A1(M) Junction 47 Study – Stage 3 Amendment

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1.0 Introduction

CH2M have been commissioned by Highways England to undertake a study at Junction 47 of the A1(M) [Jn 47] which is a four-arm grade separated roundabout that connects the Strategic Road Network [SRN] with the primary road network, in the form of the A59, approximately seven miles east of Harrogate. Jn 47 has been identified through planning applications, Harrogate District Local Plan [HDLP] assessment work and the Local Enterprise Partnership [LEP] as a significant constraint to development in the area. The junction already exhibits peak hour queues and delays.

North Yorkshire County Council [NYCC] supported by the LEP successfully bid through the Local Growth Fund for money to implement a junction improvement at Jn 47. The scheme includes:

- Traffic signals on all approaches to Jn 47 of the A1(M).
- Widening on all approaches in order to accommodate left turn flares on both diverge slips, and to increase the length of both right turn flares on the A59 approaches.
- Three lane circulatory carriageway at both the north-east and south-west corners of the junction, in order to reduce conflict between exiting and queueing vehicles. Widening is needed to accommodate the introduction of a third lane.

In addition, NYCC are proposing to fund:

- The introduction of traffic signals on the A59 at the junction with the A168 Link Road including islands which are proposed to house the required signal infrastructure. Minimal kerbline changes are required at this junction.

  For the remainder of this note the above schemes will be referred to as the LEP scheme.

1.1 Purpose of this Study

Highways England is therefore looking to undertake a study which will determine:

- how much capacity will be provided by the LEP scheme and when further improvements are likely to be required; and
- Interim and final solutions for junction improvements to accommodate future likely traffic levels.

This will help with the evidence base for the Local Plan and help determine the viability of the Local Plan, help determine a consistent approach to planning applications and secure appropriate contributions or junction improvements which are consistent with the long term vision for the junction.

It is considered important that the study is carried out with full involvement of Harrogate Borough Council [HBC], NYCC and the LEP to ensure that the outcomes can be supported by all parties.

The CH2M study is to be undertaken in three discrete stages. The remainder of this technical note presents an update to the findings of Stage 3 of the study, the primary objective of which is to establish

what improvement measures are required at Jn 47 to adequately mitigate for the expected growth in traffic through the junction in the 2035 future year. The findings of Stage 1 of the study were reported in the October 2016 technical note *A1(M) Junction 47 Study – Stage 1* (Document Ref 679066.AF.16.13 TN002). The Stage 2 findings were reported in the December 2016 technical note *A1(M) Junction 47 Study – Stage 2* (Document Ref 679066.AF.16.19 TN003). The Stage 3 findings were first reported in the April 2017 technical note *A1(M) Junction 47 Study – Stage 3* (Document Ref 679066.AF.16.27 TN004).

1.2 Stage 3 Amendment

The main elements of Stage 3 of the study are set out below.

- Undertake TRANSYT modelling assessments of potential improvement schemes at Jn 47 to understand whether they will work in capacity terms and mitigate the impact of the Harrogate District Local Plan (2035 assessment).
- Consideration will be given to whether the preferred scheme can be delivered in stages and the level of development each stage of the scheme could deliver.
- Identify potential land requirements (to be undertaken once the proposed mitigation is agreed and reported separately to this note).
- Estimate indicative costs for schemes that work in capacity terms and can be delivered in land requirement terms (to be undertaken once the proposed mitigation is agreed and reported separately to this note).

A Stage 3 study report was produced by CH2M in April 2017 which detailed the work undertaken and findings of each of the aforementioned study elements. The Stage 3 report identified the following measures, collectively referred to as Mitigation Option 3, to adequately mitigate the impact of the 2035 future year flows at J47 and the adjacent A168 junction:

- widening to three lanes on the A59 eastbound entry to Jn 47, with a second approach lane commencing at the Flaxby roundabout;
- widening to three circulatory carriageway lanes on the over bridges of the A1(M);
- widening of the north-west circulatory carriageway to three lanes between the A59 eastbound entry and northern circulatory bridge;
- two lane exit from Jn 47 eastbound through the signals with the A168 link road including widening of the bridge over the A168;
- two westbound lanes on the A59 approach from York from before the signals with the A168 link road to Jn 47;
- provision of a two-lane exit from Jn 47 towards the A1(M) southbound carriageway;
- widening of the north-east circulatory carriageway to provide four traffic lanes; and,
- widening of the south-east circulatory carriageway to provide four traffic lanes.

Since this report was produced, HBC have updated their list of potential residential and employment allocations (June 2017). HBC are now looking to allocate an additional 346,846 sqm of employment use in addition to the core allocations previously assessed. It is understood from HBC that this significant increase in employment allows for an over provision to ensure there is a choice of location and type of land for existing and new businesses. The residential allocations have also been revisited in order to meet the latest estimates of demand with an overall increase of 2,373 dwellings compared to the total dwellings previously assessed by CH2M. This has been achieved by the addition of new sites and adjusting yield on the former residential allocation sites. It was also announced during this period that the Hammerton settlement will be taken forward as the preferred Local Plan growth scenario, and as such, the Flaxby growth scenario has been discounted from this assessment.

In addition, a planning application has been submitted on the Flaxby Green employment site and mitigation has been agreed for the impact of this site. This mitigation includes:

- widening to three lanes on the A59 eastbound entry to Jn 47, with a second approach lane commencing at the Flaxby roundabout;
- widening of the north-west circulatory carriageway to three lanes between the A59 eastbound entry and northern circulatory bridge;
- provision of a two-lane exit from Jn 47 towards the A1(M) southbound carriageway;
- widening of the north-east circulatory carriageway to provide three traffic lanes;
- widening of the south-east circulatory carriageway to provide three traffic lanes; and,
- widening the southbound off slip to three lanes on the approach to and at Jn 47.

Following the alterations to the residential and employment allocations, CH2M updated the future year flow calculations that were detailed in the Stage 1 report (Document Ref 679066.AF.16.13 TN002). It was determined that the increased residential and employment allocations will lead to an additional 939 trips through J47 during the AM peak and 809 trips during the PM peak. CH2M therefore reassessed proposed Mitigation Option 3 including the upgrades proposed by Flaxby Green Park and to account for the additional flows through J47. It was determined from these TRANSYT assessment that Option 3 was no longer sufficient to mitigate the (revised) 2035 traffic flows. CH2M have therefore been instructed to undertake a revised Stage 3 assessment to identify further improvement works which will adequately mitigate for the revised 2035 Hammerton growth scenario flows.

2.0 Mitigation Options 4 and 5 – TRANSYT Assessments

Mitigation Options 4 and 5 have been assessed using TRANSYT v15 software. The methodology used in determining the 2035 future year flows of the assessment is described in the October 2016 Stage 1 report preceding this note, with updates as described in the preceding paragraph. The mitigation schemes have been assessed against the Hammerton Local Plan growth scenario, which was confirmed as the HBC preferred growth scenario in the Harrogate District Draft Local Plan Additional Sites Consultation. The main elements of the Option 4 and Option 5 mitigation schemes, over and above the mitigation identified as Option 3 within the previous Stage 3 submission (Document Ref 679066.AF.16.27 TN004) are as follows:

- Options 4 and 5 - three westbound lanes on the A59 approach from York from before the signals with the A168 link road to Jn 47 (two lanes through the A168 junction, widening back to three lanes west of the junction);
- Options 4 and 5 - widening to four lanes on the A59 eastbound entry to Jn 47 over a length of approximately 80m, with a second approach lane commencing at the Flaxby roundabout; and,
- Option 5 – widening of the A59 westbound carriageway between J47 and Flaxby roundabout to three lanes, to allow A59 westbound traffic to use all three lanes of the A59 westbound approach to J47 and the southern circulatory carriageway.

The Option 4 and 5 improvements modelling also included the Flaxby Green Park development mitigation, which was assessed and reported on by CH2M in the April 2017 technical note *Flaxby Green Junction 47 Modelling – Optima Layout Assessment in TRANSYT* (Document Ref 679066.AF.16.19 TN003),

It became clear during the modelling process that Option 4 would not adequately mitigate the predicted 2035 traffic flows at Jn 47 for the AM peak period; with the A59 westbound approach and southern circulatory carriageway remaining significantly over capacity (highest DoS of 123%). Option 4 does successfully mitigate 2035 traffic during the evening peak period, with all junction approaches and the circulatory carriageway predicted to operate within the theoretical capacity of 90% DoS.

The Option 5 modelling indicates that the improvements would successfully mitigate the 2035 AM peak flows to the extent that the junction approaches and the circulatory carriageway are predicted to operate within the absolute capacity of 100% DoS, with some approaches, most notably the A59 westbound and A1(M) northbound off-slip, operating over the theoretical capacity of 90% DoS. All junction approaches and the circulatory carriageway are predicted to operate within the theoretical capacity of 90% DoS during the PM peak period.

Whilst the Option 5 improvements are predicted to mitigate the 2035 flows so that the junctions operate within their absolute capacity, there are concerns over the feasibility and operational safety performance of the A59 carriageway, west of J47, which would be five lanes wide east of Flaxby roundabout. It is unlikely that the A59 could operate safely as a single carriageway at this location and would therefore require dualling works.

3.0 Mitigation Option 6 - TRANSYT Assessments

In response to the unresolved capacity and queuing issues identified in the Option 4 results outputs, and feasibility and safety concerns of the Option 5 proposals, further improvement measures have been identified to adequately mitigate the predicted 2035 flows through Jn 47. These measures are in addition to the improvements already identified within Option 4; this combined set of improvements are herein referred to as Option 6. The Option 6 mitigation scheme includes the following elements, in addition to those already identified in Option 4:

- creation of a free-flow segregated left turn lane from the A1(M) northbound off-slip to the A59 west, with parallel merge to the A59 westbound carriageway; and,
- widening of the south-west circulatory carriageway to extend the length of the two-lane stopline across the A59 eastbound entry, thereby allowing for right turn movements to the A59 east from both lanes of the A1(M) northbound off-slip.

The Option 6 improvements are shown annotated on a plan of the LEP scheme and attached as Appendix A to this note.

The TRANSYT capacity and queue length outputs for the Option 6 mitigation proposals (Hammerton flow assessment scenario) are presented in Table 1, with the key considerations summarised below:

- The majority of junction entries and the circulatory carriageway operate within the theoretical capacity of 90% DoS during the AM peak period.
- Some links, most notably on the A59 westbound approach and the southern circulatory carriageway are predicted to operate slightly above, or at, the theoretical capacity of 90% DoS during the AM peak period. The resulting queues at these locations are moderate and do not impact on upstream approaches.
- All junction approaches and the circulatory carriageway are predicted to operate within the theoretical capacity of 90% DoS during the PM peak period.

Although some sections of the study area are predicted to operate above the theoretical capacity of 90% DoS during the AM peak, the following points should be considered in determining the likely operation of J47:

- HBC updated their list of potential residential and employment allocations in June 2017. They are now looking to allocate an additional 346,846 sqm of employment use in addition to the core allocations previously assessed. It is understood from HBC that this significant increase in employment allows for an over provision to ensure there is a choice of location and type of land for existing and new businesses. The flows utilised in the modelling assessments are therefore likely to represent an over estimation of 2035 traffic flows; and,
- there is potential, at the preliminary and detailed design stages, to identify a white lining layout which allows for more efficient lane usage at the four-lane section of the north-east circulatory carriageway, than is currently allowed for within the modelling. If a layout can be identified that allows for a more even balancing of flows between lanes three and four of the circulatory

carriageway, immediately downstream of the A1(M) southbound entry, there is potential to increase the length of the green period on the A59 westbound approach.

It can therefore be determined that the Option 6 mitigation scheme, when considered in the context of Harrogate Borough Council pursuing the Hammerton settlement within its Local Plan, is likely to operate within capacity in 2035, in both peak periods.

TABLE 1
2035 Option 6 TRANSYT Assessment Results (Hammerton Growth Assumption)

Hammerton Growth Scenario		Option 6			
		AM 2035		PM 2035	
Approach Arm	Lane	DoS	MMQ	DoS	MMQ
A59 Harrogate	Nearside Entry	48	5	61	7
A59 Harrogate	Middle Entry 1	59	7	77	11
A59 Harrogate	Middle Entry 2	55	6	71	10
A59 Harrogate	Offside Entry	62	7	54	6
Circ @ A59 Harrogate	Nearside	72	7	72	7
Circ @ A59 Harrogate	Offside	25	3	64	1
A1(M) North	Nearside Entry	17	1	61	4
A1(M) North	Middle Entry	43	4	82	6
A1(M) North	Offside Entry	64	7	76	5
Circ @ A1(M) North	Nearside	88	12	78	6
Circ @ A1(M) North	Middle	81	7	87	11
Circ @ A1(M) North	Offside	73	4	48	2
A59 York	Nearside	45	6	30	3
A59 York	Middle	94	26	53	7
A59 York	Offside	95	20	75	12
Circ @ A59 York	Nearside	61	5	50	5
Circ @ A59 York	Middle 1	61	5	50	5
Circ @ A59 York	Middle 2	38	3	42	2
Circ @ A59 York	Offside	88	4	42	2
Circ @ A59 York	NS & M1 Feeder Lane	56	6	50	2
Circ @ A59 York	M2 & OS Feeder Lane	23	0	13	0
A1(M) South	Nearside	70	3	27	2
A1(M) South	Offside	65	3	70	5
Circ @ A1(M) South	Nearside	89	7	69	6
Circ @ A1(M) South	Middle	90	14	69	7
Circ @ A1(M) South	Offside	19	0	20	2
A168 Approach	Nearside	74	5	70	4
A168 Approach	Offside	48	2	41	2
A59 WB Approach to A168	Nearside	88	34	49	9
A59 WB Approach to A168	Middle	60	9	45	7
A59 WB Approach to A168	Offside	22	1	26	1
A59 EB Approach to A168	Nearside	63	16	73	10
A59 EB Approach to A168	Offside	58	14	69	2

4.0 Conclusions

CH2M have undertaken a series of TRANSYT model junction capacity assessments in order to identify an appropriate set of improvement measures, that will mitigate the predicted (2035) impact of the Harrogate District Local Plan (Hammerton growth assumption) at Jn 47 and the adjacent A168 junction.

Two potential mitigation schemes, which differed by whether they included two or three traffic lanes on the A59 westbound exit from J47, were initially assessed. The TRANSYT assessments indicated that Option 4 did not adequately mitigate for the impact of the predicted 2035 future year flows, with insufficient capacity on the A59 westbound entry to the junction being a key residual issue during the AM peak. Whilst Option 5 successfully mitigated the impact of the 2035 flows so that all junction approaches and the circulatory carriageway operated with capacity, there were concerns over the feasibility of providing three westbound lanes on the A59 to the west of the junction and the dualling of the carriageway that this would entail. A third option was therefore developed, which incorporated the improvements of Option 4 with the provision of a free-flow segregated left turn lane from the A1(M) northbound off-slip and widening of the south west circulatory carriageway. Subsequent TRANSYT modelling has confrmed that Option 6 adequately mitigates for the impact of 2035 flows through the study area. It is therefore recommended that Option 6 is developed as the long term (to 2035) improvement option at A1(M) Jn 47 and the A168. The Option 6 improvement works briefly include the following measures, over and above the upcoming LEP scheme improvements including the Flaxby Green Park improvements:

- widening to four lanes on the A59 eastbound entry to Jn 47 over a length of approximately 80m, with a second approach lane commencing at the Flaxby roundabout;
- widening to three circulatory carriageway lanes on the over bridges of the A1(M);
- creation of a free-flow segregated left turn lane from the A1(M) northbound off-slip to the A59 west, with parallel merge to the A59 westbound carriageway;
- widening of the A1(M) northbound off-slip to three lanes, to provide entry to the segregated left-turn lane
- widening of the south-west circulatory carriageway to extend the length of the two-lane stopline across the A59 eastbound entry, thereby allowing for right turn movements to the A59 east from both lanes of the A1(M) northbound off-slip;
- widening of the north-west circulatory carriageway to three lanes between the A59 eastbound entry and northern circulatory bridge;
- two lane exit from Jn 47 eastbound through the signals with the A168 link road including widening of the bridge over the A168;
- three westbound lanes on the A59 approach from York from before the signals with the A168 link road to Jn 47;
- provision of a two-lane exit from Jn 47 towards the A1(M) southbound carriageway;
- widening of the north-east circulatory carriageway to provide four traffic lanes;
- widening of the south-east circulatory carriageway to provide four traffic lanes; and,
- provision of a right-turn indicative arrow signal phase for movements from the A59 east to the A168.

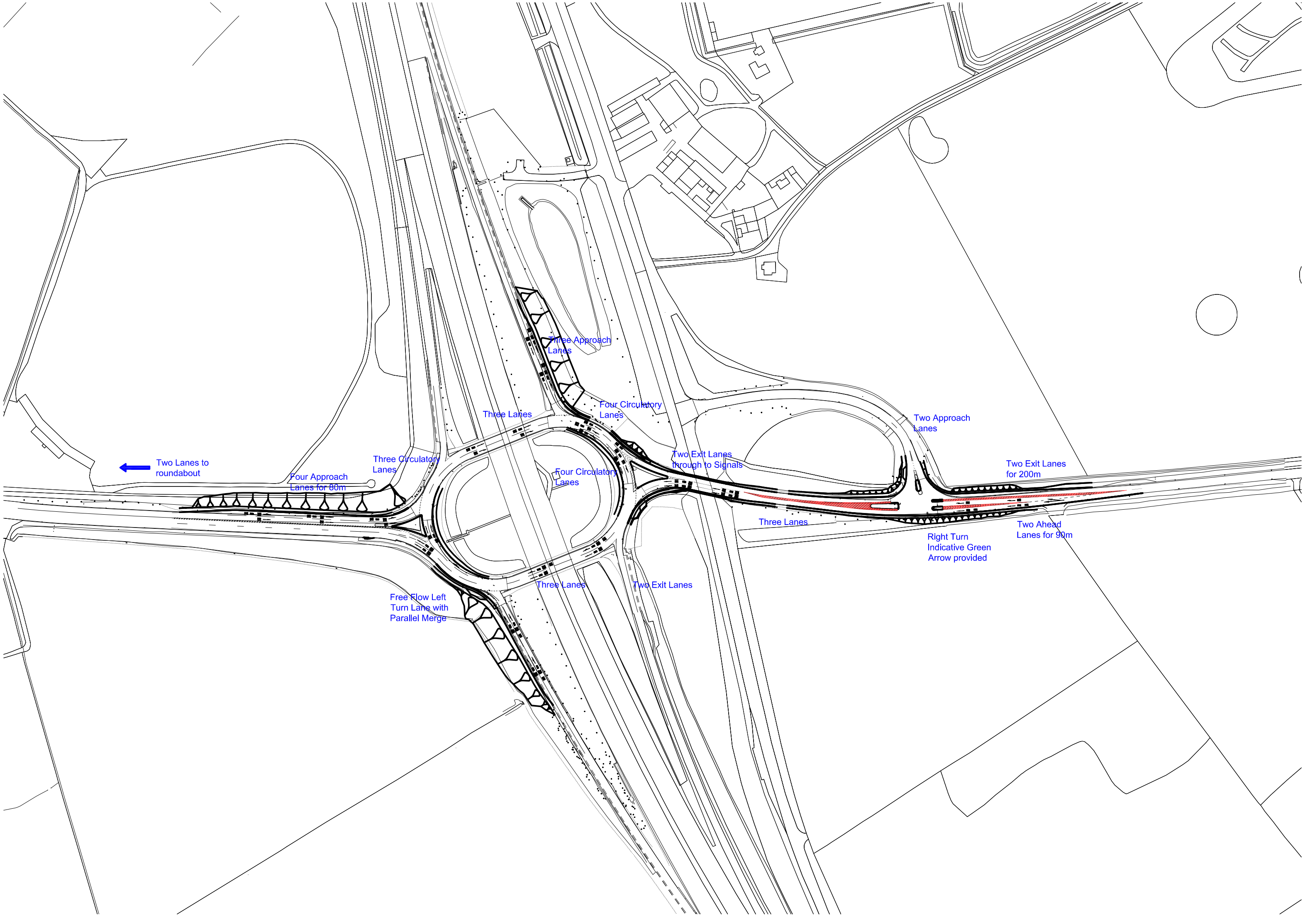
The Option 6 improvement works will also include the following elements identified as part of the Flaxby Green Park development mitigation, which was assessed and reported on by CH2M in the April 2017 technical note *Flaxby Green Junction 47 Modelling – Optima Layout Assessment in TRANSYT* (Document Ref 679066.AF.16.19 TN003):

- A1(M) southbound off-slip additional lane flaring to create three lane entry to J47.

- provision of a second flare lane (approx. 30m) on the A168 approach to the A59. The updated Stage 3 modelling has identified that each lane of this approach should be separately signalled as left and right turn lanes respectively.

The Option 6 improvements are shown annotated on a plan of the LEP scheme, attached as Appendix A to this note.

APPENDIX A


Three Approach Lanes
Three Lanes
Four Circulatory Lanes
Two Approach Lanes
Two Lanes to roundabout
Three Circulatory Lanes
Four Approach Lanes for 80m
Four Circulatory Lanes
Two Exit Lanes through to Signals
Two Exit Lanes for 200m
Three Lanes
Two Ahead Lanes for 90m
Right Turn Indicative Green Arrow provided
Three Lanes
Two Exit Lanes
Free Flow Left Turn Lane with Parallel Merge