Technical Note

Project:	Navan Cycle Scheme R147 Martha's Bridge to Circular Road		
Subject:	Traffic and Transport Analysis		
Author:	Manish Anand		
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Client signoff

Client	
Project	Navan Cycle Scheme R147 Martha's Bridge to Circular Road
Project No.	5212234
Client signature / date	

1. Introduction

1.1. Background

Meath County Council (the Client/MCC) as the Contracting Authority, appointed Atkins (the Consultant) to provide Engineering-led Multi-disciplinary Consultancy and Design services for the concept development & option selection, preliminary design and statutory processes of cycle provisions and associated works including public realm and urban enhancements on the R147 from Martha's Bridge to Circular Road in Navan, Co. Meath, as part of the Navan Cycle Scheme.

1.2. Transport Assessment Methodology

This TTA has been undertaken in accordance with current best practice guidance and planning policies. The following documents have been referenced during the preparation of this report:

- NRA Traffic and Transport Assessment Guidelines (May 2014)
- TII Project Appraisal Guidelines (October 2016)
- Design Manual for Urban Roads and Streets (DMURS)
- TII Design Manual for Roads and Bridges (TII DMRB)
- NTA Transport Strategy for the Greater Dublin Area 2016-2035
- National Cycle Manual
- Meath County Development Plan 2021-2027
- Greater Dublin Area Cycle Network Plan (December 2013)
- NTA Alternate Future Scenario for Travel Demand, November 2020

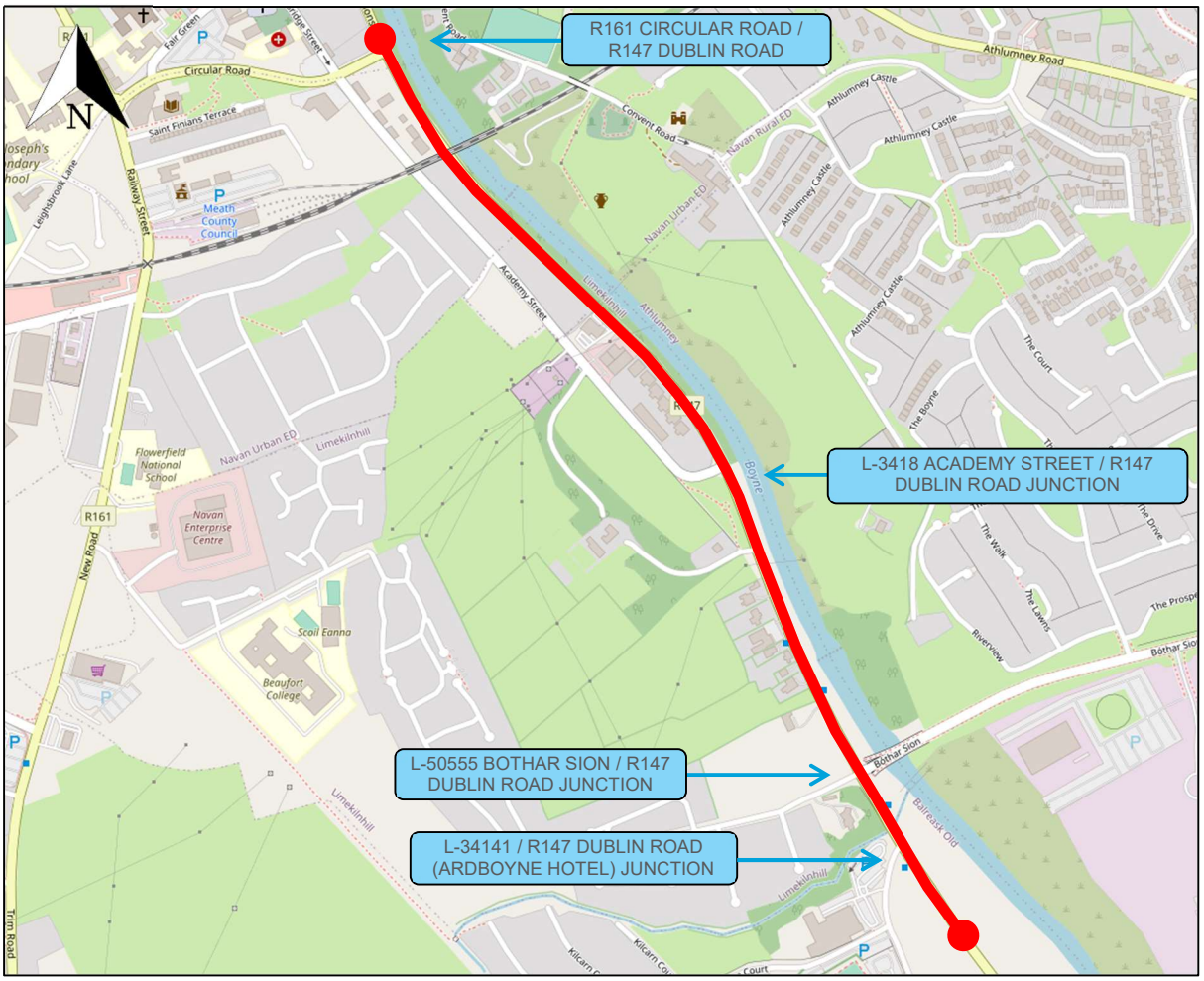
The primary objective of the Traffic and Transport Assessment (TTA) is to assess the possible impacts of the proposed Cycle scheme on relevant junctions

2. Receiving Environment

2.1. Site Location

The Project is located south of Navan Town centre, adjacent to the River Boyne. The northern end of the scheme ties into the R161 Circular Road / R147 Dublin Road junction while the southern end ties into the existing R147 Dublin Road, south of its junction with Swan Lane (L-34141). The figure below illustrates the location and the extents of the route.

Figure 2-1 – Route Location and Extents

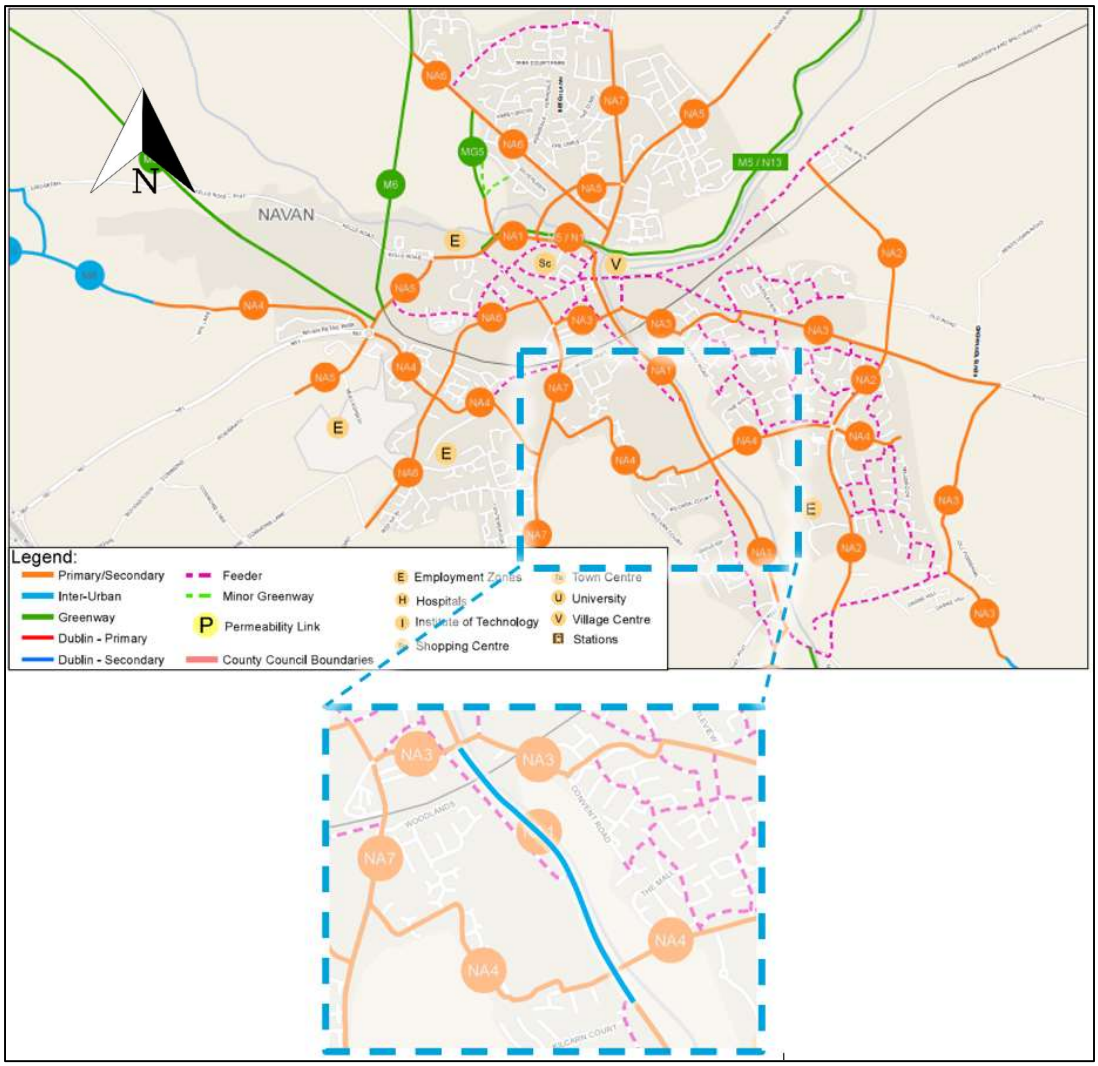


2.2. Policy Background

2.2.1. Greater Dublin Area Cycle Network

The route has been identified within the Greater Dublin Area Cycle Network Plan as a Primary/Secondary route, as shown in figure below.

Figure 2-2 - Greater Dublin Area Cycle Network Plan (Navan)



Greater Dublin Area Cycle Network Plan Primary / Secondary Routes, as shown above:

- **Na1: R147 Dublin/Kells Road between the N51 and Old Balreask Woods.**
- Na2: Metges Road/ East Orbital.
- Na3: Fairgreen to Johnstown with a new bridge over the River Boyne.
- Na4: Southern Ring from Johnstown to Athboy Road.
- Na5: Northern Cross from Athboy Road to Slane Road.
- Na6: Windtown Road to Commons Road.
- Na7: Proudstown Road to Trim Road

2.3. Surrounding Road Network

2.3.1. Links

Regional Road R147 forms the main part of the proposed cycle scheme. It is a 1+1 single carriageway with a speed limit of 50 km/h along the proposed stretch of the cycle scheme.

Other key links include:

- **R161 (Circular Road):** It is a 1+1 single carriageway with speed limit of 50 km/hr near the proposed cycle scheme. It joins R147 at the northern stretch of the cycle scheme where they form a signalised junction.

- **Academy Street:** It is a 1+1 single carriageway with speed limit of 50 km/hr near the proposed cycle scheme. It joins R147 at around middle portion of the proposed cycle scheme where they form a priority junction.
- **Bothar Sion:** It is a 1+1 single carriage with speed limit of 50 km/hr near the proposed cycle scheme. It joins R147 at the southern part of the proposed cycle scheme at the signalised junction.

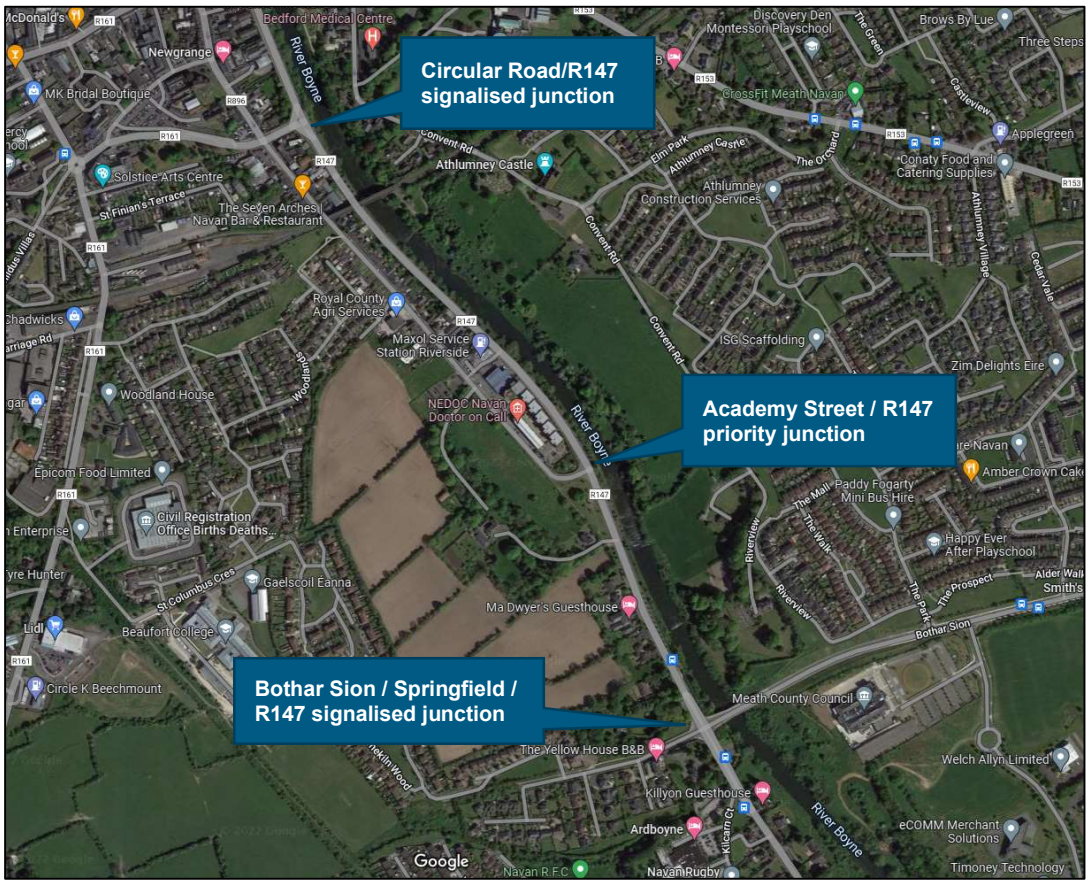
2.3.2. Junctions

The key junctions which are proposed to be upgraded for the cycle scheme are as follows:

- Circular Road/R147 Signalised Junction
- Academy Street/R147 Priority Junction
- Springfield Glen/R147/Bothar Sion signalised junction

These junctions are summarised in the figure below.

Figure 2-3 - Location of key junctions



2.3.3. Current Baseline Traffic Flows

Traffic surveys were commissioned and undertaken by NDC (Nationwide Data Collection) on March 22, 2022 at the key junctions outlined in the previous section. The survey was undertaken between 07:00 am to 07:00 pm for 12 hours.

Based on the traffic survey data the following peak hours were determined:

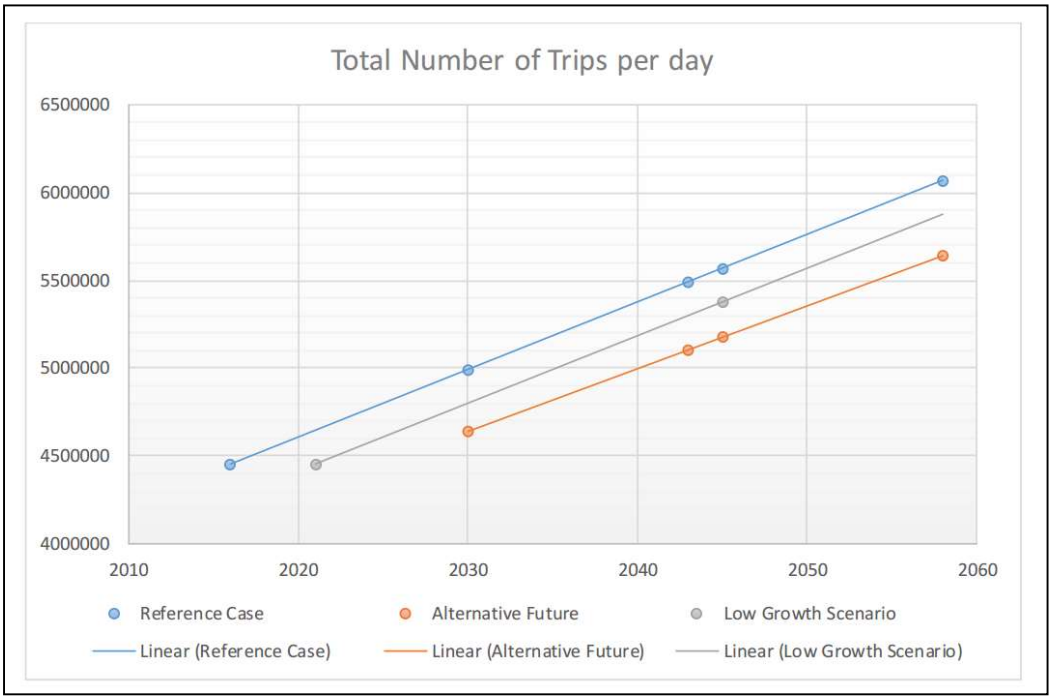
- **AM Peak:** 08:00 to 09:00 am
- **PM Peak:** 17:00 to 18:00 pm

3. Future Assessment Scenarios

3.1. Background growth (NTA Growth)

The baseline traffic has then been grown in accordance with the growth in the number of trips per day as per the NTA National Demand Forecasting Model which is shown in the figure below.

Figure 3-1 - Growth in number of trips per day (NTA National Forecasting Model)



Based on the above figure, the growth in number of trips per day for the Reference Case (Blue line) is summarised in the table below.

Table 3-1 - Growth in number of trips per day (NTA National forecasting Model)

Year	Person Trip	Growth Rate over 10 years
2020	4,600,000	
2030	5,000,000	0.087
2040	5,400,000	0.080
2050	5,800,000	0.074
Average growth over each 10 year period		**0.080**
Average growth per year		**0.008**
Growth Factor		**1.008**

Based on the above table, the number of trips per day is expected to increase by a factor of approximately 0.8% per year. The trips per day consist of all modes of transport including cars, public transport, and active mode of travel. Thus, the actual growth per mode may differ. In reality, taking into account modal shift targets and national policy, it is likely that the vehicle trip growth rate will be less than the overall trip growth rate. However, taking a conservative approach, it has been assumed that the overall growth factor applies to the baseline traffic.

3.2. Mode Share

The proposed cycle scheme will facilitate the shift in car based modal share to active travel. However, for a conservative approach, the same mode share is applied to all future year design scenarios (i.e. not taking into account a modal shift from private vehicle to active travel).

3.3. Modelled Scenarios

The model was run for following scenarios for both AM and PM peak:

- Opening Year (2024) – Do Nothing Scenario
- Opening Year (2024) – Do Something Scenario
- Opening Year + 5 (2029) – Do Nothing Scenario
- Opening Year + 5 (2029) – Do Something Scenario
- Opening Year + 15 (2039) – Do Nothing Scenario
- Opening Year + 15 (2039) – Do Something Scenario

In Do Nothing Scenarios, analysis of key junctions were carried out as per the existing condition. In Do Something scenarios, analysis of key junctions were carried out with the proposed upgrade of the junctions as a part of the cycle scheme.

Traffic for the future design years was calculated on the basis of growth factors discussed in the previous section.

3.4. Assessment Approach

The junctions were analysed individually using various transport modelling software (based on the junction type) as follows:

Table 3-2 - Junction Modelling Software Utilised

Modelling Software	Junction Type	Sites Modelled
JCT LinSig	Traffic Signals	• R147/Circular Road Junction • R147/Springfield Glen/Bothar Sion Junction • Academy Street/R147 for Do Something scenarios
TRL Junctions 9	Priority	• Academy Street/R147 for Do Nothing Scenarios • Kilcarn Ct/R147

R147/Academy Street priority junction is proposed to be upgraded to a signalised junction. Hence, it was analysed using LinSig for Do Something scenarios, while analysed using Junction 9 software for Do Nothing scenarios. All other junctions were analysed using the same modelling software for both Do Nothing and Do Something scenarios

The terminology used throughout the analysis associated with each software is explained in the following sections.

JCT LinSig

- **DOS:** This is the ratio of demand flow to capacity on a link. The saturation level is normally 90%. A degree of saturation below 90% represents a junction that is operating in an efficient and stable condition. If a link has a degree of saturation of between 90% and 100% it may still be operating to an adequate standard depending on the acceptability of queuing and delay. A degree of saturation of above 100% is considered to be over-capacity.
- **Mean Maximum Queue:** The sum of the maximum queue on a link (including uniform, random and oversaturation queues) averaged over all the cycles in the modelled time period.
- **Average Delay:** The average delay for each passenger car unit (pcu) on the lane averaged over the modelled time period.

- **Practical Reserve Capacity (PRC):** A measure of how much additional traffic could pass through the junction whilst maintaining a maximum degree of saturation of 90% on all lanes. Measured as a percentage.

TRL Junctions 9

- **RFC:** This is the ratio of demand flow to capacity. The practical capacity threshold is normally approximately 0.85. An RFC below 0.85 represents a junction which is operating in an efficient and stable condition. An RFC of between 0.85 and 1 represents variable operation, and may be said to be operating adequately, if the queueing and delay are deemed acceptable. RFC values in excess of 1 represent an oversaturated condition.
- **Queue Length:** This represents the maximum of the average queue length in pcu per time segment.
- **Average Delay:** This shows the average amount of traffic delay at the junction per vehicle over the peak hour period.

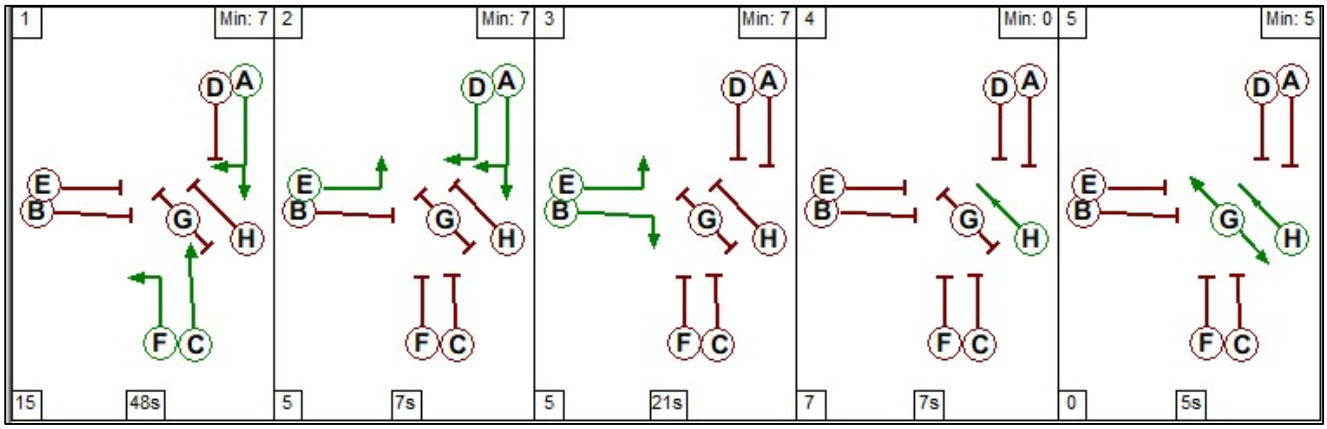
4. Traffic Impact

As outlined in the previous section, each junction was analysed individually using the most relevant software package for that junction type. The Junctions 9 and LinSig direct output reports for each junction are included in Appendix A and the results are summarised below.

4.1. R147/Circular Road Junction

The junction was analysed using LinSig software. The stage diagram for Do Something scenarios is summarised in the figure below.

Figure 4-1 - Stage sequence diagram for R147/Circular Road Junction



In the first stage, both R147 north and south are provided general green. Right turners from R147 northern arm are allowed to turn on a gap. In the second stage, R147 north arm gets right turning filter and the movement from R147 southern arm is stopped. Simultaneously, left turners from Circular Road also get green. In the third stage, both right and left turners from Circular Road get green. In the fourth stage, the cyclists get own green stage. In the fifth stage, pedestrians are provided green, while cyclists get flashing amber. That means, cyclists can also move in this stage, but they need to yield for the pedestrians.

The following assumptions were made for the analysis:

- Currently, the second stage (R147 north right filter stage) is called on demand when right turners from R147 Northern arm do not get enough gap in the first stage and they are still stuck. Based on the Traffic Signal data for the existing traffic condition, this stage is called in almost every cycle for both AM and PM Peak scenarios. Therefore, the stage was modelled to run in every cycle for both Do Nothing and Do Something scenarios for all future design years.
- The scheme has provision of only single cycle lane along all the arms which will facilitate both way cycle movement. Therefore, it's not possible to run cyclists with traffic. Therefore, cyclists need separate stages from traffic. In addition, from a safety point of view, cyclists and pedestrian cannot have one single stage where both movements get green. Hence, a separate stage for cyclists from both traffic and pedestrians was provided. After the cycle stage, in the pedestrian stage, flashing amber can be provided to the cyclists where they can travel but have to yield for the pedestrians.
- In both stage 4 and 5, cyclists are allowed to travel. Hence, cyclists can clear in stage 5 and intergreen provided after stage 5. Therefore, no intergreen was provided between both stages.
- The green time for the cycle stage was taken as 7 seconds. This is because cyclists were allowed to travel in pedestrian stage also.
- The green time for the pedestrian was based on a 5s green with an amber phase equal to the crossing width of the road divided by 1.2 m/s and a 2 s red phase before traffic regains priority.
- The junction was analysed with 120 seconds cycle time for both Do Nothing and Do Something scenario.

The results from the model is summarised below.

4.1.1. Opening Year (2024)

The results for the Opening year is shown below.

Table 4-1 - Junction Modelling Results for R147/Circular Road Junction (Opening Year)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year (2024) – AM Peak						
R147 South	10.5 pcu	15.5 s/pcu	62.1%	16.6 pcu	32.9 s/pcu	79.1%
R147 North	7.8 pcu	14.9 s/pcu	45.4%	10.2 pcu	28.2 s/pcu	79.7%
Circular Road	6.4 pcu	32.8 s/pcu	62.7%	7.6 pcu	61.7 s/pcu	77.3%
PRC (%)	**43.5%**			**13.0%**		
Opening Year (2024) – PM Peak						
R147 South	15.1 pcu	21.6 s/pcu	71.4%	22.2 pcu	45.8 s/pcu	88.4%
R147 North	5.7 pcu	36.2 s/pcu	48.2%	9.9 pcu	100.7 s/pcu	88.9%
Circular Road	8.2 pcu	28.4 s/pcu	70.6%	11.1 pcu	65.8 s/pcu	88.2%
PRC (%)	**26.1%**			**1.2%**		

The above table shows that PRC (Practical reserve Capacity) for the junction reduced by 30% and 25% respectively for Do Something AM and PM Peak scenarios when compared to Do Nothing Scenario. This reduction is attributed to the upgrade of the junction by removing left slip lanes and incorporating cycle lanes as per the DMURS standards.

In Do Nothing Scenario, the pedestrian crossing for the R147 northern arm can run during non-conflicting traffic stages and does not require a separate stage. In addition, the pedestrian crossing along the other arm is called around 10% in the modelled hour during both AM and PM peaks. Therefore, during Do Nothing scenario, the junction has extra capacity.

In Do Something scenario, the junction is upgraded to DMURS standard without any slip lanes. Therefore, pedestrian crossings must be catered for by means of a separate stage which is called every cycle. This reduces the capacity of the junction when compared to Do Nothing scenario. In addition, a dedicated cyclist stage is included which further reduces available green time for vehicles at the junction.

Overall, the DOS of all the arms were found to be in order of 80% for AM Peak and in order of 90% for PM Peak. The maximum average delay was observed to be around 1 minute 40 sec which is typical for an urban signalised junction. This suggests that the junction was found to be operating within the capacity for both peaks.

4.1.2. Opening Year + 5 (2029)

The results for the Opening year+5 is shown below.

Table 4-2 - Junction Modelling Results for R147/Circular Road Junction (Opening Year+5)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year +5 (2029) – AM Peak						
R147 South	11.5 pcu	15.9 s/pcu	64.7%	19.9 pcu	38.6 s/pcu	84.8%
R147 North	8.2 pcu	15.5 s/pcu	48.7%	10.8 pcu	29.5 s/pcu	85.5%

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Circular Road	6.7 pcu	33.5 s/pcu	65.1%	8.1 pcu	63.5 s/pcu	80.2%
PRC (%)	**38.3%**			**5.3%**		
Opening Year +5 (2029) – PM Peak						
R147 South	16.7 pcu	22.6 s/pcu	74.3%	26.8 pcu	57.7 s/pcu	93.6%
R147 North	6.4 pcu	40.0 s/pcu	53.3%	11.2 pcu	114.2 s/pcu	94.2%
Circular Road	8.8 pcu	29.4 s/pcu	73.5%	14.4 pcu	81.8 s/pcu	94.0%
PRC (%)	**21.2%**			**-4.4%**		

Similar to the Opening Year, the PRC for the Do Something scenario is reduced when compared to the Do Nothing scenario. The reduction is 33% and 25% respectively for AM and PM peak. This is again because of the reduction in capacity of the junction due to upgrade of the junction to incorporate removal of left slip lanes and separate stage for cyclists.

The junction was found to be operating within capacity for Do Something AM Peak Scenario with DOS in order of 80 to 85% for all the arms. However, for PM peak the junction was found to be operating with DOS of 94% observed for all the arms. Capacity is reduced because of the upgrade of the junction to facilitate the safe movement of cyclists and pedestrians at the expense of vehicular movement. However, the maximum average delay is observed to be around 1 minute for AM Peak and under 2 minutes for PM peak. The junction is modelled with a cycle time of 2 minutes. That means, on an average, vehicles generally have to wait not more than one cycle to clear which is typical for an urban signalised junction.

4.1.3. Opening Year + 15 (2039)

The results for the Opening year+15 is shown below.

Table 4-3 - Junction Modelling Results for R147/Circular Road Junction (Opening Year+15)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year +5 (2029) – AM Peak						
R147 South	14.0 pcu	17.1 s/pcu	70.1%	31.0 pcu	66.3 s/pcu	96.2%
R147 North	9.2 pcu	17.2 s/pcu	57.2%	11.9 pcu	30.6 s/pcu	94.7%
Circular Road	7.6 pcu	35.6 s/pcu	70.8%	11.9 pcu	89.9 s/pcu	93.1%
PRC (%)	**27.0%**			**-6.9%**		
Opening Year +5 (2029) – PM Peak						
R147 South	20.5 pcu	25.6 s/pcu	80.5%	50.7 pcu	134.9 s/pcu	103.2%
R147 North	8.0 pcu	50.7 s/pcu	65.9%	16.7 pcu	179.0 s/pcu	101.5%
Circular Road	10.2 pcu	32.3 s/pcu	79.5%	34.0 pcu	171.4 s/pcu	104.2%
PRC (%)	**11.8%**			**-15.7%**		

In Do Something scenario, the junction was found to be operating above capacity for both AM and PM Peak with DOS of around 93-96% for AM peak and 101-104% for PM peak. The delay observed is observed to be just under 2 minutes for AM peak and 3 minutes for PM peak scenario. Similar to other design years, PRC for Do Something scenario is again reduced when compared to Do Nothing scenario. The reduction was around 34%

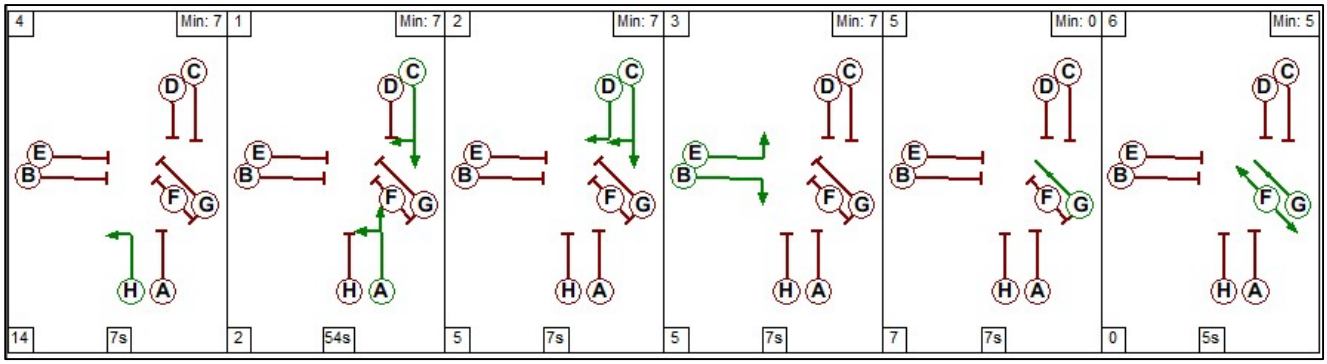
for AM peak and 26% for PM peak. This is again because of the reduction in capacity of the junction due to the upgrade of the junction to incorporate removal of left slip lanes and separate stage for cyclists.

In addition, as stated earlier, the scheme's primary aim is for facilitating active travel movements and therefore encouraging a shift in the present modal split. Therefore, it is highly likely to have a shift in mode share from single vehicle movements to active travel. Therefore, the level of background growth of car trips over 17 years is considered improbable.

4.2. R147/Academy Road Junction

As discussed in the earlier section, this junction is proposed to be upgraded to a signalised junction. Therefore, the junction was analysed using TRL Junction 9 software for Do Nothing and using LinSig for Do Something scenarios. The stage diagram for Do Something scenarios is summarised in the figure below.

Figure 4-2 - Stage sequence diagram for R147/Academy Street Junction



In the first stage, bus lane along R147 South gets green. This stage is provided for only public buses which will travel from R147 South into Academy Street. In the second stage, both R147 north and south are provided general green. Right turners from R147 northern arm are allowed to turn during a gap. In the third stage, R147 northern arm gets right turning filter and the movement from R147 southern arm is stopped. In the fourth stage, Academy Street gets green. Similar to Circular Road Junction, in the penultimate stage, the cyclists get their own green stage, and in the final stage pedestrians get green stage with flashing amber for the cyclists.

The following assumptions were made for the analysis:

- The bus stage was modelled separately. This was because of the tight turning radii along the junction, due to which it's not possible to run traffic stage with bus together. However, this stage was modelled to run on demand and this stage was provided to facilitate public bus services only. As per the traffic count, in the AM and PM peak respectively, only 4 and 6 public buses are supposed to travel along the proposed bus lane from R147 South to Academy Street. Therefore, the bus stage (Stage 1) is to be called only 4 and 6 times respectively for AM and PM peak. Hence, for both AM and PM peak, in one hour, stage 1 is modelled to run only 6 times.
- As the bus lane is located along the R147 southern arm and after stage 1, in stage 2 R147 southern arm is provided green along with R147 Northern arm. Therefore, there is no conflict between Stage 1 and Stage 2 traffic. Therefore, no amber time was provided between both stages. Only All Red time of 2 seconds was provided.
- Similar to the Circular Road Junction, the R147 North filter green stage (stage 3) is called on demand when right turners from R147 Northern arm don't get enough gap in the previous general green stage. However, there are around 12-16 vehicles in one hour turning right from R147 Northern Arm. Therefore, it's highly unlikely that the second stage will be called every cycle. Hence, the stage was modelled to run once in every four cycles for all future design years for both AM and PM Peak.
- There are around 50-60 pcu vehicles along the Academy street in the ultimate Opening+15 year scenario. Hence, it is highly unlikely that stage 4 for the Academy Street will be called in every cycle. Therefore, it was modelled to run once in every alternate cycle.

- Similar to Circular Road Junction, due to provision of single carriageway two-way cycle movement and from a safety point of view, cyclists were provided one separate stage from both traffic and pedestrians
- Similar to Circular Road Junction, cyclists are allowed to travel in final two stages. Therefore, no intergreen was provided between both stages.
- The green time for the cycle stage in this junction is also provided as 7 seconds.
- The green time for the pedestrian is again based on a 5s green with an amber phase equal to the crossing width of the road divided by 1.2 m/s and a 2 s red phase before traffic regains priority.
- The junction was analysed with 120 seconds cycle time.

The results from the model is detailed summarised below.

4.2.1. Opening Year (2024)

The result for Opening Year is summarised below.

Table 4-4 - Junction Modelling Results for R147/Academy Street Junction (Opening Year)

Arm	Do Nothing (Junction 9)				Do Something (LinSig)			
	Queue	Delay	RFC	LOS	Mean Max Queue	Delay	DOS	PRC
Opening Year (2024) – AM Peak								
R147 South					27.4 pcu	30.1 s/pcu	83.1%	8.3%
R147 North	0.2 pcu	15.21 s	0.17	C	11.0 pcu	12.4 s/pcu	50.5%	
Academy Street	0.1 pcu	5.22 s	0.05	A	1.3 pcu	69.4 s/pcu	28.4%	
Opening Year (2024) – PM Peak								
R147 South					26.0 pcu	28.7 s/pcu	81.1%	10.9%
R147 North	0.3 pcu	15.78 s	0.21	C	10.5 pcu	12.2 s/pcu	48.9%	
Academy Street	0.1 pcu	4.54 s	0.06	A	1.6 pcu	71.0 s/pcu	35.1%	

Since the junction was modelled using different software for Do Nothing and Do Something scenario, a quantitative comparison of both scenarios is not possible. For Do Nothing scenario, the LOS C suggests that the junction was just within capacity for both AM and PM peak. For Do Something scenario, the PRC was found to be in order of 8-10% for both AM and PM Peak which suggest that the junction was operating within the capacity. The maximum average delay for both peaks were observed in order of 1 minute 10 seconds which is typical for urban signalised junction.

4.2.2. Opening Year + 5 (2029)

The result for Opening Year + 5 is summarised below.

Table 4-5 - Junction Modelling Results for R147/Academy Street Junction (Opening Year + 5)

Arm	Do Nothing (Junction 9)				Do Something (LinSig)			
	Queue	Delay	RFC	LOS	Mean Max Queue	Delay	DOS	PRC
Opening Year + 5 (2029) – AM Peak								
R147 South					30.2 pcu	33.1 s/pcu	86.5%	4.0%
R147 North	0.2 pcu	16.20 s	0.19	C	11.9 pcu	12.8 s/pcu	52.7%	
Academy Street	0.1 pcu	5.16 s	0.06	A	1.3 pcu	69.3 s/pcu	29.3%	
Opening Year + 5 (2029) – PM Peak								
R147 South					28.5 pcu	31.1 s/pcu	84.4%	6.6%
R147 North	0.3 pcu	16.87 s	0.23	C	11.2 pcu	12.6 s/pcu	51.0%	
Academy Street	0.1 pcu	4.60 s	0.07	A	1.6 pcu	71.0 s/pcu	36.0%	

With LOS C in Do Nothing scenario, and PRC of 4-6% in Do Something Scenario, the junction was found to be operating within capacity for both scenarios during both AM and PM Peak. The maximum average delay for both peaks were observed in order of 1 minute 10 seconds which is typical for urban signalised junction

4.2.3. Opening Year + 15 (2039)

The result for Opening Year + 15 is summarised below.

Table 4-6 - Junction Modelling Results for R147/Academy Street Junction (Opening Year + 15)

Arm	Do Nothing (Junction 9)				Do Something (LinSig)			
	Queue	Delay	RFC	LOS	Mean Max Queue	Delay	DOS	PRC
Opening Year + 15 (2039) – AM Peak								
R147 South					38.1 pcu	44.9 s/pcu	93.6%	-4.0%
R147 North	0.3 pcu	19.28 s	0.22	C	13.5 pcu	13.7 s/pcu	57.0%	
Academy Street	0.2 pcu	5.02 s	0.07	A	1.4 pcu	70.3 s/pcu	31.8%	
Opening Year + 15 (2039) – PM Peak								
R147 South					35.2 pcu	40.1 s/pcu	91.5%	-1.7%
R147 North	0.4 pcu	20.29 s	0.28	C	12.6 pcu	13.5 s/pcu	55.2%	
Academy Street	0.2 pcu	4.42 s	0.08	A	1.8 pcu	72.1 s/pcu	39.3%	

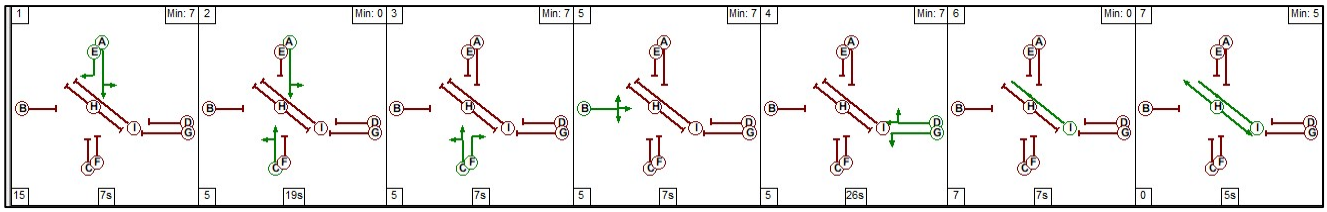
The junction was still found to be operating within capacity in Do Nothing scenario with LOS C. However, in opening+15 year scenario, the junction was found to be operating slightly above the capacity for both Do Something AM and PM Peak scenarios. The largest impact was mainly found to occur on the R147 southern arm with DOS above 90% observed for both peaks. However, the maximum average delay was observed to be in the order of 1 minute 10 seconds for both peaks which is similar to the previous design years. This level of delay is typical for an urban signalised junction.

In addition, as stated previously, the main aim of the scheme is to increase active travel mode share. Therefore, it is considered unrealistic that this level of background growth of car trips over 17 years is going to take place.

4.3. R147/Springfield Glen/Bothar Sion Junction

The junction was analysed using LinSig for Do Nothing and Do Something scenarios. The stage diagram for Do Something scenarios is summarised in the figure below.

Figure 4-3 - Stage sequence diagram for R147/Springfield Glen/Bothar Sion Junction



In the first stage, all the movements from R147 northern arm are provided green. In the second stage, left and straight movements from both R147 Northern Arms are provided green. In the third stage, all the movements from R147 Southern Arm are provided green. In the fourth and fifth sage, Springfield Glen and Botha Sion gets green respectively. Similar to previous two junctions, in the penultimate stage, the cyclists get own green stage, and in the final stage pedestrians get green stage with flashing amber for the cyclists.

The following assumptions were made for the analysis.

- In Do Nothing Scenario (existing scenario), in stage 2 both R147 northern and R147 southern arm get general green. That means, right turners from both the arms are allowed to move into the gap when available. This is because, currently the right most small lane along the R147 northern arm facilitates both straight and right turning traffic. However, in Do Something scenarios, this lane is upgraded to use only for right turning movement. Therefore, in Do Something Scenario, only straight and left movements are allowed in Stage 2 with separate right turning filter stages for the individual arms are provided (Stage 1 and Stage 3).
- Stage 1 and Stage 3 are to be called only on demand for the right turning movements on the individual arms. In the existing condition, for AM Peak both Stage 1 and Stage 3 are called every cycle. However, in PM Peak, stage 3 is called every cycle, but Stage 1 is called only 50% times in one hour. Therefore, for PM Peak, stage 1 was modelled to run one in every alternate cycle.
- Similarly, Stage 5 and 6 are also called on demand. In AM Peak, both stages are called every cycle. In PM Peak, Stage 5 for Springfield Glen lane is called 50% time, while Stage 6 for Bothar Sion lane is called every cycle. Therefore, in PM Peak Stage 5 was modelled to run once in every alternative cycle.
- Similar to previous two junctions, the scheme has provision of single lane two-way cycle movement. Therefore, cyclists need separate stage from traffic also for this junction. After the cycle stage, flashing amber can be provided to the cyclists in the pedestrian stage, where they can travel but have to yield for the pedestrians.
- Similar to Circular Road Junction, cyclists are allowed to travel in final two stages. Therefore, no intergreen was provided between both stages.
- The green time for the cycle stage was provided as 7 seconds as cyclists were also allowed to travel in stage 5 also.
- The green time for the pedestrian was based on a 5s green with an amber phase equal to the crossing width of the road divided by 1.2 m/s and a 2 s red phase before traffic regains priority.
- The junction was analysed with 120 seconds cycle time for both Do Nothing and Do Something scenarios.

The results from the model is summarised below.

4.3.1. Opening Year (2024)

The result for Opening Year is summarised below.

Table 4-7 - Junction Modelling Results: R147/Springfield/Bothar Sion Junction (Opening Year)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year (2024) – AM Peak						
Springfield	2.6 pcu	86.7 s/pcu	53.7%	2.5 pcu	81.8 s/pcu	49.7%
R147 South	23.5 pcu	72.7 s/pcu	93.2%	50.8 pcu	236.8 s/pcu	108.8%
R147 North	63.6 pcu	256.5 s/pcu	110.7%	23.5 pcu	52.7 s/pcu	81.0%
Bothar Sion	37.8 pcu	224.0 s/pcu	107.5%	40.4 pcu	245.3 s/pcu	109.0%
PRC (%)	**-23.0%**			**-21.6%**		
Opening Year (2024) – PM Peak						
Springfield	0.8 pcu	71.5 s/pcu	17.8%	0.8 pcu	69.8 s/pcu	16.4%
R147 South	19.4 pcu	49.7 s/pcu	83.5%	25.9 pcu	85.7 s/pcu	95.9%
R147 North	26.6 pcu	74.3 s/pcu	95.0%	19.4 pcu	42.6 s/pcu	66.5%
Bothar Sion	20.5 pcu	88.7 s/pcu	94.5%	20.9 pcu	93.0 s/pcu	95.2%
PRC (%)	**-5.6%**			**-6.5%**		

Due to upgrade of the R147 northern arm from two lanes to three lanes, the DOS improved by around 30% for R147 northern arm in both Do Something AM and PM peak scenarios when compared to Do Nothing scenario. However, DOS increased for R147 southern arm by 12-15% for both peaks in Do Something scenario compared to Do Nothing scenario. The impact on DOS for other arms in Do Something scenario was observed to be small for both secondary arms. In addition, in Do Nothing Scenario, two R147 southbound lanes merge into one lane just downstream of the junction creating a throttle point and additional delays. In Do Something scenario, there is provision of only one R147 southbound lane at the downstream of this junction. Therefore, no throttle point exists in this scenario and no extra delay was observed in this case.

Overall, the junction was found to be operating over capacity for both Do Nothing and Do Something scenarios. However, due to opposing impact on both R147 northern and southern arms and removal of throttle point downstream, the impact in Do Something scenario was generally neutralized. Therefore, unlike other junctions, the impact of the proposed junction upgrade was found to be small in Do Something Scenario when compared to Do Nothing Scenario. A small improvement in PRC of around 1.5% was observed in AM Peak, while a slight reduction of 1% in PM peak was observed.

4.3.2. Opening Year + 5 (2029)

The result for Opening+5 year is summarised below.

Table 4-8 - Junction Modelling Results: R147/Springfield/Bothar Sion Junction (Opening Year + 5)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year + 5 (2029) – AM Peak						
Springfield	2.8 pcu	89.3 s/pcu	57.2%	2.7 pcu	83.7 s/pcu	52.8%
R147 South	25.2 pcu	76.8 s/pcu	94.6%	63.3 pcu	300.1 s/pcu	113.2%
R147 North	74.6 pcu	297.5 s/pcu	113.6%	25.2 pcu	55.5 s/pcu	84.5%

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Bothar Sion	55.1 pcu	343.9 s/pcu	116.0%	50.1 pcu	306.7 s/pcu	113.5%
PRC (%)	**-28.9%**			**-26.2%**		
Opening Year + 5 (2029) – PM Peak						
Springfield	0.8 pcu	71.8 s/pcu	18.7%	0.8 pcu	70.0 s/pcu	17.3%
R147 South	21.3 pcu	54.5 s/pcu	87.2%	32.3 pcu	114.1 s/pcu	100.0%
R147 North	37.2 pcu	120.6 s/pcu	101.2%	20.7 pcu	43.6 s/pcu	69.2%
Bothar Sion	24.7 pcu	112.5 s/pcu	98.5%	25.6 pcu	119.6 s/pcu	99.3%
PRC (%)	**-12.5%**			**-11.1%**		

Similar to Opening Year scenario, the junction was found to be operating over the capacity for both Do Nothing and Do Something scenarios and the impact of the upgrade was found to be small. A small improvement in PRC of around 3% observed in AM Peak, while a slight reduction of 1% in PM peak was observed. This is again, due to opposing impact on DOS for both the R147 arms. For the R147 northern arm, the DOS was observed to improve by around 30% for both peaks, while for R147 Southern arm, the DOS was observed to increase by 13-18% for both peaks. The impact on DOS for other arms in Do Something scenario was observed to be small for both secondary arms.

4.3.3. Opening Year + 15 (2039)

The result for Opening+5 year is summarised below.

Table 4-9 - Junction Modelling Results: R147/Springfield/Bothar Sion Junction (AM Peak)

Arm	Do Nothing			Do Something		
	Mean Max Queue	Delay	DOS	Mean Max Queue	Delay	DOS
Opening Year + 15 (2039) – AM Peak						
Springfield	3.1 pcu	93.0 s/pcu	61.4%	3.0 pcu	86.4 s/pcu	56.8%
R147 South	40 pcu	140.2 s/pcu	102.5%	91.4 pcu	427.0 s/pcu	122.6%
R147 North	113.8 pcu	453.4 s/pcu	125.3%	29.9 pcu	65.4 s/pcu	91.5%
Bothar Sion	78.1 pcu	473.1 s/pcu	125.8%	72.2 pcu	432.9 s/pcu	123.1%
PRC (%)	**-39.7%**			**-36.7%**		
Opening Year + 15 (2039) – PM Peak						
Springfield	0.9 pcu	72.1 s/pcu	20.3%	0.9 pcu	70.3 s/pcu	18.8%
R147 South	27.1 pcu	72.2 s/pcu	94.4%	56.5 pcu	224.1 s/pcu	108.3%
R147 North	58.4 pcu	204.6 s/pcu	107.4%	23.2 pcu	45.9 s/pcu	75.1%
Bothar Sion	40.7 pcu	205.5 s/pcu	106.7%	42.4 pcu	217.8 s/pcu	107.5%
PRC (%)	**-19.4%**			**-20.3%**		

Similar to both design years, the junction was again found to be operating over the capacity for both scenarios with a small impact of the upgrade being observed. A slight reduction in PRC of around 3% was seen for AM Peak, while a slight improvement of 1% for PM peak was observed. This is again, due to opposing impact on DOS for both the R147 arms. The impact on DOS for other arms in Do Something scenario was observed to be small for both secondary arms.

5. Summary

The TTA assesses the impact of the prosed Navan Road (R147) cycle scheme on key junctions. The junctions include: R147/Circular Road Junction, R147/Academy Road Junction and R147/Springfield/Bothar Sion junction. All the junctions are proposed to be upgraded in accordance to DMURS to facilitate the movement of pedestrians and cyclists.

The background traffic has been grown in accordance with the growth in the number of trips per day as per the NTA National Demand Forecasting Model. The proposed cycle scheme will facilitate the shift in car based modal share to active travel. However, for conservative approach, same mode share is applied to all future year design scenarios.

The junctions were analysed individually using various transport modelling software on the basis of the junction type.

For all the junctions, it is proposed to have a single carriageway for both way movements of the cyclists. Therefore, it was not possible to run cyclists with traffic. In addition, from safety point of view it is not possible to only have one stage for both cyclists and pedestrians. Therefore, one separate stage was proved just for cyclists. In the pedestrian stage, cyclists are to be provide with the flashing amber where they can travel, but they have to yield for the pedestrians.

For the **Circular Road junction**, in Do Something scenario, when compared to Do Nothing scenario, a 25-35% reduction in the Practical Reserve Capacity for the junction across all the design years were observed. However, the junction was found to be operating within the capacity opening year Do Something AM and PM peak scenarios. The junction was found to be operating slightly over the capacity for Opening Year+5 PM peak Do Something scenario. For AM Peak, in Opening Year+5 design year, the junction was still operating within the capacity. For both peaks, in Opening+15 deign year scenario, the junction was found to be operating over the capacity. The reduction in the capacity of junctions in Do Something Scenario is attributed to the upgrade of the junction due to which pedestrian stage has to be included in every cycle and also due to provision of a separate cycle stage.

For **Academy Street Junction**, for both AM and PM peaks, the junction was found to be operating within the capacity during both Opening and Opening+5 design years scenarios, while over the capacity for Opening+15 year scenario. However, the junction was found to be operating with a maximum average delay of around 1 minute 10 seconds across all the scenarios which is typical for an urban junction.

For **Springfield/Bothar Sion Junction**, the junction was found to be operating over the capacity for both Do Nothing and Do Something scenarios. However, unlike other junctions, the impact of upgrade was found to be small in Do Something Scenario as compared to Do Nothing Scenario. For all the design year scenarios, a small improvement in PRC of around 1.5% was observed in AM Peak, while a slight reduction of 1% in PM peak was observed.

Overall, for most of the future year scenarios, with the upgrade of the junction the capacity of the junction reduced. However, the objective of the scheme is to facilitate the safe movement of cyclists and pedestrians at the expense of capacity for vehicles.

In addition, it should be noted that the increase in background growth over the future year, especially for Opening+15 design year scenarios, is unlikely to be realised given National and Regional travel policies and moves to more sustainable modes. Therefore, it’s highly likely that the results for future years represent the minimum level of capacity that would be available at these junctions.