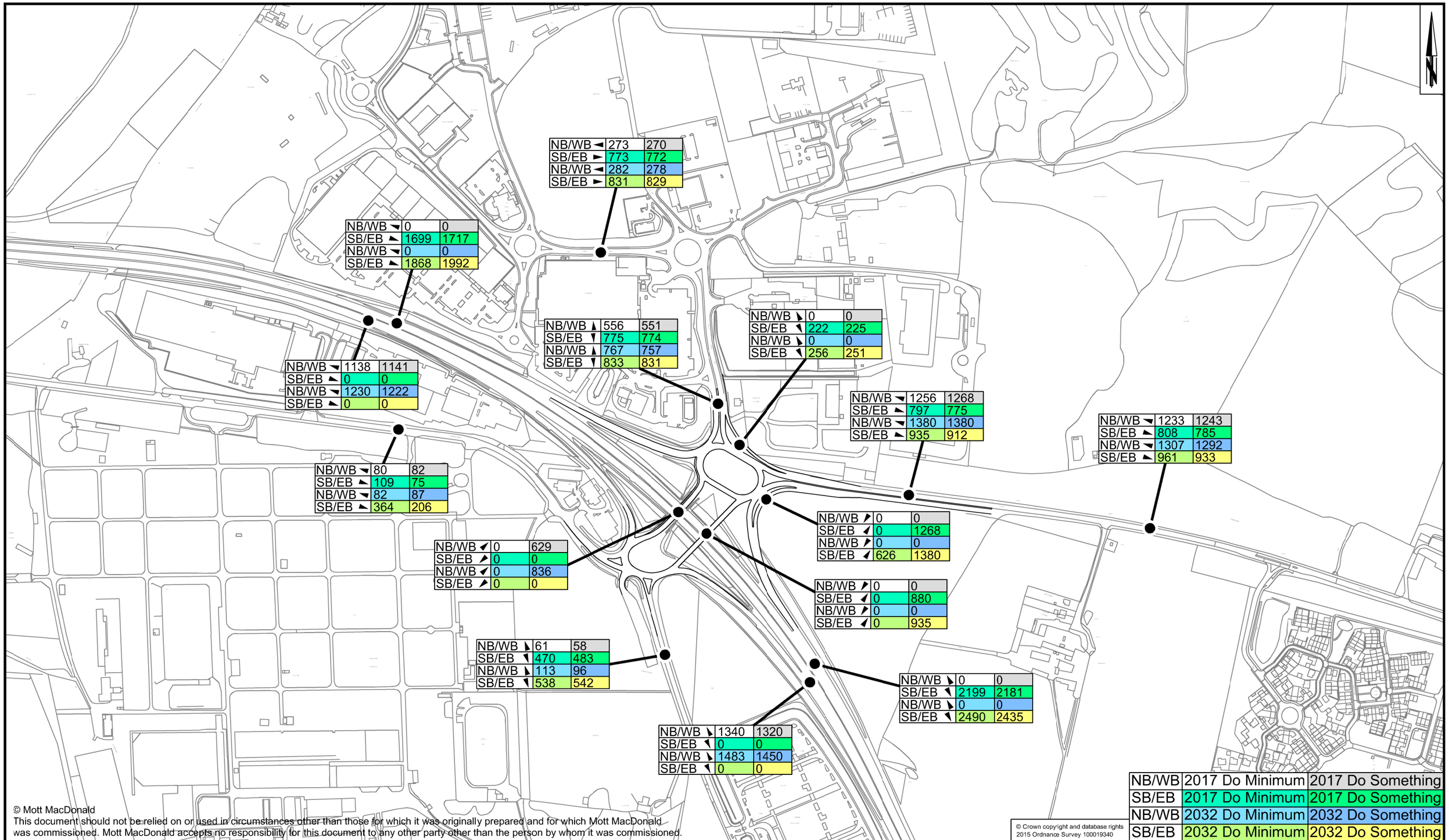

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Title

Longwater and Easton
Transport Strategy
AM Peak (PCUs)
DS2
Appendix C3

Drawn	AW
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Drawing Number: MMD-326107-C-DR-00-XX-0010

Rev	Status
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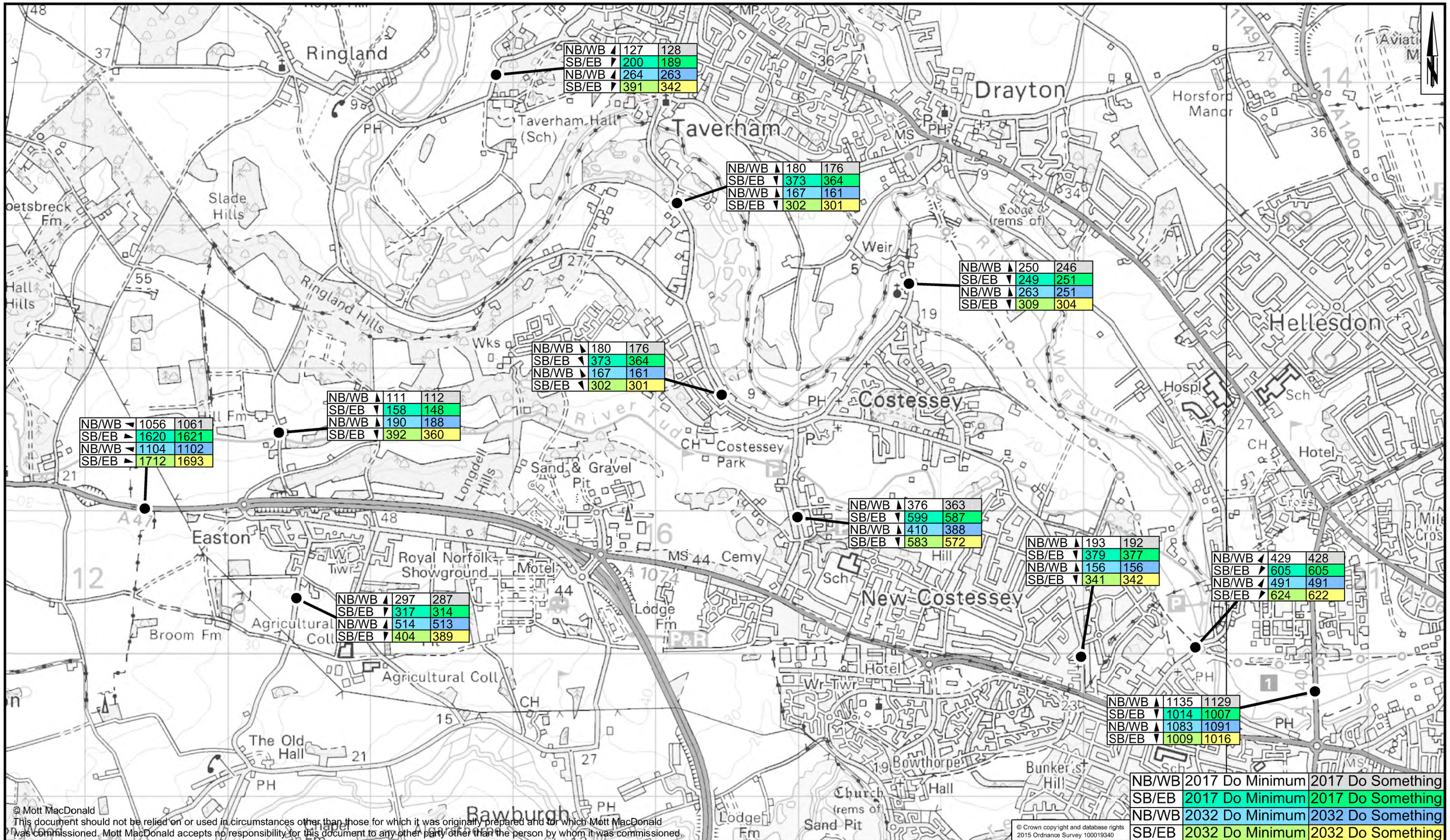

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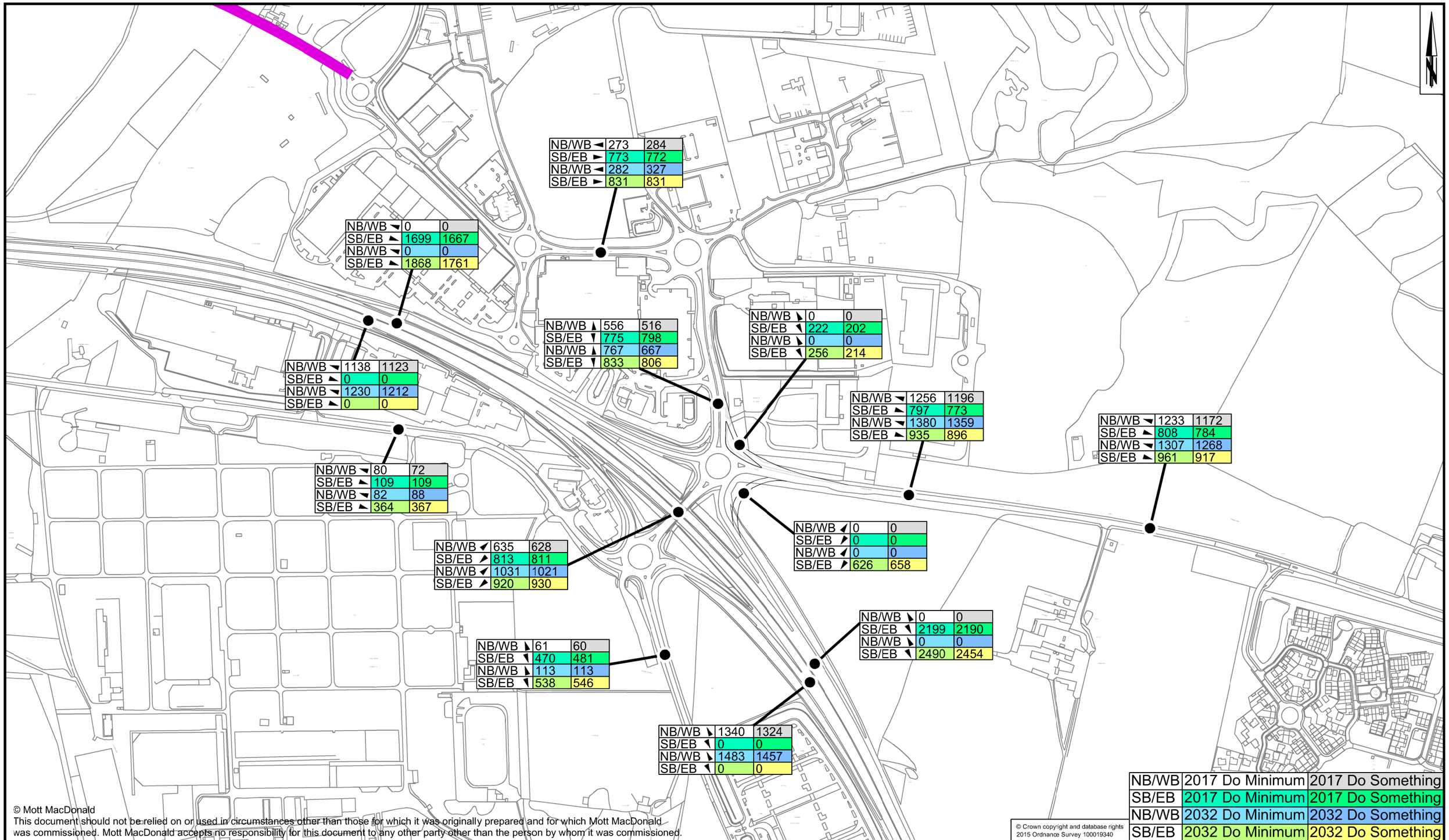
Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title: Longwater and Easton Transport Strategy
AM Peak (PCUs)
DS2
Appendix C4

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:25,000
Drawing Number	MMD-326107-C-DR-00-XX-0011
Rev	0
Status	INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS2 AM Peak.dwg Aug 10, 2015 - 2:47PM wor44127



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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

Longwater and Easton
Transport Strategy
AM Peak (PCUs)
DS3
Appendix C5

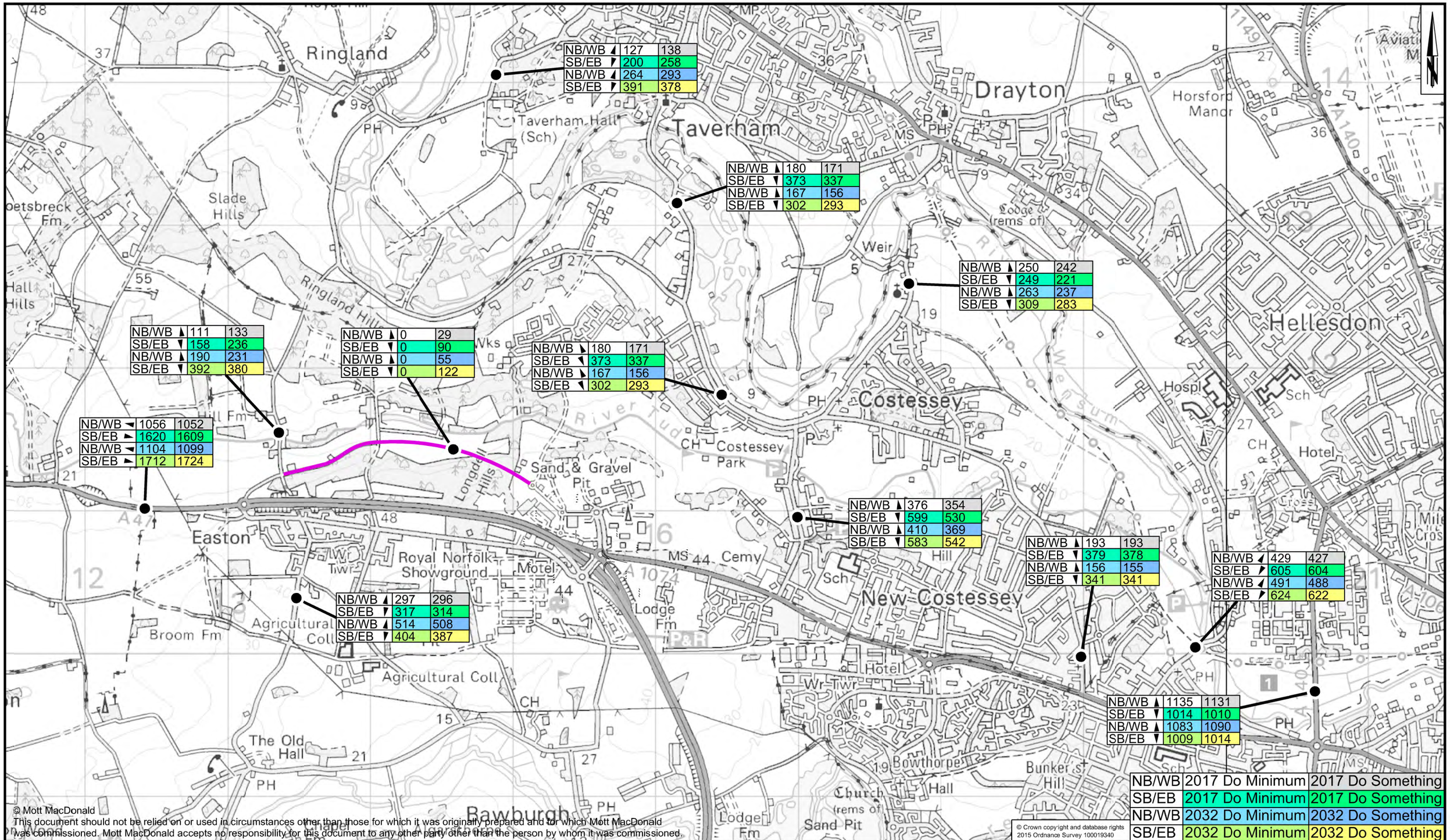
Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0012

Rev: 0

Status: INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS3 AM Peak.dwg Aug 10, 2015 - 2:50PM wor44127



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0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

Longwater and Easton
Transport Strategy
AM Peak (PCUs)
DS3
Appendix C6

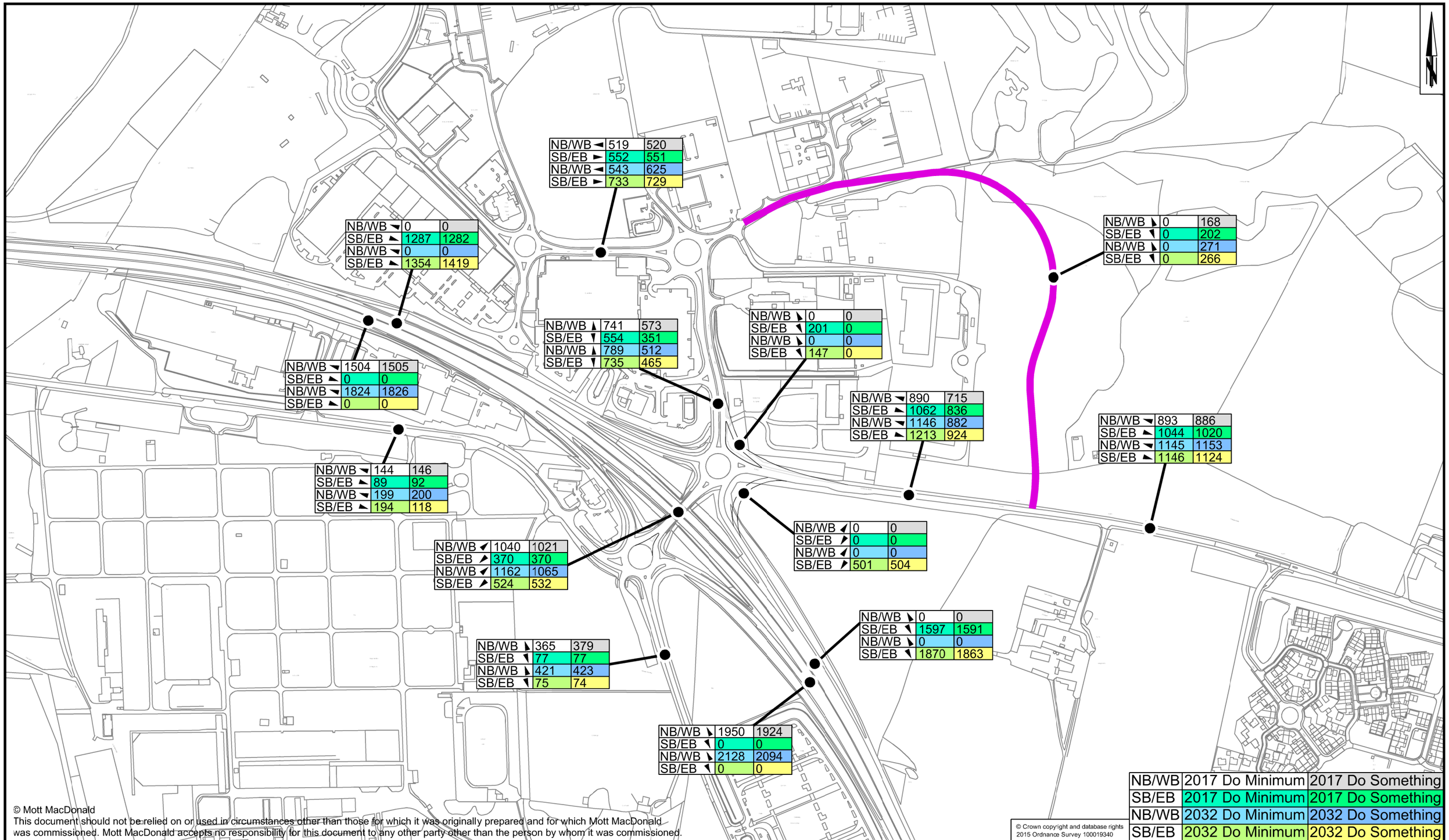
Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:25,000

Drawing Number: MMD-326107-C-DR-00-XX-0013

Rev	Status
0	INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS3 AM Peak.dwg Aug 10, 2015 - 2:50PM wor44127

Appendix D. PM Peak Traffic Flow Data (PCUs)



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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

Longwater and Easton
Transport Strategy
PM Peak (PCUs)
DS1
Appendix D1

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0014

Rev: 0

Status: INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS1 PM Peak.dwg Aug 10, 2015 - 2:52PM wor44127

NB/WB	238	236
SB/EB	133	129
NB/WB	343	336
SB/EB	222	211

NB/WB	312	303
SB/EB	203	200
NB/WB	293	286
SB/EB	189	190

NB/WB	235	231
SB/EB	212	214
NB/WB	251	245
SB/EB	299	293

NB/WB	312	303
SB/EB	203	200
NB/WB	293	286
SB/EB	189	190

NB/WB	241	241
SB/EB	136	133
NB/WB	320	313
SB/EB	216	204

NB/WB	1388	1389
SB/EB	1188	1188
NB/WB	1574	1576
SB/EB	1271	1269

NB/WB	353	352
SB/EB	320	320
NB/WB	470	462
SB/EB	538	537

NB/WB	486	471
SB/EB	378	375
NB/WB	502	487
SB/EB	461	452

NB/WB	398	398
SB/EB	213	213
NB/WB	331	331
SB/EB	186	187

NB/WB	449	448
SB/EB	599	599
NB/WB	474	472
SB/EB	547	546

NB/WB	1159	1158
SB/EB	1344	1343
NB/WB	1335	1335
SB/EB	1469	1470

NB/WB	2017 Do Minimum	2017 Do Something
SB/EB	2017 Do Minimum	2017 Do Something
NB/WB	2032 Do Minimum	2032 Do Something
SB/EB	2032 Do Minimum	2032 Do Something

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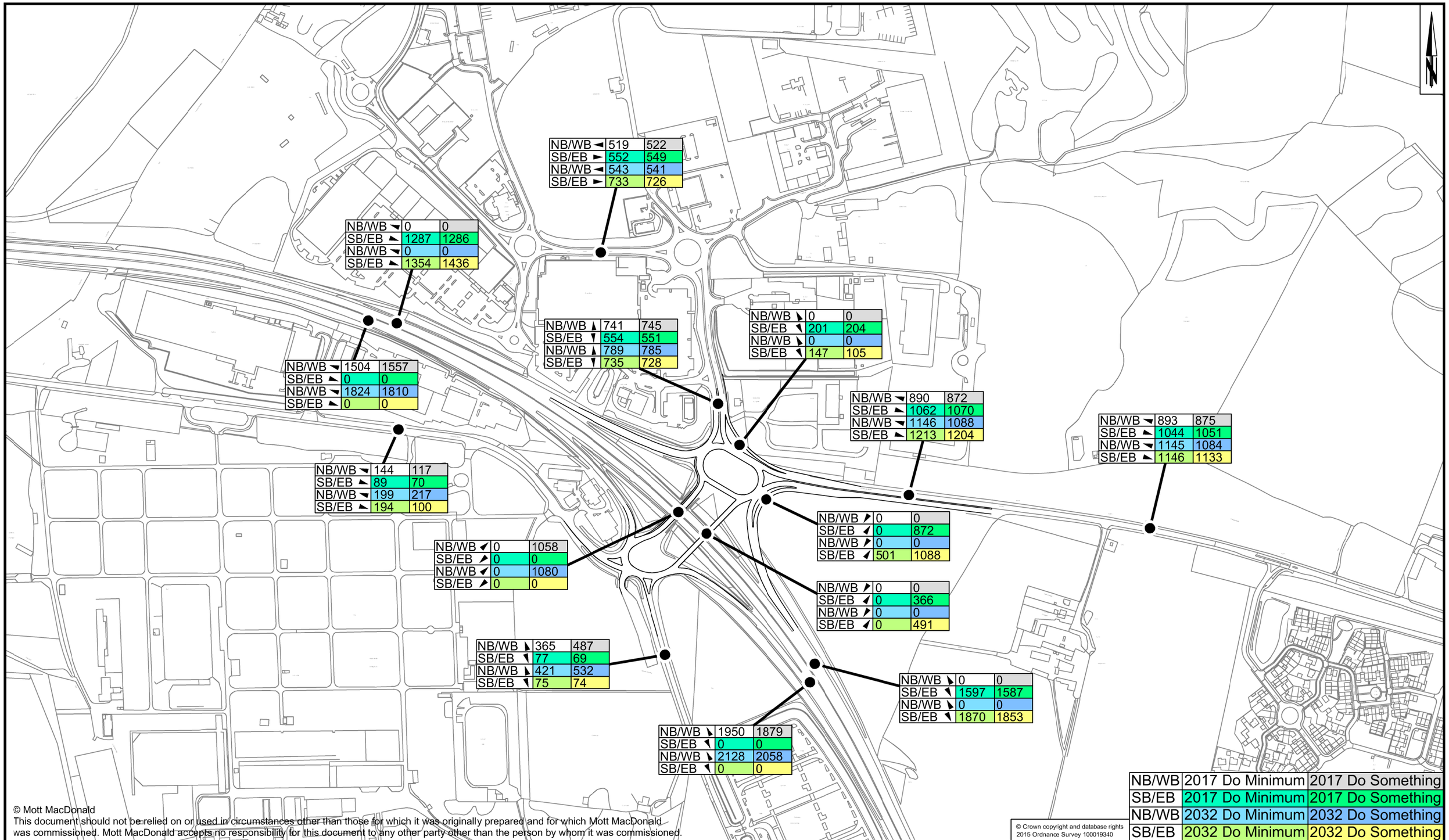
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title: Longwater and Easton Transport Strategy
PM Peak (PCUs)
DS1
Appendix D2

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:25,000
Drawing Number	MMD-326107-C-DR-00-XX-0015
Rev	0
Status	INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS1 PM Peak.dwg Aug 10, 2015 - 2:53PM wor44127



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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

Longwater and Easton
Transport Strategy
PM Peak (PCUs)
DS2
Appendix D3

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0016

Rev: 0

Status: INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS2 PM Peak.dwg Aug 10, 2015 - 2:55PM wor44127

NB/WB	238	238
SB/EB	133	127
NB/WB	343	336
SB/EB	222	217

NB/WB	312	304
SB/EB	203	199
NB/WB	293	288
SB/EB	189	186

NB/WB	235	232
SB/EB	212	212
NB/WB	251	245
SB/EB	299	284

NB/WB	312	304
SB/EB	203	199
NB/WB	293	288
SB/EB	189	186

NB/WB	241	246
SB/EB	136	131
NB/WB	320	311
SB/EB	216	209

NB/WB	1388	1393
SB/EB	1188	1183
NB/WB	1574	1564
SB/EB	1271	1266

NB/WB	353	342
SB/EB	320	335
NB/WB	470	461
SB/EB	538	552

NB/WB	486	473
SB/EB	378	373
NB/WB	502	488
SB/EB	461	435

NB/WB	398	399
SB/EB	213	213
NB/WB	331	329
SB/EB	186	187

NB/WB	449	448
SB/EB	599	599
NB/WB	474	477
SB/EB	547	545

NB/WB	1159	1159
SB/EB	1344	1334
NB/WB	1335	1343
SB/EB	1469	1468

NB/WB	2017 Do Minimum	2017 Do Something
SB/EB	2017 Do Minimum	2017 Do Something
NB/WB	2032 Do Minimum	2032 Do Something
SB/EB	2032 Do Minimum	2032 Do Something

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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

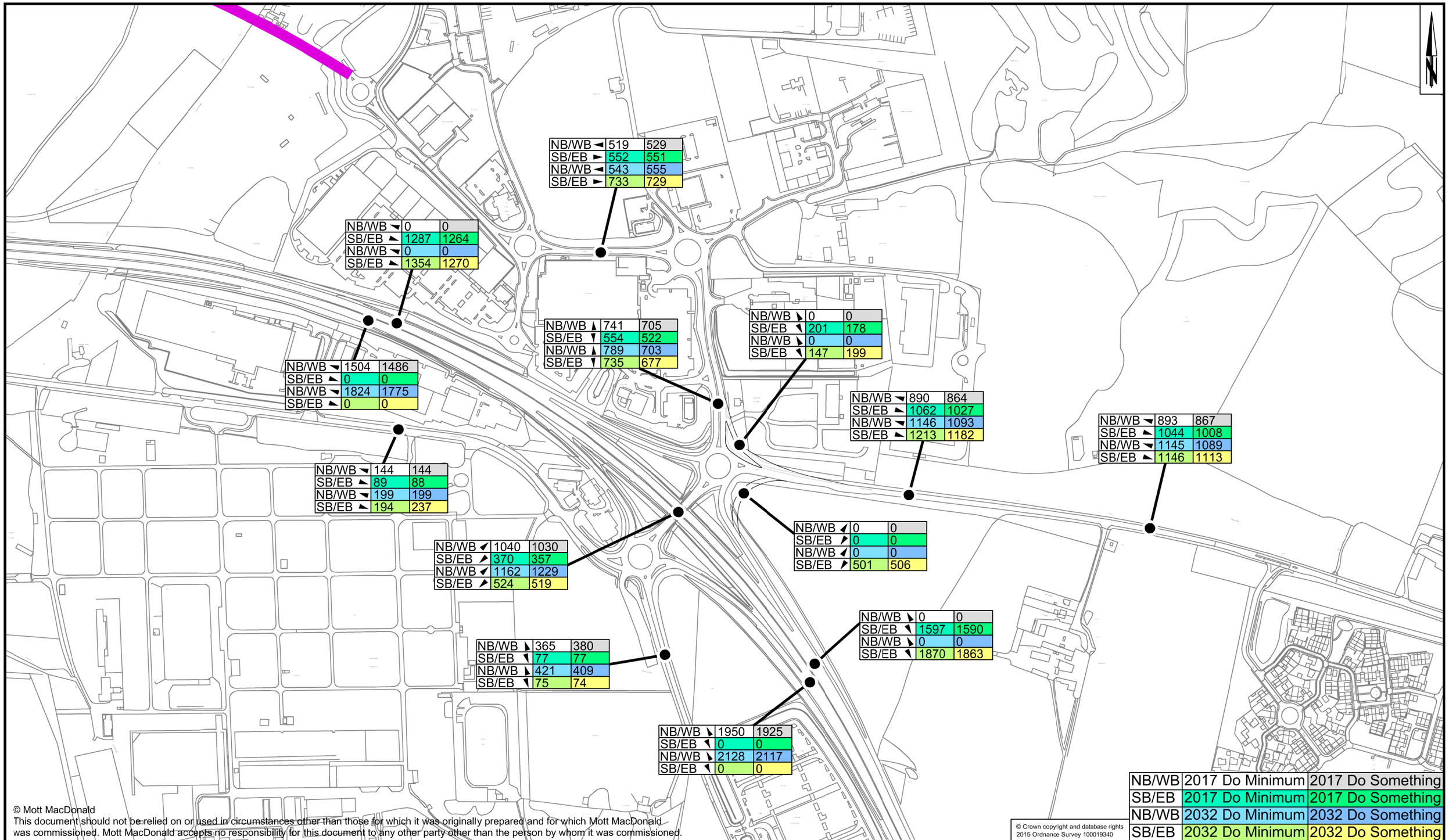
Longwater and Easton
Transport Strategy
PM Peak (PCUs)
DS2
Appendix D4

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:25,000

Drawing Number: MMD-326107-C-DR-00-XX-0017

Rev	Status
0	INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS2 PM Peak.dwg Aug 10, 2015 - 2:56PM wor44127



NB/WB	2017 Do Minimum	2017 Do Something
SB/EB	2017 Do Minimum	2017 Do Something
NB/WB	2032 Do Minimum	2032 Do Something
SB/EB	2032 Do Minimum	2032 Do Something

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0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title

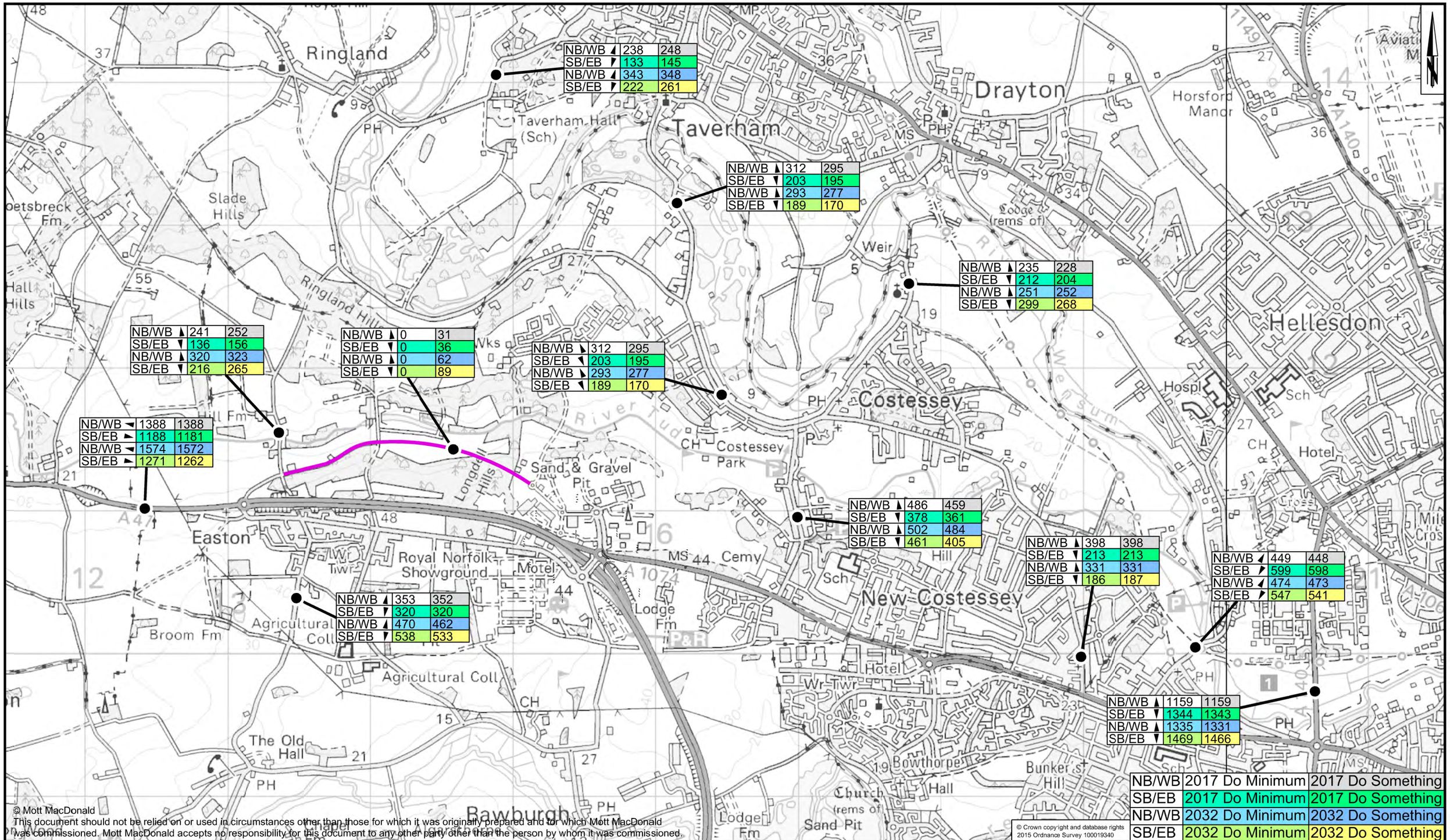
Longwater and Easton
Transport Strategy
PM Peak (PCUs)
DS3
Appendix D5

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:5000

Drawing Number: MMD-326107-C-DR-00-XX-0018

Rev	Status
0	INF

\\UKNORWVMADC01\Projects\Norwich\MM Projects\233906 - NDR 2007\233906-DP-01 NDR Transport Assessment\13.0 Longwater\CAD\Longwater Traffic Flows DS3 PM Peak.dwg Aug 10, 2015 - 2:58PM wor44127



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Rev	Date	Drawn	Description	Ch'k'd	App'd
0	07/15	AW	Longwater and Easton Transport Strategy	MS	CW

Title: Longwater and Easton Transport Strategy
PM Peak (PCUs)
DS3
Appendix D6

Drawn	AW
Checked	MS
Approved	CW
Scale at A3	1:25,000
Drawing Number	MMD-326107-C-DR-00-XX-0019
Rev	0
Status	INF

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