MOTT MACDONALD

Knowle Transport Study

Final Report

October 2020

418452-MMD-ZZ-ZZ-TN-Z-0004

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Executive Summary

This document presents the outcomes of the Knowle Transport Study which has assessed the impacts of the proposed Draft Local Plan development quanta and propose potential mitigation measures to help limit and reduce the impact of the new developments on the local road network. These measures will focus on strategic improvements to upgrade the public realm and active travel, whilst improving highway safety for all users and providing highway capacity where possible.

The Knowle Transport Study

Mott MacDonald has developed a strategic evidence base focusing on the traffic impacts of the Draft Local Plan (DLP) on Knowle, in particular the High Street and Station Road.

The overall strategic aim of the study is to:

- Deliver the future strategic growth of the town and ensure that growth and investment can be achieved across Solihull.

The following objectives have been identified:

- To assess the likely impacts, on the local highway network, of the various emerging strategies concerning the delivery of housing through the Draft Local Plan;
- To identify the necessary mitigation measures that are required to support planned growth, which can be delivered as part of the planning process or strategic transport interventions.

Modelling approach

A bespoke spreadsheet model has been created for the Knowle Transport Study. In order to identify junctions that may require mitigation, 'at risk' junctions were determined using TrafficMaster congestion data, public consultation feedback, PRISM and Survey data. Junctions deemed to be 'at risk' with a 5% DLP flow impact or greater were then modelled in Junctions 9 and LinSig software to determine if mitigation was required. The following table shows the junctions modelled along with if mitigation is required.

Junction Modelling Summary

Junction	Mitigation Required?
Hampton Road / Arden Vale Road	No
Warwick Road / Hampton Road / Lodge Road	Yes
High Street / Kenilworth Road	Yes
High Street / Wilsons Road / Warwick Road / Station Road	Yes
Warwick Road / Grove Road / Norton Green Lane	No
Station Road / Lodge Road	Yes
Station Road / Grove Road / Widney Road	Yes

Source: Mott MacDonald

A proportionate approach to mitigation has been adopted, considering the village nature of Knowle and the high street alongside the potential for public realm improvements. Mitigation therefore focusses on the following approaches:

- Local junction improvements to relieve development impacts where possible, and improve safety for all users
- Strategic improvements to upgrade Knowle High Street for public realm and active travel opportunities

In additional to individual junction improvements, three options for a one-way system were proposed. This was investigated following stakeholder engagement with SMBC, with the aim to reduce congestion. These options have undergone a high-level assessment using the spreadsheet model.

Active Travel

A PERS audit was undertaken in central Knowle to determine the current active travel environment. The Solihull LCWIP proposals were reviewed alongside desire lines through Knowle to identify areas where active travel improvements could be implemented.

A key principle in the mitigation proposals for Knowle include linking the High Street to the proposed development sites. Through encouraging active travel throughout the village, shorter vehicle trips will be removed from the network. It provides the additional opportunity to develop Knowle High Street and the frontages.

A number of links have been identified for 'quiet lanes', which are more attractive to walkers, cyclists, horse riders and additional vulnerable road users.

Placemaking Principles

Overall, the Link and Place Analysis indicates that there is a skew towards vehicles dominance within Knowle, due to the high street being a key transport connector link and the historical nature of the road layout and junction geometries. There is, however, significant scope to improve a number of key links for all road users. This could help remove the vehicle dominance in certain areas and improve the public realm within Knowle, as well as opportunities to improve road safety and walking and cycling improvements.

Scheme Prioritisation

A high-level option appraisal has been undertaken to consider individual and collections of mitigation measures against a series of appraisal criteria, incorporating the strategy objectives and a series of deliverability measures. This prioritisation methodology uses a multi-criteria assessment framework to evaluate the potential solutions and options in Mott MacDonald's in-house Investment Sifting and Evaluation Toolkit (INSET). INSET functions through undertaking a scoring assessment of multiple criteria which could include social, economic or environmental indicators of likely scheme performance.

As a result of the INSET scoring, the schemes in the following table have been identified to progress to the next stage of assessment.

INSET results summary

Option	Scheme	Scheme Description
1	Active travel	Improved links to High Street and DLP sites. LCWIP corridor improvements
4	Warwick Road / Hampton Road / Lodge Road Option 3 (Double mini roundabout)	Double mini roundabout option
5	High Street / Kenilworth Road	Placemaking/ reduced Radii/ widened footways/ removed parking

Option	Scheme	Scheme Description
6	High Street / Kenilworth Road Option 2 (with parking)	As above/ parallel parking (blue badge holders)
9	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)	As above - with additional right arrow and left turn filter
10	Station Road / Lodge Road	Simplified junction/footway improvements
11	Station Road Roundel	Roundel option - pedestrian crossings
12	Warwick Road / Wychwood Avenue Roundabout	Cycle route segregation/roundabout diameter reduction

Source: Mott MacDonald (2020)

1 Introduction

Mott MacDonald have been commissioned by Solihull Metropolitan Borough Council (SMBC) to develop a strategic evidence base focusing on the traffic impacts of the Draft Local Plan (DLP) on Knowle.

1.1 Scope of Study

This study will assess the impacts of the proposed development quanta and propose potential mitigation measures to help limit and reduce the impact of the new developments on the local road network. These measures will focus on strategic improvements to upgrade the public realm and active travel, whilst improving highway safety for all users and providing highway capacity where possible. This report details the modelling methodology and presents the analysis for each site, including junction capacity assessments. In addition, a 'link and place' assessment has identified that public realm improvements could create a higher quality place and help cater for all the functions of the High Street.

1.2 Study Aims and Objectives

The overall strategic aim of the study is to:

- Deliver the future strategic growth of the town and ensure that growth and investment can be achieved across Solihull.

The following objectives have been identified:

- To assess the likely impacts, on the local highway network, of the various emerging strategies concerning the delivery of housing through the Draft Local Plan;
- To identify the necessary mitigation measures that are required to support planned growth, which can be delivered as part of the planning process or strategic transport interventions.

A set of wider objectives have been identified throughout the project and in consultation with SMBC. These have been developed based on our understanding of the study area and local knowledge. These are proposed as follows:

- Recognise the challenges and opportunities related to substantial housing and employment growth and ensure integrated planning of land use and transport;
- Promote active travel to provide health, air quality, greenhouse gas and congestion benefits;
- Reduce the barriers to movement, including walking & cycling permeability;
- Recognise the different socio-economic and land-use characteristics of each 'character place' within the borough and ensure that transport is inclusive and accessible for all needs; and
- Enhance road safety.

1.3 Study Background

Mott MacDonald prepared several reports in 2017 and 2018, including a Traffic Impact Assessment (TIA) on behalf of SMBC. The final suite of draft reports was delivered to SMBC in July 2018. SMBC have since stated that the potential impacts on Knowle, and, on Knowle High Street and Station Road, would need to be examined in more detail.

The previous study in Knowle concluded that:

- Whilst there are mitigation options at some junctions, some are constrained due to the lack of available highway land;
- The High Street that runs through Knowle may require more consideration. As Knowle is a high street environment, the temptation to simply increase vehicular capacity at each junction needs to be balanced against the need for pedestrians, cyclists and other vulnerable users. As such, an assessment of pedestrian amenity, severance etc, might need to be considered;
- It is important to consider the cumulative impact of each of the housing development site clusters as well as the impact of the individual sites.

1.4 Local Plan Process

A robust transport evidence base can help facilitate approval of the Local Plan and reduce costs and delays to the delivery of new development, thus reducing the burden on the public purse and private sector investment.

The National Planning Policy Framework (NPPF) requires Local Plans to be "justified, effective, consistent with national policy and positively prepared to deliver sustainable development" in order to be 'sound' (Para. 35). That meets local needs and national priorities" Planning Practice Guidance, paragraph 001, ref 12-001-20140306). The Borough is in the process of developing a Local Plan to cover a 15-year period.

Within the context of transport, the NPPF identifies the important role that transport polices have in facilitating sustainable development as well as wider sustainability and health objectives. In developing a Local Plan, the Borough should therefore consider solutions which support reductions in greenhouse gas emissions and reduce congestion, including reducing the need to travel, or providing individuals with the option to travel sustainably.

Whilst the Plan should identify viable infrastructure necessary to support development, it should similarly ensure that patterns of development are adopted that facilitate the use of sustainable modes.

This work will, where appropriate, refer to MHCLG guidance such as 'Transport evidence bases in plan making and decision taking' guidance to help guide the study and form an overall Transport Evidence Base, as well as a clear strategy for enhancement, to support the Local Plan process.

1.5 Structure of Report

This report has the following structure:

- Section 2 – Modelling Methodology
- Section 3 – Local Junction Modelling
- Section 4 – Mitigation Proposals
- Section 5 – Mitigation Testing
- Section 6 – Active Travel
- Section 7 – Placemaking Principles
- Section 8 – Scheme Prioritisation

2 Modelling Methodology

2.1 Introduction

A bespoke spreadsheet model has been created for the Knowle Transport Study. This model utilised existing traffic survey data which was factored to the DLP years of 2026 and 2036. The number of trips from each DLP site were then generated and distributed across the network based on data from PRISM model outputs. The resulting outputs have then been used to determine the likely impacts of the DLP sites in the study area.

2.2 Traffic Surveys

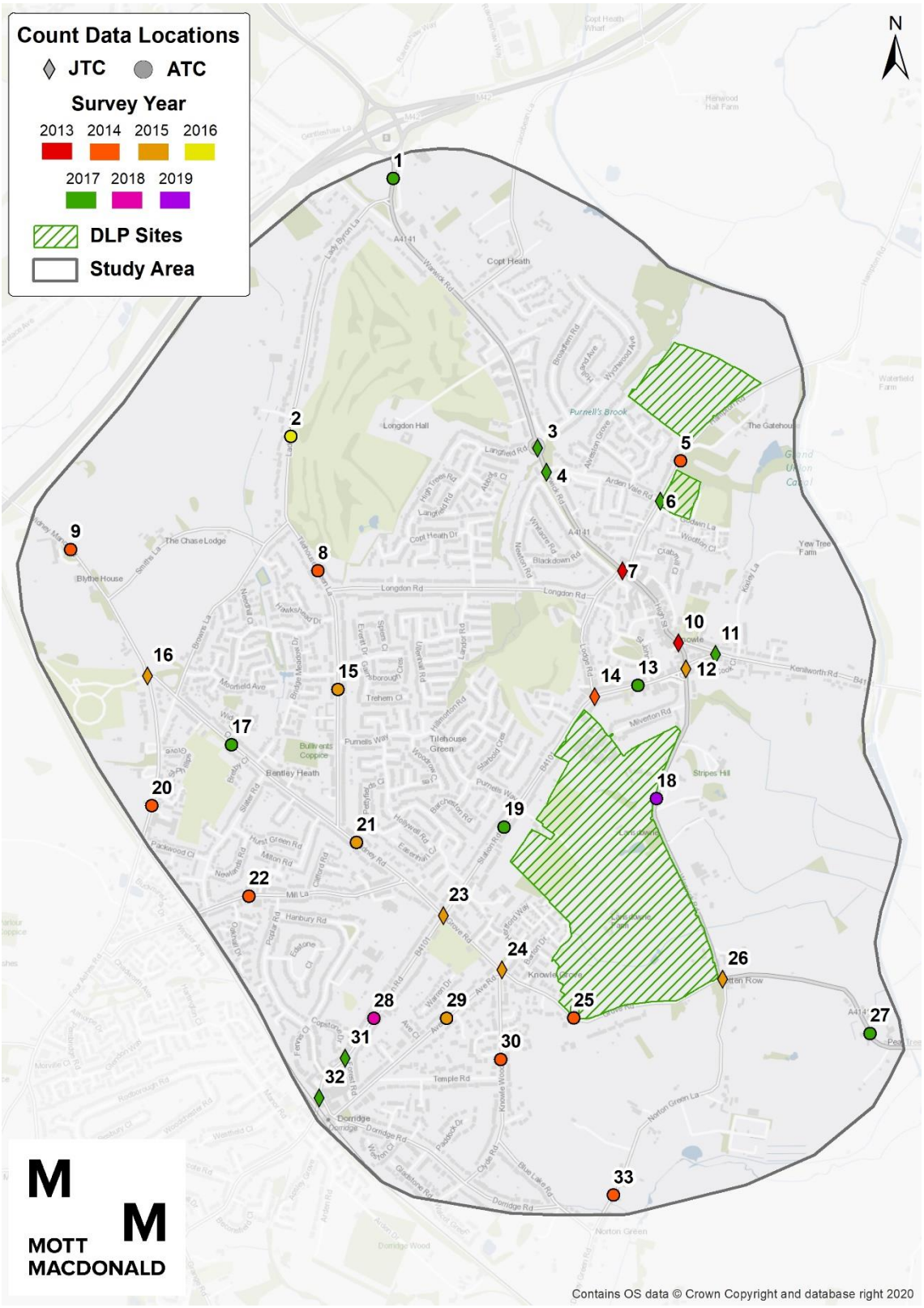
It was intended to update the traffic surveys in early 2020, but due to the onset of the Covid-19 pandemic, these surveys were not undertaken. Since it has not been possible to carry out any new data collection, existing data has been used for this study, which is in some cases over five years old. Data cross checking has therefore been carried out in order to test the validity of the information used in this instance.

Survey data has been extracted from the following sources:

- TfWM Data Insight;
- Mott MacDonald Solihull Traffic Impact Assessment (2017); and
- Transport Assessments for developments in the study area.

The locations of the surveys used for the base model, along with the survey type and year, are shown in Figure 2.1.

Figure 2.1: Survey Location, Type and Year



Source: TfWM Data Insight, Mott MacDonald TIA Surveys and Middlefield Avenue TA

As can be seen by Figure 2.1, all the major routes and junctions have been covered by a survey of one type or another withing the last six to seven years.

2.3 Background Traffic Growth to 2017 Base

The Knowle Spreadsheet Model has a 2017 base, since this is the last time a large tranche of surveys was undertaken in the study area. Given that surveys were undertaken across multiple years, factors have been derived from Trip End Model Presentation Programme (TEMPro) to growth the counts to the common 2017 base, based on observed data.

TEMPro is a programme used to calculate growth rates of middle layer super output areas (MSOAs). The calculation is derived from the National Trip End Model (NTEM) datasets which determine long-term forecasts representing the Department for Transport's (DfT) best estimate of long-term response to demographic and economic trends. Planning data within NTEM is taken from Local Authority (LA) plans, monitoring reports, and targets for the whole LA area and are distributed to NTEM zones according to expected growth factors and factors from historic trends. NTEM also takes 2011 census data into account, amongst other datasets. The DfT keep the datasets within TEMPro sufficiently current to ensure the most accurate outputs.

Within TEMPro the MSOA *'E02002106'* was selected, which covers Knowle, with a growth rate calculated for the 'Car Driver' mode over all purposes. The origin/destination trip end type was selected for the weekday AM and PM peak periods (07:00-10:00 and 16:00-19:00 respectively) and then an NTM Traffic Growth Calculation was done to get a single factor representing both origin and destination trips.

The factors are shown in Table 2.1.

Table 2.1: TEMPro Factor Applied for 2017 Base

Survey Year	AM Factor	PM Factor
2013	1.050	1.049
2014	1.039	1.038
2015	1.028	1.027
2016	1.011	1.011
2018	0.989	0.990
2019	0.979	0.979

2.4 Existing Traffic Conditions

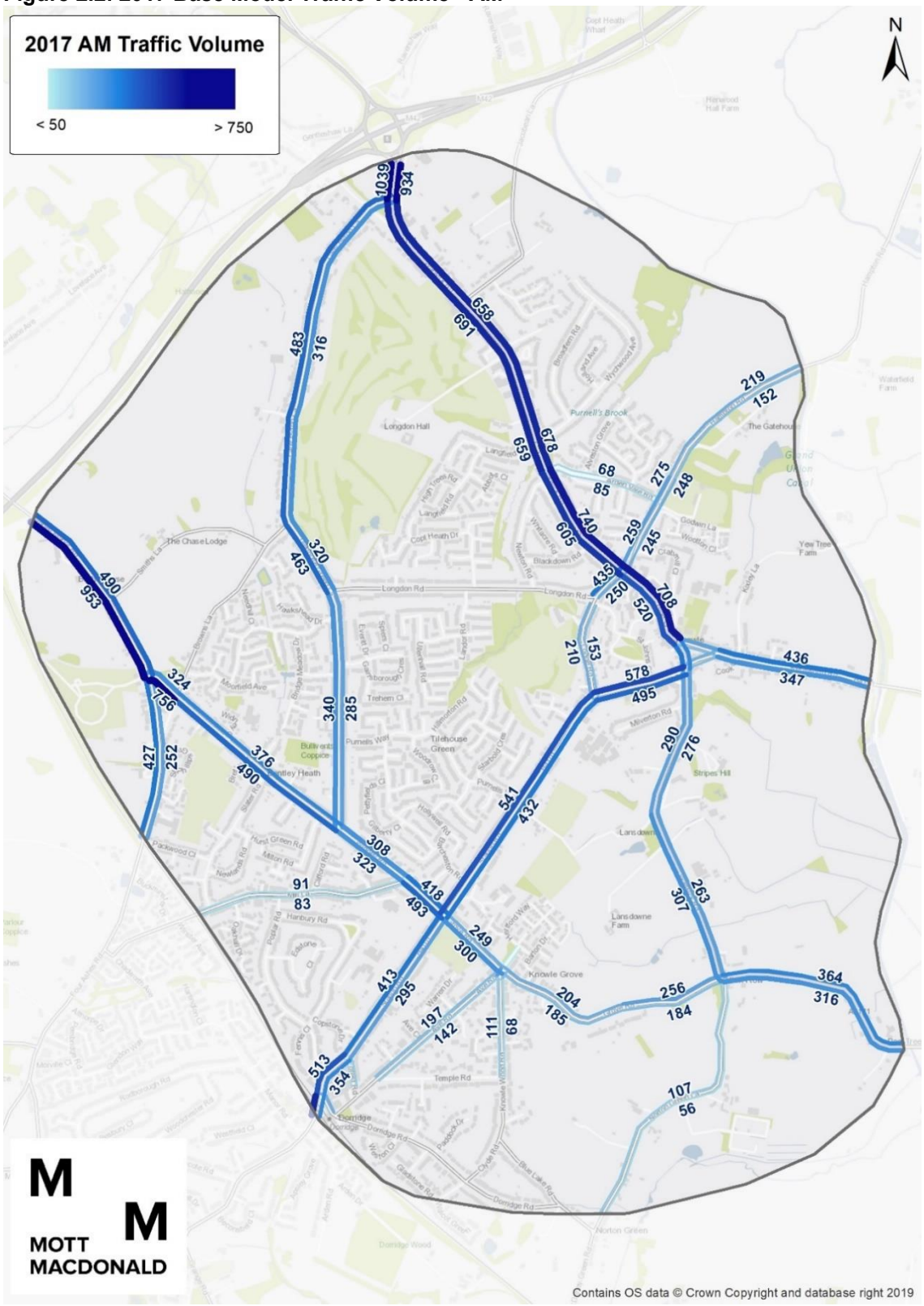
2.4.1 2017 Base Traffic Flows

All the survey data in Figure 2.1 was accumulated into a 2017 base network within the spreadsheet model. The link flows are shown for the AM and PM peaks in Figure 2.2 and Figure 2.3 respectively.

The AM peak for this study is 08:00-09:00 and the PM peak is 17:00-18:00. As can been seen in the figure below, some adjacent volumes do not match. This is due to the link flow being taken from the nearest survey, with different surveys producing different volumes, mainly due to normal daily variation in traffic levels. This is to be expected as the counts were conducted over different years and in addition there are many small side-roads between counts which attract small volumes on any given day.

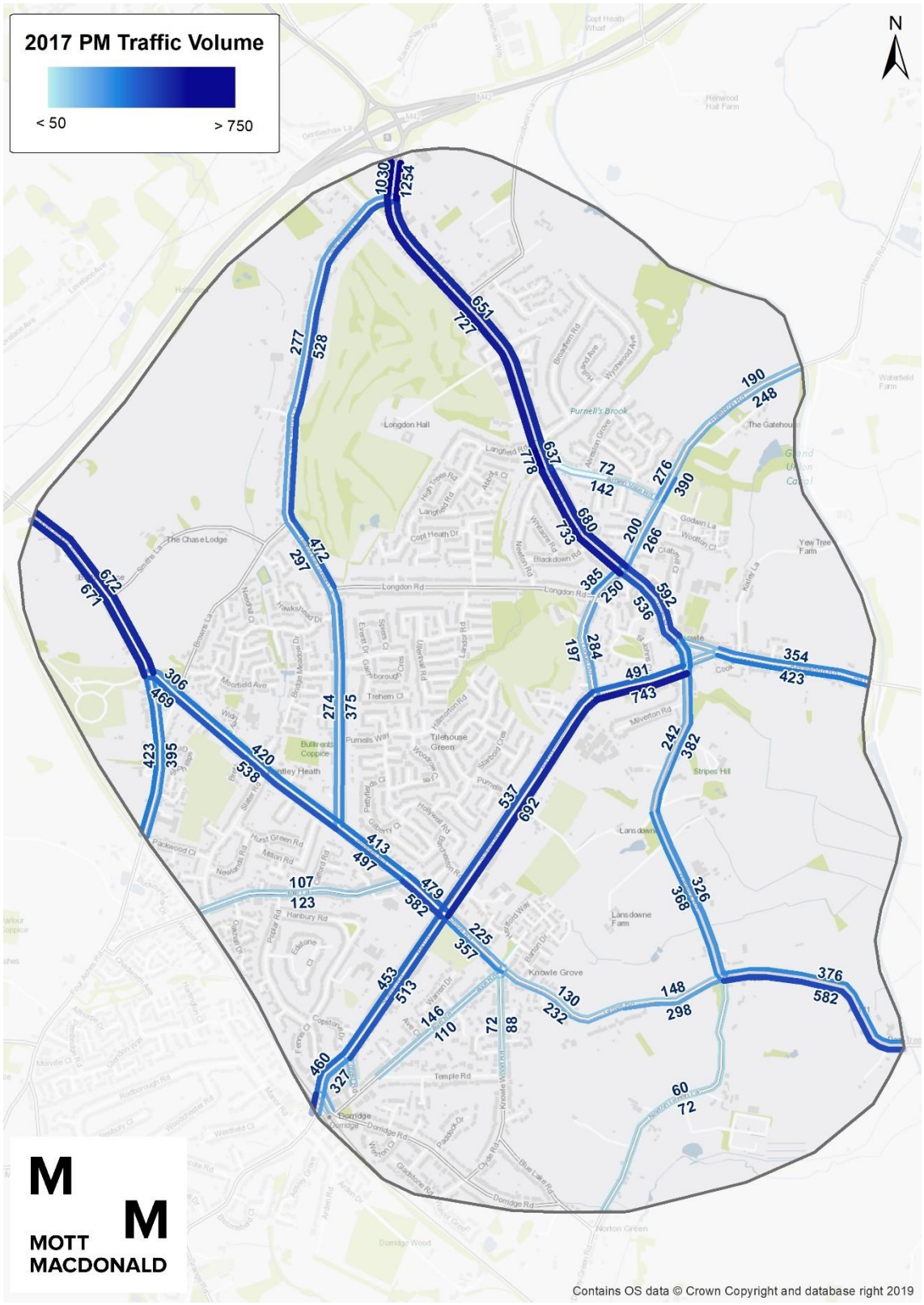
The flows have not been balanced within the model as it is not needed for the high-level nature of this study.

Figure 2.2: 2017 Base Model Traffic Volume - AM



Source: Knowle Spreadsheet Model

Figure 2.3: 2017 Base Model Traffic Volume - PM



Source: Knowle Spreadsheet Model

These figures show that in both peaks, the highest flow in and out of the study area is on the A4141 to the south of the M42. This flow feeds to and from Lady Byron Lane and the A4141 Warwick Road, with Warwick Road seeing a higher volume of traffic. This high level of flow travels down to the centre of Knowle, with a two-way flow of around 1,200 vehicles in the AM and 1,100 vehicles in the PM on Knowle High Street.

This then leads to a high flow in Station Road down to Grove Road, especially in the PM. Between Grove Road and Warwick Road, Station Road has a two-way flow of around 1,000 vehicles in the AM and 1,200 vehicles in the PM. Station Road sees the highest traffic out of the roads between Knowle and Dorridge.

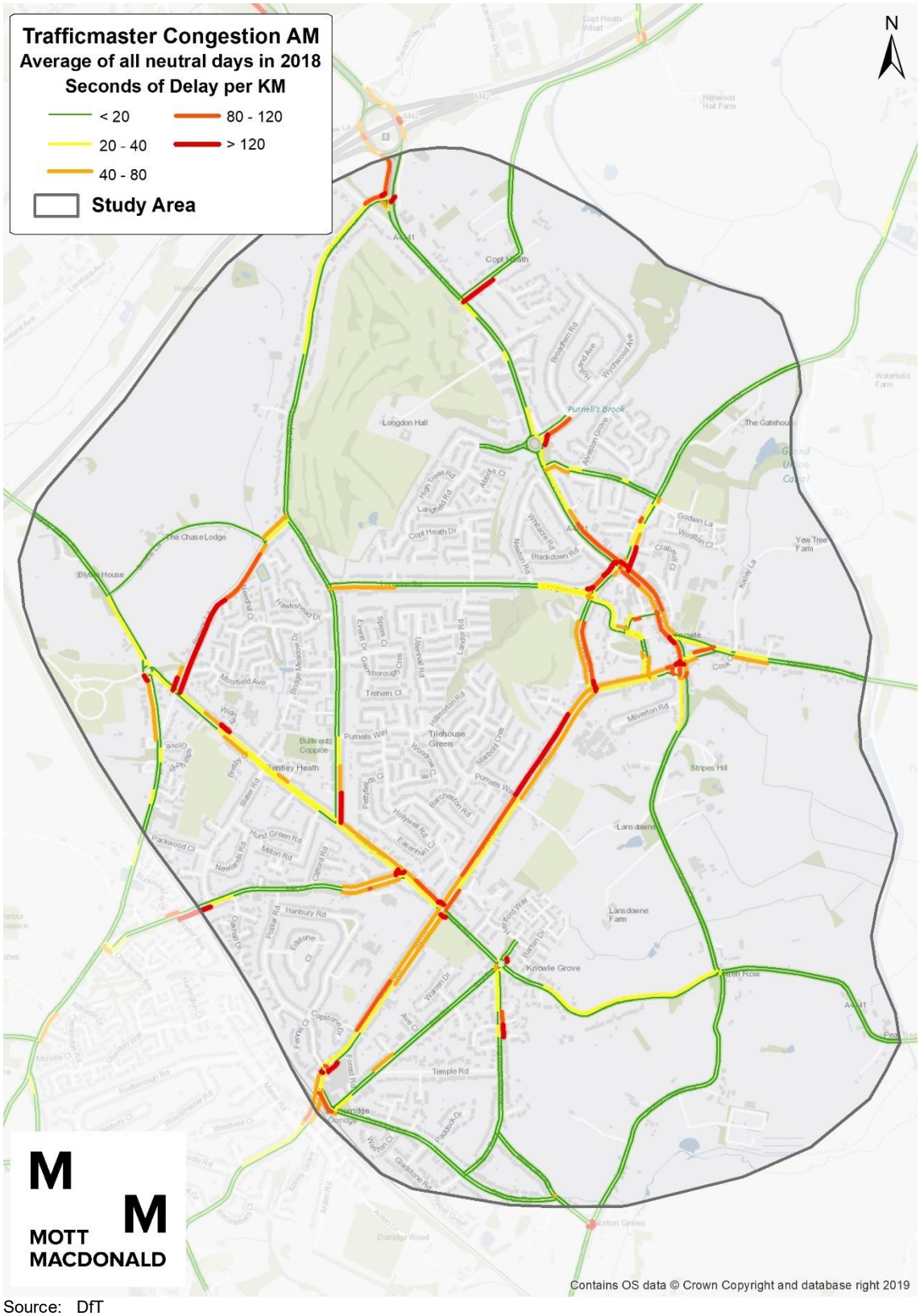
Widney Manor Road also has a high flow in and out of the study area in both peak periods. This then splits between Four Ashes Road and Widney Road. With the highest flows on the edge of the study area being on Widney Manor Road and Warwick Road to the north, it shows that the majority of trips leaving or entering the study area travel to the north-west, to the M42 or towards Solihull.

There are still reasonably high flows on roads to the west however, such as on Kenilworth Road and Warwick Road westbound, and high flows towards Dorridge. Generally, the flows show a tidal nature at the borders of the study area, with more traffic leaving in the AM and arriving in the PM. This is not however the case for Station Road from Dorridge.

2.4.2 Congestion data

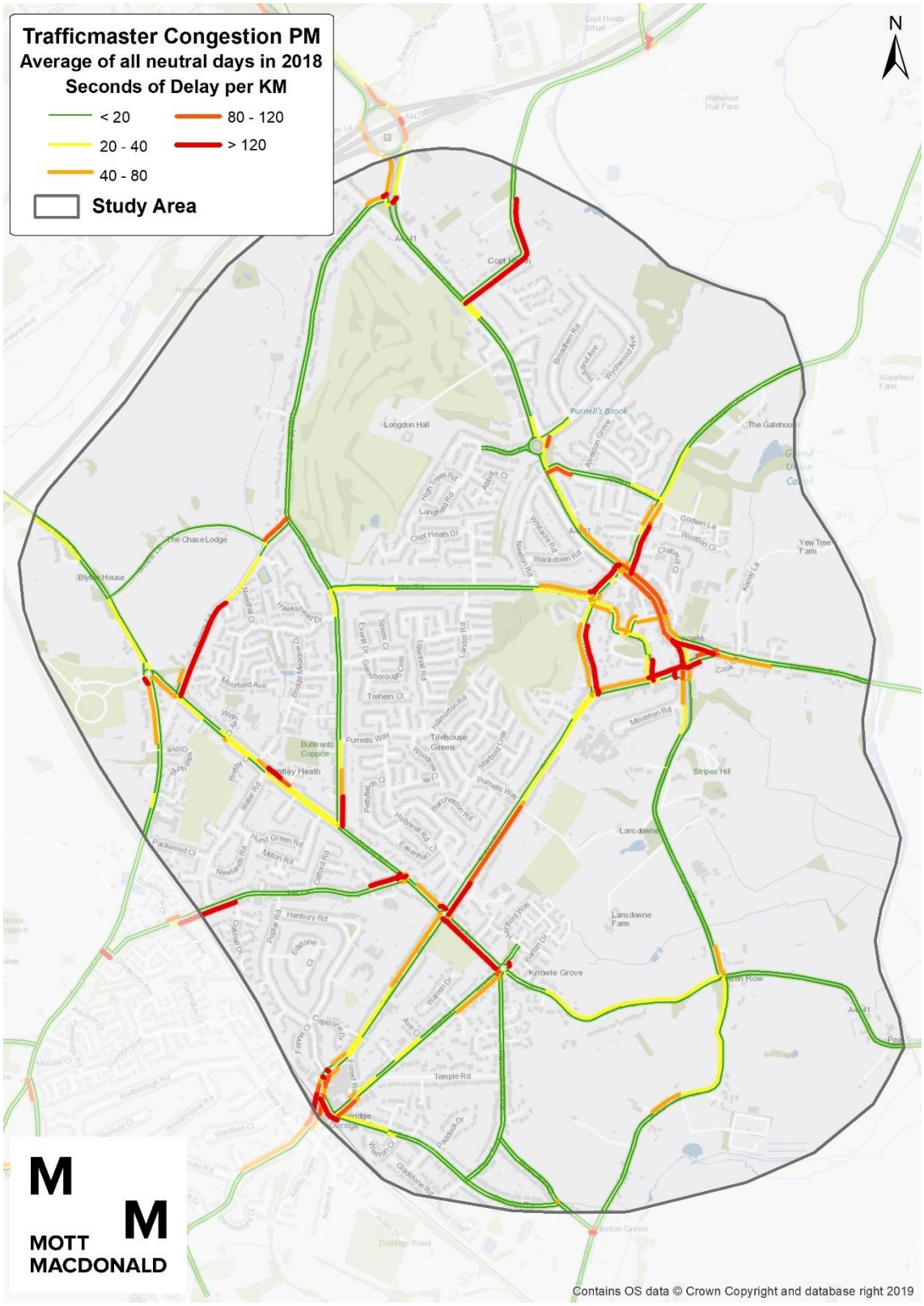
Department for Transport (DfT) Trafficmaster Data was acquired for all of the neutral weekdays in 2018 for the main roads within the study area. The average delay per km in the AM and PM peaks is shown in Figure 2.4 and Figure 2.5 respectively.

Figure 2.4: Trafficmaster Delay AM 2018



Source: DfT

Figure 2.5: Trafficmaster Delay PM 2018



Source: DfT

These figures show that in both the AM and PM peaks, the main areas of delay in the study area are on the following roads and junctions:

- Knowle High Street
- Lodge Road
- Station Road
- Browns Lane
- A4141 Warwick Road / Lodge Road / Hampton Road junction
- High Street / Kenilworth Road junction
- High Street / Wilsons Road / Station Road junction
- Station Road / Lodge Road junction
- Station Road / Grove Road / Widney Road junction

2.5 Background Traffic Growth to 2026 and 2036

In order to determine future baseline traffic levels without the DLP developments, a traffic growth rate has been calculated using TEMPro. These growth rates have been applied to the 2017 baseline traffic flows to obtain the future year flows in 2026 and 2036, in line with the DLP years.

As with the factors calculated to get to a 2017 base, within TEMPro the MSOA *'E02002106'* was selected, which covers Knowle, with a growth rate calculated for the 'Car Driver' mode over all purposes. The origin/destination trip end type was selected for the weekday AM and PM peak periods (07:00-10:00 and 16:00-19:00 respectively) and then an NTM Traffic Growth Calculation was done to get a single factor representing both origin and destination trips.

To avoid the double counting of developments trips, the number of households assumed in the DLP have been removed from the TEMPro assumptions when calculating the 2026 and 2036 growth rates. This is to provide background growth without the DLP to better determine the impact of the DLP developments.

TEMPro assumes an increase of 195 households for the Knowle MSOA between 2017 and 2026 and an increase of 420 households between 2017 and 2036. This is less than the DLP development levels of 300 dwellings in 2026 and 900 dwellings in 2036. Therefore, for both future years the number of households used in the TEMPro assumptions has been kept the same as 2017. This has resulted in the following factors.

Table 2.2: TEMPro Growth Factors

Year	AM	PM
2026	1.056 (+5.6%)	1.053 (+5.3%)
2036	1.095 (+9.5%)	1.091 (+9.1%)

Source: TEMPro (2020)

2.6 Trip Generation

Traffic generations have been derived based on the emerging high level masterplans for each site. The masterplans are illustrative in nature and may be subject to minor fluctuations in terms of development quanta, however the quanta used to undertake this study is considered to present a robust estimate of development within the Local Plan period.

Trip rates have been derived from TRICS based on the following search and filtering criteria:

- Residential Developments
- Houses Privately Owned
- England (excluding Greater London)
- Development size: 60 – 1,000 dwellings
- Date range: 01/01/2011 – 24/09/2019
- Weekdays only
- Location types: Edge of town centre, suburban area and edge of town
- Population within one mile: 5,001 – 15,000
- Population within five miles: 75,001 – 250,000
- Car ownership: 1.1 – 2.0 cars per household

The resulting trip rates are summarised in Table 2.3.

Table 2.3: Residential Trip Rates (per dwelling)

	AM Peak (08:00 – 09:00)			PM Peak (17:00 – 18:00)		
Area	Arr	Dep	Tot	Arr	Dep	Tot
Traffic Impact Assessment Cluster 1	0.135	0.414	0.549	0.378	0.155	0.533

Source: TRICS (2020)

A summary of the preliminary development quanta for each site is provided by SMBC and is shown in Table 2.4.

Table 2.4: Development Quanta

Site	Development by 2026	Development by 2036
8A (north)	50 dwellings	150 dwellings
8B (South)	50 dwellings	150 dwelling
9	200 dwellings	600 dwellings

Source: SMBC

The development quanta provided by SMBC for each site has been used to generate forecast traffic in both 2026 and 2036. A summary of the total forecast traffic generation at both sites is shown in Table 2.5.

Table 2.5: Traffic Generation

Site	DLP Year	Development	AM (08:00-09:00)		PM (17:00-18:00)	
			Arr	Dep	Arr	Dep
Site 8 (8A and 8B combined)	2026	100 dwellings	14	41	38	16
	2036	300 dwellings	41	124	113	47
Site 9	2026	200 dwellings	27	83	76	31
	2036	600 dwellings	81	248	227	93

Source: Mott MacDonald

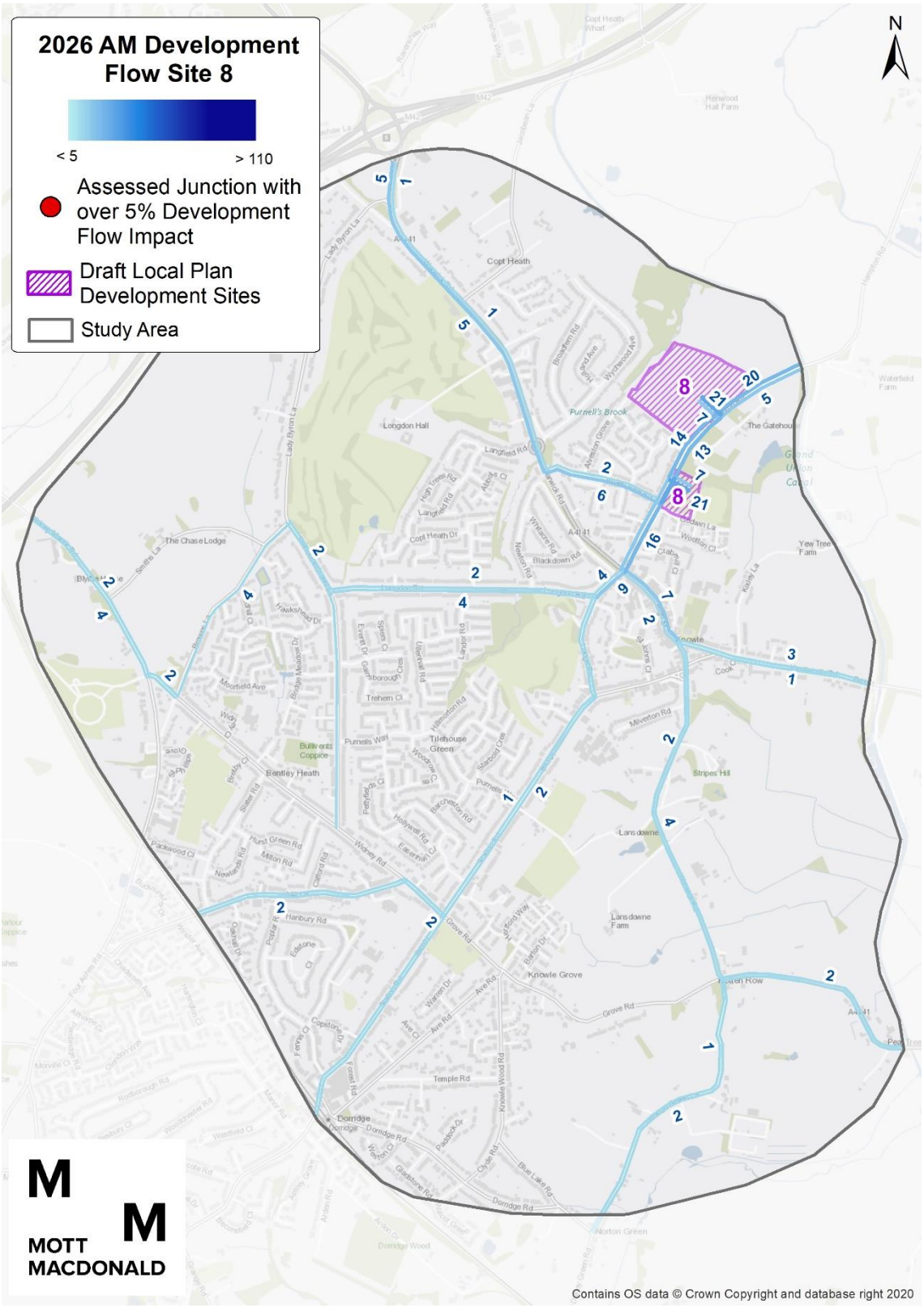
2.7 Trip Distribution and Assignment

The distributions calculated in the DLP PRISM scenario (version 1) for each site have been used to distribute the vehicle trips generated in Table 2.5.

2.7.1 Site 8

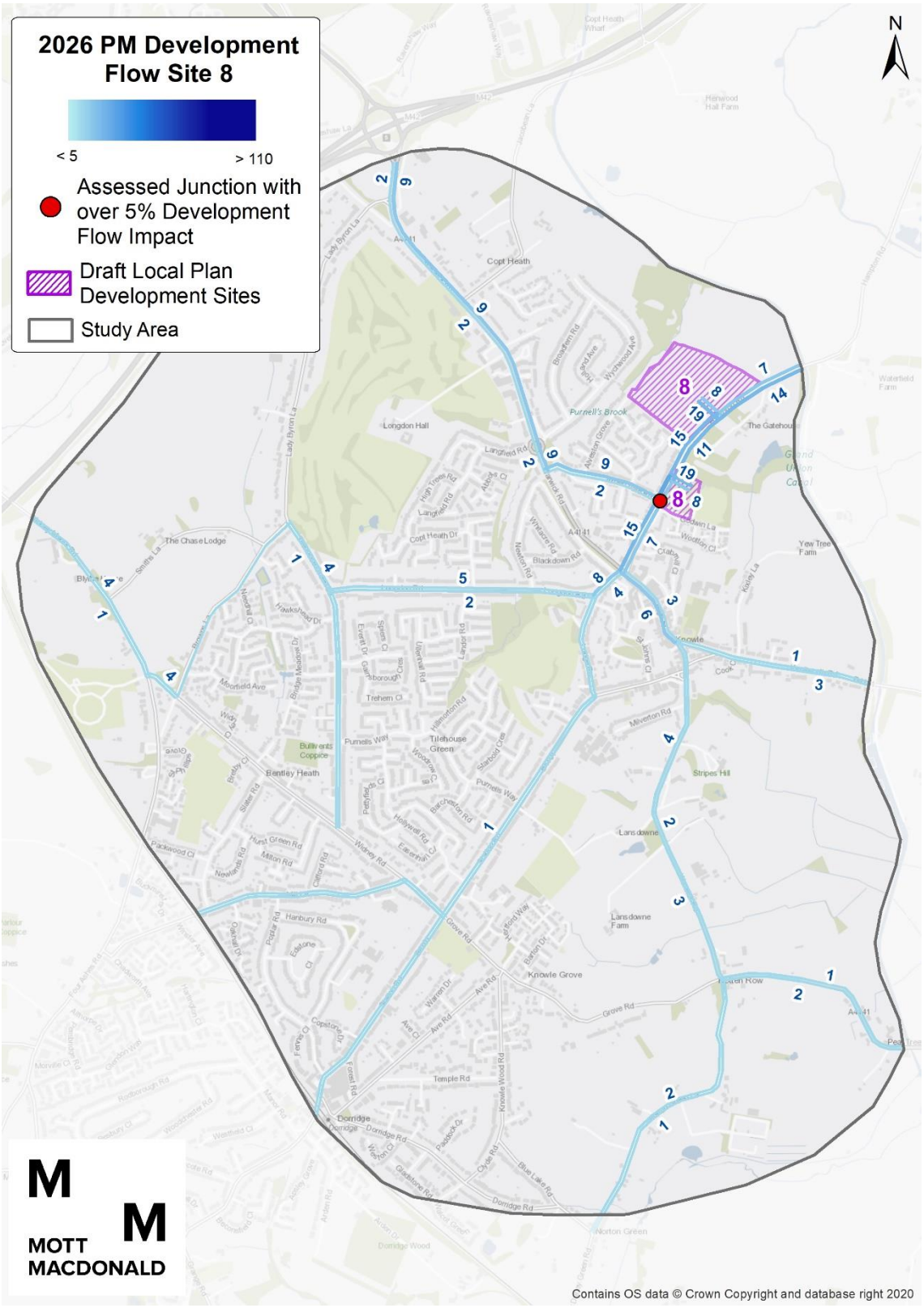
The distributions from Site 8, along with if the resulting junction impact is over 5%, is shown in Figure 2.6 and Figure 2.7 for the AM and PM respectively for 2026. Figure 2.8 and Figure 2.9 show the same for 2036.

Figure 2.6: Site 8 Distribution 2026 AM



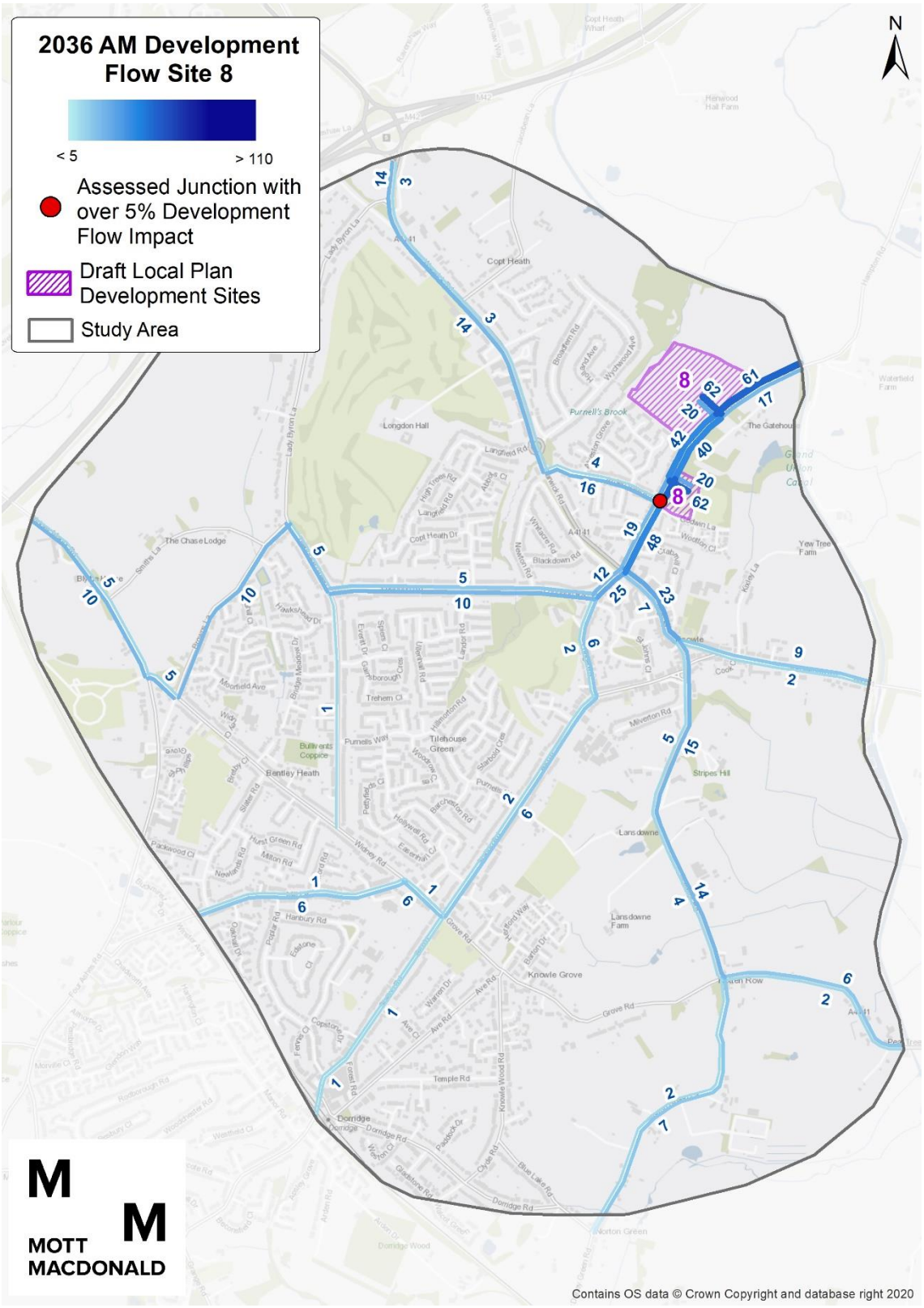
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.7: Site 8 Distribution 2026 PM



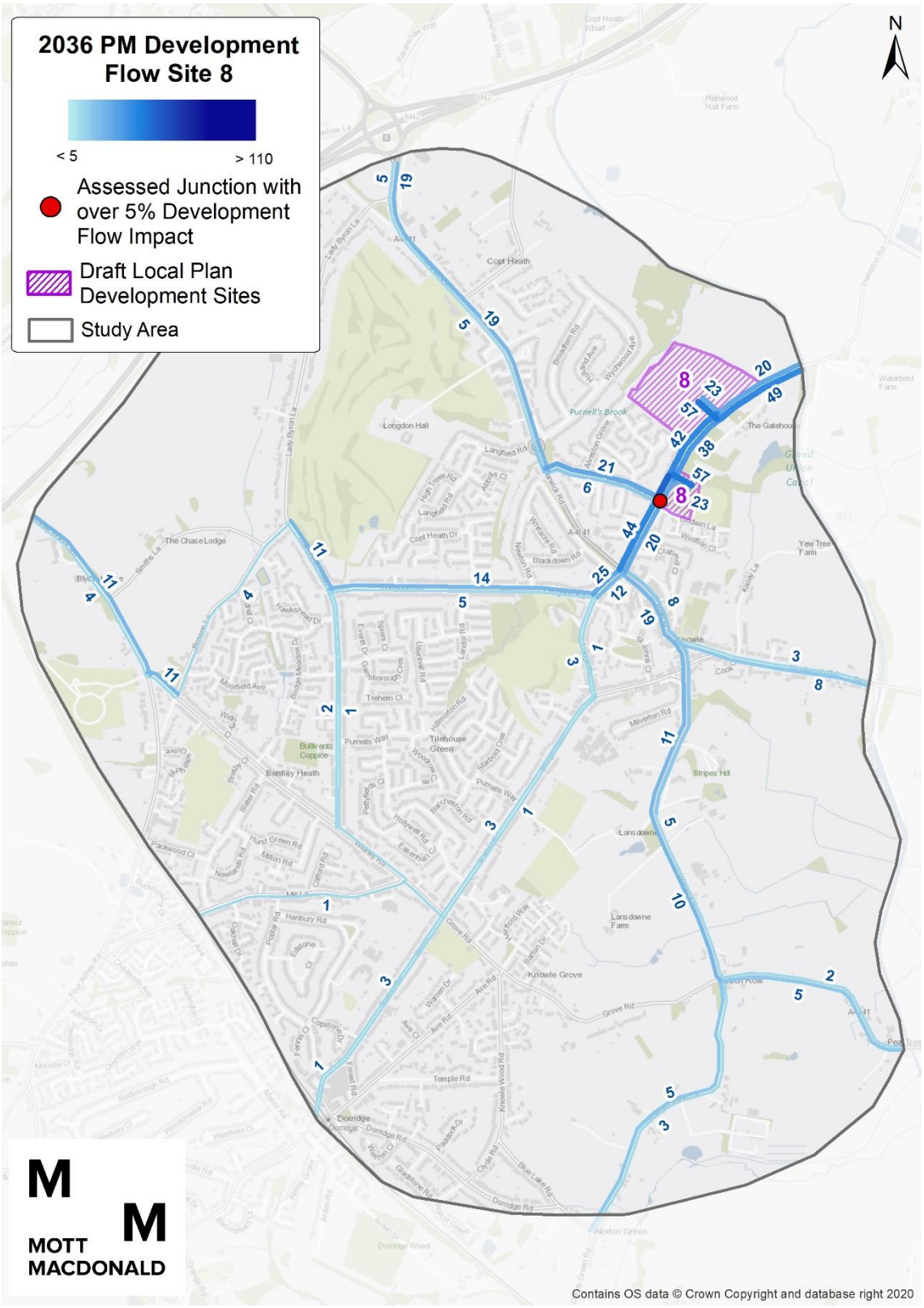
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.8: Site 8 Distribution 2036 AM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.9: Site 8 Distribution 2036 PM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

These show that the only junction with a flow impact over 5% caused by Site 8 is the Hampton Road / Arden Vale Road junction. This is the case in the PM of 2026 and both the AM and PM of 2036.

The distribution calculated in PRISM shows a significant number of trips travelling northbound on Hampton Road away from the study area. These trips are generally travelling to the *'UK Central'* area on rural roads rather than on the M42. UK Central, an area around Birmingham International and the NEC, is forecast to have high growth in the future. Additionally, PRISM forecasts future delays which may be impacting the route choice away from the M42.

The other trips going north or towards the M42 are forecast to use Arden Vale Road. There are fewer trips forecast to be travelling to the south of the site, with 30 trips on the High Street in the AM of 2036 and 27 in the PM.

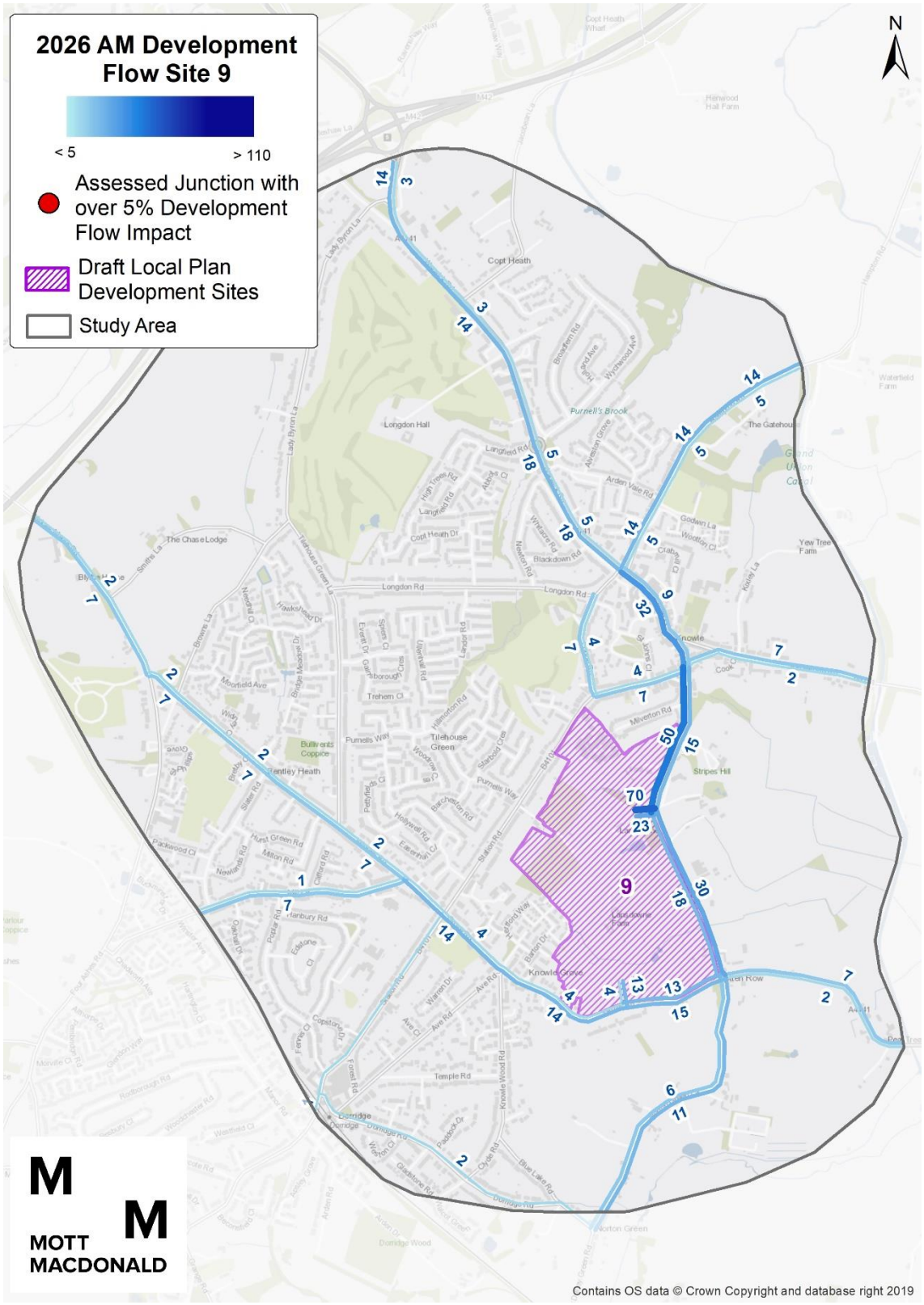
2.7.2 Site 9

For Site 9, the PRISM model assumed one access to the site which was located on Warwick Road. However, the draft masterplans provided by SMBC shows another access on Grove Road. The size of the parcels of land accessible by Grove Road have been estimated and rate of 30 dwellings per hectare has been assumed. This has equated to 16% of the dwellings being accessible via Grove Road and 84% accessible via Warwick Road.

These proportions have been used to split the trips at the access points and the same distribution, from PRISM, has been assumed for both.

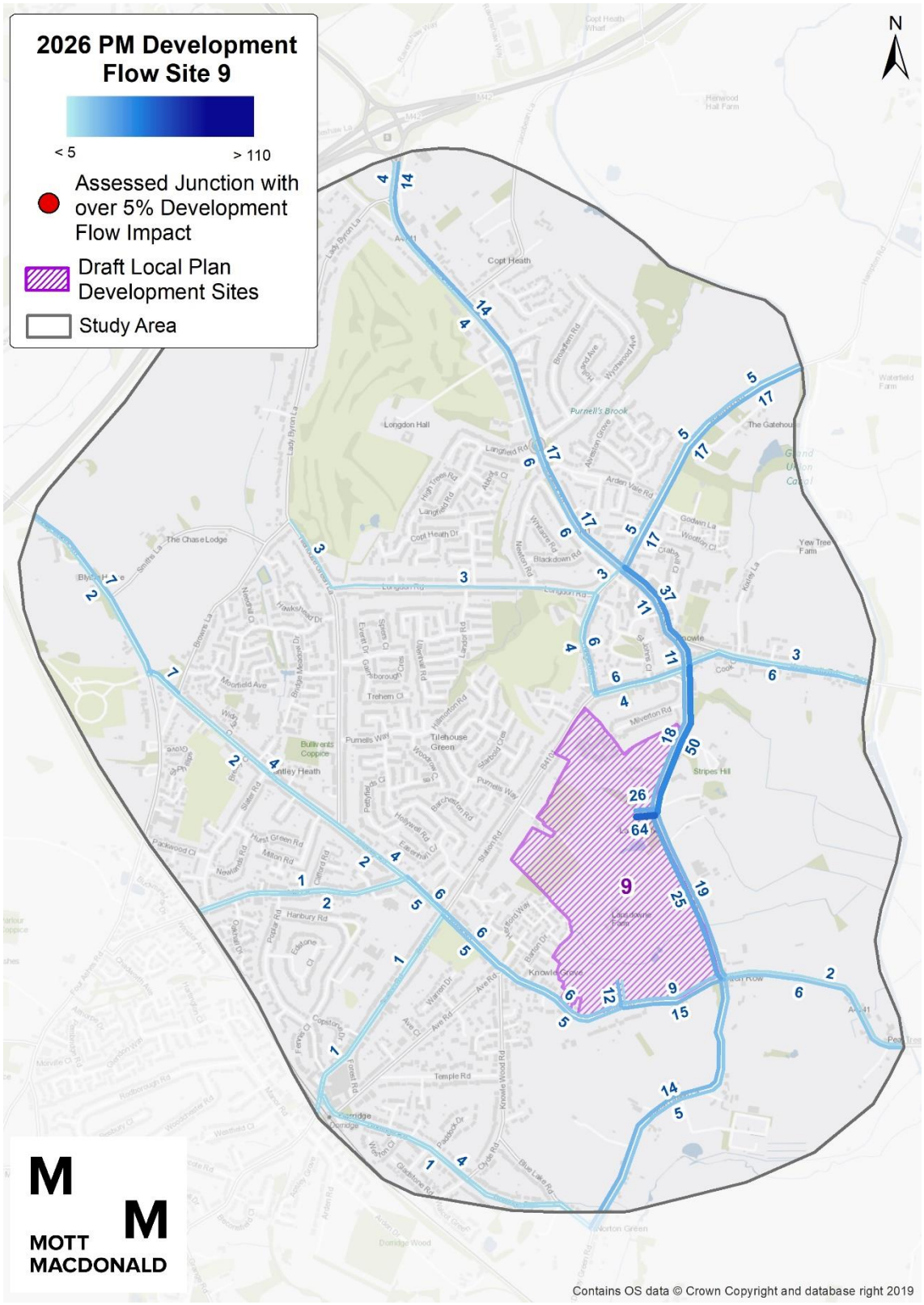
The distributions from Site 9, along with if the resulting junction impact is over 5%, is shown in Figure 2.10 and Figure 2.11 for the AM and PM respectively for 2026. Figure 2.12 and Figure 2.13 show the same for 2036.

Figure 2.10: Site 9 Distribution 2026 AM



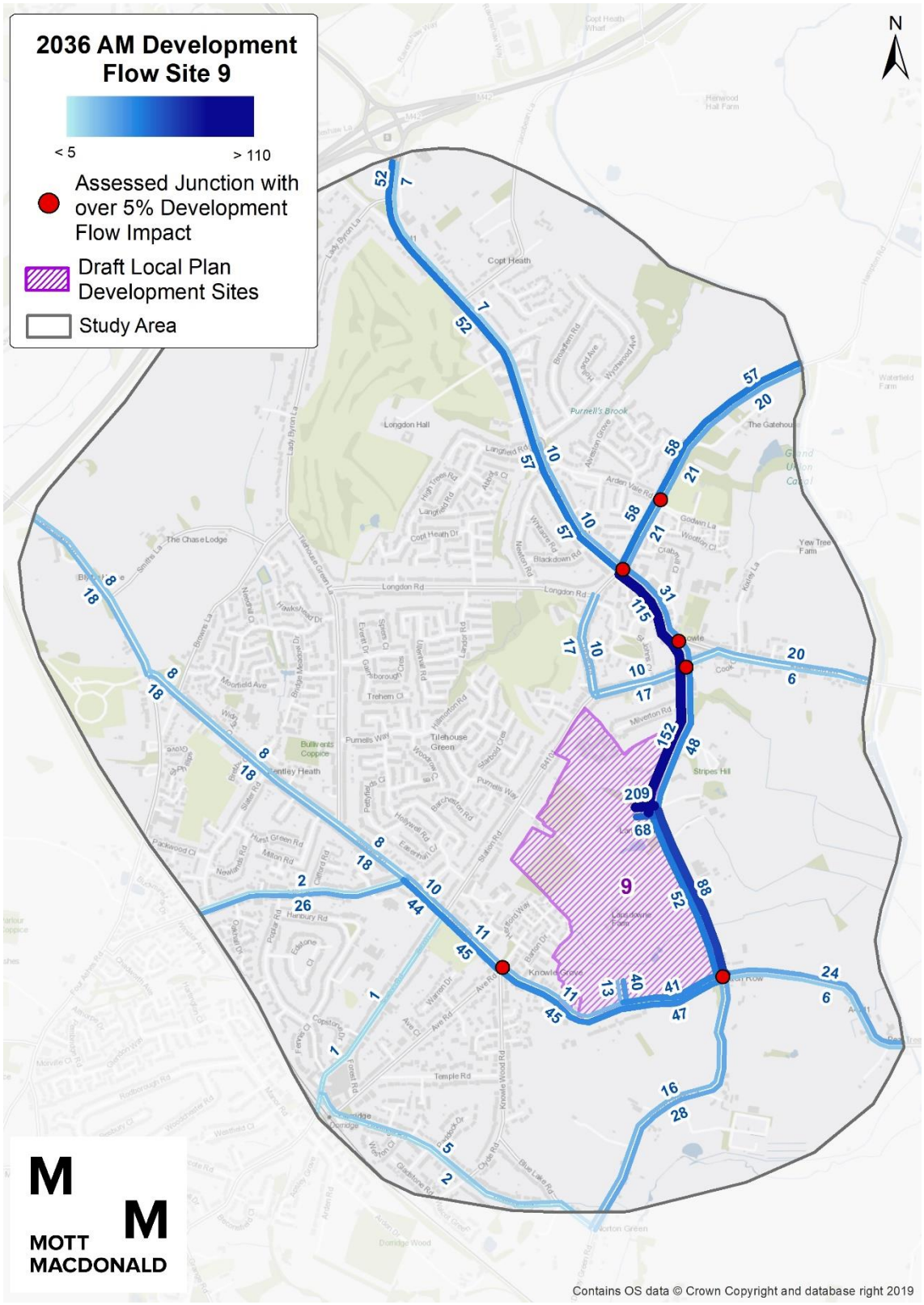
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.11: Site 9 Distribution 2026 PM



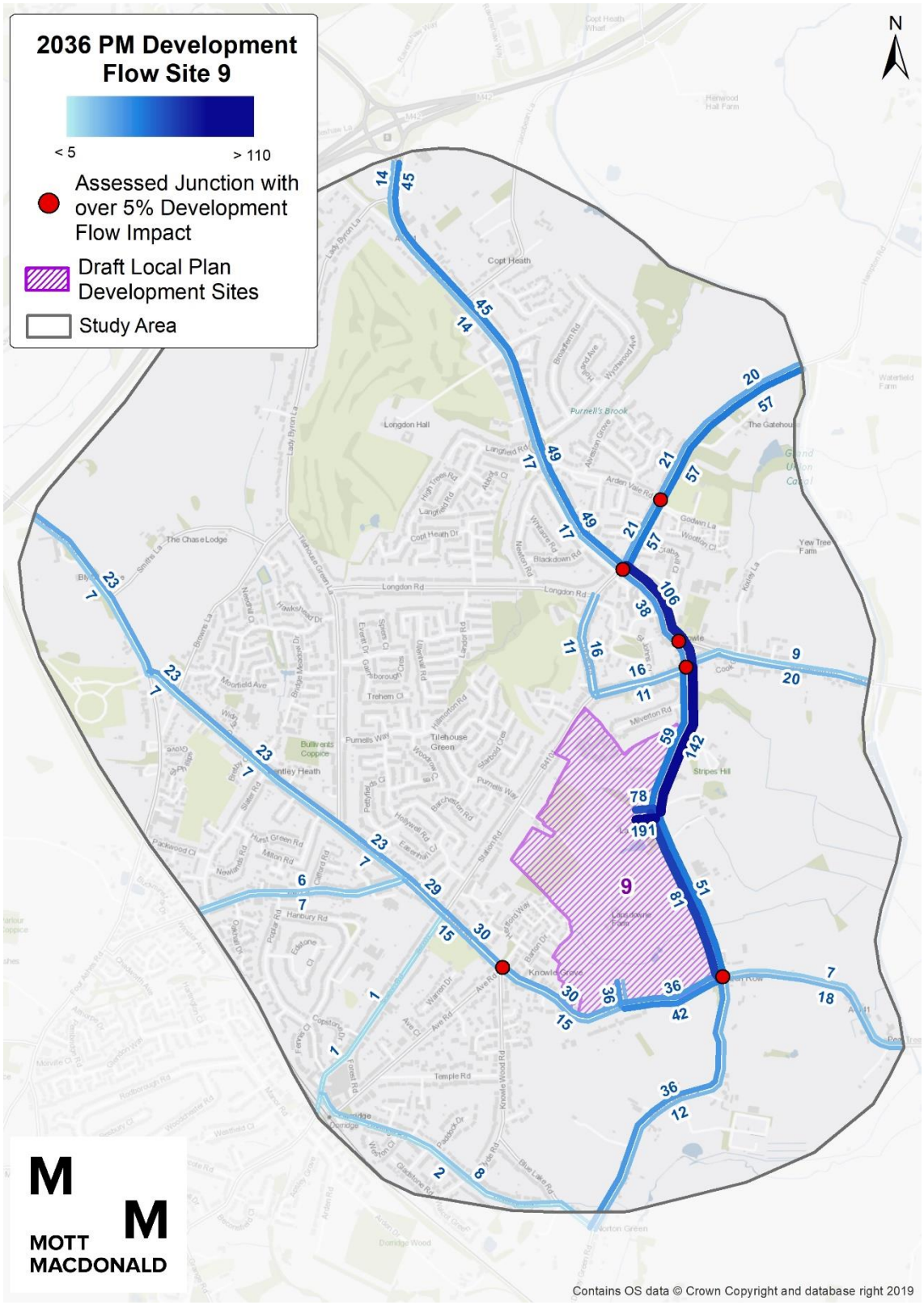
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.12: Site 9 Distribution 2036 AM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.13: Site 9 Distribution 2036 PM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

These show that in 2026, Site 9 is not forecast to result in a 5% development flow impact at any of the junctions in this study. There is more of a significant impact in 2036, with Site 9 development flows resulting in six junctions seeing an increase of over 5%. These junctions are:

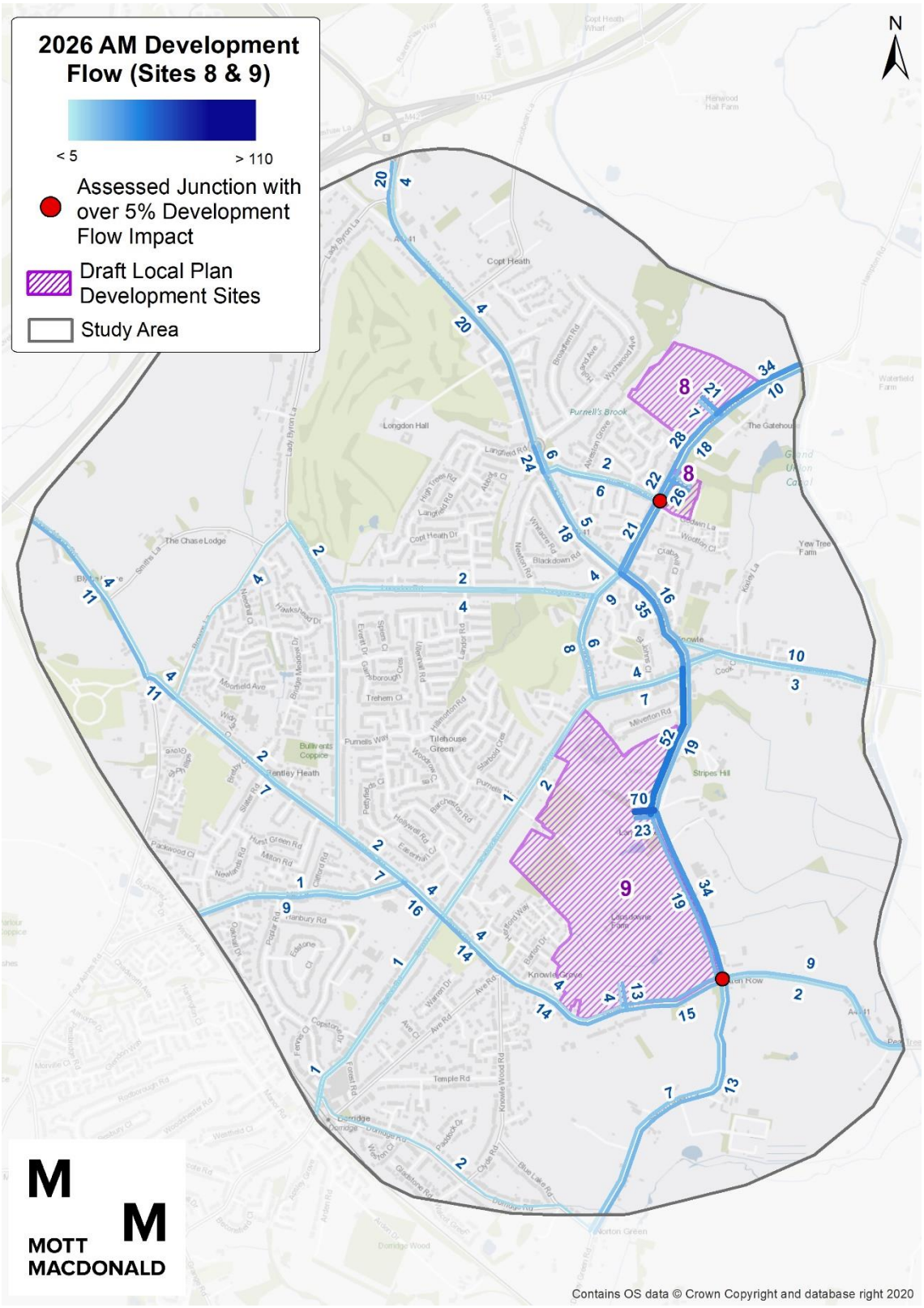
- Hampton Road / Arden Vale Road
- Warwick Road / Hampton Road / High Street / Lodge Road
- High Street / Kenilworth Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Warwick Road / Grove Road / Norton Green Lane
- Grove Road / Middlefield Avenue / Knowle Rood Road

A large number of trips from the site travel via Knowle High Street, 146 in the AM of 2036 and 144 in the PM. These trips then split between Hampton Road and Warwick Road.

2.7.3 Cumulative of Site 8 and 9

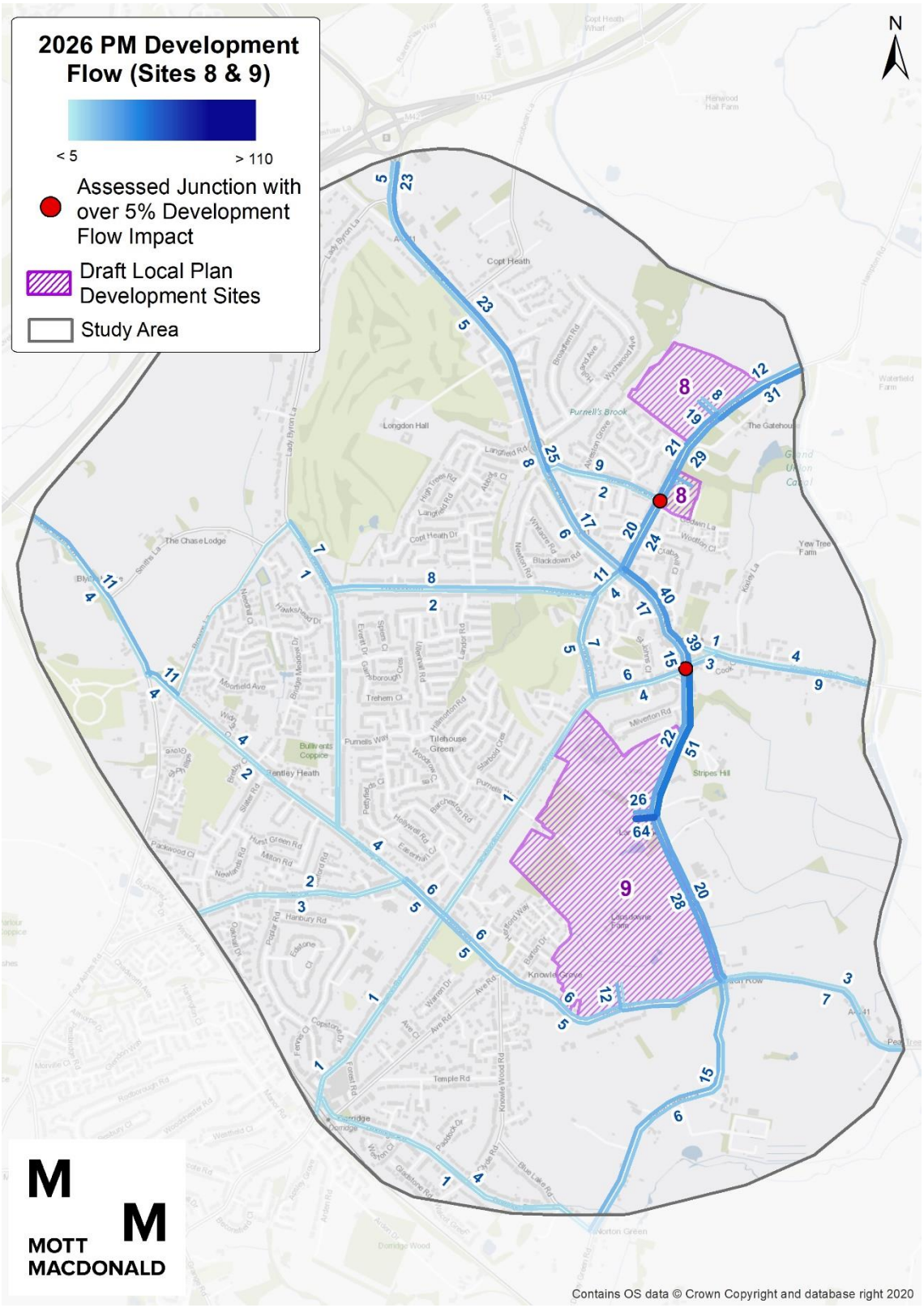
The distributions from Site 8 and Site 9 have been combined to show the cumulative impact. Figure 2.14 and Figure 2.15 show the combined distributions for the AM and PM respectively for 2026, along with if the junction impact caused by the increased flow is over 5%. Figure 2.16 and Figure 2.17 show the same for 2036.

Figure 2.14: Site 8 and Site 9 Cumulative Distribution 2026 AM



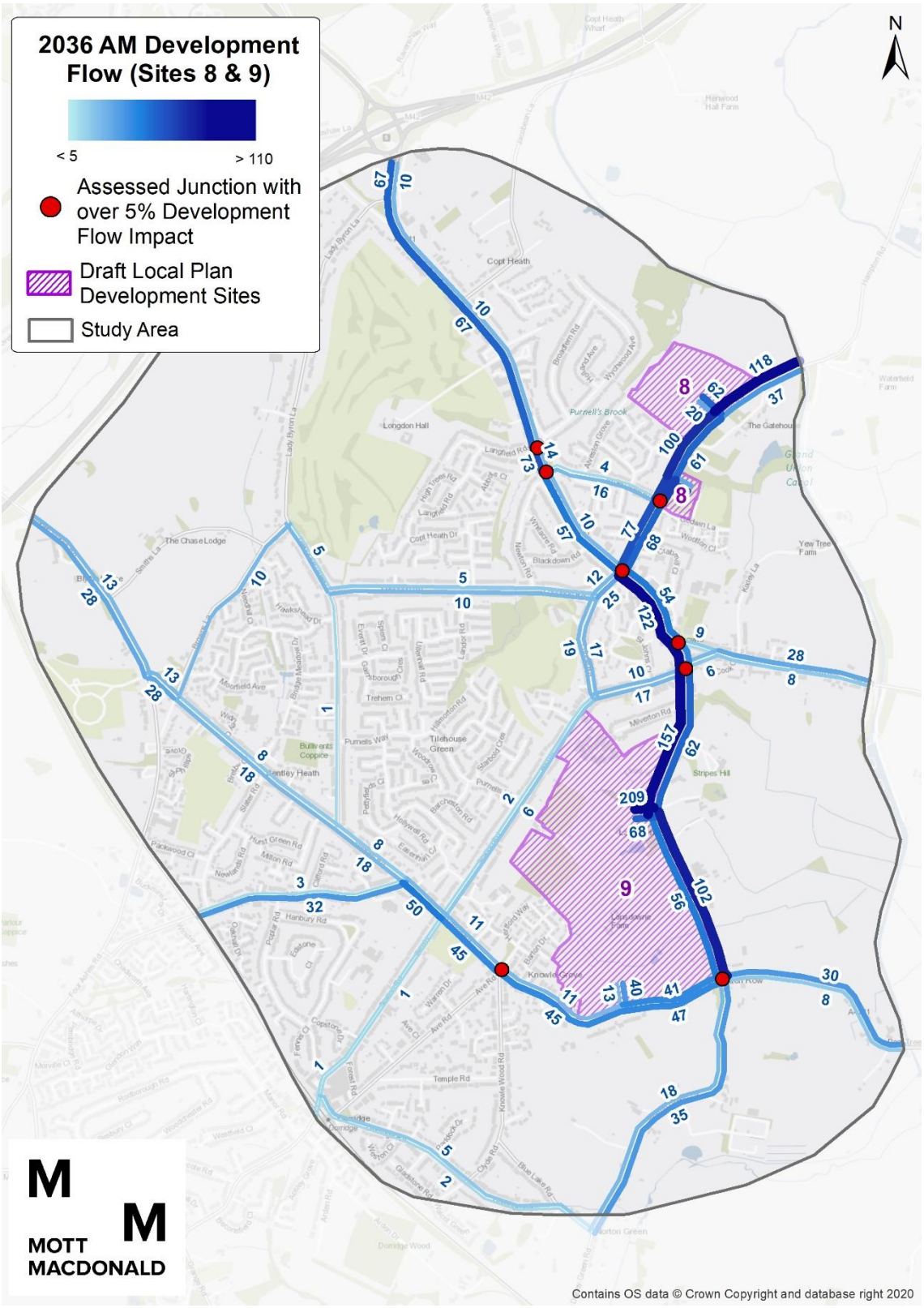
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.15: Site 8 and Site 9 Cumulative Distribution 2026 PM



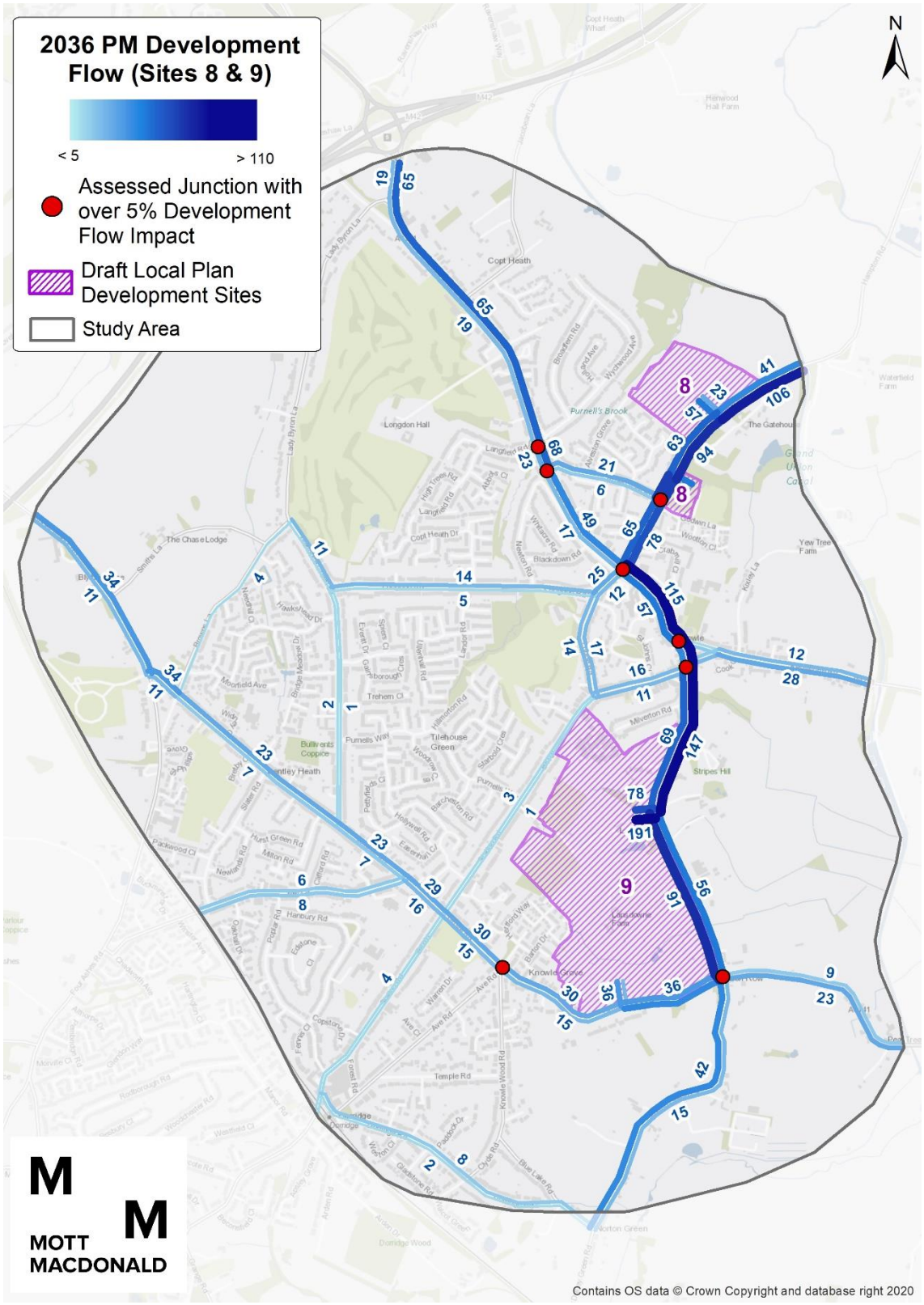
Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.16: Site 8 and Site 9 Cumulative Distribution 2036 AM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

Figure 2.17: Site 8 and Site 9 Cumulative Distribution 2036 PM



Source: Mott MacDonald, TEMPro, TRICS, PRISM

With the combination of the two sites, three junctions result in an increase of over 5% in 2026 as a result of the DLP. These are:

- Hampton Road / Arden Vale Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Warwick Road / Grove Road / Norton Green Lane

In 2036 there is an even greater impact, with the DLP flows resulting in eight junctions seeing an increase of over 5%. These junctions are:

- Warwick Road / Wychwood Avenue / Langfield Road
- Warwick Road / Arden Vale Road
- Hampton Road / Arden Vale Road
- Warwick Road / Hampton Road / High Street / Lodge Road
- High Street / Kenilworth Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Warwick Road / Grove Road / Norton Green Lane
- Grove Road / Middlefield Avenue / Knowle Rood Road

2.8 Limitations

It was intended to update the traffic surveys in early 2020, but due to the onset of the Covid-19 pandemic, these surveys were not undertaken. This was due to the aftereffects on the transportation system following the UK entering into a period of lockdown. This in turn caused traffic levels to drop to levels far lower than would typically be expected for a prolonged period over the spring and summer periods in 2020. As a result, repeat traffic surveys were not undertaken as this would not have provided representative baseline traffic flows. Therefore, it was agreed with SMBC that this study would be completed based on existing data sources, including data that is older than 5 years.

3 Local Junction Modelling

3.1 Introduction

All of the junctions in the study have been assessed to determine if they are likely to need mitigation as a result of the DLP. The junctions identified have then undergone detailed local junction modelling for 2036 with and without DLP scenarios in Junctions 9 software. This is to show the impact of the DLP and to determine if the junction requires mitigation.

The models are constrained by the survey data available, which is sometimes over five-years old and does not have observed queues. Therefore, the queue in the models could not be calibrated.

3.2 Identification of Impacted Junctions

In order to identify junctions that may require mitigation, 'at risk' junctions were determined from the baseline information. If any of these 'at risk' junctions had a development impact of over 5% then it was investigated for mitigation.

The 'at risk' junctions were identified using:

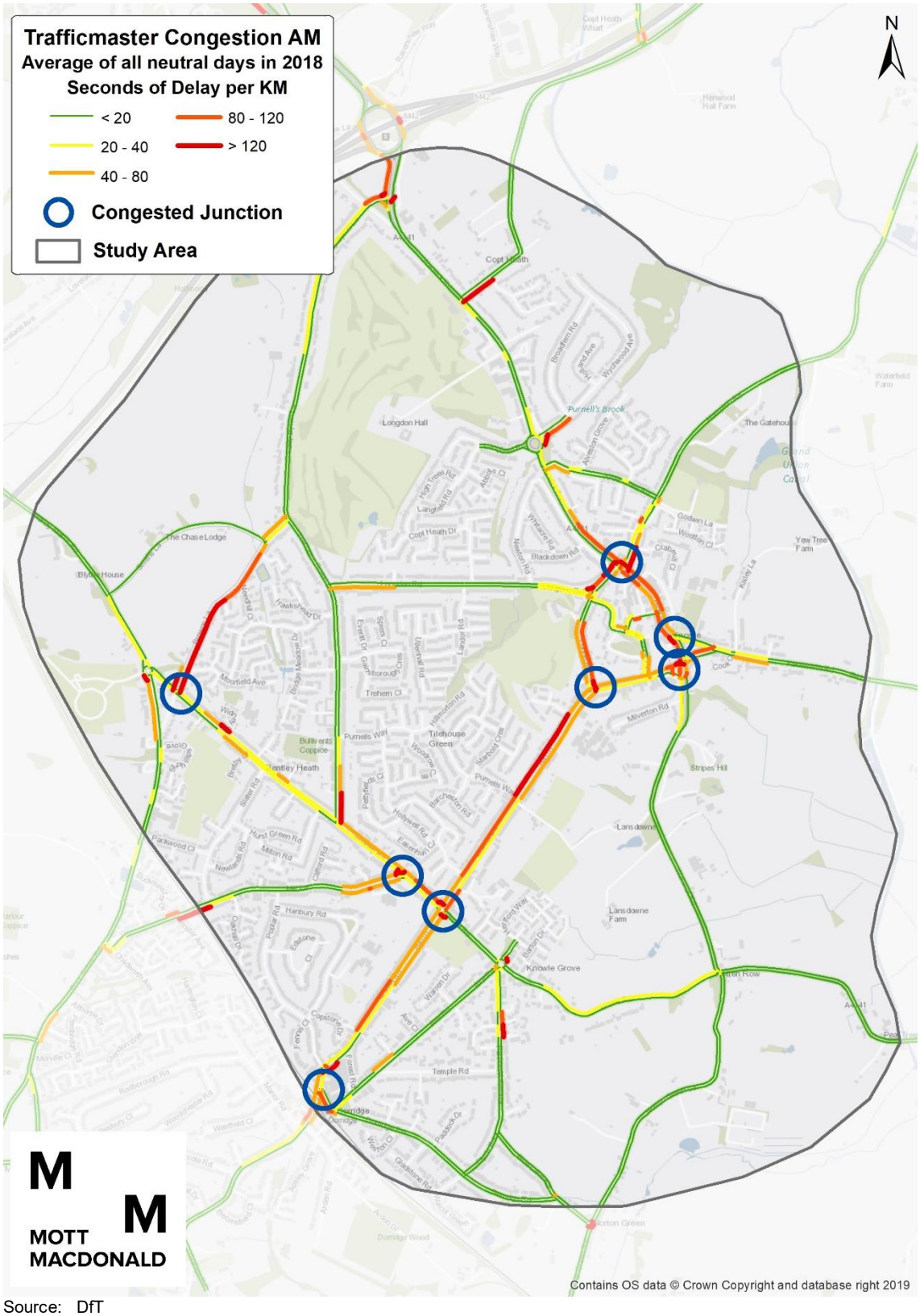
- TrafficMaster congestion data;
- Public consultation feedback;
- PRISM; and
- Survey data.

3.2.1 Trafficmaster Data

Section 2.4.2 shows the current delay within the study area for 2018 in the AM and PM peaks. This has been used to highlight junctions where there is deemed to be significant delay. Figure 3.1 and Figure 3.2 show which junctions have been selected in the AM and PM peaks respectively.

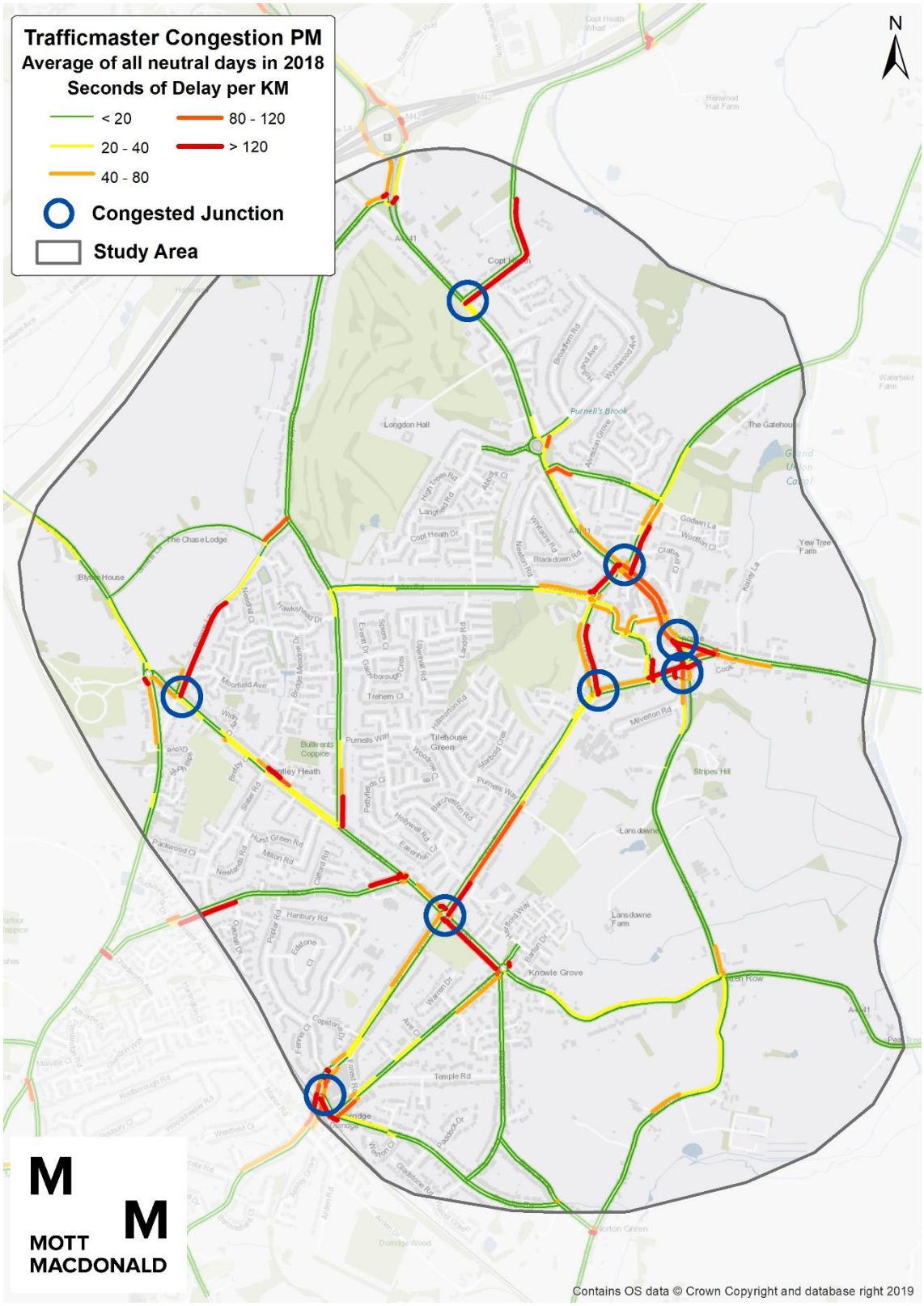
Junctions have been highlighted if there is significant delay on multiple arms or if there is a long section of road that sees delay leading up to a junction.

Figure 3.1: Congested Junctions AM



Source: DfT

Figure 3.2: Congested Junctions PM



Source: DfT

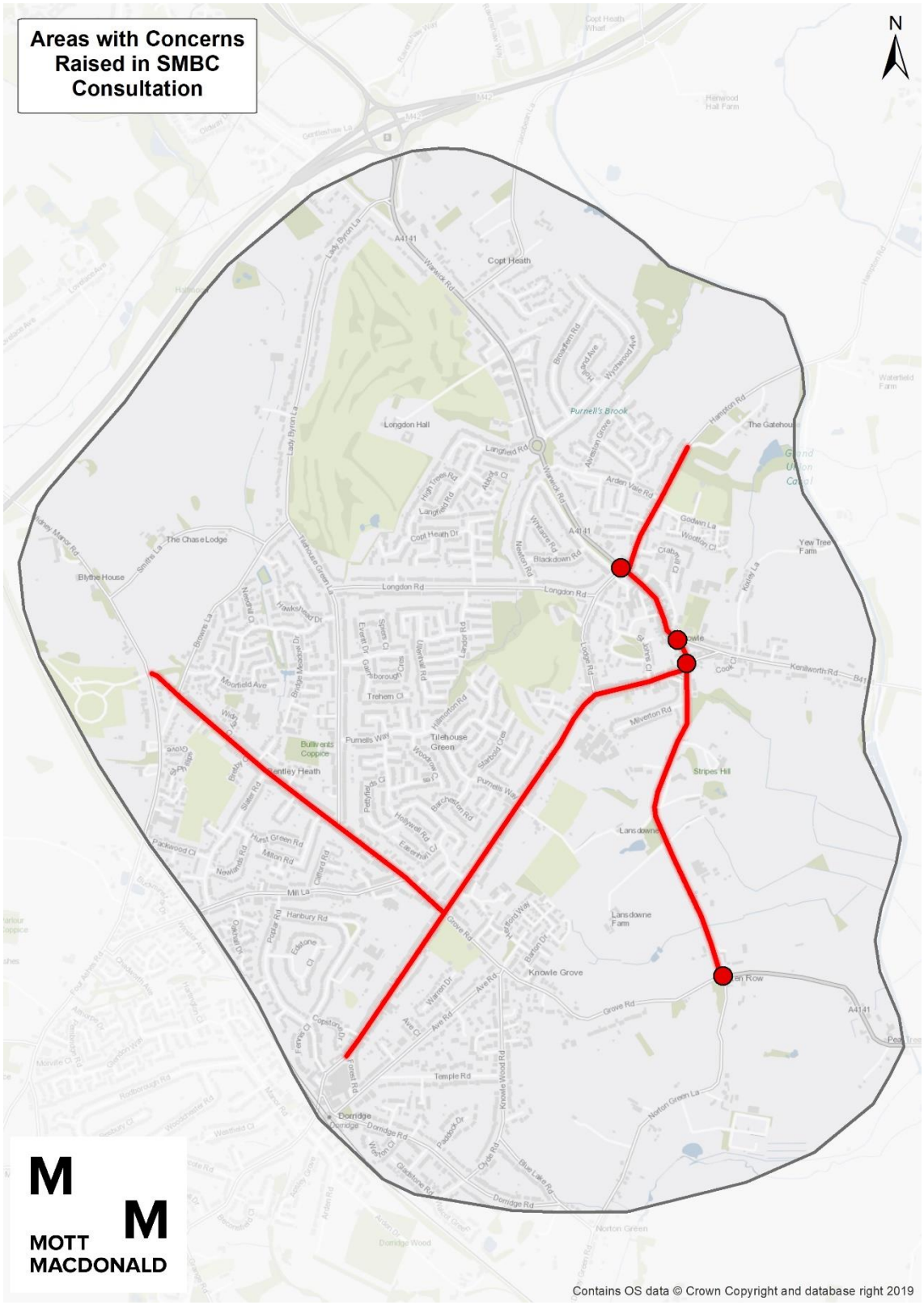
These figures have identified that the following junctions have significant observed delay:

- Warwick Road / Hampton Road / Lodge Road
- High Street / Kenilworth Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Station Road / Lodge Road
- Station Road / Grove Road / Widney Road
- Station Road / Station Approach
- Warwick Road / Jacobean Lane
- Widney Road / Mill Lane
- Widney Road / Browns Lane

3.2.2 Public Consultation

A number of junctions and roads have had concerns raised in Public Consultation relating to the DLP developments. These are shown in Figure 3.3.

Figure 3.3: Public Consultation Feedback



Source: SMBC

3.2.3 PRISM

DLP 2016 Base PRISM scenario (version 1) was reviewed in the Knowle Transport Study Baseline Report. This showed that no junctions or links were over capacity in the model.

3.2.4 Surveyed Traffic

The survey data has been reviewed to determine which junctions see high volumes of traffic on multiple arms. If this junction were then to have a 5% development flow impact, this would mean a significant number of additional trips through the junction, which may warrant further investigation. The junctions that have been identified are:

- A4141 / Lady Byron Lane
- Warwick Road / Hampton Road / Lodge Road
- High Street / Kenilworth Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Station Road / Lodge Road
- Station Road / Grove Road / Widney Road
- Warwick Road / Grove Road / Norton Green Lane
- Widney Road / Tilehouse Green Lane
- Widney Manor Road / Widney Road / Four Ashes Road

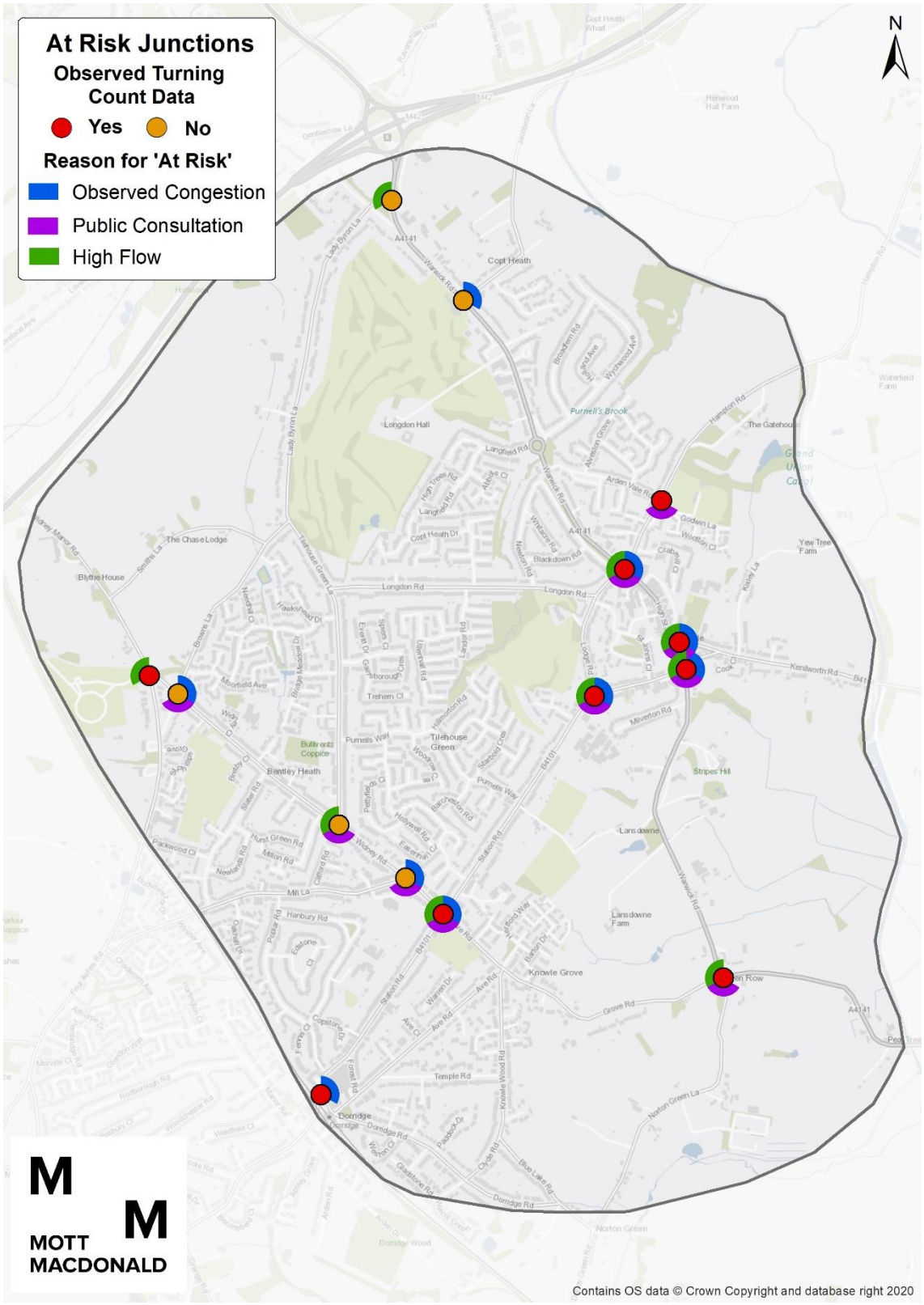
3.2.5 At Risk Junctions

If a junction has been highlighted as currently having congestion, has had a concern raised at public consultation, is over capacity in PRISM or has high surveyed flows, then it has been deemed to be ‘at risk’. These junctions are shown in Figure 3.4.

Some junctions have not got surveyed turning counts available and therefore could not be investigated further in this study. These are shown as orange in Figure 3.4. The reasons for the junction being selected are also shown, with:

- A blue border showing there was observed Trafficmaster delay at the junction (seen in Section 3.2.1)
- A purple border showing the junction or road was raised as a concern in public consultations (seen in Section 3.2.2)
- A green border showing the junction was identified as having high observed flows (seen in Section 3.2.4)

Figure 3.4: At Risk Junctions



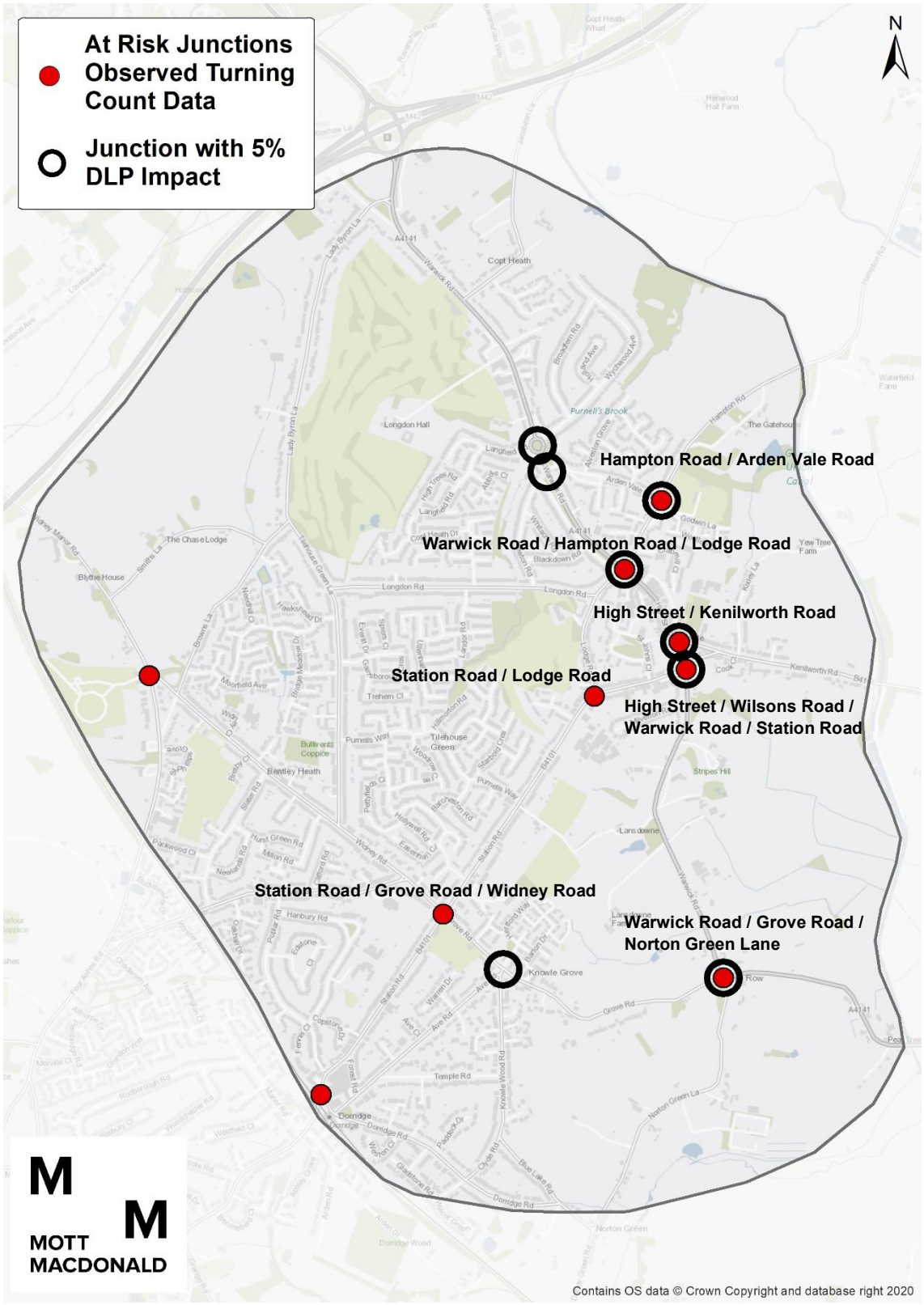
Source: Mott MacDonald

3.2.6 DLP Junction Impact

If one of the junctions identified as ‘at risk’ has a DLP development flow impact of 5% or higher, then that junction has been identified for detailed junction modelling.

The ‘at risk’ junctions (identified in Figure 3.4) and the junctions identified as having a 5% DLP impact (covered in Section 2.7.3) are shown in Figure 3.5.

Figure 3.5: Junctions with Over 5% Junction Impact



Source: Mott MacDonald

This has resulted in five ‘at risk’ junctions with a 5% development impact or over. These junctions are:

- Hampton Road / Arden Vale Road
- Warwick Road / Hampton Road / Lodge Road
- High Street / Kenilworth Road
- High Street / Wilsons Road / Warwick Road / Station Road
- Warwick Road / Grove Road / Norton Green Lane

Whilst the junction of Station Road / Grove Road / Widney Road does not have a 5% DLP flow impact, it still sees a relatively large flow increase. Since there is already observed delay at this junction, it has also been assessed.

Additionally, the junction of Station Road / Lodge Road also does not have a 5% DLP flow impact but is close to the village centre and interacts with the High Street / Wilsons Road / Warwick Road / Station Road junctions and sees an increase in flow. Therefore, this has also been assessed.

The junctions of Warwick Road with Arden Vale Road and Wychwood Avenue / Langfield Road do have a 5% DLP flow impact but have not been determined to be at risk. The junction of Warwick Road / Arden Vale Road does not show any delay on Warwick Road, which is unlikely to be made much worse by the increased flow. The flow on Arden Vale Road westbound (causing delay at the junction) is only forecast to increase by 16 vehicles in the AM peak and 6 in the PM peak. The roundabout of Warwick Road / Wychwood Avenue / Langfield Road does not see significant delay and has been identified for potential mitigation to improve pedestrian and cyclist movements.

The junction of Grove Road / Middlefield Avenue / Knowle Rood Road has a 5% DLP flow impact but does not see any current congestion on any of its arms leading into the junction.

3.3 Hampton Road / Arden Vale Road

The junction of Hampton Road / Arden Vale Road (Junction 6 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.6.

Figure 3.6: Hampton Road / Arden Vale Road

Source: Mott MacDonald/OpenStreetMap

3.3.1.1 2036 Base

The modelling results for the Hampton Road / Arden Vale Road junction in 2036 without DLP development are shown in Table 3.1. The corresponding arms are shown in Figure 3.6.

Table 3.1: Hampton Road / Arden Vale Road 2036 Without DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	0.1	7.86	0.06	A	0	7.53	0.05	A
B-A	0.2	10.72	0.15	B	0.1	11.09	0.09	B
C-AB	0.1	5.04	0.05	A	0.5	5.75	0.24	A

Source: Junctions 9 (2020)

This shows that the model is predicting the junction to be well within capacity, with the maximum RFC being 0.24 over the two peaks. An RFC value of 0.85 or over is when the junction is generally deemed to over its ideal operational capacity.

3.3.1.2 2036 Base + Site 8 & Site 9

The modelling results for the Hampton Road / Arden Vale Road junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.2. The corresponding arms are shown in Figure 3.6.

Table 3.2: Hampton Road / Arden Vale Road 2036 With DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	0.1	8.14	0.07	A	0.1	7.18	0.08	A
B-A	0.2	12.1	0.16	B	0.1	13.85	0.11	B
C-AB	0.2	5.04	0.09	A	0.7	5.83	0.28	A

Source: Junctions 9 (2020)

This table shows that the junction is forecast to still have spare capacity in 2036 with the DLP developments.

3.3.1.3 Summary

The junction of Hampton Road / Arden Vale Road was identified for further assessment due to concerns raised in public consultation and with there being a junction flow impact of over 5% caused by the DLP.

The junction is forecast to still be well within capacity in 2036 with the DLP development flows. Therefore, this junction has not been assessed further.

3.4 Warwick Road / Hampton Road / Lodge Road

The junction of Warwick Road / Hampton Road / Lodge Road (Junction 7 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.7.

Figure 3.7: Warwick Road / Hampton Road / Lodge Road

Source: Mott MacDonald/ OpenStreetMap

3.4.1.1 2036 Base

The modelling results for the Warwick Road / Hampton Road / Lodge Road junction in 2036 without DLP development are shown in Table 3.3. The corresponding arms are shown in Figure 3.7.

Table 3.3: Warwick Road / Hampton Road / Lodge Road 2036 Without DLP

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
B-C	2.3	27.94	0.71	D	2.4	24.28	0.72	C
B-AD	6.9	**125.23**	**0.93**	**F**	0.6	25.24	0.39	D
A-BCD	0.6	12.86	0.37	B	0.1	8.26	0.12	A
D-A	0.8	16.82	0.46	C	0.6	12.38	0.38	B
D-BC	0.6	29.82	0.37	D	0.3	18.11	0.26	C
C-ABD	0.6	9.85	0.39	A	0.5	9.61	0.34	A

Source: Junctions 9 (2020)

This shows that the model is predicting the junction to be over capacity on Lodge Road, for movements turning right, with an RFC of 0.93 (with the limit for a junction working at operational

capacity being 0.85). The other arms are forecast to still be within capacity in the AM, with all arms being under capacity in the PM.

3.4.1.2 2036 Base + Site 8 & Site 9

The modelling results for the Warwick Road / Hampton Road / Lodge Road junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.4. The corresponding arms are shown in Figure 3.7.

Table 3.4: Warwick Road / Hampton Road / Lodge Road 2036 With DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	2.6	31.82	0.74	D	2.8	28.97	0.75	D
B-AD	15.5	**245.41**	**1.08**	**F**	1.1	33.67	0.53	D
A-BCD	1.3	16.91	0.54	C	0.3	9.66	0.22	A
D-A	4.3	**69.8**	**0.86**	**F**	1.4	20.16	0.59	C
D-BC	3.1	**124.39**	**0.83**	**F**	0.6	28.62	0.4	D
C-ABD	0.7	10.64	0.4	B	0.5	9.79	0.35	A

Source: Junctions 9 (2020)

This table shows that whilst the junction is forecast to still have spare capacity in the PM peak in 2036 with the DLP developments, in the AM peak the Lodge Road arm is forecast to be over capacity. The Lodge Road arm is forecast to become further over capacity for vehicles turning right, resulting in further delays. The Hampton Road arm becomes is at capacity or just over capacity as a result of the DLP developments, with delays for all movements.

3.4.1.3 Summary

The junction of Warwick Road / Hampton Road / Lodge Road was identified for further assessment due to observed congestion, concerns raised in public consultation, high flows and with there being a junction flow impact of over 5% caused by the DLP.

The junction is forecast to be over capacity in the AM peak on Lodge Road for right turners in 2036 without the DLP development. This is forecast to become further over capacity in 2036 with DLP development, resulting in further delays.

This junction has been identified for further assessment to see if a revised junction layout could benefit both traffic operation and non-motorised users. Although impacts have been identified as result of the cumulative impact of DLP development, this is unlikely to demonstrate a severe traffic impact that results in a significant change to the operational performance of the junction.

3.5 High Street / Kenilworth Road

The junction of High Street / Kenilworth Road (Junction 10 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.8.

Figure 3.8: High Street / Kenilworth Road

Source: Mott MacDonald/ OpenStreetMap

3.5.1.1 2036 Base

The modelling results for the High Street / Kenilworth Road junction in 2036 without DLP development are shown in Table 3.5. The corresponding arms are shown in Figure 3.8.

Table 3.5: High Street / Kenilworth Road 2036 Without DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	0.0	14.09	0.04	B	0.0	9.89	0.03	A
B-A	2.0	30.5	0.68	D	1.5	23.34	0.60	C
C-AB	0.2	5.34	0.08	A	0.1	4.94	0.05	A

Source: Junctions 9 (2020)

This shows that the model is predicting the junction to be within capacity, with the maximum RFC being 0.68 over the two peaks.

3.5.1.2 2036 Base + Site 8 & Site 9

The modelling results for the High Street / Kenilworth Road junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.6. The corresponding arms are shown in Figure 3.8.

Table 3.6: High Street / Kenilworth Road 2036 With DLP

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
B-C	0.1	19.3	0.05	C	0	13.23	0.04	B
B-A	2.9	**43.5**	**0.76**	**E**	2.2	33.98	0.70	D
C-AB	0.2	4.95	0.10	A	0.1	4.87	0.06	A

Source: Junctions 9 (2020)

This table shows that the junction is forecast to have delays on Kenilworth Road in the AM of 2036, caused by the DLP developments. The High Street arms are forecast to still have plenty of spare capacity in both the AM and PM.

3.5.1.3 Summary

The junction of High Street / Kenilworth Road was identified for further assessment due to observed congestion, concerns raised in public consultation, high flows and with there being a junction flow impact of over 5% caused by the DLP.

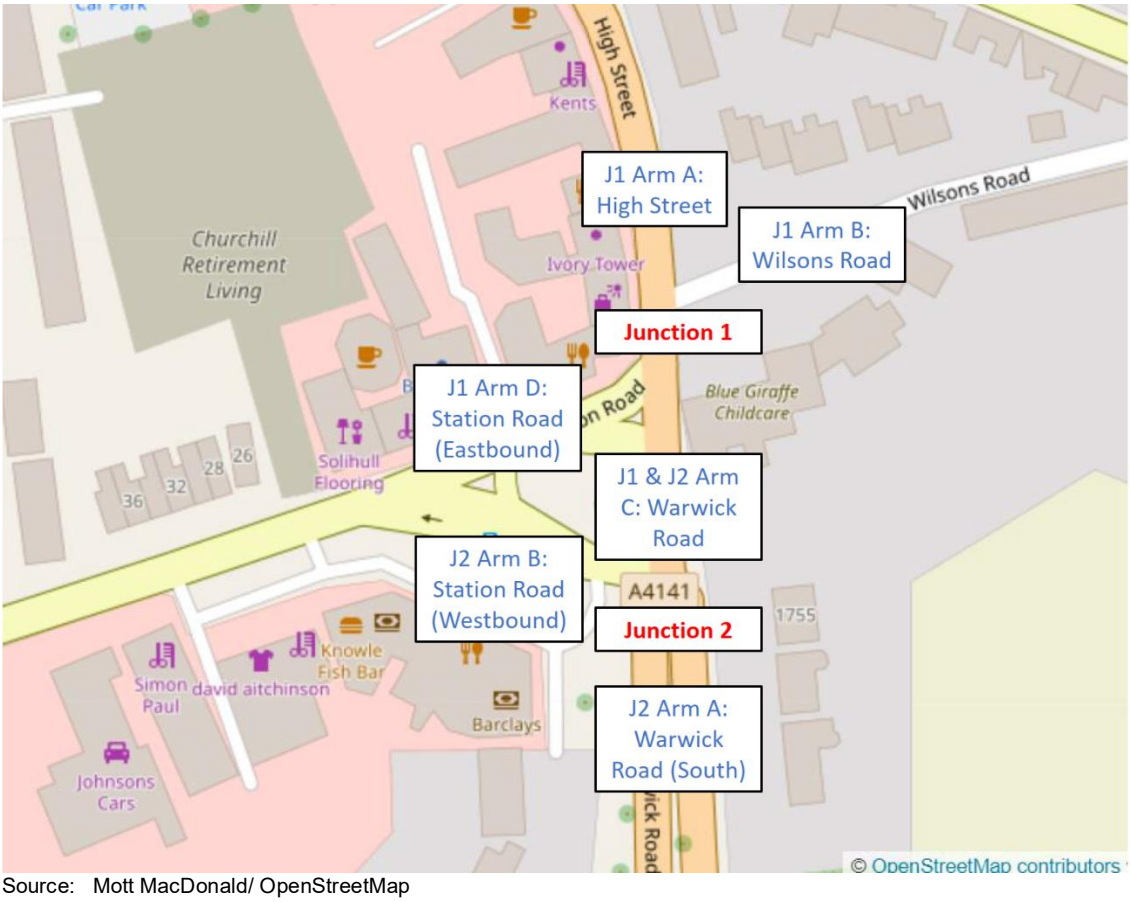
The junction is forecast to still be within capacity in 2036 without the DLP development flows. The developments then result in the Kenilworth Road arm having increased delay, with a bad Level of Service (LOS).

Therefore, this junction has been identified for further assessment.

3.6 High Street / Wilsons Road / Warwick Road / Station Road

The junction of High Street / Wilsons Road / Warwick Road / Station Road (Junction 12 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.9, which has been modelled as two junctions.

Figure 3.9: High Street / Wilsons Road / Warwick Road / Station Road



Source: Mott MacDonald/ OpenStreetMap

3.6.1.1 2036 Base

The modelling results for the High Street / Wilsons Road / Warwick Road / Station Road junction in 2036 without DLP development are shown in Table 3.7. The corresponding arms are shown in Figure 3.9.

Table 3.7: High Street / Wilsons Road / Warwick Road / Station Road 2036 Without DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
J1: B-CD	0.7	11.25	0.42	B	1.2	16.19	0.56	C
J1: B-A	0.1	19.20	0.06	C	0.1	20.85	0.11	C
J1: AB-CD	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J1: D-AB	4.9	**38.92**	**0.85**	**E**	1.7	17.54	0.63	C
J1: D-C	0.2	13.04	0.20	B	0.5	15.87	0.32	C
J1: CD-AB	4.7	17.91	0.76	C	1.4	8.36	0.45	A
J2: B-AC	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J2: C-AB	1.7	14.23	0.62	B	3.8	20.58	0.77	C

Source: Junctions 9 (2020)

This shows that the model is predicting the junction will be over capacity on Station Road eastbound for vehicles turning left in the AM of 2036 without the DLP. All other arms are forecast to have an RFC lower than 0.85 in the AM, with all arms within capacity in the PM.

3.6.1.2 2036 Base + Site 8 & Site 9

The modelling results for the High Street / Wilsons Road / Warwick Road / Station Road junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.8. The corresponding arms are shown in Figure 3.9.

Table 3.8: High Street / Wilsons Road / Warwick Road / Station Road 2036 With DLP

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
J1: B-CD	0.8	12.04	0.44	B	1.8	21.52	0.65	C
J1: B-A	0.1	24.64	0.07	C	0.2	28.97	0.15	D
J1: AB-CD	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J1: D-AB	11.6	**86.89**	**0.98**	**F**	1.9	20.18	0.67	C
J1: D-C	0.4	16.04	0.26	C	0.7	20.46	0.42	C
J1: CD-AB	12.2	**40.72**	**0.90**	**E**	2.0	9.54	0.53	A
J2: B-AC	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J2: C-AB	2.1	16.88	0.67	C	**27.5**	**82.98**	**1.00**	**F**

Source: Junctions 9 (2020)

This table shows that the junction is forecast to have further delays on Station Road eastbound in the AM of 2036, caused by the DLP developments. The DLP is also forecast to result in delays on Warwick Road northbound at the junction with Wilsons Road in the AM.

In the PM, the DLP is predicted to result in significant delays on Warwick Road southbound at the junction with Station Road. This movement is forecast to have in long queues as a result of the DLP.

3.6.1.3 Summary

The junction of High Street / Wilsons Road / Warwick Road / Station Road was identified for further assessment due to observed congestion, concerns raised in public consultation, high flows and with there being a junction flow impact of over 5% caused by the DLP.

The junction is forecast to be within capacity for all arms except for Station Road eastbound in the AM of 2036 without the DLP development flows. On Station Road the RFC is predicted to be at 0.85 without the DLP.

The developments then result in increased delays at Station Road eastbound, with an RFC of 0.98. The DLP is also forecast to result in Warwick Road northbound (at Wilsons Road) becoming over capacity in the AM and southbound (at Station Road) being over capacity in the PM.

Therefore, this junction has been identified for further assessment.

3.7 Warwick Road / Grove Road / Norton Green Lane

The junction of Warwick Road / Grove Road / Norton Green Lane (Junction 26 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been

assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.10, which has been modelled as two junctions.

Figure 3.10: Warwick Road / Grove Road / Norton Green Lane

Source: Mott MacDonald/ OpenStreetMap

3.7.1.1 2036 Base

The modelling results for the Warwick Road / Grove Road / Norton Green Lane junction in 2036 without DLP development are shown in Table 3.9. The corresponding arms are shown in Figure 3.10.

Table 3.9: Warwick Road / Grove Road / Norton Green Lane 2036 Without DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
J1: B-C	0.4	11.93	0.28	B	0.1	9.47	0.06	A
J1: B-A	1.2	22.8	0.55	C	0.9	20.73	0.47	C
J1: C-AB	0.3	6.58	0.17	A	0.3	5.75	0.12	A
J2: B-AC	0.3	8.68	0.25	A	0.2	10.32	0.17	B
J2: C-AB	0.3	5.26	0.14	A	0.7	6.15	0.26	A

Source: Junctions 9 (2020)

This shows that the model is predicting the junction will be well within capacity in 2036 without the DLP developments.

3.7.1.2 2036 Base + Site 8 & Site 9

The modelling results for the Warwick Road / Grove Road / Norton Green Lane junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.10. The corresponding arms are shown in Figure 3.9.

Table 3.10: Warwick Road / Grove Road / Norton Green Lane 2036 With DLP

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
J1: B-C	0.7	16.61	0.42	C	0.2	12.43	0.18	B
J1: B-A	1.8	34.62	0.66	D	1.2	29.44	0.56	D
J1: C-AB	0.7	7.37	0.31	A	0.8	7.25	0.31	A
J2: B-AC	0.4	9.96	0.31	A	0.3	10.22	0.25	B
J2: C-AB	0.6	5.8	0.25	A	0.8	6.34	0.3	A

Source: Junctions 9 (2020)

This table shows that the junction is forecast to still be within capacity in 2036 with DLP development.

3.7.1.3 Summary

The junction of Warwick Road / Grove Road / Norton Green Lane was identified for further assessment due to concerns raised in public consultation, high flows and with there being a junction flow impact of over 5% caused by the DLP.

The junction is forecast to still be within capacity in 2036 with the DLP development flows. Therefore, this junction has not been assessed further.

3.8 Station Road / Lodge Road

The junction of Station Road / Lodge Road (Junction 14 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The junction has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the junction is shown in Figure 3.11.

Figure 3.11: Station Road / Lodge Road

Source: Mott MacDonald/ OpenStreetMap

3.8.1.1 2036 Base

The modelling results for the Station Road / Lodge Road junction in 2036 without DLP development are shown in Table 3.11. The corresponding arms are shown in Figure 3.11.

Table 3.11: Station Road / Lodge Road 2036 Without DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	0.1	8.39	0.08	A	0.2	18.14	0.14	C
B-A	0.6	14.83	0.38	B	3.3	**40.15**	**0.78**	**E**
C-AB	0.1	8.27	0.05	A	0.1	7.39	0.11	A

Source: Junctions 9 (2020)

This shows that in 2036 without DLP development, the model is forecasting that only Lodge Road in the PM is forecast to be causing significant delays. All other arms are predicted to be well within capacity. The right-turners from Station Road are forecast to have a poor LOS, and whilst the RFC is under 0.85 there is still forecast to be significant delay.

3.8.1.2 2036 Base + Site 8 & Site 9

The modelling results for the Station Road / Lodge Road junction in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.12. The corresponding arms are shown in Figure 3.11.

Table 3.12: Station Road / Lodge Road 2036 With DLP

	AM				PM			
Movement	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
B-C	0.1	8.88	0.08	A	0.3	19.31	0.21	C
B-A	0.8	17.82	0.43	C	3.4	**42.29**	**0.79**	**E**
C-AB	0.1	8.25	0.09	A	0.1	7.4	0.11	A

Source: Junctions 9 (2020)

This table shows that whilst the delays increase with the DLP developments, the increase is minor. Generally, the junction is forecast to perform at a similar level with the DLP compared to without the DLP.

3.8.1.3 Summary

The junction of Station Road / Lodge Road was identified for further assessment due to observed congestion, concerns raised in public consultation, high flows and due to its location near the village centre.

In both the with and without DLP scenarios, the only arm causing delays in Lodge Road, for vehicles turning right. The increase in DLP flow has a relatively small impact on the junction's performance. However, this will be assessed further as delays have been noted.

3.9 Station Road / Grove Road / Widney Road

The roundabout of Station Road / Grove Road / Widney Road (Junction 23 in Figure 2.1) has been identified in Section 3.2.6 as requiring further assessment. The roundabout has been assessed in Junctions 9 in 2036 without the DLP and then with DLP development. The layout of the roundabout is shown in Figure 3.12.

Figure 3.12: Station Road / Grove Road / Widney Road

Source: Mott MacDonald/ OpenStreetMap

3.9.1.1 2036 Base

The modelling results for the Station Road / Grove Road / Widney Road roundabout in 2036 without DLP development are shown in Table 3.13. The corresponding arms are shown in Figure 3.12.

Table 3.13: Station Road / Lodge Road 2036 Without DLP

	AM				PM			
Arm	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**	**Queue (Veh)**	**Delay (s)**	**RFC**	**LOS**
Arm 1	1.6	11.87	0.62	B	3.6	22.27	0.79	C
Arm 2	0.9	9.53	0.49	A	1.8	15.26	0.64	C
Arm 3	1.6	11.63	0.61	B	2.9	17.87	0.75	C
Arm 4	1.8	13.08	0.65	B	3	19.19	0.76	C

Source: Junctions 9 (2020)

This shows that in 2036 without DLP development, the model is forecasting the roundabout to be within capacity in both peaks. In the PM peak, both Station Road arms and the Widney Road

arm are predicted to have RFCs of 0.75 or higher, but they are not at an RFC of 0.85 where the junction is deemed to be over operation capacity.

3.9.1.2 2036 Base + Site 8 & Site 9

The modelling results for the Station Road / Grove Road / Widney Road roundabout in 2036 with DLP development (both Site 8 and Site 9) are shown in Table 3.14. The corresponding arms are shown in Figure 3.12.

Table 3.14: Station Road / Lodge Road 2036 With DLP

	AM				PM			
Arm	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Arm 1	1.7	12.43	0.63	B	4.1	25.34	0.81	D
Arm 2	1.2	10.91	0.56	B	2	16.5	0.67	C
Arm 3	1.7	12.86	0.64	B	3.1	19.31	0.76	C
Arm 4	1.9	13.76	0.66	B	3.7	23.23	0.80	C

Source: Junctions 9 (2020)

This table shows that whilst the RFC values increase with the DLP developments, the increase is minor. Generally, the junction is forecast to perform at a similar level with the DLP compared to without the DLP and be within capacity.

3.9.1.3 Summary

The junction of Station Road / Grove Road / Widney Road was identified for further assessment due to observed congestion, concerns raised in public consultation, high flows and due to there still being a significant number of DLP trips through the roundabout.

In both the with and without DLP scenarios, the roundabout is forecast to be within capacity. The delays are worse in the PM, and they increase slightly with DLP development, but the RFCs are still below 0.85. This junctions has been assessed further to look at connectivity between Knowle and Dorridge Station for active modes.

3.10 Summary

Junctions were selected for detailed modelling following a review of observed TrafficMaster delay, concerns raised in public consultation, delays in PRISM, survey data and DLP junction impact. The junctions selected, results from the detailed modelling and if further assessment is required is shown in Table 3.15.

Table 3.15: Junction Modelling Summary

Junction	Reason for Selection	2036 Without DLP Modelling Results	2036 With DLP Modelling Results	Assessment Required?
Hampton Road / Arden Vale Road	Public consultation and 5% DLP Junction Impact.	All arms within capacity	All arms within capacity	No
Warwick Road / Hampton Road / Lodge Road	Observed Congestion, public consultation, high flows and 5% DLP Junction Impact.	Over capacity on Lodge Road in AM	Lodge Road further over capacity and Hampton Road also over capacity in AM. Significant delays forecast.	Yes

Junction	Reason for Selection	2036 Without DLP Modelling Results	2036 With DLP Modelling Results	Assessment Required?
High Street / Kenilworth Road	Observed Congestion, public consultation, high flows and 5% DLP Junction Impact.	All arms within capacity	Delays on Kenilworth Road, but RFC still under 0.85	Yes
High Street / Wilsons Road / Warwick Road / Station Road	Observed Congestion, public consultation, high flows and 5% DLP Junction Impact.	Over capacity on Station Road in AM	Station Road further over capacity and Warwick Road also over capacity in AM. Warwick Road over capacity in the PM. Significant delays forecast.	Yes
Warwick Road / Grove Road / Norton Green Lane	Public consultation and 5% DLP Junction Impact.	All arms within capacity	All arms within capacity	No
Station Road / Lodge Road	Observed Congestion, public consultation, high flows and location	Delays on Lodge Road, but RFC still under 0.85	Delays on Lodge Road, but RFC still under 0.85. Minimal DLP impact.	Yes
Station Road / Grove Road / Widney Road	Observed Congestion, public consultation, high flows and significant number of DLP flows	All arms within capacity	All arms within capacity, though some getting close to 0.85 RFC. Minimal DLP impact.	Yes

Source: Mott MacDonald

4 Mitigation Proposals

4.1 Introduction

A proportionate approach to mitigation has been adopted, considering the village nature of Knowle and the high street alongside the potential for Public Realm improvements. Mitigation therefore focusses on the following approaches:

- Local junction improvements to relieve development impacts where possible, and to improve safety for all users
- Strategic improvements to upgrade Knowle High Street for public realm and active travel opportunities

Many of the scheme concepts have been designed in line with Manual for Streets 2 (MfS2) which is the companion guide to the Department for Transport's (DfT) Manual for Streets (MfS) and focuses on lightly trafficked and residential streets. Because of this, MfS2 was published with DfT's endorsement to show how the key principles of MfS can be applied to busier streets and non-trunk roads.

MfS2 states that these junction types can be advantageous in reducing traffic speeds and are particularly suitable where the speed limit is 30mph or less. The ability to include pedestrian crossings in close proximity to exits is also demonstrated, enabling them to be located on pedestrian desire lines.

MfS2 cites more informal examples, where a public realm focused schemes have been installed with proven public realm and safety benefits compared to the original priority junction. Evidence from supporting standards and Government-endorsed guidance in MfS2 together with case studies of similar examples across the country show that these designs can provide a safe alternative design solution.

4.2 Warwick Road / Hampton Road / Lodge Road

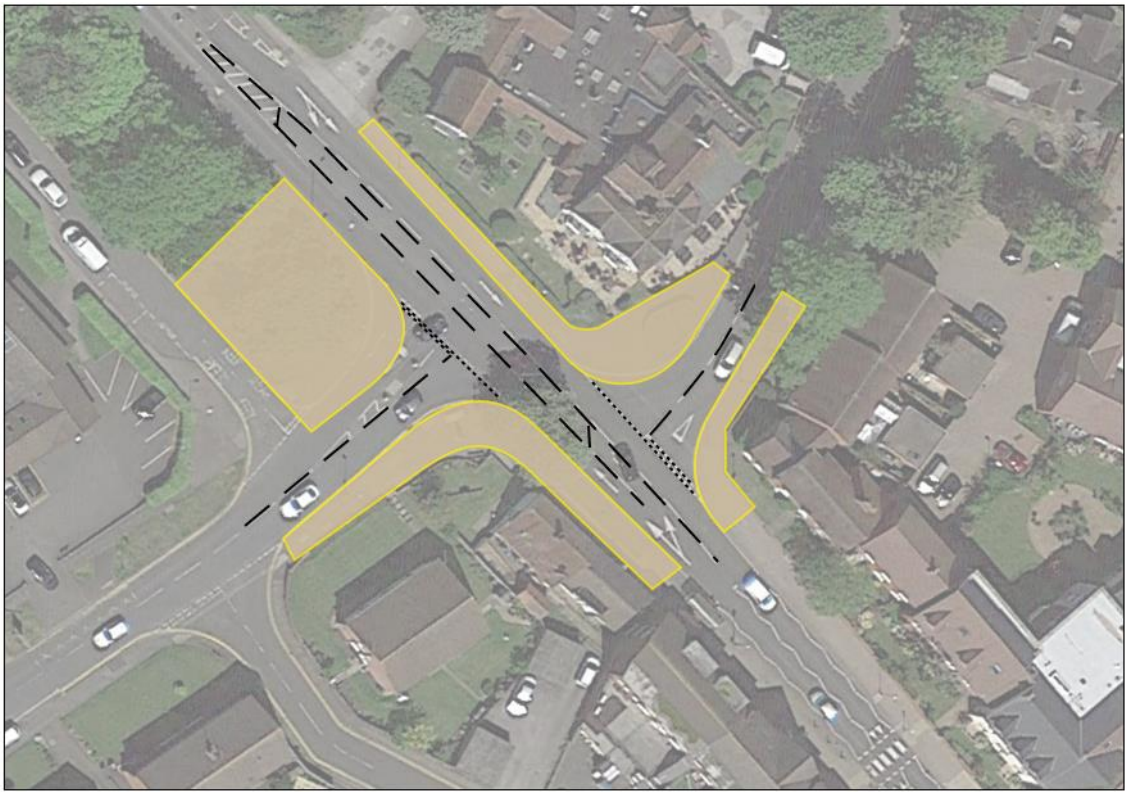
4.2.1 Option 1 – Placemaking Junction

This proposed scheme concept provides improved footways and encourages slower speeds by simplifying the junction and visually narrowing the carriageway and kerb realignment.

The rationale behind this junction concept is to provide a safer junction for pedestrians and to identify and strengthen the entry point to the High Street to achieve a clear transition between higher speed roads and the village itself where a reduction in traffic speeds is sought. In addition, this junction will be on the proposed Knowle – Solihull cycle route and should show exemplar cycling infrastructure as per the recent DfT "Gear Change" philosophy.

This proposal would reduce capacity of the junction however and is likely to result in some degree of additional queuing at peak times for vehicles on both Lodge Road and Hampton Road.

Figure 4.1: Warwick Road / Hampton Road / Lodge Road Option 1



Source: Mott MacDonald

4.2.2 Option 2 – Signalised Junction

This option looks at a signalised concept which aims to mitigate the DLP vehicular impacts and reduce queues on Lodge Road and Hampton Road. This option, whilst potentially improving the operation of junction for vehicles, could increase the perception of vehicle dominance in the area with no public realm benefits. However, pedestrian crossings could be put in place alongside red phases to improve safety.

Figure 4.2: Warwick Road / Hampton Road / Lodge Road Option 2 (Signalised)

Source: Mott MacDonald

4.2.3 Option 2 – Double mini roundabout

This option would introduce a double mini-roundabout option which aims to serve the dominant traffic movements and reduce queues on Lodge Road and Hampton Road. This option could potentially improve the operation of the junction and be designed with public realm principles delivering some additional non-traffic related benefits. The existing pedestrian crossing would remain in place on High Street and additional pedestrian and cycle crossings could be introduced as part of the scheme.

Figure 4.3: Warwick Road / Hampton Road / Lodge Road Option 3 Double mini roundabout

Source: Mott MacDonald

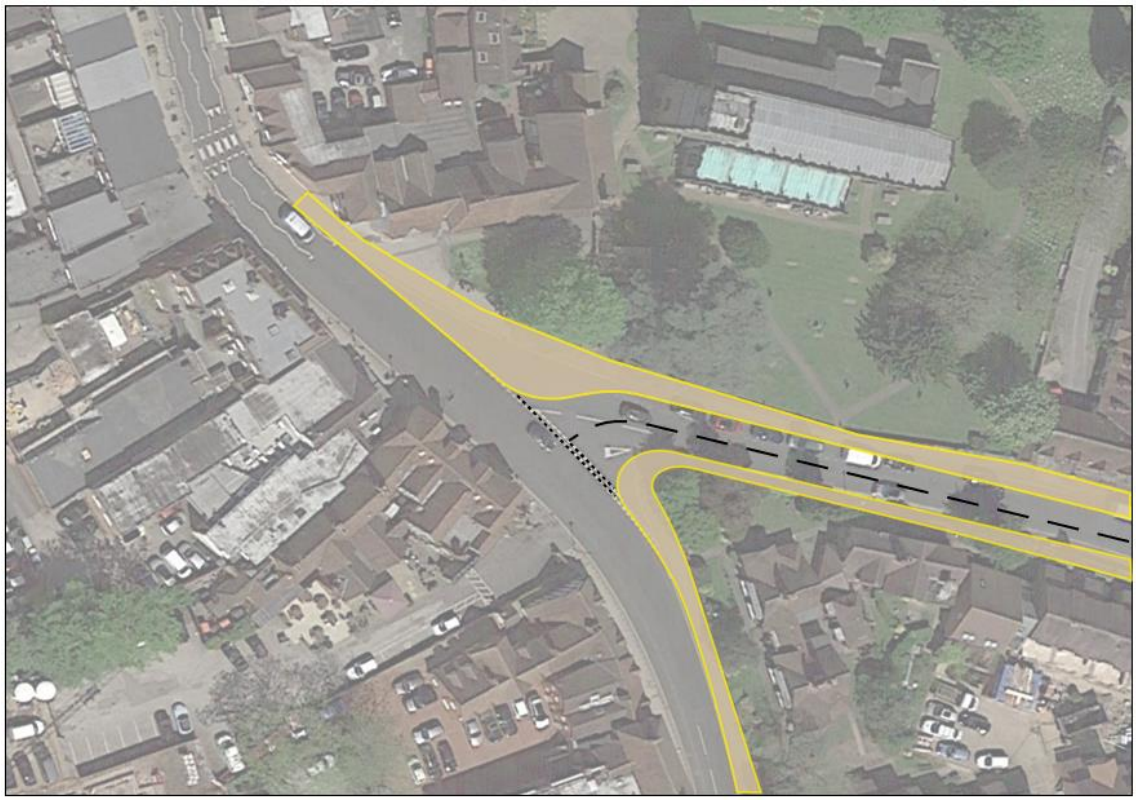
4.3 High Street / Kenilworth Road

This proposed scheme concept gives more road space over to a wider footway and reduces the radii of the junction itself.

The rationale behind this junction concept is to slow vehicle speeds along the High Street and Kenilworth Road and simplify the junction to provide a safer junction for pedestrians to cross.

The 12 parking spaces are also removed which has been observed as blocking vehicles turning from High Street to Kenilworth Road. Theses spaces could be re-provided in other car parks in Knowle.

Figure 4.4: High Street / Kenilworth Road



Source: Mott MacDonald

An alternative design is shown below in Figure 4.5 which keeps the junction principles described above but retains a small amount of parking for blue badge holders only.

Figure 4.5: High Street / Kenilworth Road Option 2 (with parking)

Source: Mott MacDonald

4.4 High Street / Wilsons Road / Warwick Road / Station Road

4.4.1 Option 1 – Placemaking Junction

This proposed scheme concept gives road space over to a public realm area using the constraint of the prominent tree (which would be retained) and creates a meeting area or 'place'. The junction itself would be a priority junction with reduced radii and considers a reduced width of carriageways and detailing of kerbs, verges and street furniture to improve the quality of the high street environment. This approach looks at ways to create a series of features and places throughout the village.

The existing bus loop and stop could be provided within a pedestrianised area if required for all options.

Figure 4.6: High Street/ Wilsons Road/ Warwick Road/ Station Road Option 1

Source: Mott MacDonald

4.4.2 Option 2 – Signalisation

This signalised scheme concept uses the principles placemaking principles described above but moves the Station Road approach south. By introducing signals, this can provide control over traffic flow and potentially improve the operation of the junction whilst balancing vehicle demand with other users.

Figure 4.7: High Street/ Wilsons Road/ Warwick Road/ Station Road Option 2 (signalised)

Source: Mott MacDonald

4.4.3 Option 3 – Signalisation with left filter

This signalised scheme concept is the same as the previous but provides an indicative right arrow and left turn filter to improve operation of the junction. This would increase the dominance of vehicles at the junction and reduce space for public realm.

Figure 4.8: High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)

Source: Mott MacDonald

4.5 Station Road / Lodge Road

Whilst DLP impacts at this junction are minimal there is still some delay experienced. There are limited interventions that could be introduced at this location. For example, a mini roundabout would not be feasible due to residential frontages and drives that require access.

There is merit in applying the same placemaking principles to this junction as it is close the village centre and interacts with the Station Road/ High Street Junction further downstream. This would create a uniform highway environment along this link. In addition, this proposed scheme concept provides improved footways and encourages slower speeds by simplifying the junction and visually narrowing the carriageway by removing the ghost right turn.

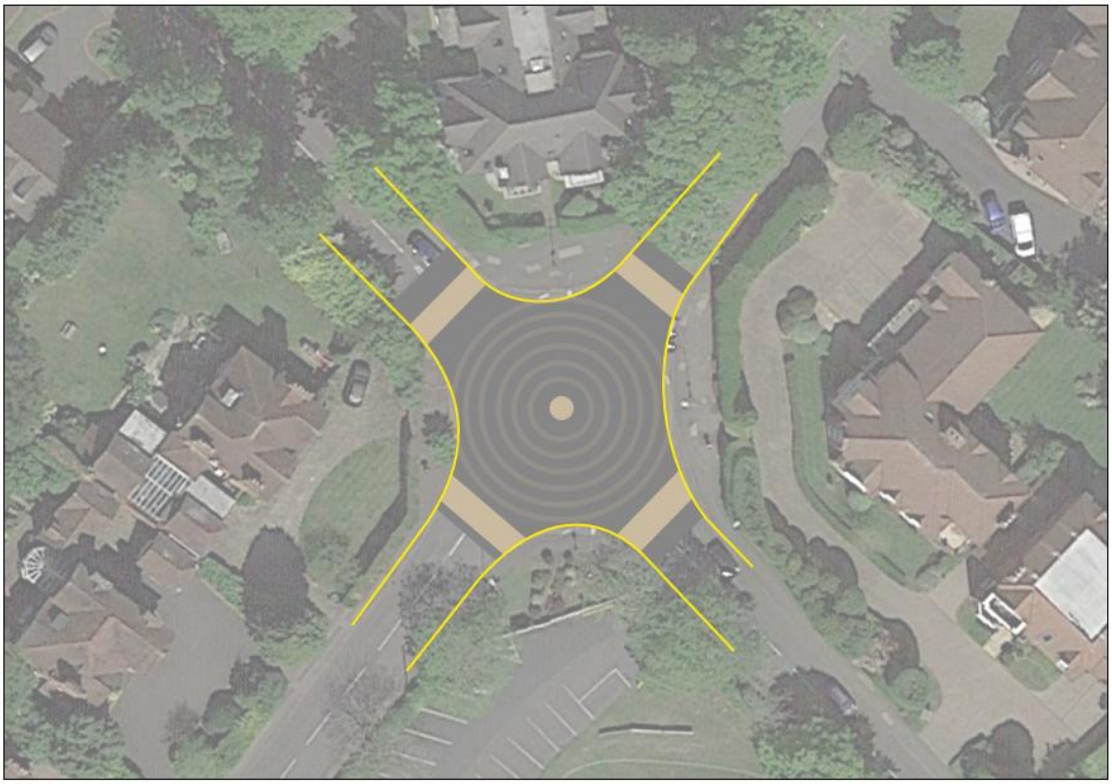
Figure 4.9: Station Road / Lodge Road

Source: Mott MacDonald

4.6 Station Road / Grove Road / Widney Road

A roundel concept scheme has been developed as an alternative solution the current mini-roundabout. This could potentially be a more appropriate design solution for the location, which will encourage better self-enforcement of lower speeds (20mph speed limit could be introduced) and provide wider public realm and environmental benefits, as well as improved facilities for cyclists and pedestrians.

Figure 4.10: Station Road / Lodge Road Roundel Concept



Source: Mott MacDonald

It would be advised that to progress this concept that roundel is against designed with relevant and applicable standards and guidance in mind, such as Chapter 5 of DMRB CD116 as well as MfS2. A Stage 1 Road Safety Audit should also be undertaken at preliminary design stage to understand any safety implication. This would provide evidence from supporting standards and Government-endorsed guidance in MfS2 together with case studies of similar examples across the country have been reviewed and included to evidence that the Roundel design would provide a safe alternative design solution.

4.7 Additional Junction Concepts in Knowle

4.7.1 Warwick Road / Arden Vale Road / Wychwood Avenue / Langfield Road

Whilst not identified as being over capacity as a result of DLP development, this junction has been raised by SMBC to be included within the study to consider possible improvements. The SMBC LCWIP study has identified the Warwick Road as a key corridor and would include this junction. As such, the following junction concept have been developed at as part of a wider package of junction improvements for all users.

This junction concept provides segregated cycle routes both northbound and southbound, providing an upgrade to the existing cycle facilities. The centre diameter would be reduced overall and is expected to provide similar highway capacity to the existing situation. This junction has not been assessed further in the individual junction modelling.

Figure 4.11: Warwick Road / Arden Vale Road / Wychwood Avenue / Langfield Road Roundabout

Source: Mott MacDonald

An alternative design could look at introducing a Dutch-style roundabout at this location and would complement the LCWIP proposals well. This concept gives priority to walking and cycling and should lead to safer journeys for all road users, including drivers. The segregated cycle track is used to keep cyclists away from circulating vehicular traffic. While this forms part of the system of segregated cycle tracks commonly used in the Netherlands, it is also used at roundabouts in urban environments where cyclists typically share roads with other traffic.

It draws upon the CROW (Netherlands) cycling infrastructure design guidance, and uses ‘continental geometry’ (short turning radii to reduce speeds and a single circulating vehicle lane) and also has a kerb-segregated cycle track at carriageway level, orbiting the roundabout, with priority for cyclists across the entry and exit lanes

Figure 4.12 below shows an example of a Dutch-style roundabout in Fendon Road, Cambridge.

Figure 4.12: Fendon Road Roundabout in Cambridge

Source: https://www.camcycle.org.uk/blog/2020/07/cambridge-celebrates-arrival-of-uks-first-dutch-style-roundabout/

4.8 Scheme cost estimates

At this stage it has only been possible to provide indicative scheme costs and can be found in Appendix C. This has been developed to provide a range of cost estimates depending on level of finish and type of materials used. A gold, silver and bronze standard costs range at £650, £450, £350 per square metre has been used to provide these broad estimates, which is based on Mott MacDonald benchmarking of similar projects across the UK. For the purposed of this assessment approximate scheme measurements have been taken from Google Earth.

4.9 One-Way Systems

Through stakeholder engagement with SMBC, the potential for a one-way system in Knowle village centre was raised. The aim of which is to reduce congestion. Three options have been proposed in this study, with a high-level assessment being undertaken in the spreadsheet model.

4.9.1 Potential Issues, Opportunities and Considerations

There are potential issues with one-way systems, such as:

- Streets suffering from rat-running
- The need for TROs
- Traffic will simply be diverted onto other less suitable streets
- The attraction of more traffic albeit in the remaining direction
- Residents and businesses having to access their street by an alternative and less convenient route which may involve the use of other neighbouring streets
- Traffic speeds increasing due to drivers' perception that there is no opposing traffic

- Without physical traffic calming there may be an increase in risk of accidents and their severity

Apart from potential traffic benefits, a one-way system could benefit pedestrians through wider pavements, and it could also improve the high street environment.

Some other considerations include:

- Some, particularly short sections of one-way street, are likely to be contravened by drivers thereby requiring police enforcement.
- If a one-way street is proposed, an exemption for pedal cyclists may be considered. Contra-flow bus and cycle lanes may also be considered, where appropriate.

4.9.2 Option 1

The first option considered for a one-way system is shown in Figure 4.13. This is in a clockwise direction, with Knowle High Street being southbound only and Lodge Road being northbound only. Additionally, Kenilworth Road between the High Street and Wilsons Road would become eastbound only and Wilsons Road would become westbound only.

For this option, the one-way system would continue on the High Street until Station Road, with Station Road being two-way.

Figure 4.13: One-Way System Option 1

Source: Mott MacDonald

4.9.3 Option 2

Option 2 of the one-way system is similar to Option 1, except the one-way system stops on the High Street southbound at Wilsons Road, with Wilsons Road being two-way. This is to allow west to east movements from Station Road to Kenilworth Road, which would have to go via Lodge Road and back down the High Street in Option 1.

4.9.4 Option 3

A third option was raised by SMBC, with just changing Kenilworth Road to one-way eastbound between the High Street and Wilsons Road. All other streets would remain as they currently are.

5 Mitigation Testing

5.1 Individual Junction Modelling

This section presents the results from the junction modelling for each mitigation concept. Junction capacity assessments, using Junctions 9 software for roundabouts and priority junctions and LinSig for signals, have been undertaken for 2036 DLP scenario for the AM and PM peak periods.

It should be noted that it was not possible to validate each junction model against observed queues as it is not been possible to undertake new queue surveys due to current traffic conditions being unrepresentative due to Covid-19. Therefore, the modelling results should be seen as indicative and could be refined with more up to date data.

5.2 Warwick Road/ Hampton Rd/ Lodge Rd

5.2.1 Option 1 – Placemaking Junction

Table 5.1 shows the results for the proposed placemaking option which provides a simpler junction type with tighter radii and wider footways. Figure 4.1 shows the proposed layout for the junction.

Table 5.1: Warwick Road/Hampton Road/Lodge Road - Option 1 results

	AM				PM			
Movement	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
Stream B-C	**48.5**	**647.29**	**1.39**	**F**	15.8	**150.28**	**1.04**	**F**
Stream B-AD	**35.5**	**654.59**	**1.38**	**F**	6.9	**218.83**	**0.99**	**F**
Stream A-BCD	1.3	17.62	0.56	C	0.3	9.81	0.22	A
Stream D-A	8.9	**131.69**	**1.01**	**F**	1.5	22.5	0.61	**C**
Stream D-BC	5.1	**194.56**	**0.96**	**F**	0.8	**36.22**	0.46	**E**
Stream C-ABD	0.7	10.54	0.40	B	0.5	9.8	0.35	A

Source: Junctions 9 (2020)

The option is forecast to be over capacity in 2036 with the DLP development flows, with significant queues and delay demonstrated due to the reduction in highway capacity. In order for this junction type to be taken forward, this would need to be balanced against the anticipated safety improvements and public realm opportunities to create a higher quality environment and entrance to the High Street. It is advised to test for re-assignment effects in a strategic model to determine if any re-routing would occur with this junction in place. This could potentially show improved results to the network overall whilst providing the added benefits to the High Street.

5.2.2 Mitigation Option 2 – Signalisation

Table 5.2 shows the results for the proposed signalised option which aims to mitigate the DLP vehicular impacts and reduce queues on Lodge Road and Hampton Road. Figure 4.2 shows the proposed layout for the junction.

Table 5.2: Warwick Road/Hampton Road/Lodge Road - Option 2 results

	AM			PM		
	DOS (%)	Queue (PCU)	PRC	DOS (%)	Queue (PCU)	PRC
Hampton Rd	**155.3%**	**69.4**		**173.9%**	**80.5**	
Warwick Road East	**99.3%**	31.3		**97.3%**	23.5	
Lodge Road	**136.7%**	**90.5**	-72.6%	**165.7%**	**113.7**	-93.2%
Warwick Road West (left & ahead turns)	**98.1%**	29.2		**101.0%**	29.9	
Warwick Road West (right turn)	**106.4%**	17.8		77.5%	6.1	
Ped link	0.0%			0.0%		

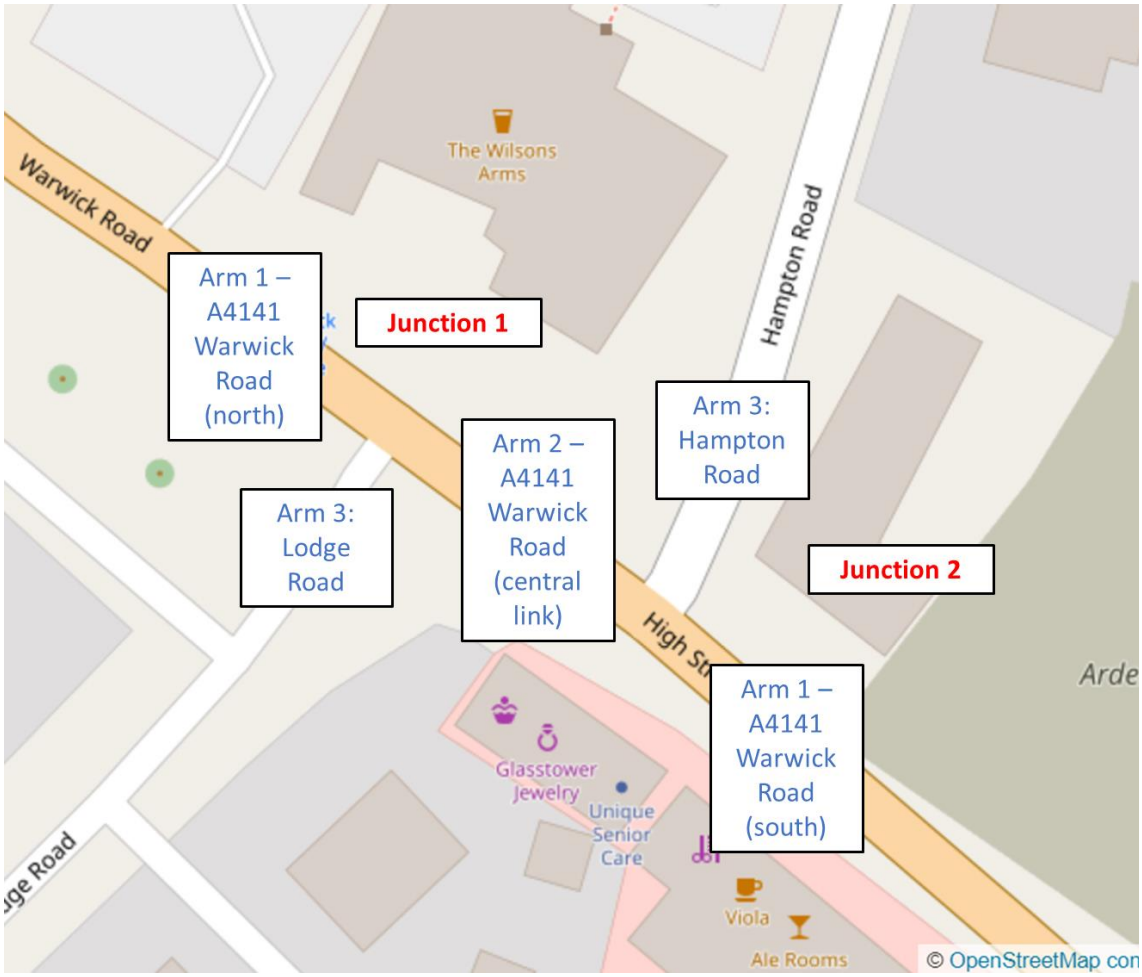
Source: LinSig (2020)

The option is forecast to be over capacity in 2036 with the DLP development flows, with significant queues and delay demonstrated. When compared to the 2036 with DLP results for the existing junction layout, the introduction of signals does not improve the junction performance. This is likely due to the inter-green time involved with the signal timings, when no lights are green to allow vehicles to clear, which has taken away capacity from the junction.

5.2.3 Mitigation Option 3 – Double mini roundabout

Table 5.5 shows the results for the proposed double mini roundabout option, as shown in Figure 4.3. The labelling of the arms in the junction model are shown in Figure 5.1.

Figure 5.1: Warwick Road/Hampton Road/Lodge Road – Option 3 Model Layout



Source: Mott MacDonald/ OpenStreetMap

Table 5.3: Warwick Road/Hampton Road/Lodge Road - Option 3 results

	AM				PM			
Movement	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**	**Queue (PCU)**	**Delay (s)**	**RFC**	**LOS**
J1: Arm 1	7.5	31.11	**0.89**	D	3.4	14.59	0.78	B
J1: Arm 2	2.0	12.70	0.67	B	2.2	13.49	0.70	B
J1: Arm 3	16.2	**110.14**	**1.00**	**F**	8.7	**69.03**	**0.93**	**F**
J2: Arm 1	4.6	24.47	0.83	C	2.8	16.08	0.74	C
J2: Arm 2	32.2	**120.75**	**1.04**	**F**	4.0	19.22	0.81	C
J2: Arm 3	3.3	**37.98**	0.78	**E**	2.6	28.97	0.73	D

Source: Junctions 9 (2020)

This shows that the double mini-roundabout option is forecast to be just over capacity on some arms in 2036 with DLP development. In the AM peak there are benefits on Hampton Road compared to the existing layout, with some slight decreases in delay on Lodge Road. However, this option does cause delay on Warwick Road eastbound in the AM peak. The delay on

Warwick Road eastbound between the two roundabouts is long enough to cause blocking back at the previous roundabout.

Despite this, the double mini-roundabout is the best performing of the proposed mitigation options and would benefit from further design work and microsimulation modelling to provide a more detailed assessment. It is worth noting that the local junction models presented above are a worst-case scenario with no assessment of re-routing of future year traffic. There is potential for a proportion of traffic choosing an alternative route to Lodge Road. If designed with placemaking principles in mind this option would also provide the wider placemaking benefits to non-motorised users at the entrance to the High Street.

5.2.4 Summary

The mitigation option with the best junction performance is the double mini-roundabout. However, it is recommended that this is investigated further in a microsimulation model. If no alternative options can be considered, it is recommended that the junction remains as a two priority junctions given that the likely impact of the unmitigated DLP development on the junction is not demonstrated as severe.

5.3 High Street/ Kenilworth Road

Table 5.4 shows the results for High Street/ Kenilworth Road. The proposed mitigation for the junction provides a simpler junction type, with tighter radii and improved footways. Parking on Kenilworth Road is also removed.

Figure 4.4 above shows the proposal for the junction. As the arm layout of the junction has not changed within the model, please refer to Figure 3.8.

Table 5.4: High Street/Kenilworth Road Results

	AM				PM			
Movement	Queue (PCU)	Delay (s)	RFC	LOS	Queue (PCU)	Delay (s)	RFC	LOS
B-AC	2.9	41.75	0.75	E	2.4	35.58	0.71	**E**
C-AB	0.2	4.97	0.09	A	0.1	4.9	0.06	A

Source: Junctions 9 (2020)

5.3.1 Summary

The mitigation is forecast to be within capacity in 2036 with the DLP development flows and operates similarly to the 2036 DLP existing junction scenario. The Kenilworth Road arm is still experiencing delay, with a Level of Service (LOS) of E, however with parking removed this is unlikely to result in blocking back onto the High Street for vehicles turning into Kenilworth Road. In addition, the junction is likely to be safer for all users with wider footways and higher quality environment.

5.4 High Street / Wilsons Road / Warwick Road / Station Road

A number of different proposals have been tested for the High Street / Wilsons Road / Warwick Road / Station Road junction.

5.4.1 Option 1 – Placemaking Junction

The proposal is a simple staggered junction, with reduced radii and provides the potential for improved public realm, creating a sense of space. Figure 4.6 displays this mitigation concept

and Figure 5.2 displays the junction layout for the mitigation test. The model results are displayed in Table 5.5 below.

Figure 5.2: High Street / Wilsons Road / Warwick Road / Station Road

Source: Mott MacDonald/ OpenStreetMap

Table 5.5: High Street / Wilsons Road / Warwick Road / Station Road – Option 1 results

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
B-ACD	1	14.96	0.51	B	120.7	2527.27	2.63	F
AB-CD	7.6	36	0.87	E	21.2	86.71	0.97	F
D-ABC	77.6	538.87	1.33	F	146.6	1708.39	2.04	F
CD-AB	4.1	14.29	0.71	B	1.1	7.88	0.39	A

Source: Junctions 9 (2020)

The results show that there is forecast to be increased delay on all arms, with a significant impact compared to the existing situation, both with and without DLP development. The increased flow on Warwick Road and High Street, especially with DLP development, result in the side roads of Station Road and Wilsons Road having very high delays. Additionally, it results in the right-turn from High Street to Station Road also being over capacity. This is significantly worse than the existing forecast and demonstrates that despite wider placemaking improvements the impact on highway capacity would not be acceptable.

It is worth noting that the results in the tables above are showing RFCs of 1.00 or greater. The instability of the model when flows are over absolute capacity on a link is a limitation of the model software, where queue lengths are subject to exponential growth. For this reason, the results below should be seen as indicative rather than representative. This still highlights that the change in flows result in the junction being far over capacity, resulting in significant delays.

5.4.2 Option 2 – Signalisation

A signalised option has been developed and is displayed in Figure 4.7. Table 5.6 below shows the results of the first signalised option.

Table 5.6: High Street / Wilsons Road / Warwick Road / Station Road - Signalised Option 1

	AM			PM		
	DOS (%)	Queue (PCU)	PRC	DOS (%)	Queue (PCU)	PRC
Junction 1						
A4141 at Station Road southbound	**113.6%**	**62.8**		**114.4%**	**87.6**	
Station Road	**110.8%**	45.8	-26.2%	**113.3%**	43.8	-27.1%
A4141 at Station Road northbound	44.4%	6.9		28.9%	3.8	
Junction 2						
A4141 at Wilsons Road southbound	25.5%	0.2		36.7%	0.3	
Wilsons Road	38.7%	0.3	-26.2%	55.2%	0.6	-27.2%
A4141 at Wilsons Road northbound	68.4%	17.4		47.3%	7.4	

Source: LinSig (2020)

The results show that the junction is over capacity with significant queues forecast on Station Road and on the A4141 at Station Road. As a result, a second signalised option has been tested with a dedicated left turn filter and indicative right turn. The results are presented below.

5.4.3 Option 3 – Signalisation with left filter

Table 5.7: High Street / Wilsons Road / Warwick Road / Station Road Signalised Option 3

	AM			PM		
	DOS (%)	Queue (PCU)	PRC	DOS (%)	Queue (PCU)	PRC
Junction 1						
A4141 at Station Road southbound	61.4%	11.1		74.4%	16.0	
Station Road	65.2%	10.5	38.0%	75.5%	9.4	19.2%
A4141 at Station Road northbound	61.4%	10.0		36.4%	5.3	
Junction 2						
A4141 at Wilsons Road southbound	25.5%	0.2		36.7%	0.3	
Wilsons Road	38.8%	0.3	38.0%	55.4%	0.6	19.2%
A4141 at Wilsons Road northbound	72.2%	12.3		50.5%	8.0	

Source: LinSig (2020)

The operation of this junction is improved and is within capacity in both the AM and PM peaks. Queues are reduced and DoS is forecast to be within capacity with DLP development in place.

This option also provides some public realm benefits and improvement to footways, whilst dealing with the residual traffic impacts of the DLP scenario.

5.4.4 Summary

The results show that Option 3 is the best performing option. This is a signalised junction which balances highway capacity with public realm improvements.

5.5 Station Road / Lodge Road

This proposed junction has had the same placemaking principles applied as the other mitigation junctions, with a uniform highway environment designed throughout the link. Improvements to footways are proposed as well as a reduced junction radii to encourage slower speeds and improve safety. Figure 4.9 shows the concept design. As the arm layout of the junction has not changed, please refer to Figure 3.11. Table 5.8 shows the results of the junctions modelling.

Table 5.8: Station Road/ Lodge Road Roundabout

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
B-C	0.1	8.62	0.08	A	0.3	19.4	0.21	C
B-A	0.7	15.91	0.41	C	3.4	**42.46**	0.79	**E**
C-AB	0.3	5.25	0.13	A	0.5	4.52	0.19	A

Source: Junctions 9 (2020)

The results demonstrate that compared to the existing layout, there is no change in junction performance. As was shown in Section 3.8.1.2, the increase in DLP flow has a relatively small impact on the junction's performance.

5.5.1 Summary

This junction option performs well and could form part of wider improvements along Station Road to the High Street junction. This would improve pedestrian experience with no impact on highway capacity.

5.6 Station Road/ Grove Road / Widney Road Roundabout

A roundel design has been proposed at the Station Road roundabout. It is noted that the existing layout is forecast to perform at a similar level with the DLP compared to without the DLP and be within capacity. However, public perception is that this junction does suffer from delay and capacity issues, and on-site observations by Mott MacDonald has shown the layout of the existing mini roundabout to be constrained. The junction also provides poor crossing points for pedestrians with some key trip generators nearby, such as schools, medical centre and sports facilities. Dorridge station is also approximately 1km south of the junction.

As Junctions 9 (ARCADY module) is not ideally suited to testing this type of junction, a number of sensitivity tests have been analysed below. Each model has been setup with similar geometry, with both standard and mini-roundabout options being tested, both with and without the proposed pedestrian crossings. It is advised that to further understand the operation of roundel designs, this is tested in a microsimulation model with and without priority rules.

Each mitigation proposal follows a similar geometry and the concept design is shown above in Figure 4.10. As the arm layout of the junction has not changed, please refer to Figure 3.12.

5.6.1 Standard Roundabout with Zebra Crossing on each arm

Table 5.9 shows the modelling results for a standard compact roundabout. The concept design would lack a raised central island and is commonplace for a compact roundabout, although it is acknowledged that the size of the junction and its associated entry flares are more akin to a mini roundabout. This shows that there is an impact from the additional pedestrian crossings with RFC increasing to marginally above 0.85 in the PM peak. This has assumed a worst-case pedestrian demand in the absence of any pedestrian counts.

Table 5.9: Station Rood Roundabout: Standard Roundabout Zebra Crossing on Each Arm

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Arm 1	1.8	13.4	0.65	B	4.6	28.53	**0.83**	D
Arm 2	1.3	11.13	0.56	B	2	16.54	0.67	C
Arm 3	2.4	17.69	0.71	C	5.6	35.84	**0.87**	**E**
Arm 4	2.4	17.35	0.72	C	5.5	34.66	**0.86**	D

Source: Junctions 9 (2020)

5.6.2 Mini Roundabout

The results in Table 5.10 show that the mini roundabout scenario reduces overall capacity and is above acceptable thresholds, particularly for the PM peak. This does not account for driver behaviour or improved gap acceptance which the proposed junction would offer and is likely to show an absolute worst-case scenario.

Table 5.10: Station Road Roundabout: Mini Roundabout No Zebra Crossings

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Arm 1	2	14.74	0.67	B	5	31.48	0.85	D
Arm 2	1.7	15.5	0.64	C	3.9	33.55	0.81	D
Arm 3	3.3	24.96	0.78	C	9.1	**58.39**	**0.93**	**F**
Arm 4	7.8	**58.5**	**0.92**	**F**	**38.8**	**216.91**	**1.12**	**F**

Source: Junctions 9 (2020)

5.6.3 Mini Roundabout with Zebra Crossing on Each Arm

The results in Table 5.11 show that there is a slight worsening with zebra crossings in place compared to the results in Section 5.6.2.

Table 5.11: Station Road Roundabout: Mini Roundabout and Zebra Crossings

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
Arm 1	2.1	15.75	0.68	C	5.2	32.7	**0.85**	D
Arm 2	1.8	15.69	0.64	C	3.8	32.55	0.81	D
Arm 3	5.4	**41.93**	**0.86**	**E**	**24.4**	**140.41**	**1.05**	**F**
Arm 4	13	**93.09**	**0.98**	**F**	**48.4**	**314.98**	**1.16**	**F**

Source: Junctions 9 (2020)

5.6.4 Summary

The baseline and future year assessments (with and without development) demonstrate that the overall impact from DLP sites is small, and the junction will operate within recommended thresholds in the base and DLP scenario

It is acknowledged that the opportunity to make improvements at this junction are very limited. The extent of mitigation is limited by the land availability close to the junction, however the proposed amendments to the junction are achievable and provide some improvement to offset the impact of development for non-car modes.

The mitigated scheme is accepted as offering an improvement to the junction in terms of safety and improved pedestrian crossings, as well as the benefits to reduced vehicle speeds.

The modelling results and sensitivity tests presented above reflect a slight worsening in performance of the junction, with the mini roundabout tests representing an absolute worst-case scenario.

MM recommend that further testing is undertaken using microsimulation modelling to further understand the impact of a roundel design. Overall, this type of junction is deemed to be appropriate and the mitigation suggested is reasonable given the constraints.

5.7 One-Way System

5.7.1 Methodology

For this study, a high-level assessment has been undertaken on the one-way systems as described in Section 4.8 to give an indication on the impacts. The Knowle Spreadsheet Model has been utilised to redistribute the traffic and the % impact on each of the junctions has been calculated.

There are a number of considerations for this methodology:

- It does not account for rerouting away from the one-way system at an earlier point in the network (however, there are a limited number of alternative routes)
- The flows between junctions have not been balanced, so the worst-case flow has been used to determine the number of vehicles rerouted
- Full origins and destinations are not known through the one-way system, therefore assumptions have been made using other turning counts on the destination of trips that have been rerouted
- Local junction models have been undertaken in order determine if the increased flow would cause delays for Option 3 only. This has not been undertaken for Options 1 and 2 as the disbenefits shown within spreadsheet modelling results were too great and deemed unacceptable and thus discounted on that basis.

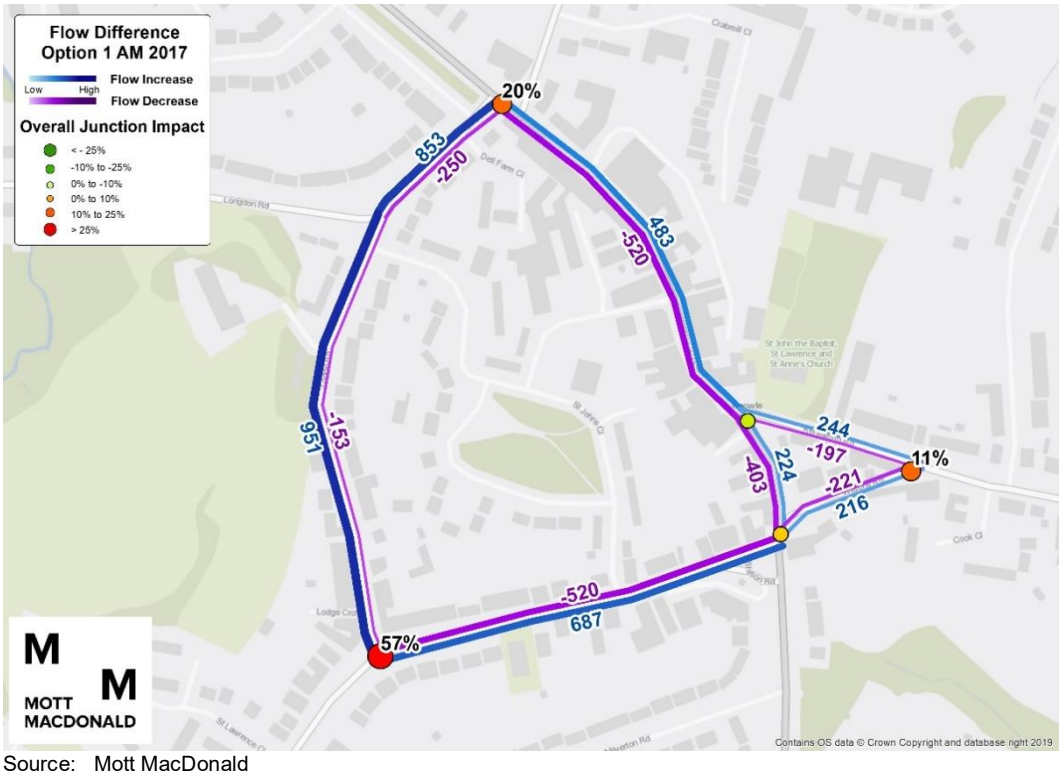
Despite the limitations, this methodology gives an indication of the impacts of the one-way system options.

The options have been tested in 2017 and 2036 baseline scenarios, without DLP development.

5.7.2 Option 1

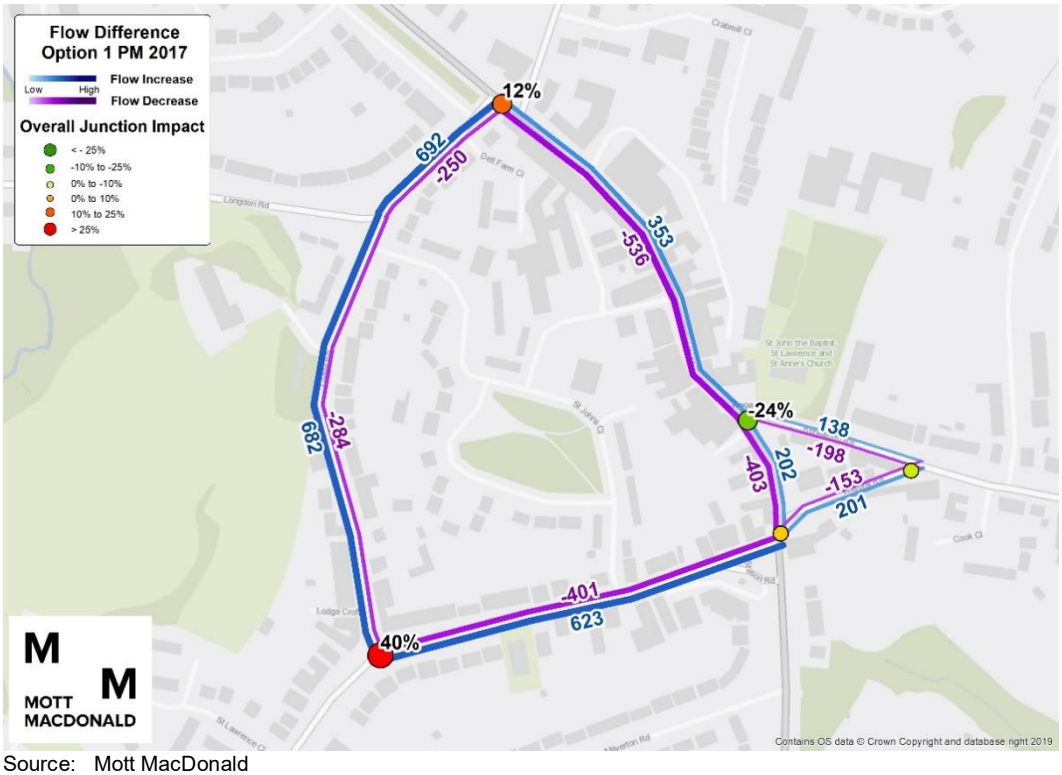
Figure 5.3 and Figure 5.4 show the difference in vehicle flow and the resulting junction impact caused by the one-way system (Option 1) in 2017 for the AM and PM respectively. Figure 5.5 and Figure 5.6 then show the equivalent results for 2036.

Figure 5.3: Option 1 Flow Difference and Junction Impact 2017 AM



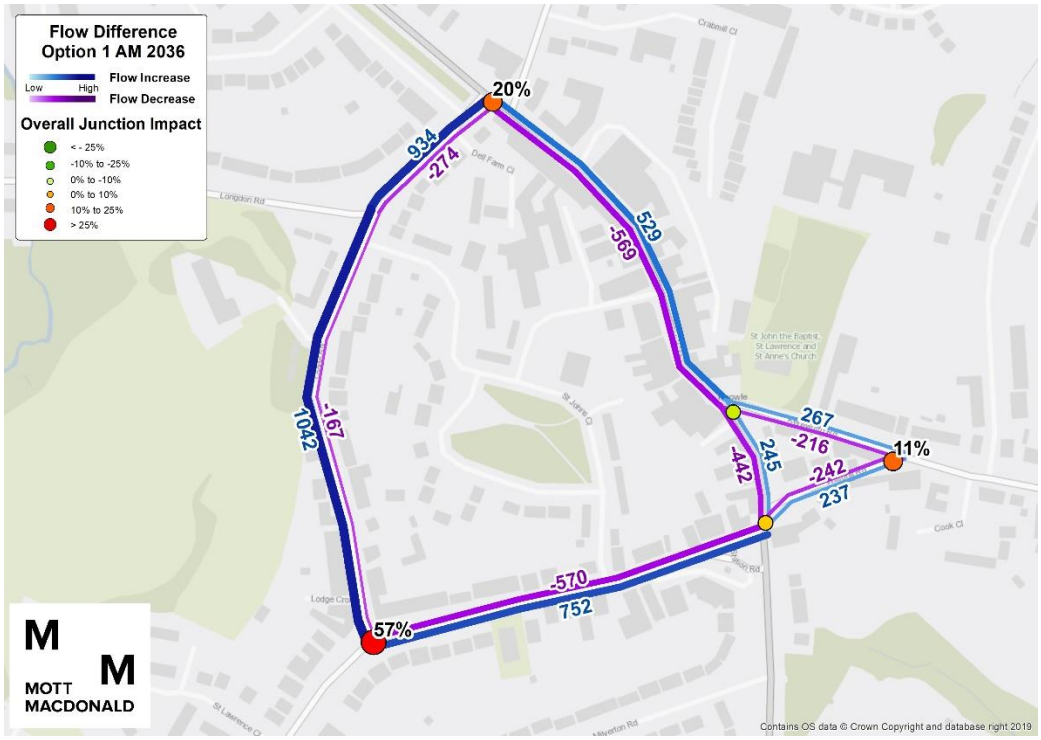
Source: Mott MacDonald

Figure 5.4: Option 1 Flow Difference and Junction Impact 2017 PM



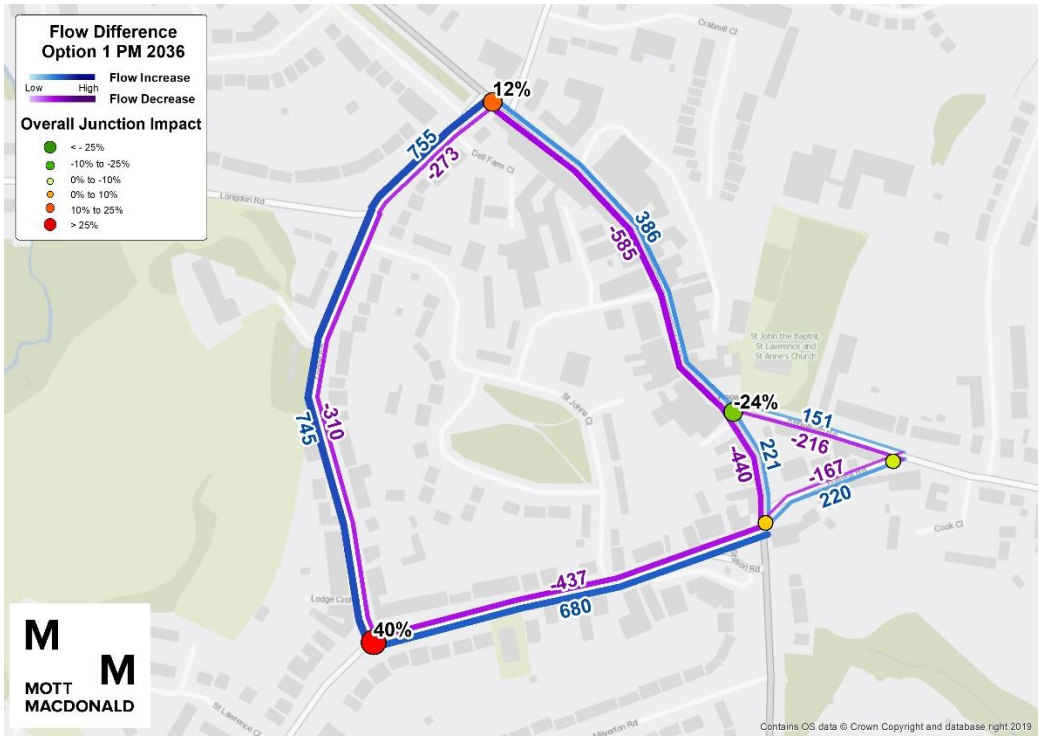
Source: Mott MacDonald

Figure 5.5: Option 1 Flow Difference and Junction Impact 2036 AM



Source: Mott MacDonald

Figure 5.6: Option 1 Flow Difference and Junction Impact 2036 PM



Source: Mott MacDonald

These figures show that the one-way system would have a significant impact on the Station Road / Lodge Road junction. There would be a large increase in right turns from Station Road to Lodge Road, which would likely cause delay.

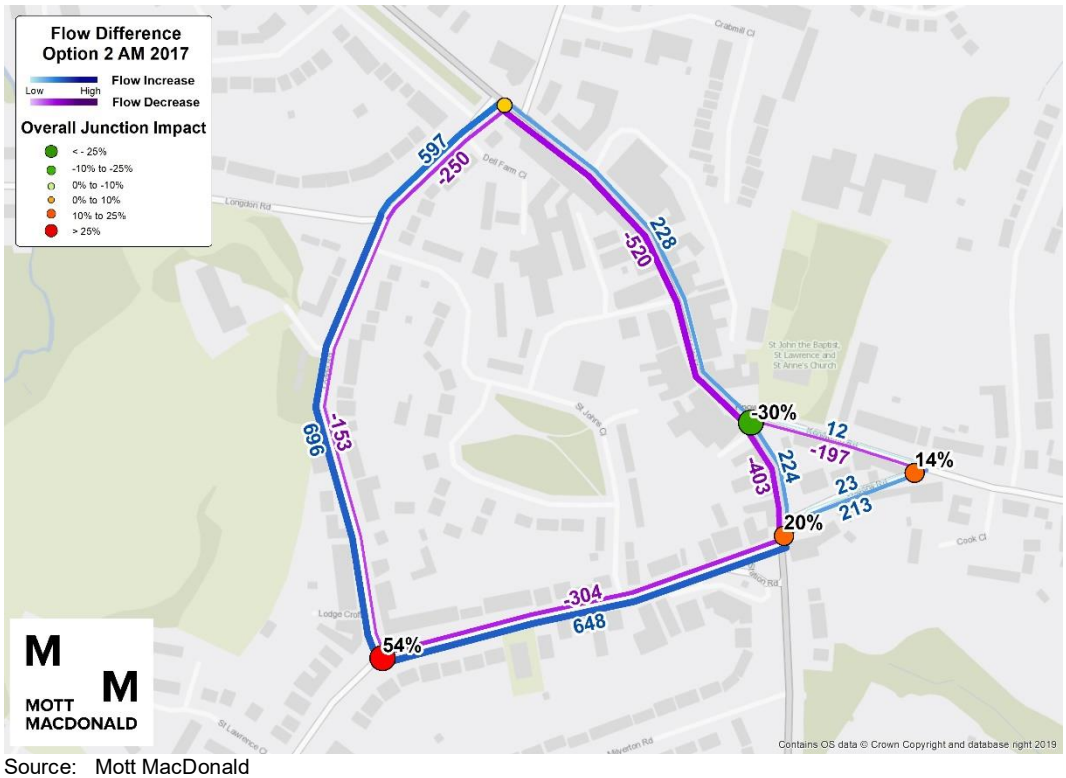
In the AM of 2017, the one-way system would likely result in an additional 900 vehicles on Lodge Road northbound, with only a corresponding decrease of 200 southbound. In both the AM and PM peaks in 2017 and 2036, there would be a net decrease on the High Street, with the increase southbound being less than the decrease northbound.

With the eastbound movement from Station Road to Kenilworth Road being banned in this option, there is an increase of right-turners from Lodge Road to the High Street, heading to Kenilworth Road. This is causing an increase in flow at the junction, and with it being a right turn it is likely to cause delay.

5.7.3 Option 2

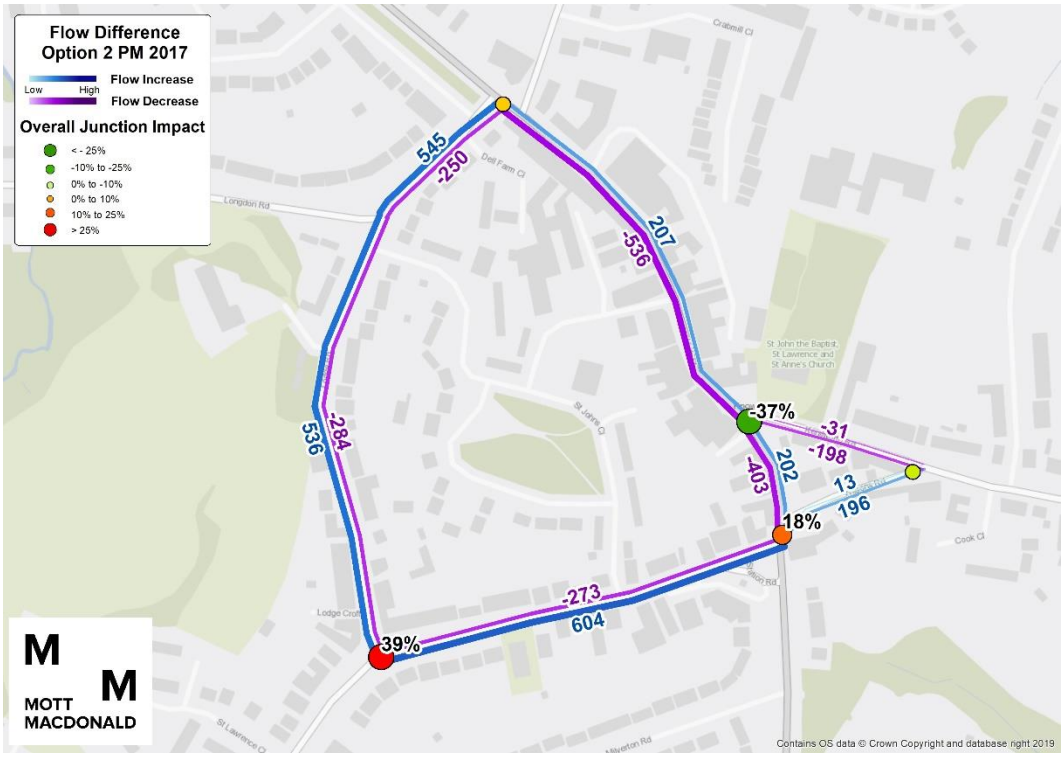
Figure 5.7 and Figure 5.8 show the difference in vehicle flow and the resulting junction impact caused by the one-way system (Option 2) in 2017 for the AM and PM respectively. Figure 5.9 and Figure 5.10 then show the equivalent results for 2036.

Figure 5.7: Option 2 Flow Difference and Junction Impact 2017 AM



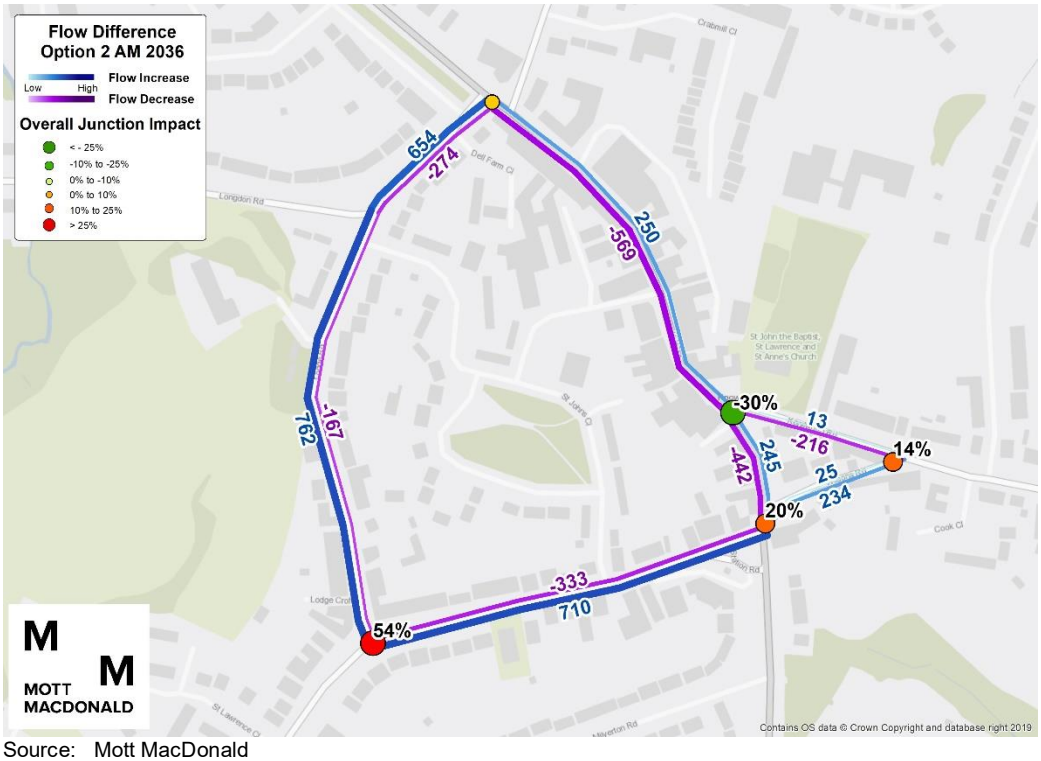
Source: Mott MacDonald

Figure 5.8: Option 2 Flow Difference and Junction Impact 2017 PM



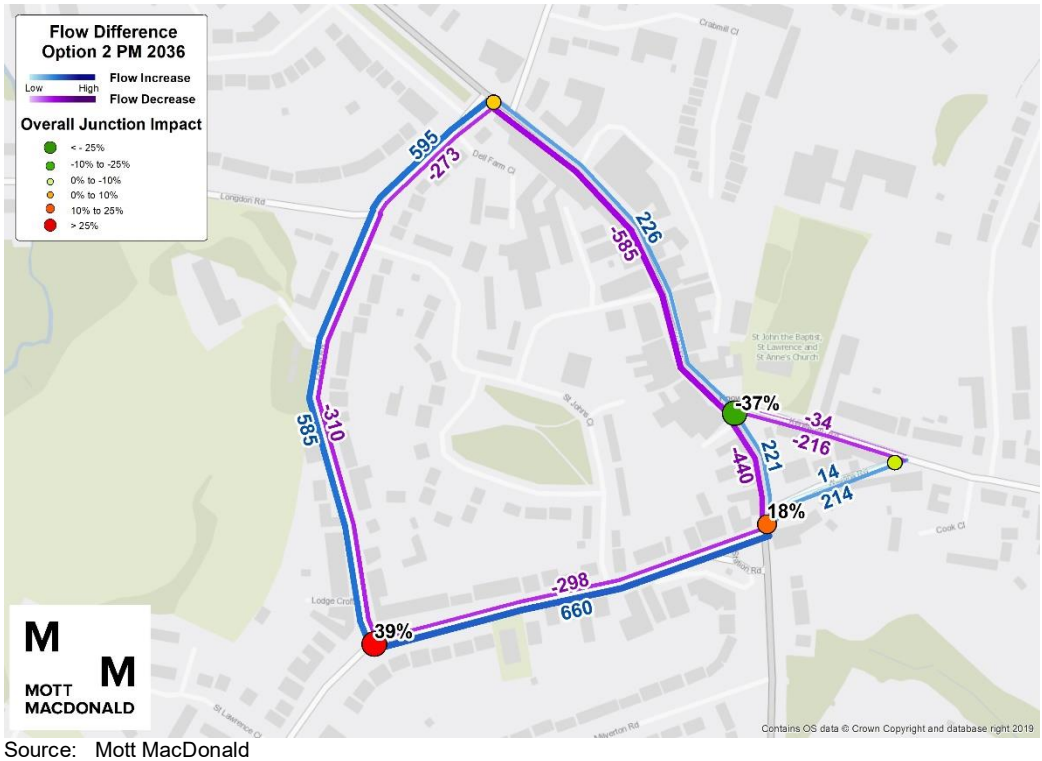
Source: Mott MacDonald

Figure 5.9: Option 2 Flow Difference and Junction Impact 2036 AM



Source: Mott MacDonald

Figure 5.10: Option 2 Flow Difference and Junction Impact 2036 PM



Source: Mott MacDonald

These show that Option 2 is likely to cause less of a change in flow compared to Option 1. This is due to the movement from Station Road to Kenilworth Road being allowed, reducing the trips diverting all the way around the one-way system.

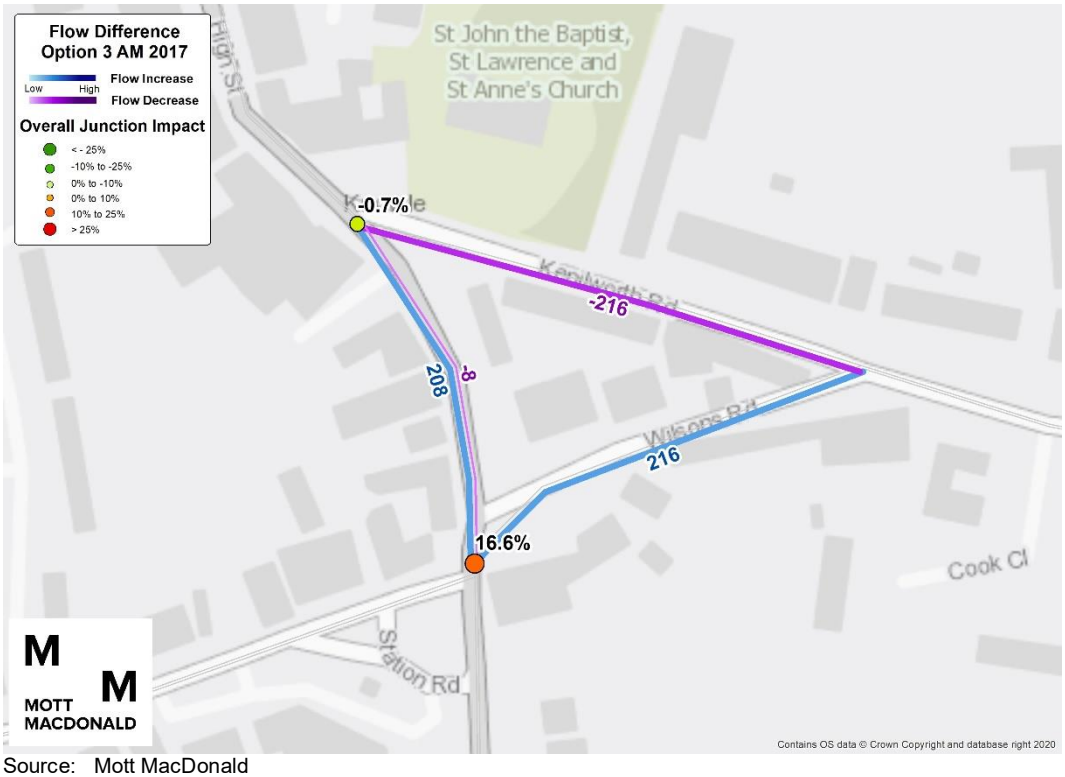
There is still a significant impact on the Station Road / Lodge Road junction, with the main impact being right turners to Lodge Road, which is likely to cause delays.

Whilst the impacts are smaller in this option, the only junction that sees a significant decrease in flow is Hight Street with Kenilworth Road. As was seen in Section 3.5, this junction is forecast to be within capacity in 2036 without DLP development. The delay caused in the with DLP scenario is for right turners from Kenilworth Road, which in this one-way system are diverted to Wilsons Road, which sees a large flow increase.

5.7.4 Option 3

Figure 5.11 and Figure 5.12 show the difference in vehicle flow and the resulting junction impact caused by Option 3 of the one-way system in 2017 for the AM and PM respectively. Figure 5.13 and Figure 5.14 then show the equivalent results for 2036.

Figure 5.11: Option 3 Flow Difference and Junction Impact 2017 AM



Source: Mott MacDonald

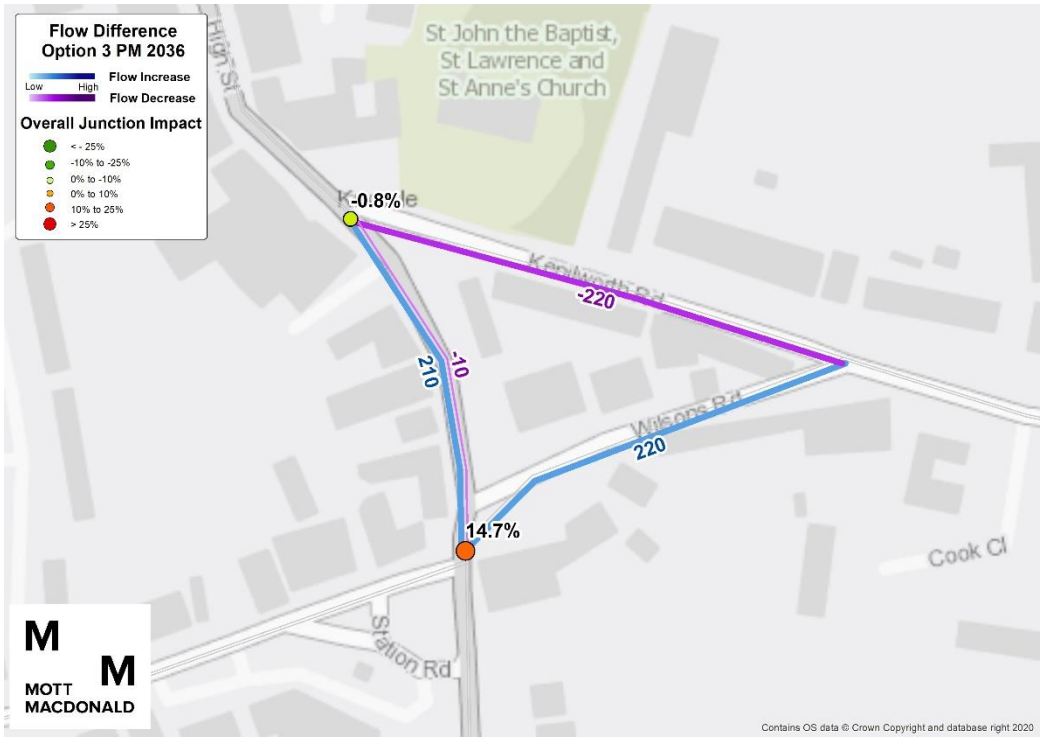
Figure 5.12: Option 3 Flow Difference and Junction Impact 2017 PM

Source: Mott MacDonald

Figure 5.13: Option 3 Flow Difference and Junction Impact 2036 AM

Source: Mott MacDonald

Figure 5.14: Option 3 Flow Difference and Junction Impact 2036 PM



Source: Mott MacDonald

These show that Option 3 results in a significant increase in flow on Wilsons Road, with the junction with the A4141 having a large flow impact as a result. This junction (High Street / Wilsons Road / Warwick Road / Station Road) has been modelled to determine the impact of the one-way system.

Two options have been assessed at the junction, one with the current junction layout and one with the signalised mitigation layout. These have been assessed in Junctions 9 and LinSig respectively. The models used in Section 3 and Section 5.1 have been utilised for this assessment, with the 2036 without DLP scenario being selected.

5.7.4.1 Existing Layout at High Street / Wilsons Road / Warwick Road / Station Road

The modelling results for Option 3 of the one-way system at the High Street / Wilsons Road / Warwick Road / Station Road junction, with no change to the junction layout, are shown in Table 5.12. The base 2036 results (without Option 3) can be seen in Table 3.7.

Table 5.12: High Street / Wilsons Road / Warwick Road / Station Road 2036 with Option 3

	AM				PM			
Movement	Queue (Veh)	Delay (s)	RFC	LOS	Queue (Veh)	Delay (s)	RFC	LOS
J1: B-CD	**31.9**	**512.55**	**1.30**	**F**	**41.0**	**575.45**	**1.33**	**F**
J1: B-A	**34.6**	**510.20**	**1.30**	**F**	**35.4**	**575.39**	**1.32**	**F**
J1: AB-CD	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J1: D-AB	5.0	**39.25**	**0.85**	**E**	1.7	17.73	0.64	C
J1: D-C	0.3	13.59	0.21	B	0.5	16.95	0.34	C
J1: CD-AB	4.7	17.89	0.76	C	1.4	8.36	0.45	A
J2: B-AC	0.0	0.00	0.00	A	0.0	0.00	0.00	A
J2: C-AB	1.7	14.23	0.62	B	3.8	20.58	0.77	C

Source: Junctions 9 (2020)

This shows that the one-way system results in significant delays on Wilsons Road (J1 Arm B), with RFCs of 1.3 or over. This is far over absolute capacity for the arm, which results in very high delays.

It should be noted that once the flow on an arm is over absolute capacity, the delays increase at an exponential rate. Therefore, the predicted delay shown may not be reflective of the actual delay. However, since the junction is so far over capacity, there is still expected to be significant delay.

The increased time per vehicle travelling from Kenilworth Road to the High Street, travelling northbound, has been calculated to show the delay caused by the introduction of the one-way system. This has been done by comparing the delay at the High Street / Wilsons Road / Warwick Road / Station Road junction and the High Street / Kenilworth Road junction, as well as the increased journey time relating to the additional journey distance.

The additional journey time per vehicle is expected to be around 8 minutes in the AM peak and 9 minutes in the PM peak. However, as was noted above, the delay calculated in the model is not likely to be fully reflective of the actual delay.

5.7.4.2 Existing Layout at High Street / Wilsons Road / Warwick Road / Station Road

The modelling results for Option 3 of the one-way system at the High Street / Wilsons Road / Warwick Road / Station Road junction, with the signalised mitigation option, are shown in Table 5.12. The base 2036 results (without Option 3) can be seen in Table 3.7.

Table 5.13: High Street / Wilsons Road / Warwick Road / Station Road 2036 Signalised with Option 3

	AM			PM		
Lane	Queue (Veh)	Delay (s)	Deg Sat (%)	Queue (Veh)	Delay (s)	Deg Sat (%)
A4141 at Station Road southbound	8.5	11.5	52%	10.8	11.3	61%
Station Road	5.2	13.0	44%	5.6	26.5	67%
A4141 at Station Road northbound	12.6	**91.0**	**93%**	5.6	29.9	46%
A4141 at Wilsons Road southbound	0.1	1.3	22%	0.2	1.4	30%
Wilsons Road	19.1	**72.4**	**98%**	56.0	**164.2**	**106%**
A4141 at Wilsons Road northbound	6.5	4.8	61%	5.2	3.4	44%

Source: LinSig (2020)

This shows that the one-way system still results in significant delays with the mitigation at the junction, though the delays are lower compared to if the junction remained in its current layout. Wilsons Road is forecast to have a Degree of Saturation of 98% in the AM and 106% in the PM.

The increased time per vehicle travelling from Kenilworth Road to the High Street, travelling northbound, has been calculated to show the delay caused by the introduction of the one-way system. This has been done by comparing the delay at the High Street / Wilsons Road / Warwick Road / Station Road junction and the High Street / Kenilworth Road junction, as well as the increased journey time relating to the additional journey distance.

The additional journey time per vehicle is expected to be around 45 seconds in the AM peak and 2 minutes 25 seconds in the PM peak. This does not consider the delay caused to vehicles already on Wilsons Road that experience further delay as a result so the rerouted flows.

6 Active Travel

6.1 Introduction

This section discusses the current and proposed active travel provision within Knowle. This introduces several coordinated active travel measures will enable a cohesive provision in Knowle, and potentially reduce the number of short distance vehicle trips within the borough and increase the sustainable mode share.

6.2 Background

6.2.1 Pedestrian Environment Review System (PERS)

A PERS audit was undertaken for the baseline report (delivered September 2020), which provides additional detail on the pedestrian environment in Knowle. Overall, Knowle scored highly throughout the audit, with the majority of links scoring an 'improvement' score, and A4141 to Kenilworth Road and Station Road scoring 'good'. Figure 6.1 displays the results of the audit. The key takeaways from the PERS audit were that the environment has good surface quality, with permeability, tactile and dropped kerbs providing a pleasant pedestrian environment.

Figure 6.1: Knowle PERS Results

Source: Mott MacDonald

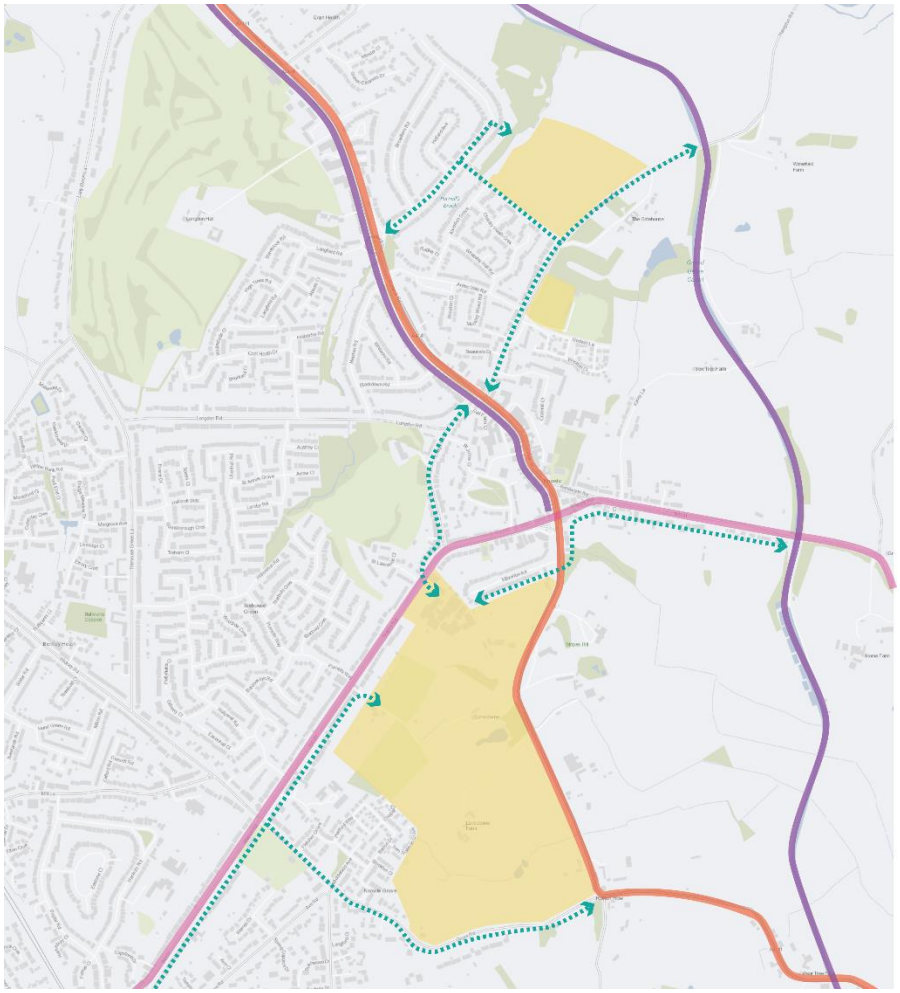
6.2.2 Desire Lines and LCWIP

Figure 6.2 displays the desire lines through Knowle and the Solihull LCWIP proposals. There is one main link east to west of the village, Station Road to Kenilworth Road, with the A4141 running north to south.

The Local Cycling and Walking Infrastructure Plan (LCWIP) proposals (purple links) within Solihull include routes along the Grand Union Canal and from Station Road junction (with the A4141) heading north along the A4141. These routes provide a more direct route towards Solihull, encouraging more cyclists to use sustainable travel.

There also key walking desire lines, which provides additional connectivity to the development sites. The development sites have the opportunity to be connected to the desire lines and LCWIP proposals to encourage residents to take active travel measures as a primary option. The key desire line connecting Knowle to Dorridge Station has the potential to increase rail patronage for the station.

Figure 6.2: Desire Line and LCWIP



Source: Mott MacDonald

6.2.3 Principles – linking the High Street to DLP sites

A key principle in the mitigation proposals for Knowle include linking the High Street to the proposed development sites. Through encouraging active travel throughout the village, shorter vehicle trips will be removed from the network. It provides the additional opportunity to develop Knowle High Street and the frontages.

6.2.4 Quiet Lane approach

Quiet Lanes are defined as minor rural roads, which have been designated by local highway authorities to pay additional attention to the needs to walkers, cyclists, horse riders and vulnerable road users. They offer additional protection from speeding traffic. This approach makes routes more attractive to active travel users, with an additional sense of safety and security.

The following links have been highlighted as a potential for quiet lane features being introduced:

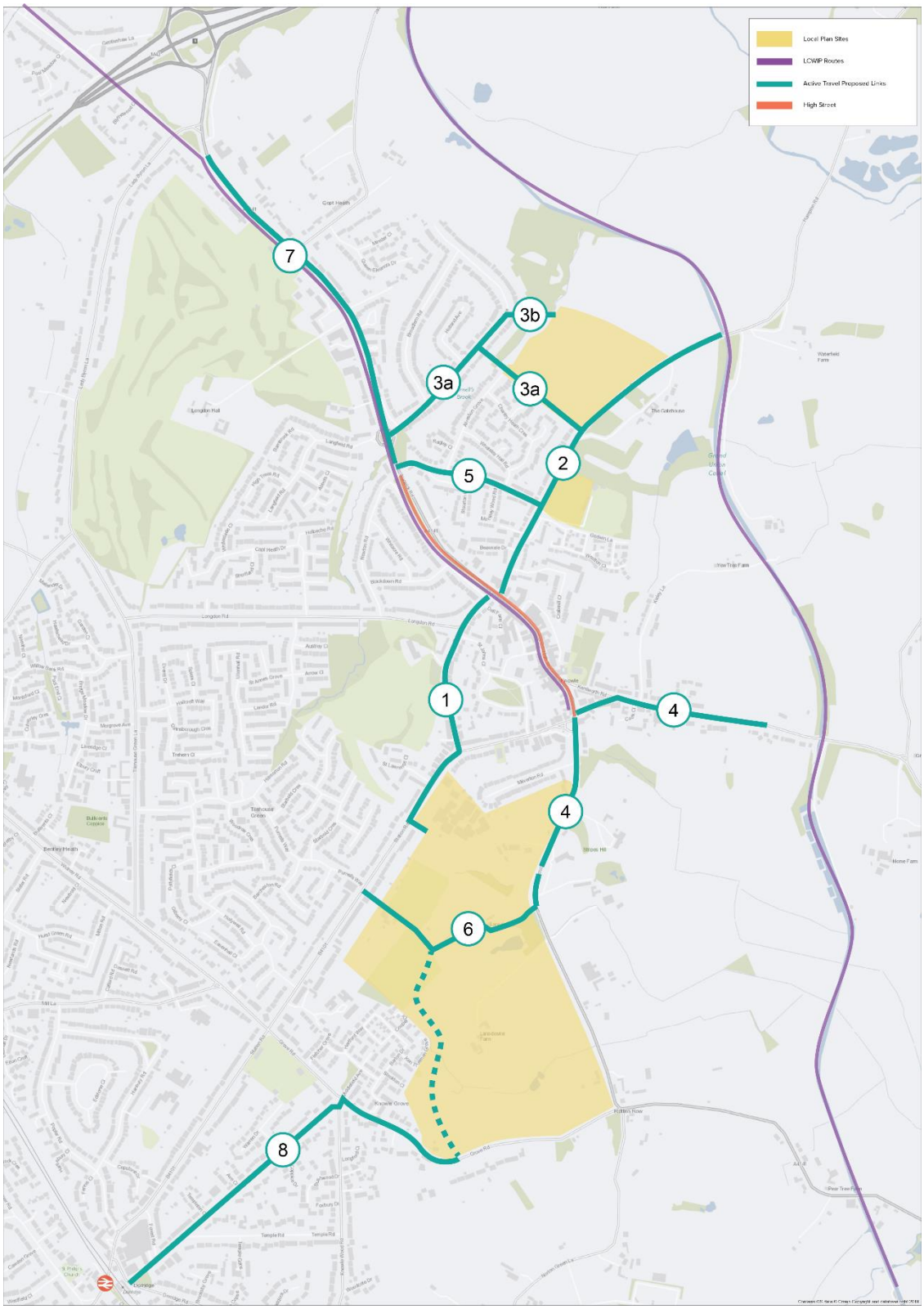
- Lodge Road
- Hampton Road
- Site to Kenilworth Road
- Ardenvale Road
- Grove Road
- Avenue Road

6.3 Proposed Links

Figure 6.3 shows the proposed active travel links as part of the mitigation proposals for Knowle.

One of the main aims of the proposed links is to provide additional connectivity to the new developments within Knowle, and encourage more sustainable transport trips on the network.

Figure 6.3: Active Travel Proposed Links



Source: Mott MacDonald

Each link is explained additionally below:

1. Quiet Lane – Lodge Road
2. Quiet Lane – Hampton Road
3. 3a – New Local Plan site link to Wychwood Avenue
   3b – Wychwood Avenue - both quiet lanes connecting to development site 8
4. Quiet Lane – Site to Kenilworth Road
5. Quiet Lane – Ardenvale Road
6. Quiet Lane – Grove Road
7. Warwick Road - Segregated LCWIP Route
8. Quiet Lane – Avenue Road

7 Placemaking Principles

This section explores the relationship between Link and Place. Link and Place Analysis is an approach to planning and designing urban streets which recognise their dual functions as both transport infrastructure and important elements of public realm. This analysis assesses urban roads on two dimensions; the role as a 'link' and the role as 'place'.

As a result of this assessment, placemaking principles have been at the forefront of any concept junction designs identified earlier in this study. In addition, a few examples of placemaking opportunities in Knowle have been included in Appendix B and show the type of surfaces and finished that could improve placemaking and urban realm.

7.1 Link

As a 'link' a street acts as a transport conduit within a wider urban street network. Users primarily aim to follow a straightforward, continuous path with minimal disruption. The key design objective for a link is to enable people to save time.

7.2 Place

As a 'place' a street acts as a destination where activities occur. Users primarily aim to use facilities on or adjacent to the street and often spend time in the area carrying out a variety of activities. The key design objective for a place is to enable people to spent time.

The function of the street as a place also includes vehicle-related activities such as dropping-off passengers, loading and unloading and parking.

7.3 Link and Place Spectrum

Classification of streets according to their function as a 'link' and a 'place' should occur along a spectrum to consider the variety of urban street morphology. An equal number of 'link' and 'place' categories should be defined which reflect the degree to which a street acts according to each function. Link categories consider traffic volume, number of modes, road classification, etc. Place categories should consider the quality and volume of the public realm, associated activities and the cultural significance of surrounding buildings.

7.4 Street Classification Matrix

The 'link' and 'place' spectrums are placed into a matrix to determine the categorisation of a street according to both functions. 'Place' categories are assigned a letter from A-D depending upon the number of categories used) and the 'link' categories are assigned numbers from I-IV. Therefore, a street classified as I-D would be characterised as a major motorway with a low sense of 'place' and a street classified as IV-A could be a pedestrianised urban square.

7.5 Methodology

Link and Place Analysis was applied to select streets within Knowle to examine the role of the urban street network in terms of both transport function and urban realm.

Four categories were assigned for both 'link' and 'place' ranging from minor to major. For 'Place' these categories were assigned letter values between A (Major) and D (Minor). For 'Link' categories were given numbers between I (Major) and IV (Minor).

The Street Classification Matrix used for Knowle is illustrated in Figure 7.1 below.

Figure 7.1: Street Classification Matrix

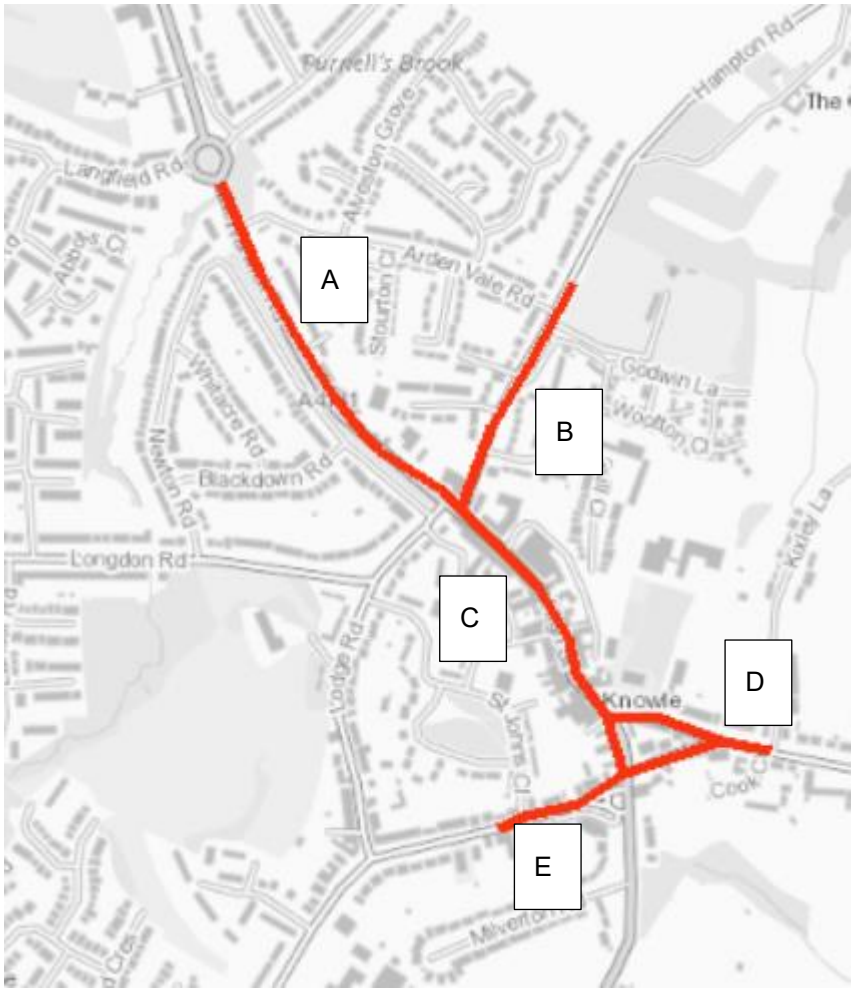
		Place			
Link		A Major	B Significant	C Moderate	D Minor
	1 Major	I - A	I – B	I – C	I – D
	2 Significant	II – A	II – B	II – C	II – D
	3 Moderate	III – A	III – B	III - C	III – D
	4 Minor	IV - A	IV - B	IV – C	IV - D

Source: Mott MacDonald

7.6 Study Area

Figure 7.2 illustrates the streets which were assessed using link and place Analysis.

Figure 7.2: Knowle Area Selected Streets



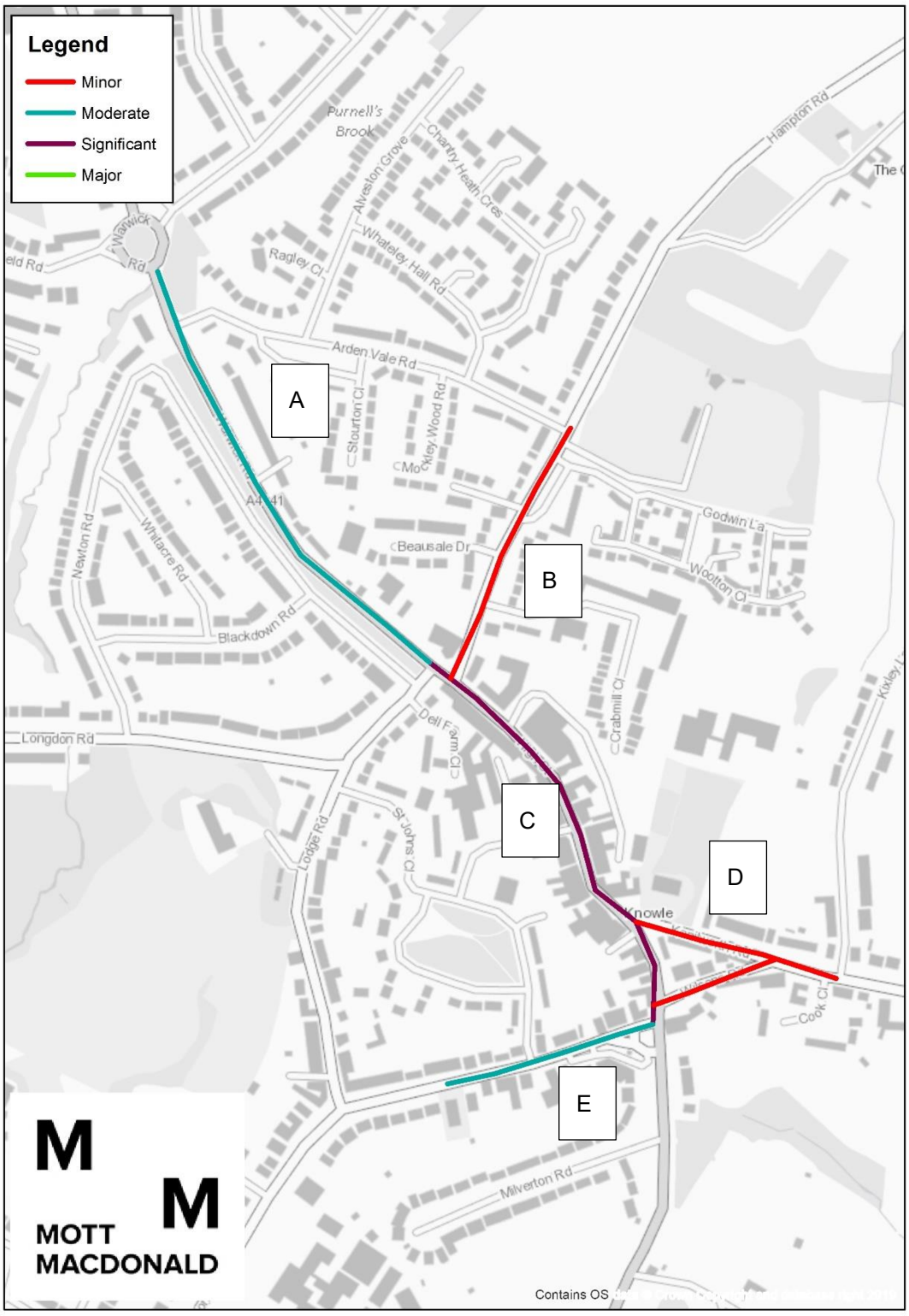
Source: Mott MacDonald/ OpenStreetMap Contributors

Each street was assigned a reference between A-E. Streets were divided into discrete sections at points where the characteristics of the streets was noticeably different, including commercial properties.

7.6.1 Place Categorisation

Figure 7.3 indicates the classification of the streets according to their function as ‘places’.

Figure 7.3: Place Categorisation



Source: Mott MacDonald/ OpenStreetMap Contributors

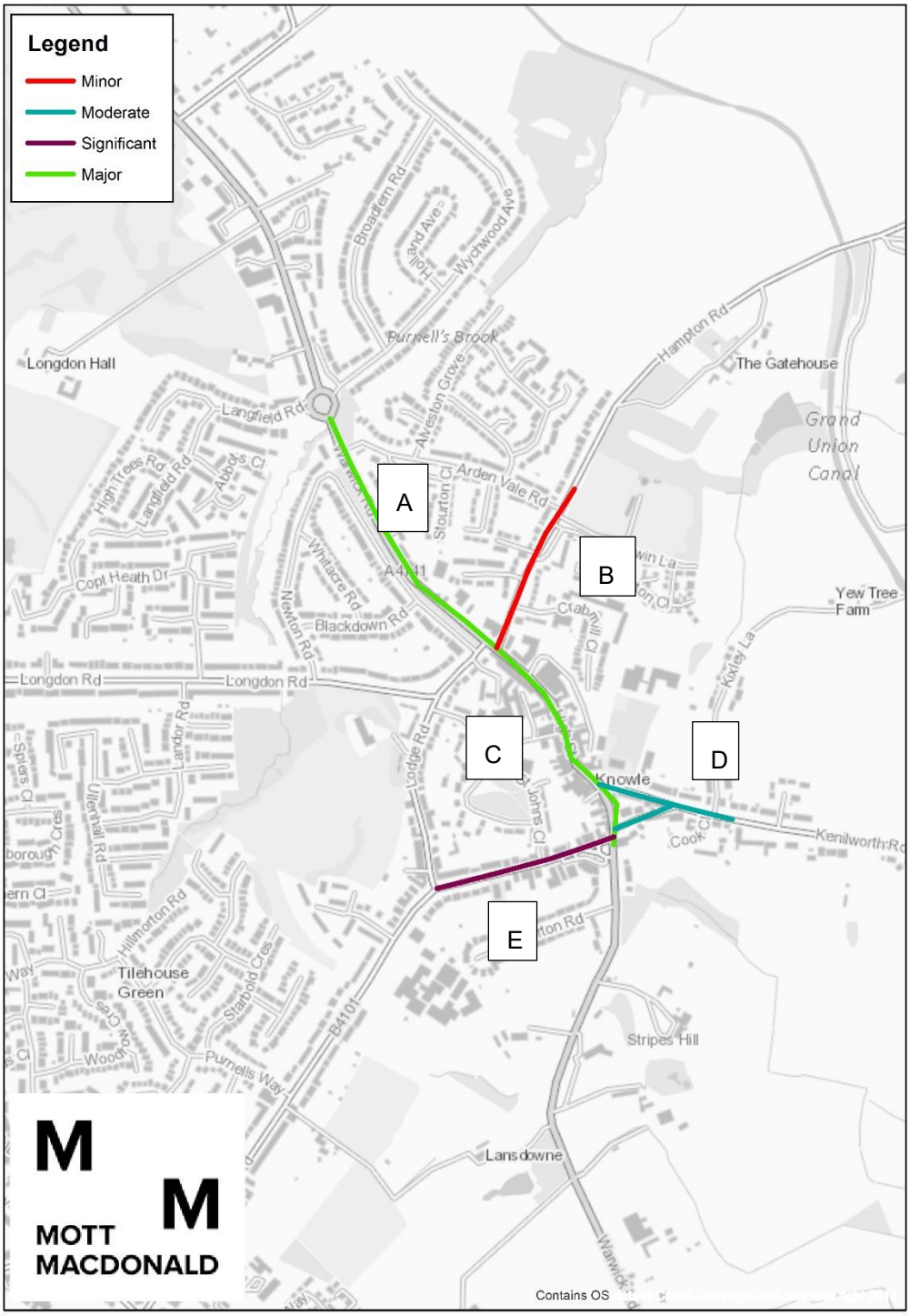
The ‘Place’ analysis indicated that many of the streets within Knowle function as ‘moderate’ places for people to spend time. This is primarily due to vehicle dominance and demand, with a limited option for public realm and vitality currently. Junction layouts and geometries are also historical in nature and tend to prioritise vehicles.

There are no major places for pedestrians within Knowle, due to lack of pedestrian infrastructure, although the exception to this being Knowle High Street which dedicated as Significant. This is due to shop frontage, wider pavements and crossing points. In this location the opportunities for improving the public realm are larger.

Links A, B and C are not appealing places for people to spend time due to large vehicle dominance and minimal open spaces.

7.6.2 Link Categorisation

Figure 7.4: Link Categorisation



Source: Mott MacDonald/ OpenStreetMap Contributors

There are several ‘major’ streets within Knowle, namely the A4141. These streets serve the local and strategic road networks and this means that streets are primarily vehicle dominated. Whilst classifying links, the number of modes and bus routes/stops was also considered.

Residential streets from the A4141 are classified as moderate or minor, due to the lower vehicle flows and the reduction in strategic importance.

7.6.3 Link and Place Categorisation

Table 7.1 indicates the categorisation of streets as ‘links’ and ‘places’ as well as the composite score calculated using the table in Figure 7.1.

Table 7.1: Link and Place Categorisation

Link	Place Status	Link Status	Place-Link Status
A – Warwick Road	C	I	I-C
B – Hampton Road	D	IV	IV-D
C – High Street	B	I	I-B
D – Kenilworth Road	D	III	III-D
E – Station Road	C	II	II-C

7.7 Summary

Overall, the Link and Place Analysis indicates that there is a skew towards vehicle dominance within Knowle, due to the High Street being a key transport connector link and the historical nature of the road layout and junction geometries. There is, however, significant scope to improve a number of key links for all road users. This could help remove the vehicle dominance in certain areas and improve the public realm within Knowle, as well as opportunities to improve road safety and walking and cycling improvements.

This analysis has identified a couple of streets, namely Station Road, Hampton Road and High Street, where interventions could improve the ‘place’ function, and an area could be created where people want to spend time.

8 Scheme Prioritisation

8.1 Introduction

A high-level option appraisal has been undertaken to consider individual and collections of mitigation measures against a series of appraisal criteria, incorporating the strategy objectives and a series of deliverability measures. This presents the best performing measures at this stage of the study.

8.2 Multi-criteria assessment methodology

The MCA framework used to evaluate the potential solutions and options is Mott MacDonald's in-house Investment Sifting and Evaluation Toolkit (INSET). INSET is a scalable and flexible tool that can be adapted for any stage of the scheme development process to help decision-makers manage information on investment options and evaluate them across multiple criteria. It provides a clear and transparent audit trail to demonstrate how selected schemes have been prioritised or selected for further scheme development and enables a wider conversation around the merits of individual schemes or investment decisions. For other studies, INSET has been used in stakeholder engagement sessions, transport committee meetings and in peer review settings to illustrate how robust decisions have been arrived upon.

INSET functions through undertaking a scoring assessment of multiple criteria which could include social, economic or environmental indicators of likely scheme performance. Assessment criteria are commonly defined as measurable elements that can be linked to an evidence base.

8.3 INSET Themes

For the assessment of the Knowle Transport, the following have been set following a review of the study aims and objectives and prevailing local and national policy:

- Transport benefits
- Wider economic benefits
- Environmental impacts
- Social impacts
- Alignment with objectives
- Deliverability

Underpinning the assessment of these themes are structured main and sub-criteria. The number of criteria changes depending on the stage of the assessment as the level of detail and appraisal increases**.** Appendix A shows the criteria used for the assessment.

8.4 Option Scoring

INSET allows for a variety of scoring mechanisms which can be tailored to suit specific criteria. For example, environmental impacts may be scored on a 5-point or 7-point scale from large negative being the lowest score and large positive the highest score. Alternatively, an option's fit to local policy may range from 0-5 where 5 is a strong fit. Some criteria may simply have a yes or no answer. INSET not only allows for various methods to be used within the same framework, but can also 'normalise' all scores to allow the different mechanisms to be treated in the same way.

8.5 Stage 1 - Weighting

INSET allows criteria to be weighted depending on their importance to the overall assessment.

In line with key national and local policy, transport benefits and social benefits have been treated as the most important factor. Therefore, both categories have been given a weighting of two, whereas all other categories are weighted as one.

8.6 Initial Sifting Results

Table 8.1 summarises how the strategic solutions scored against the six assessment themes. Whilst a 'Do Minimum' scenario has been included within the assessment, it is used as a baseline against which to compare the other solutions. As such, its performance will not be commented on as it will clearly fail to resolve the known transport impacts resulting from DLP development.

Within the table, 'Very Good' describes criteria which the scheme fully meets. 'Good' describes the criteria that a scheme mostly provides benefit to, where the positives outweigh the negatives. 'Neutral' describes the criteria that the scheme does not impact. 'Low' describes criteria where the negatives outweigh the positives whilst 'Very Low' indicates that there are no positives to the scheme.

Table 8.1: Comparison of schemes scores (in order of rank)

Rank	Scheme	Transport Benefits	Wider Economic Benefits	Environment	Social Impacts (Quality of Life)	Alignment with Objectives	Deliverability
1	Active travel	Good	Neutral	Neutral	Good	Neutral	Neutral
2	Warwick Road Roundabout	Good	Neutral	Neutral	Good	Good	Neutral
3	Station Road Roundel	Good	Neutral	Neutral	Good	Good	Neutral
4	High Street Kenilworth Road	Good	Neutral	Neutral	Good	Neutral	Good
4	High Street Kenilworth Road Option 2 (with parking)	Good	Neutral	Neutral	Good	Neutral	Good
6	Station Road / Lodge Road	Good	Neutral	Neutral	Neutral	Neutral	Good
7	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)	Good	Neutral	Neutral	Low	Neutral	Neutral
8	Warwick Road / Hampton Road / Lodge Road Option 3 (Double mini roundabout)	Neutral	Low	Neutral	Neutral	Neutral	Neutral
9	Warwick Road / Hampton Road / Lodge Road Option 2 (Signalised)	Low	Low	Low	Neutral	Neutral	Neutral

10	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 1	Low	Low	Low	Good	Neutral	Neutral
11	Warwick Road / Hampton Road / Lodge Road Option 1	Low	Low	Low	Good	Neutral	Neutral
12	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 2 (signalised)	Low	Low	Low	Low	Neutral	Neutral
13	One-Way System Option 1	Low	Low	Low	Low	Low	Low
13	One-Way System Option 2	Low	Low	Low	Low	Low	Low
13	One-Way System Option 3	Low	Low	Low	Low	Low	Low

Source: Mott MacDonald (2020)

Table 8.2 provides the scoring attributed to each proposed scheme.

Table 8.2: Scheme INSET scores (order of rank)

Rank	Scheme	Transport Benefits	Wider Economic Benefits	Environment	Social Impacts (Quality of Life)	Alignment with Objectives	Deliverability	Total Score
1	Active travel	1.50	0.00	0.50	1.60	0.75	0.63	0.83
2	Warwick Road Roundabout	1.50	0.00	0.00	1.20	1.00	0.50	0.70
3	Station Road Roundel	1.00	0.00	0.00	1.00	1.00	0.88	0.65
4	High Street Kenilworth Road	1.00	0.00	0.00	1.00	0.50	1.00	0.58
4	High Street Kenilworth Road Option 2 (with parking)	1.00	0.00	0.00	1.00	0.50	1.00	0.58
6	Station Road / Lodge Road	1.00	0.00	0.00	0.80	0.50	1.00	0.55
7	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)	1.25	0.50	0.00	-0.40	0.75	0.75	0.48
8	Warwick Road / Hampton Road / Lodge Road Option 3 (Double mini roundabout)	0.75	-0.50	0.00	0.20	0.75	0.75	0.33
9	Warwick Road / Hampton Road / Lodge Road Option 2 (Signalised)	-0.50	-0.50	-0.50	0.20	0.75	0.75	0.03

10	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 1	-0.50	-1.00	-0.50	1.00	0.25	0.75	0.00
11	Warwick Road / Hampton Road / Lodge Road Option 1	-0.50	-1.00	-0.50	1.00	0.25	0.25	-0.08
12	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 2 (signalised)	-0.25	-1.00	-0.50	-0.40	0.75	0.75	-0.11
13	One-Way System Option 1	-0.50	-1.00	-0.50	-0.40	-0.25	-0.13	-0.46
13	One-Way System Option 2	-0.50	-1.00	-0.50	-0.40	-0.25	-0.13	-0.46
13	One-Way System Option 3	-0.50	-1.00	-0.50	-0.40	-0.25	-0.13	-0.46

Source: Mott MacDonald (2020)

8.7 INSET Stage 1 Conclusion

The conclusions of the initial sifting of the strategic solutions are provided in Table 8.3 below along with a decision on whether they should pass to the next stage of the assessment.

Table 8.3 INSET results summary

Option	Scheme	Pass/Fail	Summary	Scheme Description
1	Active travel	Pass	Neutral impact on congestion and delay Active travel benefits Social benefits - Journey Quality Provides sustainable alternatives for DLP sites Improved local connectivity Medium cost	Improved links to High Street and DLP sites. LCWIP corridor improvements
2	Warwick Road / Hampton Road / Lodge Road Option 1	Fail	Junction modelling shows increase in delay Some placemaking benefits Better pedestrian environment and improved safety Could create a better entrance into High St/Village Can be costly and complex to implement	Placemaking/ unsignalised/visual carriageway narrowing
3	Warwick Road / Hampton Road / Lodge Road Option 2 (Signalised)	Fail	Junction modelling shows increase in delay Minimal placemaking benefits Better pedestrian environment Can be complex and have a lack of political support	Signalised /limited placemaking
4	Warwick Road / Hampton Road / Lodge Road Option 3 (Double mini roundabout)	Pass	Congestion and delay could be improved Some placemaking benefits Safety improvements/ slower speeds Reasonably low-med cost	Double mini option /some placemaking
5	High Street Kenilworth Road	Pass	Operates no worse than existing Pedestrian environment improved Safety improvements Parking blocking turning traffic removed	Placemaking/ reduced Radii/ widened footways/ removed parking
6	High Street Kenilworth Road Option 2 (with parking)	Pass	Operates no worse than existing Pedestrian environment improved Safety improvements Parking moved	As above/ parallel parking (blue badge holders)

			further east to reduce issue	
7	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 1	Fail	Could significantly increase localised congestion Some placemaking/safety benefits Could be implemented with sustainable measures Costly and complex to implement	Placemaking/carriageway width reduction
8	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 2 (signalised)	Fail	Increase to localised congestion Some placemaking/safety benefits Could be implemented with sustainable measures Costly and complex to implement	Placemaking/signalised/ junction moved south of existing
9	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)	Pass	Junction operates within capacity Mitigates DLP impacts Some placemaking opportunities Improved footways	As above - with additional right arrow and left turn filter
10	Station Road / Lodge Road	Pass	Improve local connectivity Minimal impacts on congestion and air quality Sustainable alternative, health benefits Can be implemented alongside another scheme, therefore reasonable low cost	Simplified junction/footway improvements
11	Station Road Roundel	Pass	Potential for no-worse operation Placemaking benefits Safety benefits Pedestrian crossing improvements	Roundel option - pedestrian crossings
12	Warwick Road Roundabout	Pass	Improved local connectivity High quality cycle link into Knowle High cost and complex	Cycle route segregation/roundabout diameter reduction
13	One-Way System Option 1	Fail	Rerouting onto residential roads Potential speed issues on High Street	Clockwise (Knowle High Street SB only, Lodge Road NB only, Kenilworth Road EB only, Wilsons Road WB only)

			Impact on key junctions	
14	One-Way System Option 2	Fail	Rerouting onto residential roads Potential speed issues on High Street Impact on key junctions	Clockwise (Knowle High Street SB only, Lodge Road NB only, Kenilworth Road EB only, Wilsons Road two-way)
15	One-Way System Option 3	Fail	Significant delays on Wilsons Road increased time per vehicle travelling from Kenilworth Road to the High Street	Kenilworth Road EB only, other roads same as before

Source: Mott MacDonald (2020)

9 Summary and Conclusion

9.1 Introduction

Mott MacDonald have been commissioned by Solihull Metropolitan Borough Council (SMBC) to develop a strategic evidence base focusing on the traffic impacts of the Draft Local Plan (DLP) on Knowle.

This study presents an assessment of the impacts of the proposed development quanta and sets out potential mitigation measures to help limit and reduce the impact of the new developments on the local road network. These measures focus on strategic improvements to upgrade the public realm and active travel, whilst improving highway safety for all users and providing additional highway capacity where practicable.

9.2 Modelling

A bespoke spreadsheet model has been created for the Knowle Transport Study.

For the base flows, it was intended to update the traffic surveys in early 2020, but due to the onset of the Covid-19 pandemic these surveys were not undertaken. Since new surveys have been possible in time for this study, older survey data has been used, in some cases this is over five years old.

The existing traffic survey data was factored to the DLP years of 2026 and 2036 using TEMPro. The number of trips from each DLP site were then generated using data from TRICS and distributed across the network based on outputs from the PRISM model. The resulting outputs have then been used to determine the impact of the DLP sites in the study area.

9.3 Local Junction Modelling

In order to identify junctions that may require mitigation, ‘at risk’ junctions were determined using TrafficMaster congestion data, public consultation feedback, PRISM model outputs and observed data. Junctions deemed to be ‘at risk’ with a 5% DLP flow impact or greater were then modelled in Junctions 9 software to determine their operational performance and therefore if mitigation was required. The following table shows the junctions modelled along with a comment as to whether mitigation is required.

Table 9.1: Junction Modelling Summary

Junction	Mitigation Required?
Hampton Road / Arden Vale Road	No
Warwick Road / Hampton Road / Lodge Road	Yes
High Street / Kenilworth Road	Yes
High Street / Wilsons Road / Warwick Road / Station Road	Yes
Warwick Road / Grove Road / Norton Green Lane	No
Station Road / Lodge Road	Yes
Station Road / Grove Road / Widney Road	Yes

Source: Mott MacDonald

9.4 Mitigation Proposals

A proportionate approach to mitigation has been adopted, considering the village nature of Knowle and the high street alongside the potential for public realm improvements. Mitigation therefore focusses on the following approaches:

- Local junction improvements to relieve development impacts where possible, and improve safety for all users
- Strategic improvements to upgrade Knowle High Street for public realm and active travel opportunities

9.5 Mitigation Testing

Each of the mitigation concepts at each junction were then assessed using Junctions 9 software for roundabouts and priority junctions, and LinSig for signals. They have been assessed for the 2036 DLP scenario for the AM and PM peak periods.

In additional to individual junction improvements, three options for a one-way system were proposed. This was investigated following stakeholder engagement with SMBC, with the aim to reduce congestion. These options have undergone a high-level assessment using the spreadsheet model.

9.6 Active Travel

A PERS audit was undertaken in central Knowle to determine the current active travel environment. The Solihull LCWIP proposals were reviewed alongside desire lines through Knowle to identify areas where active travel improvements could be implemented.

A key principle in the mitigation proposals for Knowle include linking the High Street to the proposed development sites. Through encouraging active travel throughout the village, shorter vehicle trips will be removed from the network. It provides the additional opportunity to develop Knowle High Street and the frontages.

A number of links have been identified for ‘quiet lanes’, which are more attractive to walkers, cyclists, horse riders and additional vulnerable road users.

9.7 Placemaking Principles

Link and Place Analysis is an approach to planning and designing urban streets which recognise their dual functions as both transport infrastructure and important elements of public realm. This analysis assesses urban roads on two dimensions; the role as a ‘link’ and the role as ‘place’.

Overall, the Link and Place Analysis indicates that there is a skew towards vehicles dominance within Knowle, due to the High Street being a key transport connector link and the historical nature of the road layout and junction geometries. There is, however, significant scope to improve a number of key links for all road users. This could help remove the vehicle dominance in certain areas and improve the public realm within Knowle, as well as opportunities to improve road safety and walking and cycling improvements.

9.8 Scheme Prioritisation

A high-level option appraisal has been undertaken, using INSET, to consider individual and collections of mitigation measures against a series of appraisal criteria, incorporating the strategy objectives and a series of deliverability measures.

As a result of the INSET scoring, the schemes in the following table have been identified to progress to the next stage of assessment.

Table 9.2 INSET results summary

Option	Scheme	Scheme Description
1	Active travel	Improved links to High Street and DLP sites. LCWIP corridor improvements
4	Warwick Road / Hampton Road / Lodge Road Option 3 (Double mini roundabout)	Double mini roundabout option
5	High Street / Kenilworth Road	Placemaking/ reduced Radii/ widened footways/ removed parking
6	High Street / Kenilworth Road Option 2 (with parking)	As above/ parallel parking (blue badge holders)
9	High Street/ Wilsons Road/ Warwick Road/ Station Road Option 3 (signalised)	As above - with additional right arrow and left turn filter
10	Station Road / Lodge Road	Simplified junction/footway improvements
11	Station Road Roundel	Roundel option - pedestrian crossings
12	Warwick Road / Wychwood Avenue Roundabout	Cycle route segregation/roundabout diameter reduction

Source: Mott MacDonald (2020)

Appendices

A. INSET scoring criteria

Theme	*Main Criteria*	*Sub Criteria*
Transport Benefits	Local connectivity	Improve local connectivity
	Congestion relief	Ability to relieve congestion
Wider Economic Benefits	Potential to deliver and mitigate for growth	Increased transport capacity
Environment	Environmental impact	Impact on the environment
Social Impacts (Quality of life)	Social impact	Access to amenities and opportunities
		Non-Motorised Access
		Accessibility and Inclusion
		Journey Quality
		Reduce personal injury accidents on the
Alignment with Objectives	Alignment with objectives	Fit with wider policy objectives
		Population & economic growth
		Sustainable growth
		Physical and mental wellbeing.
Deliverability	Affordability	Scheme cost
	Complexity	Level of complexity

B. Placemaking examples

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Knowle High Street Visualisation

Existing

Potential enhancements

- Public Realm Enhancements
- Visual Narrowing
- Decluttering

Active Travel Potential Enhancements

Existing

Potential enhancements

- Segregated route along Warwick Road
- Physical separation from traffic
- Two-way

C. Scheme cost estimates

Knowle High Street Costs	Gold	Silver	Bronze
High Street combined	£6,880,000	£4,770,000	£3,710,000
Hampton Rd/ Arden Vale Rd combined	£2,110,000	£1,460,000	£1,140,000
Lodge Rd / Hampton Rd Jct - Placemaking	£ 900,000	£ 620,000	£ 490,000
Lodge Rd / Hampton Rd Jct - Signalised	£1,000,000	£ 720,000	£ 590,000
Lodge Rd / Hampton Rd Jct - Double mini roundabout	£ 900,000	£ 620,000	£ 490,000
High Street / Kenilworth Road	£ 490,000	£ 340,000	£ 260,000
High Street / Wilsons Road / Warwick Road / Station Road - Placemaking	£2,710,000	£1,880,000	£1,460,000
High Street / Wilsons Road / Warwick Road / Station Road - Signalised Op 1	£2,810,000	£1,980,000	£1,560,000
High Street / Wilsons Road / Warwick Road / Station Road - Signalised Op 2	£2,810,000	£1,980,000	£1,560,000
Station Road/ Lodge Road Junction	£ 620,000	£ 430,000	£ 330,000
Station Road - Roundel	£ 610,000	£ 420,000	£ 330,000
Warwick Road / Arden Vale Road / Wychwood Avenue / Langfield Road	£2,560,000	£1,770,000	£1,380,000
Active Travel measures			
Section	**Low**	**High**	
1. Quiet Lane - Lodge Rd	£ 120,000	£ 310,000	
2. Quiet Lane - Hampton Road 1	£ 140,000	£ 370,000	
3a. Section 3a	£ 90,000	£ 240,000	
3b. Section 3b	£ 30,000	£ 90,000	
4. Quiet Lane - Site to Kenilworth Rd	£ 150,000	£ 400,000	
5. Quiet Lane - Arden Vale	£ 60,000	£ 150,000	
6. Quiet Lane - Grove Road	£ 270,000	£ 710,000	
7. Segregated LCWIP route	£ 200,000	£ 530,000	
8. Avenue Road	£ 150,000	£ 410,000	

Assumptions

Gold, silver and bronze standard costs at £650, £450, £350 per square metre. Estimates based on MM benchmarking of similar projects across the UK and are indicative only at this stage. Approximate scheme measurements taken from Google Earth.

Gold

Use of high-quality materials throughout.

Full resurfacing, including footways and carriageway.

Comprehensive or multiple changes to junction layouts and geometries.

High quality planting, including semi-mature trees and rain gardens.

Low/Med degree of certainty around risks.

Silver

Use of high-quality materials throughout.

Partial resurfacing, including footways and carriageway.

Some changes to junction layouts and geometries.

Good quality planting, including semi-mature trees.

Med/High degree of certainty around risks.

Bronze

Use of high-quality materials on footways only.

Limited resurfacing, largely footways.

Minor changes to junction layouts and geometries.

Good quality planting, limited provision of semi-mature trees.

High degree of certainty around risks.

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