Tionscadal Éireann
Project Ireland
2040

N19 SHANNON AIRPORT ACCESS ROAD IMPROVEMENT SCHEME

TRAFFIC MODELLING REPORT

Comhairle Contae an Chláir
Clare County Council

June 2023
Rev 6

An Roinn Iompair
Department of Transport

Bonneagar Iompair Éireann
Transport Infrastructure Ireland

Mid West
National Road Design Office

FEHILY TIMONEY

CLANDILLON
CIVIL CONSULTING

REVISION CONTROL SHEET

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

1.1 Context

In October 2019 Fehily Timoney and Company Ltd./Clandillon Civil Consulting Ltd (FTC) were appointed to carry out the development of the N19 Shannon Airport Access scheme through stages 1 to 4 of the Transport Infrastructure Ireland (TII) Project Management process. The scheme is currently at Phase 2 – Option Selection.

The Project Appraisal Plan (PAP) for this scheme was prepared at Phase 0 by the MidWest National Road Design Office (MWNRDO) in May 2018 and submitted to TII Strategic Planning Unit and to the Department of Transport, Tourism and Sport (DTTAS), now the Department of Transport, for approval in advance of the current contract.

The PAP classifies the scheme as a Minor Project, for which the appraisal procedures set out in Project Appraisal Guidelines (PAG) Unit 12 applies. However, the cost estimates developed in Phase 1 indicate a likelihood that the outturn cost will exceed the €20m threshold. So, at the current stage (Phase 2), MidWest NRDO have taken the decision to appraise it as a Major Project. Accordingly, this Traffic Modelling Report forms one of the appraisal deliverables for the scheme at this stage.

In Phase 1, the proposed traffic modelling methodology was set out in an Annex to the PAP, which was submitted to TII Strategic Planning Unit. This Annex proposed collection of project-specific traffic survey data in March/April/May 2020. Due to the Covid-19 pandemic, this was not possible. This report describes the Phase 2 Traffic Model that was developed instead using existing available data.

1.2 Scheme Location

The N19 National Primary Road extends from M18 Junction 9 to Knockbeagh Point Roundabout, a distance of approximately 5km. The route provides access to Shannon International Airport and the Shannon Free Zone industrial area, and a northern access to Shannon Town.

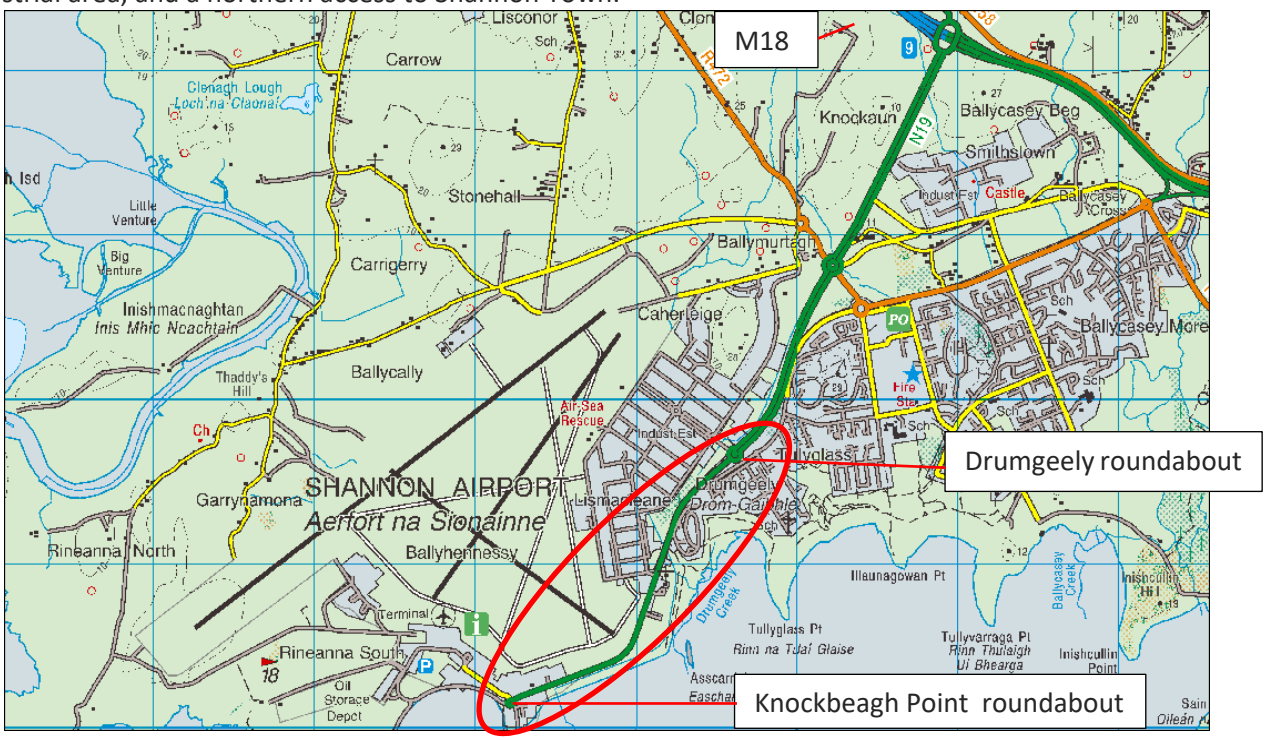


Figure 1-1: Scheme Location

1.3 Context - Land Uses Served

Shannon International Airport is the third busiest airport in the Republic of Ireland, with the longest runway. In 2019, Shannon Airport handled 1.71 million passengers, a growth of approximately 3% per annum from the low point of 2012. It has capacity for more and aims to grow back to at least 2.5m passengers per year.

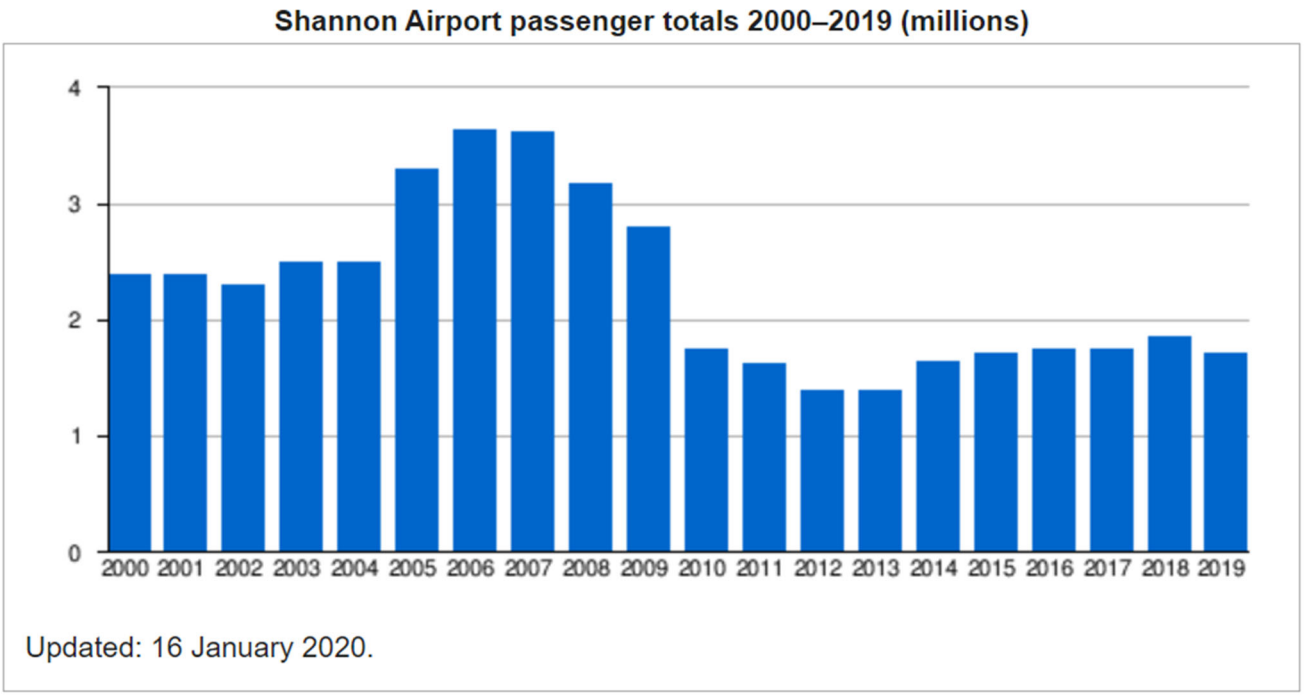


Figure 1-2: Shannon Airport Passenger Numbers

The Shannon Free Zone (SFZ) is Ireland's biggest multi-sectoral business park and houses the country's largest cluster of FDI investment outside of Dublin. It claims to be the world's first free trade zone. The site adjacent to the runways (Shannon Free Zone West) was established in 1959; a further site (Shannon Free Zone East) at Smithstown was developed later.

Shannon Free Zone is home to more than 100 international and Irish companies employing over 8,000 highly skilled employees and offers a range of incentives to businesses.

The SFZ is owned by Shannon Commercial Properties. Their website notes: -

"As we enter into our next phase of our masterplan to grow the Shannon Free Zone, we have exciting plans in the development pipeline."

1.4 Scheme Options

A Project Brief for the scheme was delivered in accordance with TII PAG guidance. That document considered a wide range of options and alternatives to meet the scheme objectives. A high-level review has sifted out some of these options as unlikely to meet the objectives of the scheme. The emerging conclusion from the Phase 1 Feasibility Study was that the options to be appraised comprise "packages" or combinations of:

Road link options

- On-line (within-corridor) upgrades to the south-western end of the N19.

Road Junction Options

- Closure of the minor junction at Drumgeely Hill;
- Improvements to road geometry at roundabouts;
- Signal control of junctions (which could facilitate bus priority at signals); and
- Grade separation of Drumgeely roundabout.

Pedestrian and Cyclist options

- Options to provide improved footpath/cycleway along the N19 corridor between Shannon Town and the Airport; and
- Options for new or upgraded facilities for pedestrians or cyclists to cross the N19.

1.5 Need for Traffic Modelling

The purpose of the traffic model is twofold:

- to inform the choice between the options listed above, by assessing the traffic impacts of options for changes to the link standard, or junction configuration, or provision of pedestrian crossings along the N19; and
- to predict the traffic impacts of the selected option, as a key input to the economic and environmental impact of the scheme.

2. TRAFFIC DATA

2.1 Junction Turning Counts

Classified video turning counts were undertaken on Tuesday 26th November 2019 at 10 road junctions as shown in **Figure 2.1**. These counts were undertaken for Shannon Commercial Properties, for their own planning purposes, and they have kindly made the data available to the project.

High-mast telescopic video camera systems were used to record the operation of each junction between 00:00 and 24:00. 15-minute survey intervals were used, and vehicles were classified as:

- Motorcycles
- Cars
- Light Goods Vehicles (LGV)
- Medium Goods Vehicles (OGV1)
- Heavy Goods Vehicles (OGV2)
- Buses & Coaches (PSV).

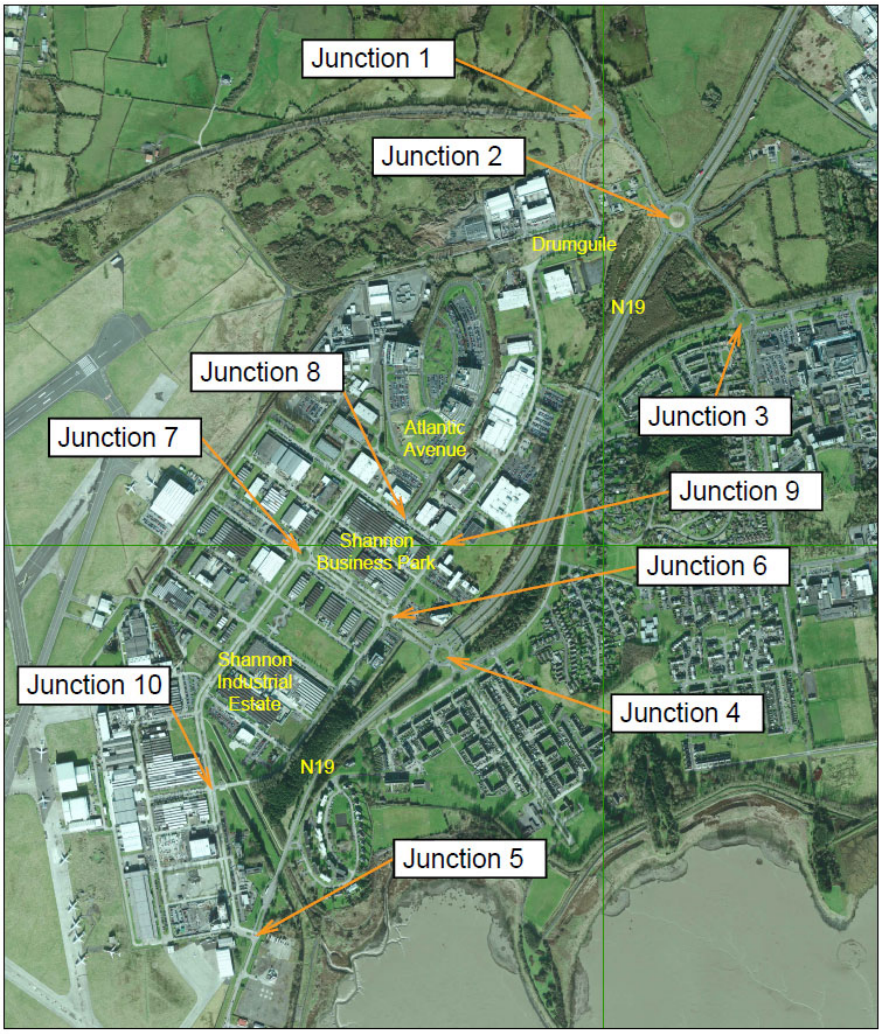


Figure 2-1: November 2019 JTC Survey Locations

Junctions 1 to 6 from this survey were used for traffic model development.

The vehicle mix recorded at Drumgeely roundabout is shown in **Table 2.1**:

Table 2-1: Vehicle Mix from 24-hour Classified Video Count

Car (& MC)	LGV	OGV1	OGV2	PSV	Total
18119	1532	305	279	185	20420
88.7%	7.5%	1.5%	1.4%	0.9%	100.0%
96.2%		3.8%			
Light		Heavy			
92.2%	7.8%	39.7%	36.3%	24.1%	

2.2 Permanent Traffic Counter

TII Traffic Monitoring Unit has permanent induction loop counters on the stretch of the N19 northeast of the Drumgeely roundabout. This counter came on-stream in late February 2019. A full year of data has been downloaded covering 1st March 2019 to 29th February 2020, that is largely unaffected by the Covid-19 pandemic.

Figure 2-2: Location of TMU Counter

2.3 Journey Time Surveys

Journey time surveys were undertaken on 29th November 2017, using the "moving observer" method.

Two runs were undertaken in each direction in each of three time periods – AM peak, Interpeak, PM peak.

The average journey time recorded was 3 minutes 11 seconds for the 2.15 km journey between Knockbeagh roundabout and Drumgeely roundabout, an average speed of 40.5 kph.

Table 2-2: Observed journey times

	AM	IP	PM
southbound	**03:06**	**03:06**	**03:08**
northbound	**03:13**	**03:18**	**03:21**
southbound	**03:00**	**03:10**	**03:09**
northbound	**03:07**	**03:18**	**03:22**

Because Drumgeely roundabout forms one end of the survey route, these times include delay to northbound traffic at Drumgeely roundabout but not delay to southbound traffic. The data show northbound journeys slower than southbound, with the slowest journeys in the PM peak, consistent with the greatest congestion being at Drumgeely roundabout.

3. ANALYSIS OF TRAFFIC DATA

3.1 Context – Daily and Seasonal Variation from TMU Counter

Figure 3.1 shows variation in flow over the year. There is relatively little summer/winter variation. The busiest week is at end August / start September. This is understood from Shannon International Airport to be when airport passenger throughput is highest. **Figure 3.2** shows variation in flow over an average weekday (Mon-Fri October 2019 excluding week of Bank Holiday). Traffic flow is dominated by tidal commuter peaks.

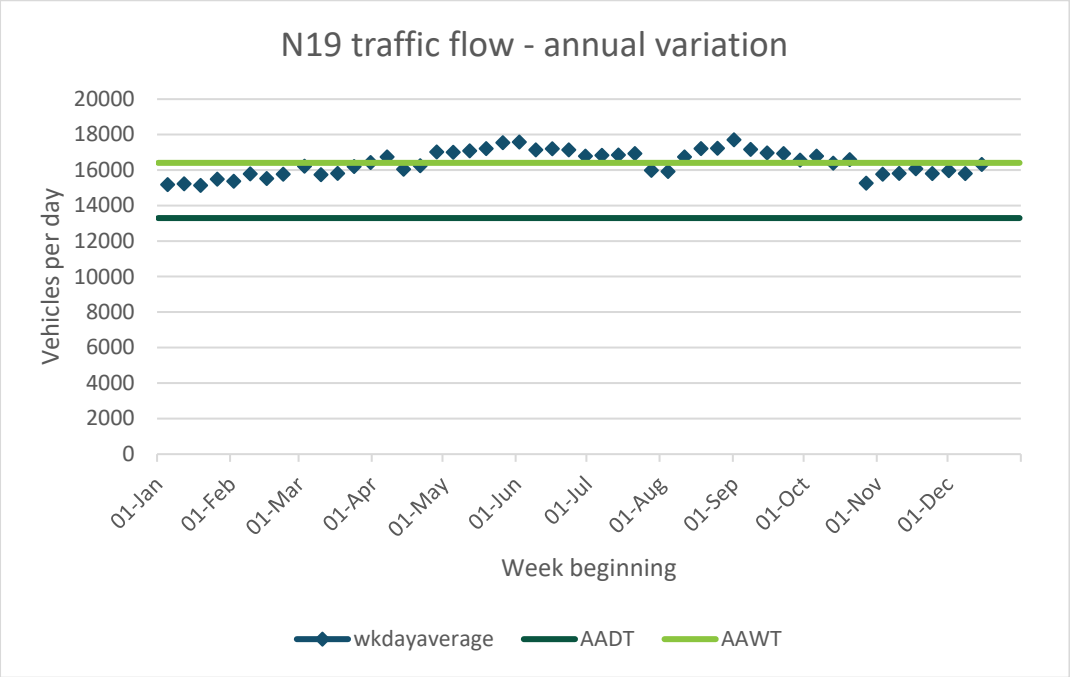


Figure 3-1: Seasonal variation

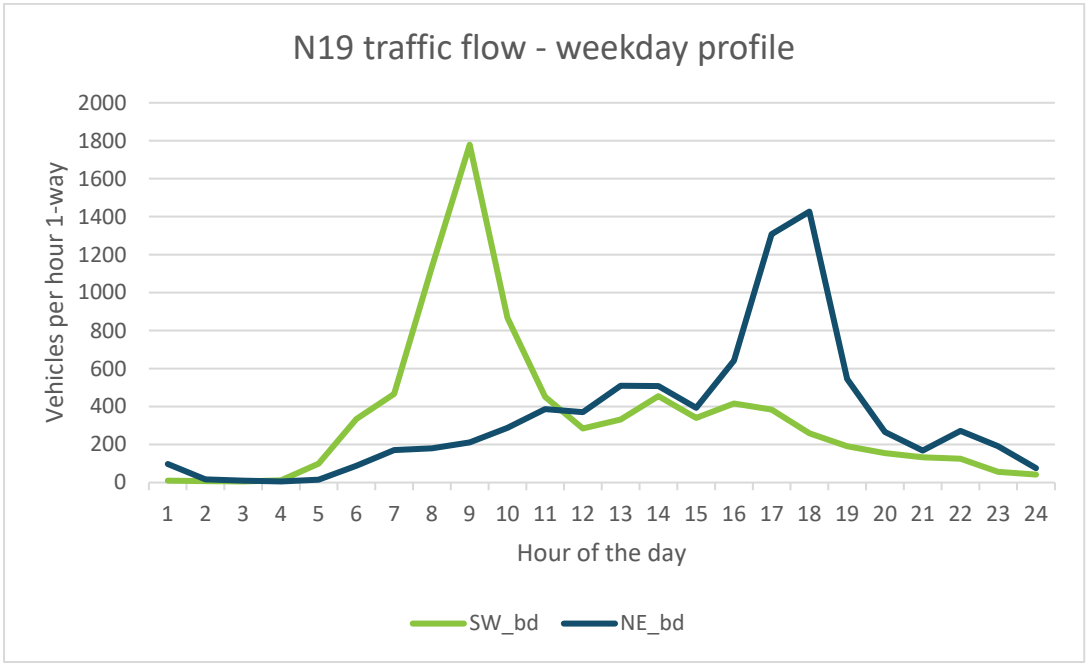


Figure 3-2: Daily variation

Figure 3.3 shows variation in flow by day of week. These are calculated over the full year, excluding Bank Holidays and the Christmas fortnight. This illustrates that Friday is little different from any other weekday in terms of traffic volumes and that weekend flows are very much lower than those during the week.

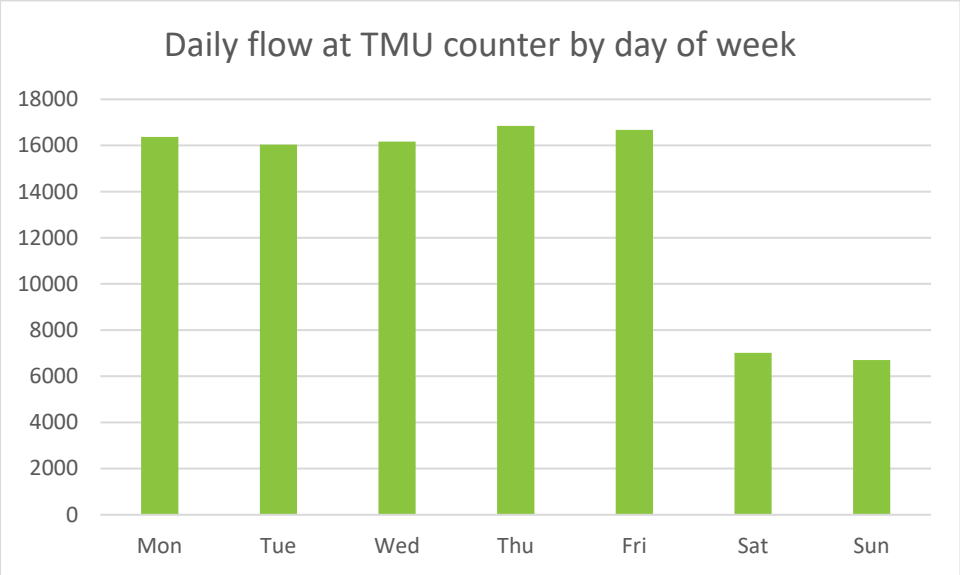


Figure 3-3: Variation by day of week

3.2 Context – Peak Turning Movements at Drumgeely Roundabout

Figure 3.4 shows the observed peak hour turning movements at Drumgeely roundabout. It can be seen that the largest movements are from N19(NE) to the Shannon Free Zone West (SFZW) business park in the AM and back in the PM. The second-largest movements are from N19(NE) to N19(SW) in the AM, and back in the PM. The third-largest movements are from Shannon Town to the SFZW business park in the AM and back in the PM.

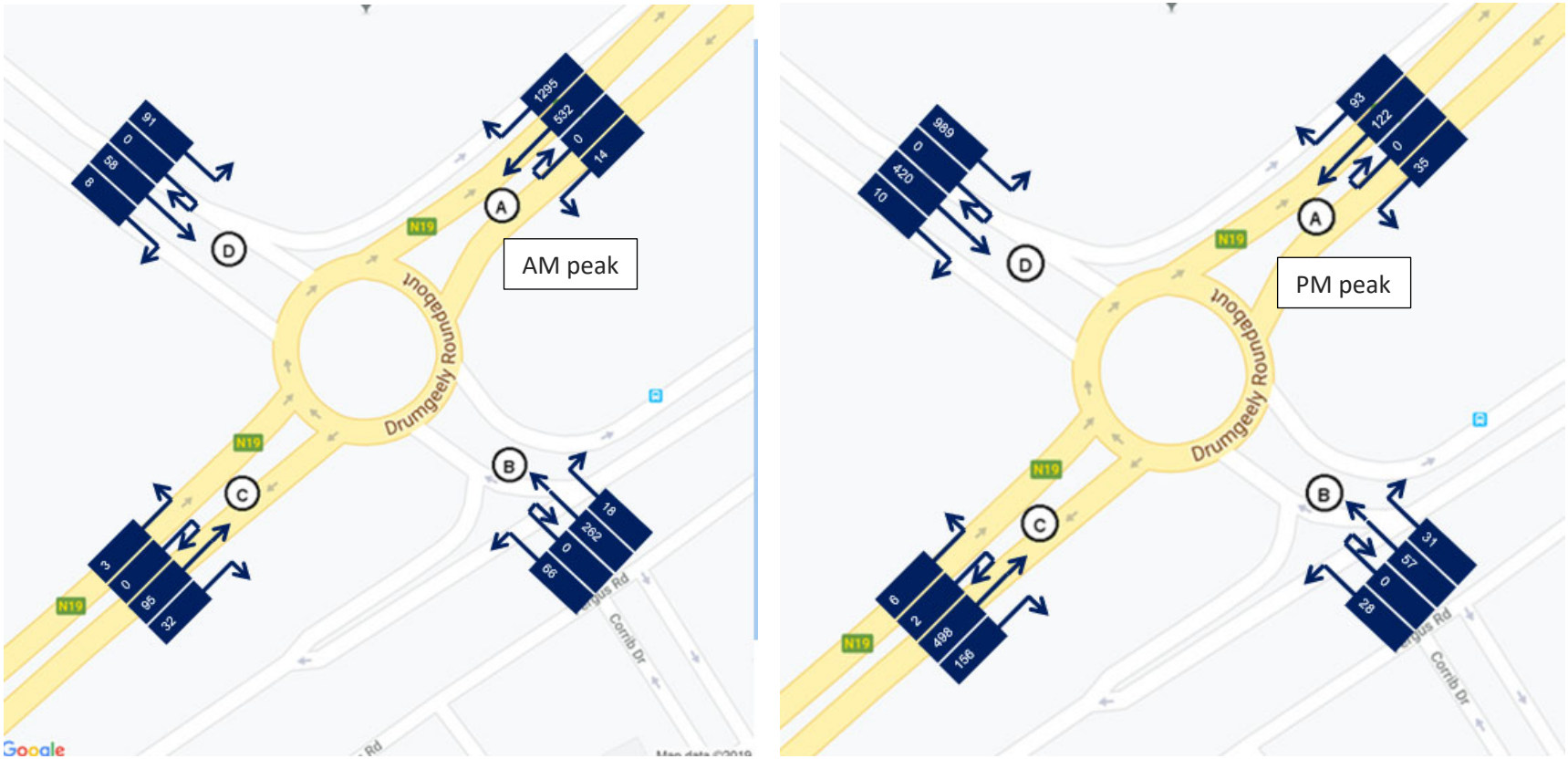


Figure 3-4: Peak flows at Drumgeely roundabout

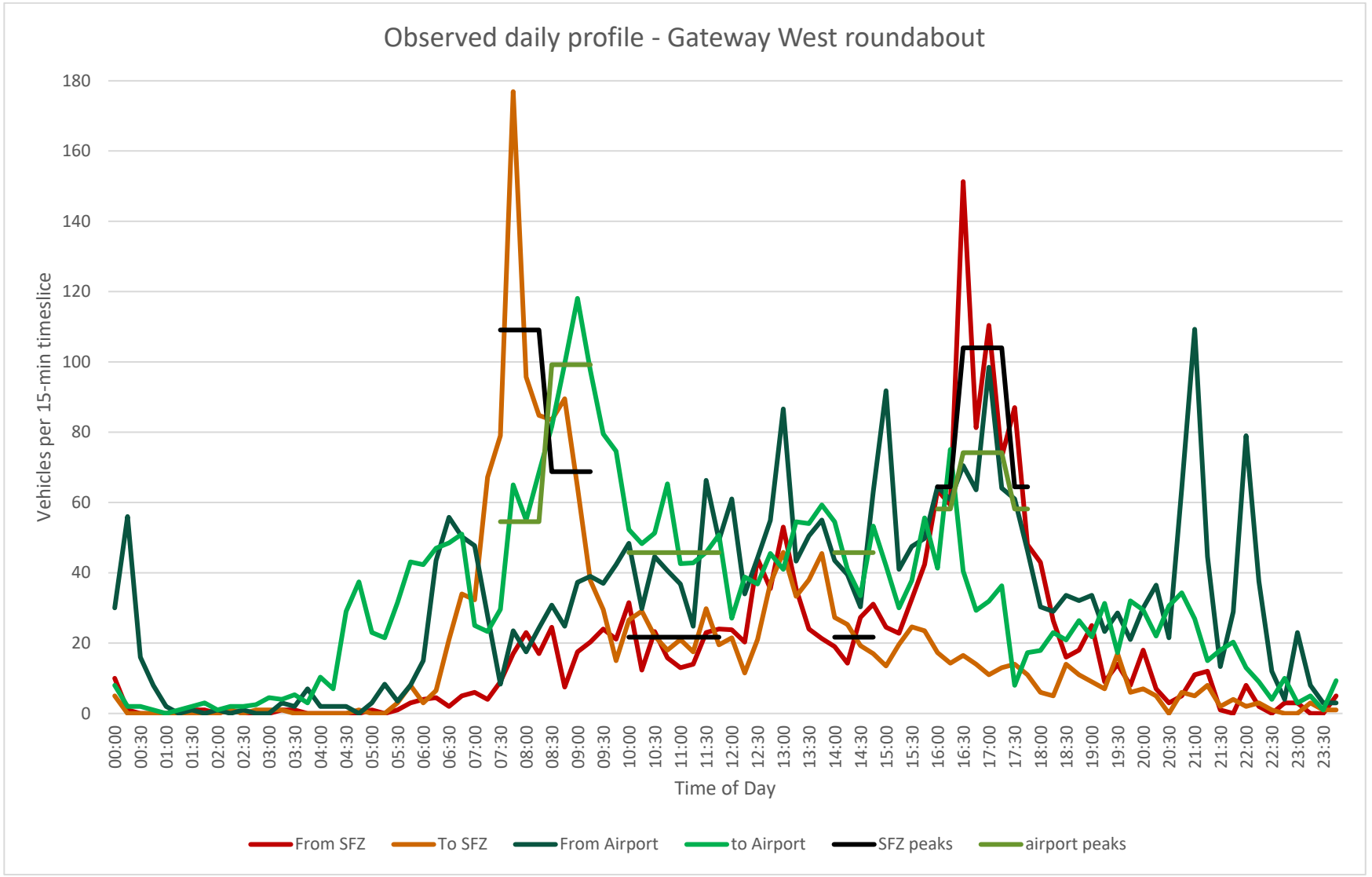


Figure 3-5: Flow profiles at Gateway West roundabout

3.3 Selection of Modelled Time Periods

Figure 3-5 shows daily traffic profiles observed at the Gateway West roundabout, for four different movements. This illustrates a number of features of the traffic patterns on the N19.

The traffic to and from the SFZW business park is highly peaked. The busiest hour for arrivals at the business park is 07:30-08:30, with a spike between 07:45 and 08:00, presumably for commuters starting work at 8am.

The busiest hour for departures from the business park is 16:30-17:30, with a spike between 16:30 and 16:45.

A secondary peak at lunchtime can be observed for both arrivals and departures from the business park.

Traffic to the airport is busiest in the hour 08:30-09:30, possibly involving a combination of commuters starting work around 9am and passengers arriving for morning flights.

Traffic from the airport does have a PM peak in the hour 16:30-17:30 but flows are not particularly high. A number of spikes can be seen on the graph, with flows of around 90 vehicles in particular 15-minute periods, reflecting flight arrivals.

Accordingly, in order to fully represent the range of travel conditions on the N19, five time periods have been modelled:

Table 3-1: Selection of Modelled Time Periods

Name	Period	Notes
Early AM peak	07:30-08:30	Dominated by traffic to SFZW
Late AM peak	08:30-09:30	Main flow is traffic to airport
Interpeak	Average of 10:00-11:00, 11:00-12:00, 14:00-15:00	Inflows and outflows broadly balanced. More traffic to/from airport than SFZW
PM peak	16:30-17:30	Tidal flow from airport and SFZW; more from SFZW
PM shoulder	16:00-16:30 and 17:30-18:00	Tidal flow from airport and SFZW; similar flows from each

3.4 AADT Estimates from Modelled Time Periods

The cost-benefit analysis and peak hour operational appraisal use modelled hourly flows directly. For presentation purposes, for environmental impact assessment, and to inform pavement design, it is helpful to convert these modelled hourly flows to Annual Average Daily Traffic (AADT), being a standard measure of traffic levels on a road. This was done in two stages.

Table 3.1 shows the ratios of flow in each modelled hour to 24-hour flow on the day of survey (this is taken from the total flows using Drumgeely roundabout on the survey day; the numbers are thus higher than the flows on any individual approach link).

Table 3-2: Time period expansion factors (from count data)

Modelled hour	Hourly flow in model period	24-hour total on survey day	factor
AM early peak	2341	21113	9.019
AM late peak	2110		10.008
Interpeak	916		23.047
PM peak	2446		8.633
PM shoulder	1843		11.457

Daily flow could be estimated from hourly flow in any one of these time periods, by multiplying by the factor shown.

A more robust estimate is obtained by using a linear combination of these five estimators. The proposed linear combination is based on the proportion of daily traffic that can be considered to relate to each period.

Figure 3.6 shows these proportions of daily traffic (calculated excluding the overnight hours with lowest flows).

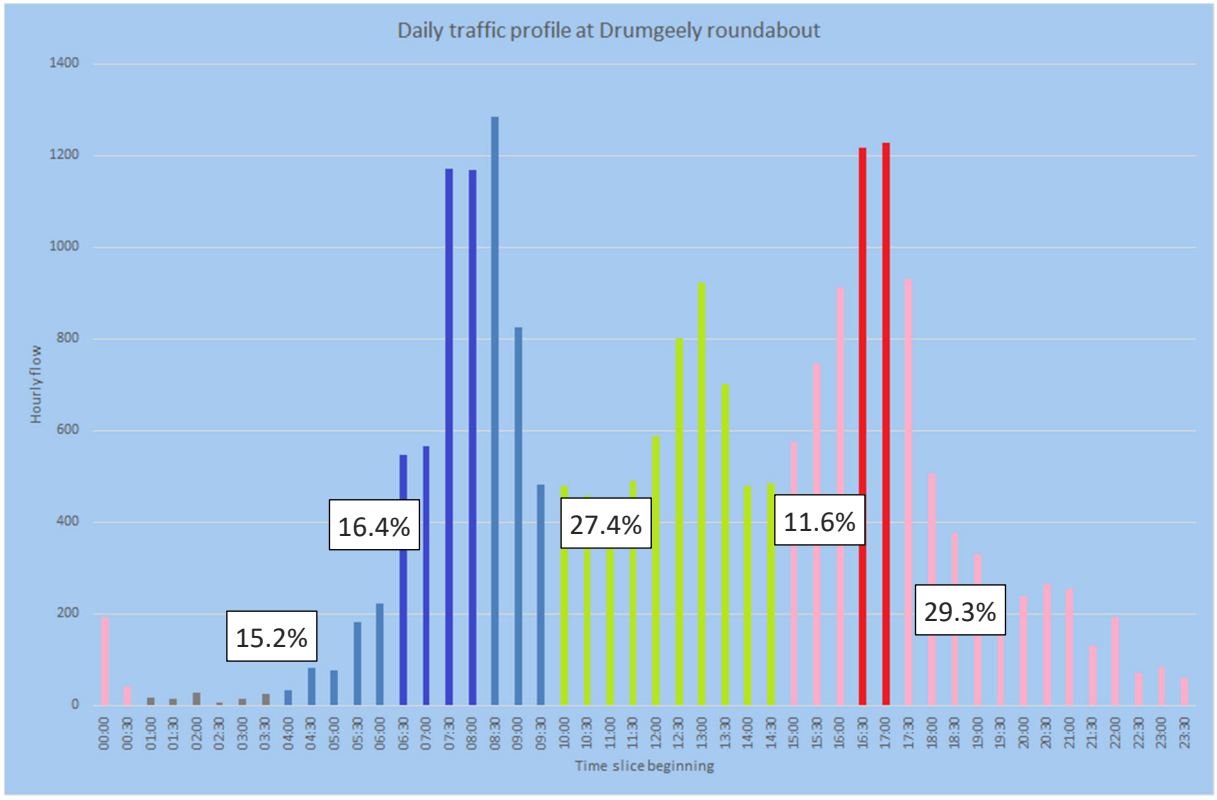


Figure 3-6: Typical weekday profile

A robust estimate of daily traffic is therefore:

16.4% x (9.019 x AM early flow) + 15.2% x (10.008 x AM_late flow) + 27.4% x (23.047 x IP flow) + 11.6% x (8.633 x PM_peak flow) + 29.3% x (11.457 x PM_peak flow)

= 1.483 x AM_early + 1.520 x AM_late + 6.320 x IP + 1.005 x PM_peak + 3.358 x PM_shoulder.

Note that this process is mathematically equivalent to an approach of factoring up hourly flows to periods of the day, and then adding period totals to get a daily total (as recommended in PAG unit 16.0).

The second stage of the calculation uses a full year's data from the TMU counter on the N19 to compare flows on the survey day with annual average traffic levels.

At this site, recorded flow for the survey day is 16,015 vehicles per day, compared with a recorded AADT of 13,297 vehicles per day. So the correction factor from survey day to Annual Average traffic levels is 13,297/16,015 = 0.830 (most of this being due to the much-lower weekend flows dragging down the 7-day average).

Multiplying the previous numbers by this factor, it is estimated that AADT traffic flows on each link of the model can be considered as being made up of:

1.23 x traffic at modelled AM_early peak hour levels and flow patterns

+

1.26 x traffic at modelled AM_late peak hour levels and flow patterns

+

5.25 x traffic at modelled interpeak hour levels and flow patterns

+

0.83 x traffic at modelled PM_peak hour levels and flow patterns

+

2.79 x traffic at modelled PM_shoulder hour levels and flow patterns.

4. BASE YEAR MODEL DEVELOPMENT

4.1 Network extent

A road network was developed in SATURN, coding all node positions against an OSI-referenced map background. **Figure 4.1** shows the extent of the network.

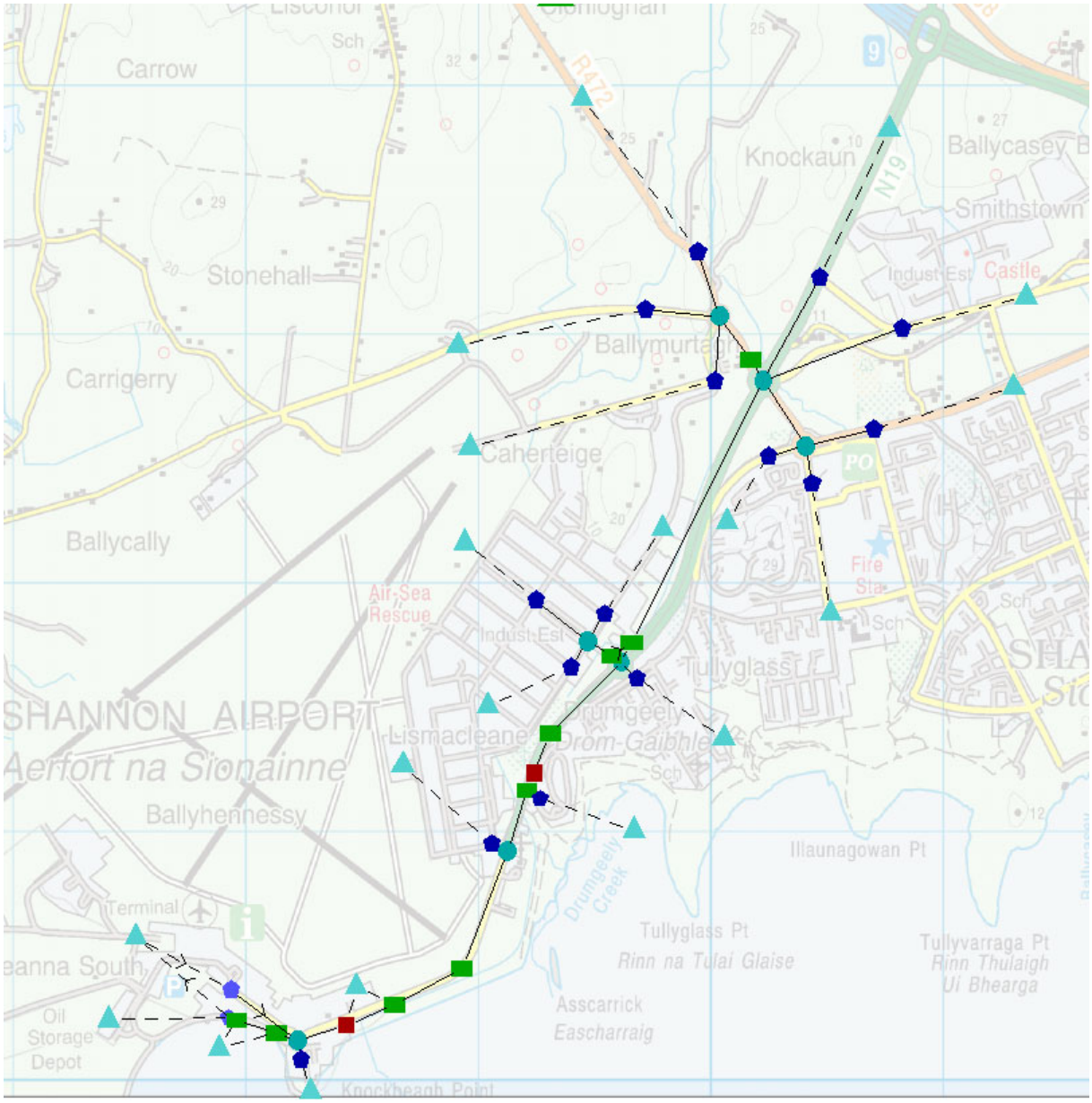


Figure 4-1: Model network

Note that there is minimal route choice in this network.

Traffic inbound to Shannon Airport has the option of leaving the N19 at Shannon Town roundabout, passing through three smaller roundabouts on the local road network and rejoining the N19 at Drumgeely roundabout, yielding priority to traffic that stays on the N19.

In order to assess whether this local route should be included in the model, a sensitivity test was carried out with this route included. Modelled freeflow speeds for this test are shown in Figure 4-2.

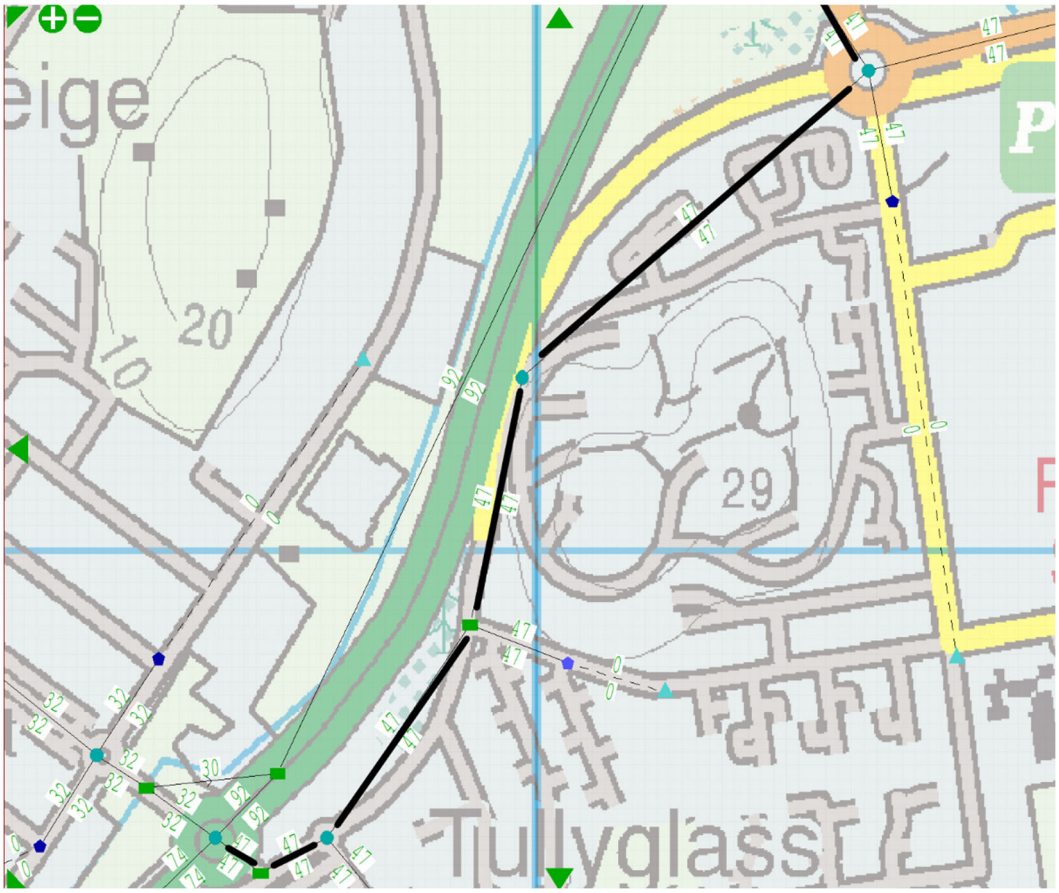


Figure 4-2: Alternative route included for sensitivity test

Select link analysis was used to identify the use made of this alternative route. The results showed that, even at Do-Minimum design year traffic levels, neither northbound nor southbound N19 traffic diverted to use the alternative route (which uses the old road to Shannon Airport, superseded by the current N19).

Accordingly, it was concluded that this route is not and would not be used by through traffic, and it was excluded from further consideration.

A further sensitivity test was undertaken looking at extending the network on the west side of the N19 – this is reported in Appendix B.

4.2 Network characteristics

The initial speed-flow curves used in the network and the saturation flows at junctions were based on data from the NTA regional model. These were subsequently modified as part of the calibration process.

Observed traffic turning counts for each of the five modelled time periods were coded into the model, for light and heavy vehicles separately. Flows were coded in units of pcus, with each heavy vehicle given a weight of 2.5 pcus.

4.3 Zoning

The model was initially set up with 19 zones representing entry/exit points to the model network. 5 zones represent different areas of the airport, 5 zones represent the different access points to the Shannon Free Zone(West) Business park, 6 zones represent routes for traffic to/from/via parts of Shannon Town, one zone represents the M18/N18/N19 junction, and 2 zones represent routes for traffic arriving/departing to/from areas to the rural areas northwest of the airport.

Subsequently a twentieth zone was added to represent a significant development site immediately to the southeast of the Gateway West roundabout.

4.4 Assignment

The model uses a conventional static equilibrium assignment procedure applied to hourly flows, with two user classes. The cost functions used in the assignment model were based on those in the National Transport Authority (NTA) Regional Model. The resulting values are shown in **Table 4.1** (these are not critical as there is minimal route choice in the network).

Table 4-1: Elements of Generalised Cost

Vehicle Class	Cents per km	Cents per hour
Light	41.42	9.83
Heavy	85.44	55.92

4.5 Trip Matrices

Initial prior matrices were developed by a process of combining turning count data, assuming that turning proportions at each junction apply equally to flows from each origin.

A matrix estimation procedure was then applied to fit these matrices more closely to the count data, and the fitted matrices assigned back to the network. The classified video turning counts were used for this fitting process at the level of light and heavy vehicles.

Figure 4.2 – Figure 4.6 shows the effect of this procedure in bringing the modelled flows closer to the count data. In each case the diagonal line represents the ideal in which modelled flows match counted flows exactly.

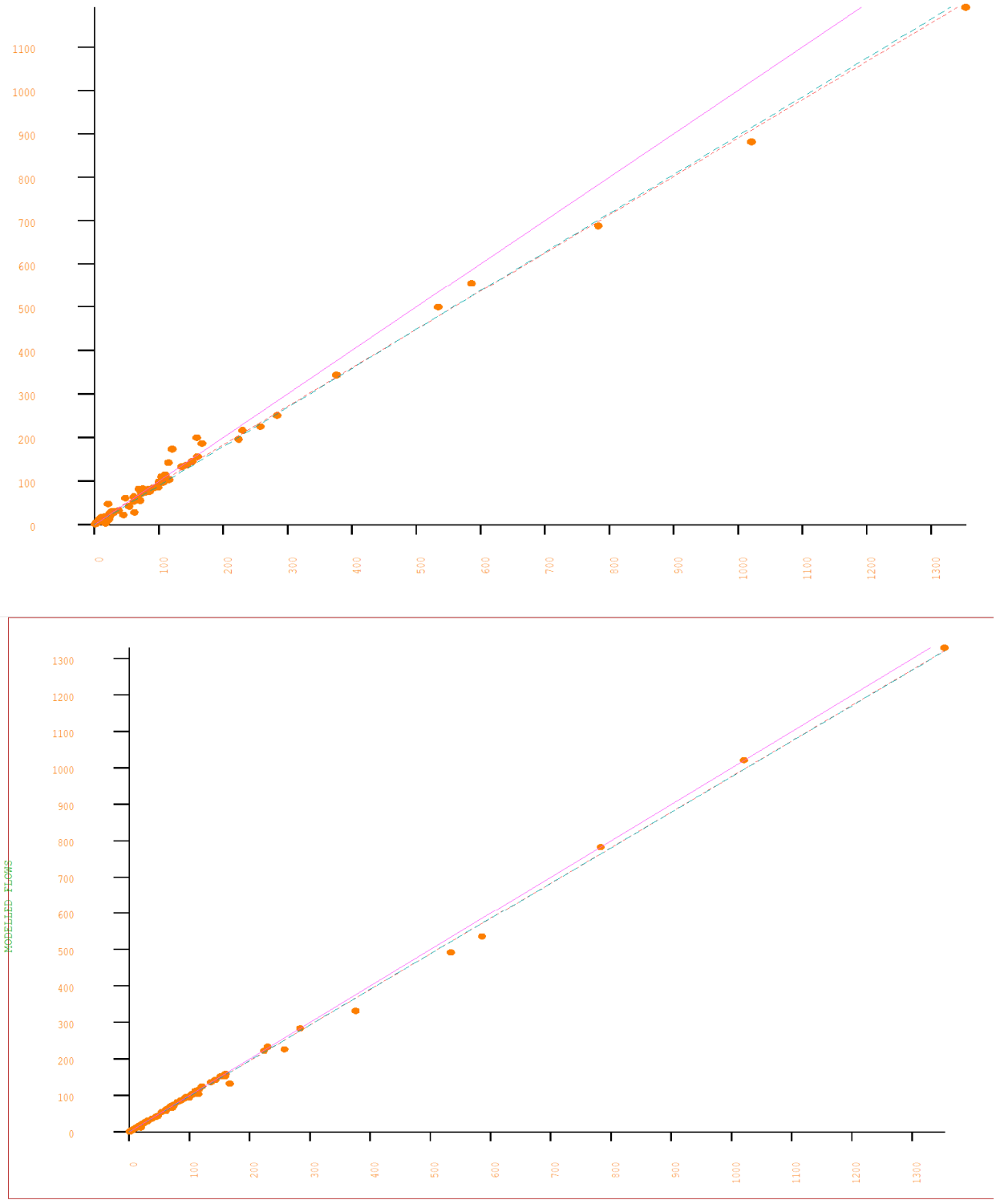


Figure 4-3: Modelled and Observed traffic flows before & after matrix estimation - AM early peak

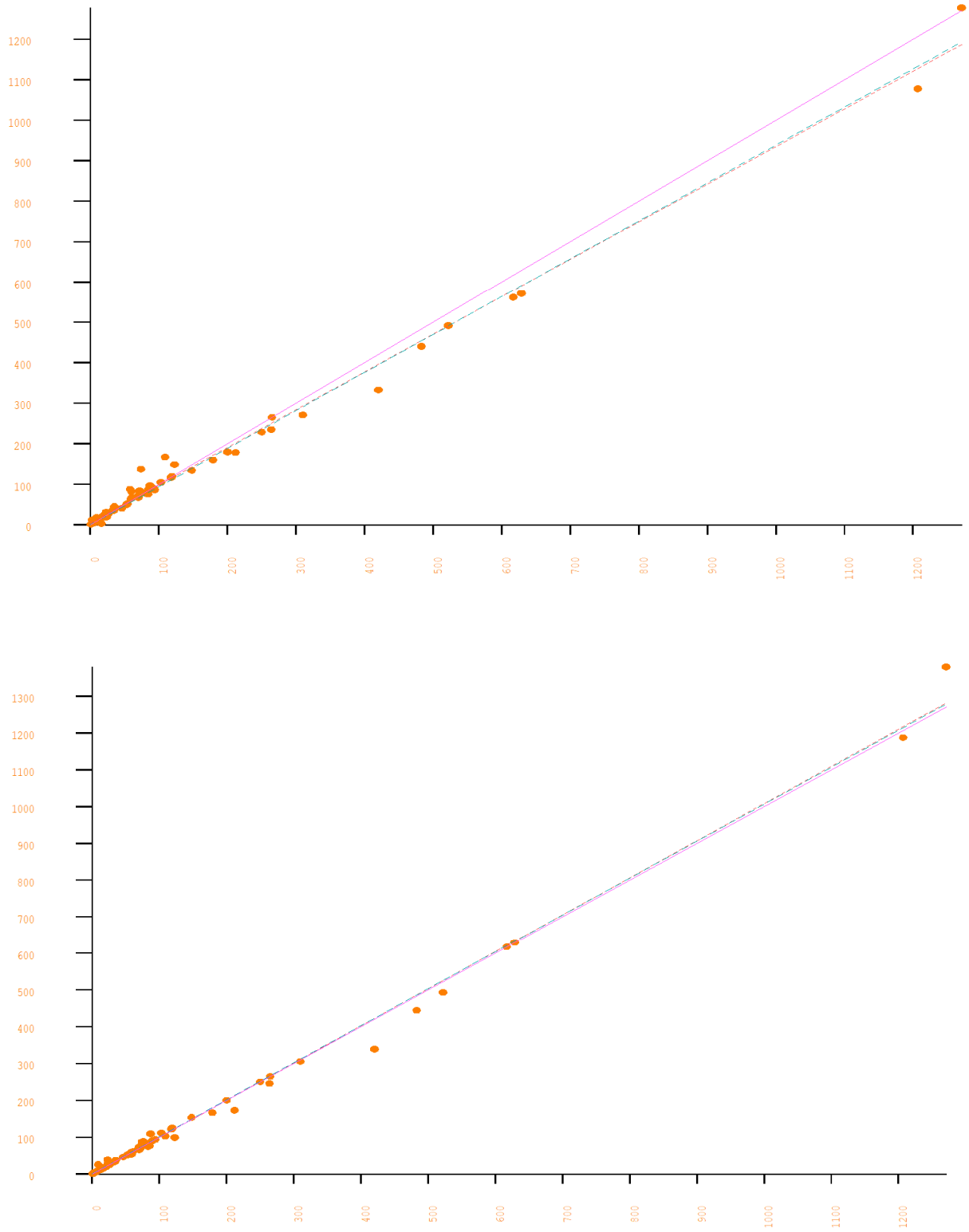


Figure 4-4: Modelled and Observed traffic flows before & after matrix estimation - AM late peak

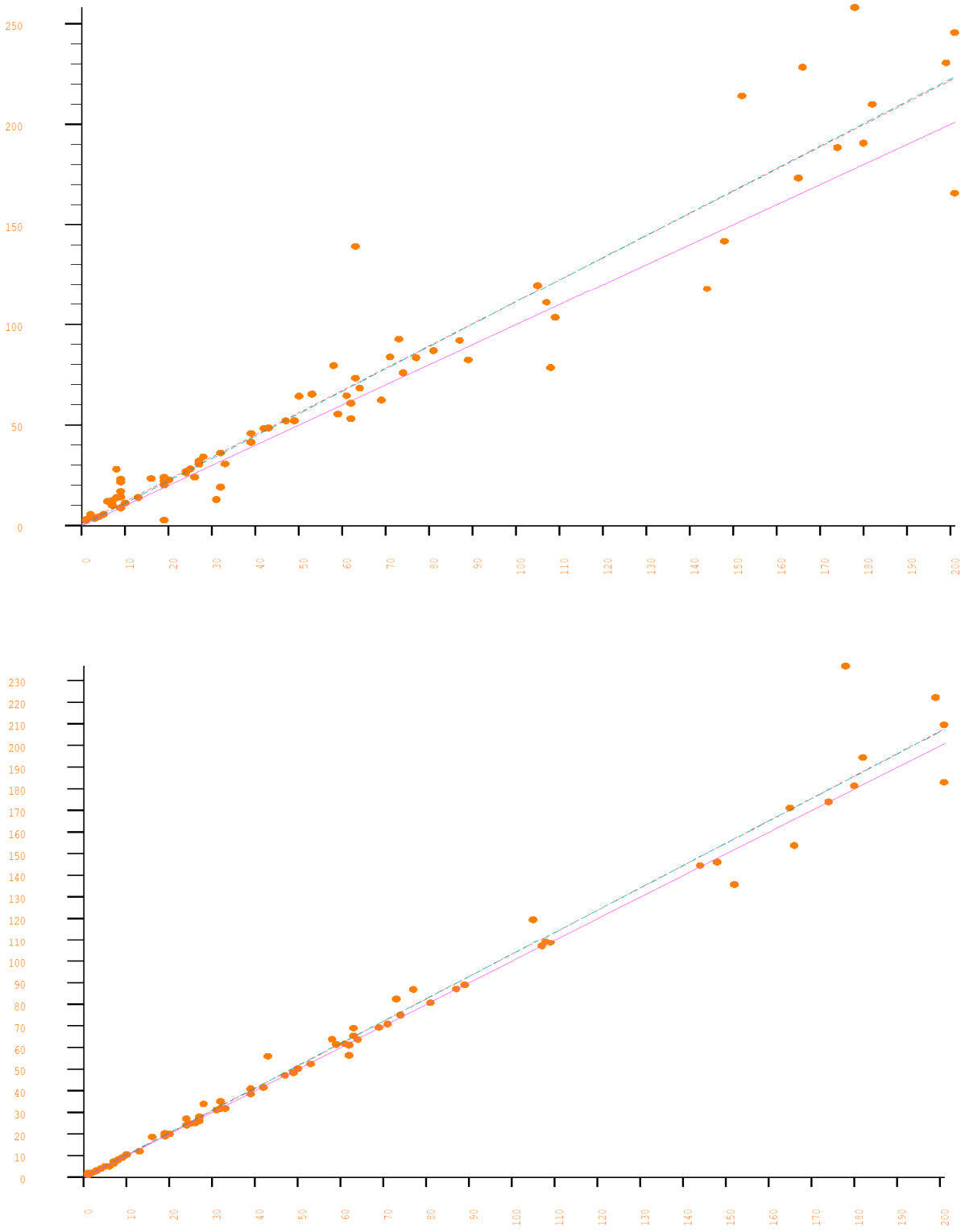


Figure 4-5: Modelled and Observed traffic flows before & after matrix estimation - interpeak

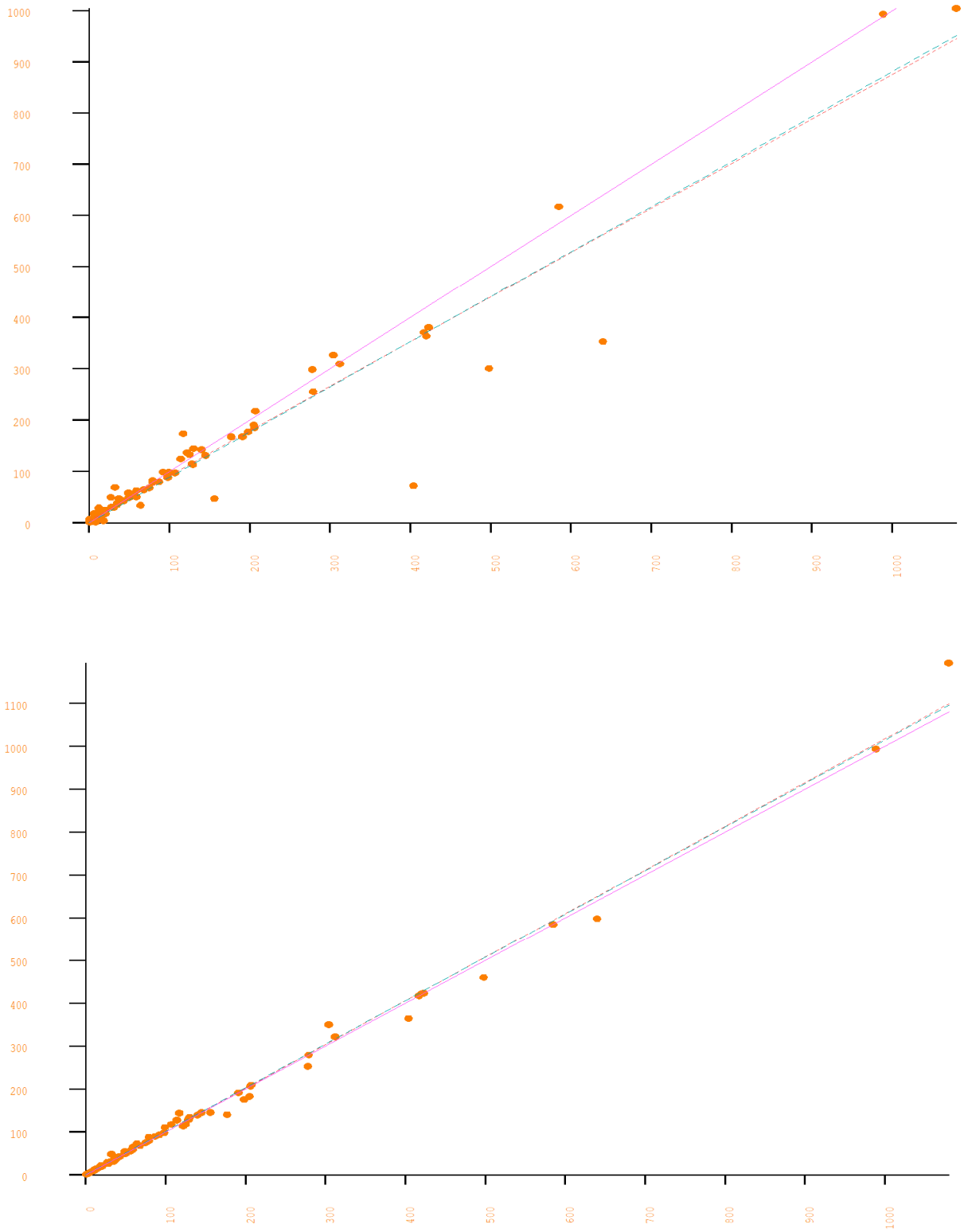


Figure 4-6: Modelled and Observed traffic flows before & after matrix estimation - PM peak hour

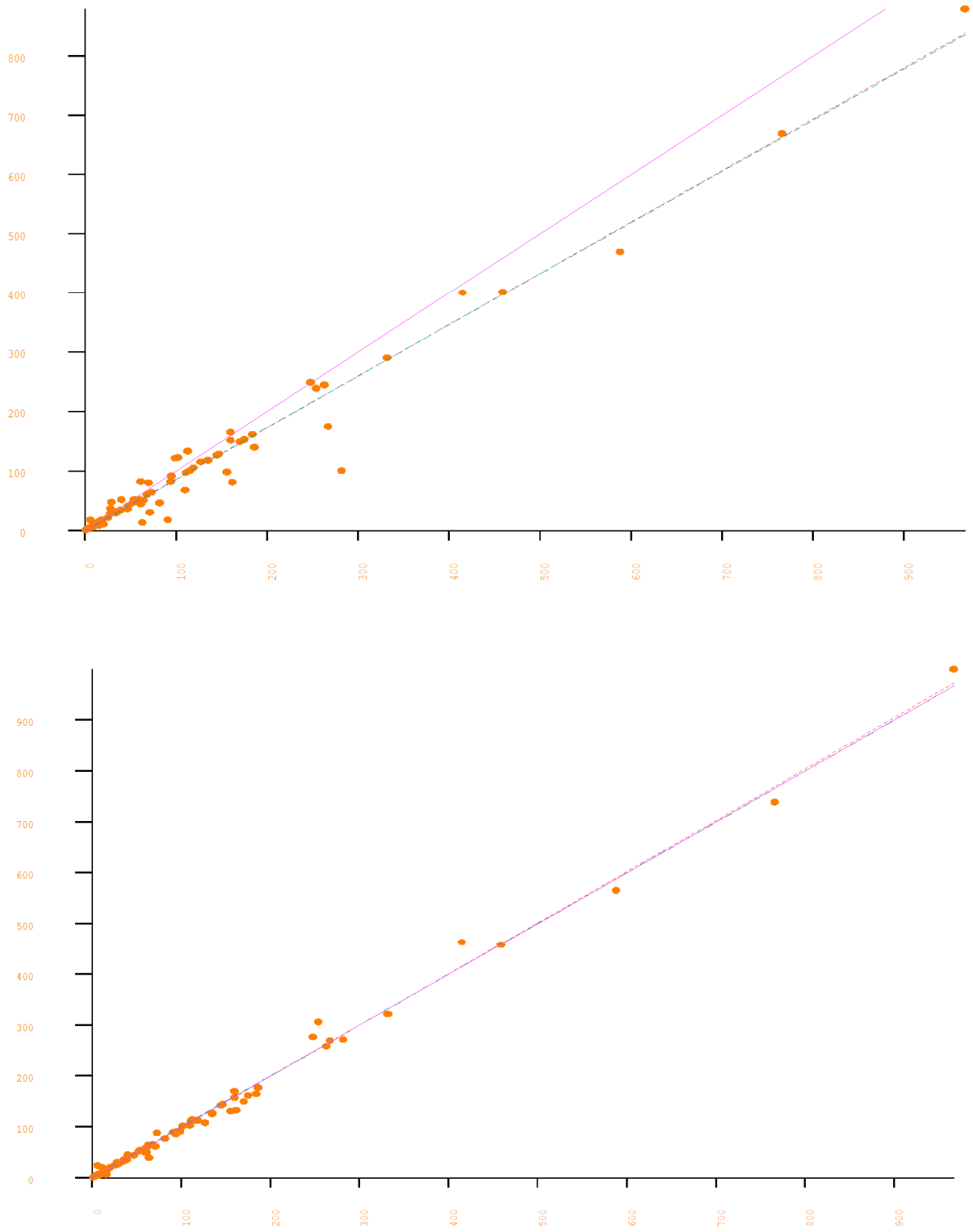


Figure 4-7: Modelled and Observed traffic flows before & after matrix estimation - PM shoulder hour

Appendix A presents the fit to calibration data in the form of GEH statistics. This is a standard measure of fit that allows for both the absolute size and the relative size of differences in flow.

PAG guidance recommends that a well-fitting model should match the calibration data to within a GEH value of 5 for 85% or more of all counts. For the N19 model, represents a simple layout with minimal route choice, 100% of counts are matched within a GEH value of 5.

4.6 Journey Time Calibration

"Moving observer" journey time surveys were undertaken by the Mid-West NRDO on 29th November 2017 between the Airport roundabout (Knockbeagh Point) and the Drumgeely Roundabout. A total of six runs were undertaken in each direction, covering AM peak, interpeak and PM peak conditions.

The model was calibrated to reproduce these journey times, by small adjustments to the speed-flow curves and saturation flows used.

Table 4.2 shows the level of fit achieved:

Table 4-2: Model fit to surveyed journey times

	AM-late	*dif*	AM-early	*dif*	PM peak	*dif*	PM-shoulder	*dif*	IP	*dif*
Survey	00:03:07	*5.1%*	00:03:07	*0.8%*	00:03:15	*-1.5%*	00:03:15	*-1.5%*	00:03:13	*-6.2%*
Model	00:03:16		00:03:08		00:03:12		00:03:12		00:03:01	
Average	-0.7%									

4.7 Validation

The model is fitted to count data from Tuesday 26th November 2019. Data from the permanent counter on the N19 has been used in interpreting the data, but not in model-building, and is therefore available as an independent check on the levels of traffic flow in the base year model. **Table 4-3** presents this comparison.

Table 4-3: Model comparison

Modelled time period	Observed flow		Modelled flow		*% difference*		GEH statistic	
	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
AM early	1842	24	1781	19	-3%	-21%	1.43	1.08
AM late	1651	51	1647	46	0%	-10%	0.10	0.72
Interpeak	584	55	579	48	-1%	-13%	0.21	0.98
PM peak	1589	83	1655	71	4%	-14%	1.64	1.37
PM shoulder	1353	43	1426	30	5%	-30%	1.96	2.15

Journey time and distance were sense-checked against those from a leading internet journey planner.

Figure 4-8: Journey Time and Distance

4.8 Base year Model Results

Figure 4.8 shows the resulting modelled AADT flows for the base year 2019.

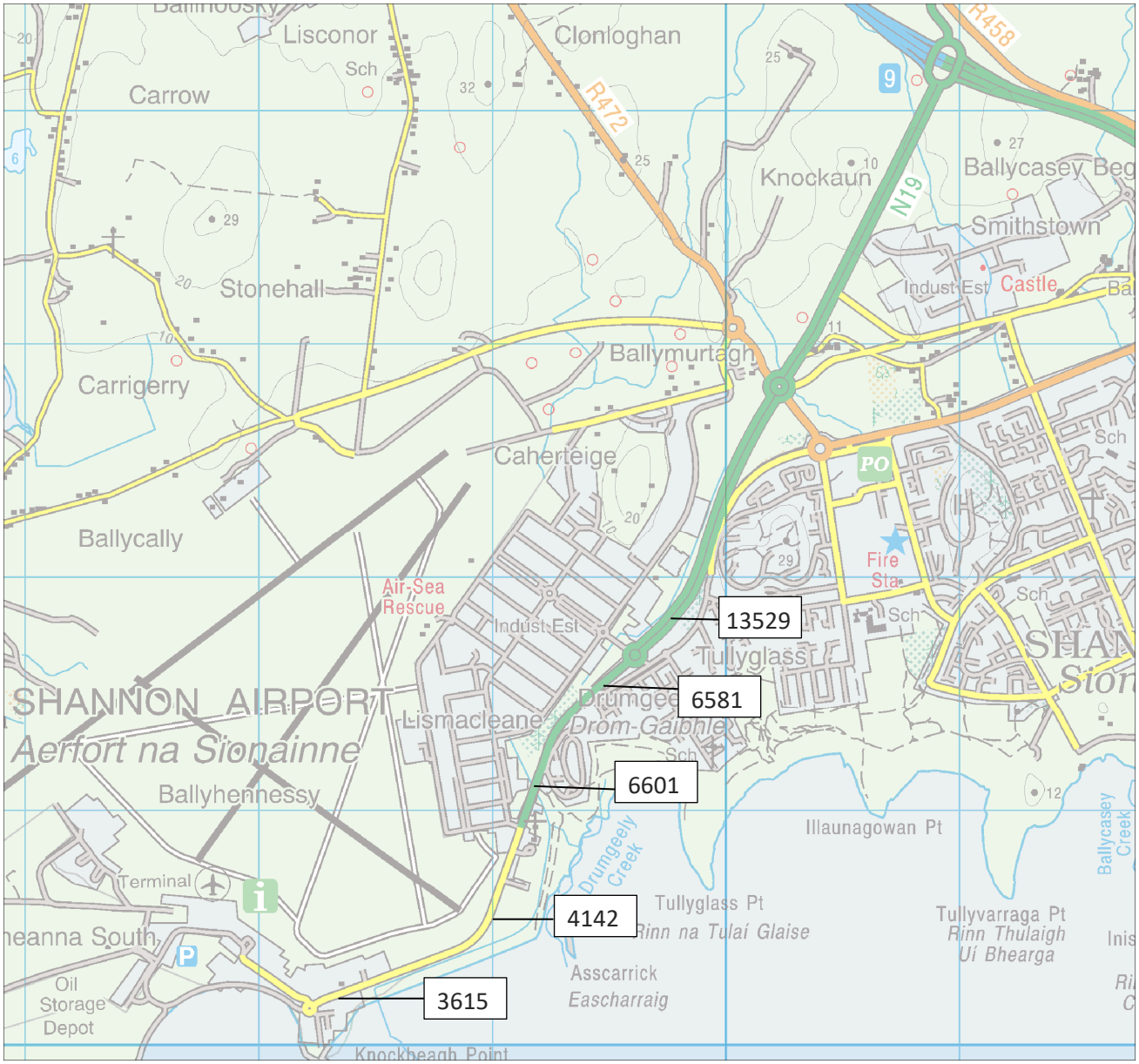


Figure 4-9: Modelled AADT flows in base year

Figures 4-9 and 4-10 show desire line diagrams, indicating the relative size of the daily flow totals in the model between each origin-destination pair. This is for the late AM peak hour and the PM peak hour, and indicates that the largest individual flows are to and from the M18 junction.

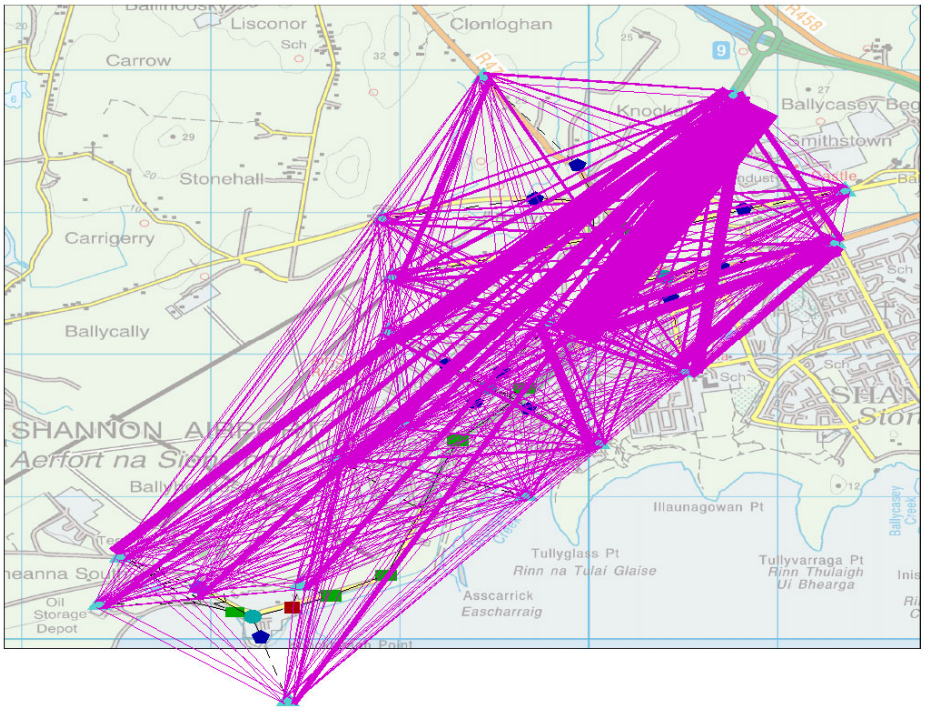


Figure 4-10: Modelled AM Period Desire Line Diagram

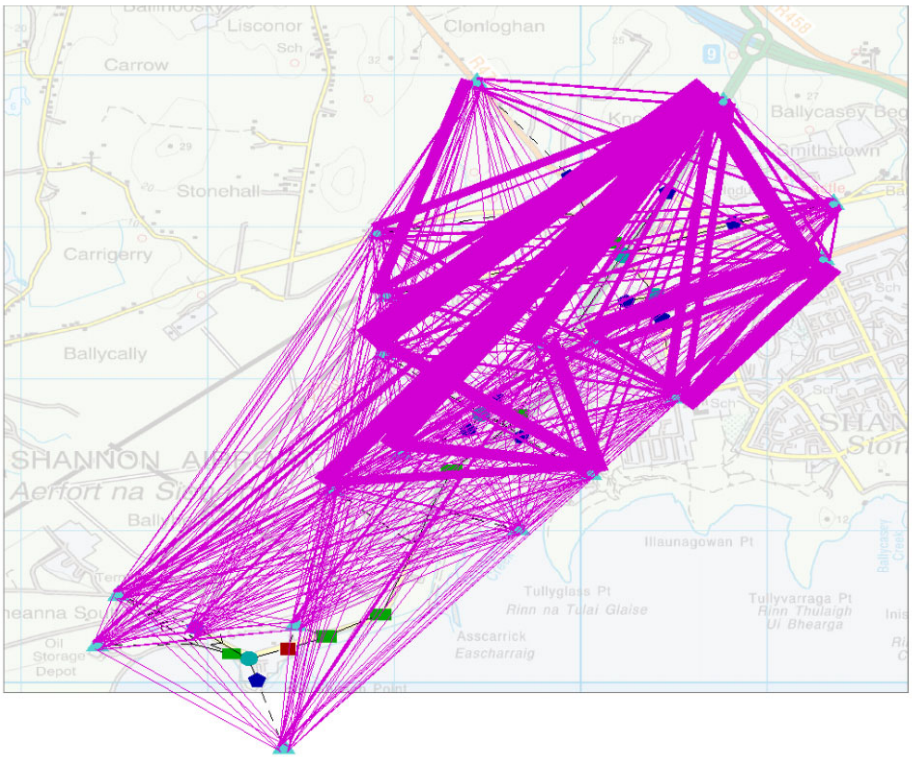


Figure 4-11: Modelled PM Peak Period Desire Line Diagram

5. FORECASTING

The traffic modelling work has a base year of 2020. At this stage the assumed opening year is 2025[1], which gives a design year of 2040. This will be reviewed as needed at the next stage of the TII project management process. Additionally, for economic appraisal traffic forecasts are required for a horizon year of 2050, being the year in which traffic growth is assumed to cease in the current PAG projections.

In the initial growth scenario, three different sets of growth rates were used:

5.1 Growth Rates Used – Shannon Town

Zones of the model corresponding to Shannon Town and the surrounding rural area were allocated a growth rate from the corresponding zone of the National Transport Model (NTM) (TII zone-based growth rates published alongside PAG unit 5.3).

Table 5-1: Growth Rates Used – Shannon Town

Shannon Town	AM LV Origin	AM LV Dest	AM HV Origin	AM HV Dest	IP LV Origin	IP LV Dest	IP HV Origin	IP HV Dest
2020-2025	5.5%	6.0%	7.8%	7.6%	3.4%	3.4%	8.0%	8.1%
2020-2040	13.6%	14.9%	26.3%	26.2%	8.0%	8.0%	27.1%	27.4%
2020-2050	12.3%	10.7%	43.7%	43.0%	8.7%	8.7%	44.4%	45.6%

5.2 Growth Rates Used – Shannon Airport

Zones of the model corresponding to Shannon International Airport were based on unpublished National Transport Model growth rates for "special zones" (major ports and airports) kindly supplied by TII Strategic Planning Unit.

Table 5-2: Growth Rates Used – Shannon Airport

Shannon Airport	AM LV Origin	AM LV Dest	AM HV Origin	AM HV Dest	IP LV O	IP LV D	IP HV O	IP HV D
2020-2025	11.8%	5.2%	5.3%	5.1%	6.5%	6.9%	5.4%	5.6%
2020-2040	39.9%	6.8%	20.2%	19.7%	20.2%	22.7%	20.8%	21.4%
2020-2050	50.4%	11.6%	36.1%	35.1%	27.0%	30.8%	36.1%	37.0%

Note that NTM uses AM peak and Interpeak periods, with separate growth rates for light and heavy vehicles and for trip origins and destinations. PM peak period growth rates are the same as AM peak rates but with origins and destinations transposed.

[1] May change at subsequent stages; this is what has been modelled at Phase 2 – Option Selection.

5.3 Growth Rates Used – Shannon Free Zone

Traffic growth for zones of the model corresponding to the Shannon Free Zone West business park were based on planning information kindly supplied by Shannon Commercial Properties. There is a Masterplan for the site, but this has not been shared with the project team.

It is proposed that at later stages, a more detailed planning scenario for the business park will be developed in consultation with Shannon Commercial Properties, if concerns about commercial confidentiality can be met. The initial estimate of likely growth is based on information supplied, as follows:

Table 5-3: Information Supplied by Shannon Commercial Properties

Vehicle Movements		North entrance		Main entrance		South Entrance		Development Site		TOTAL
		In	Out	In	Out	In	Out	In	Out	Overall
Base 2019	AM	271	69	1518	143	436	66			4961
	PM	84	341	151	1412	54	416			
Growth in Masterplan 2019-23	AM	+90	+49	+286	+154	+66	+35			+1416
	PM	+32	+118	+102	+375	+23	+86			
Growth in Masterplan 2024-28	AM	+110	+59	+425	+229	+450	+18	+243	+35	+3276
	PM	+40	+146	+150	+555	+37	+493	+20	+266	

The level of development in the Masterplan does not yet have planning permission, and is therefore "uncommitted" in terms of PAG guidance.

Accordingly, at this stage, two demand growth scenarios were developed:

In the with-Masterplan growth scenario:

- the 2025 opening[2] year demand matrices assume the 2019-2023 Masterplan fully implemented.
- the 2040 design year scenario additionally assumes the 2024-2028 Masterplan fully implemented, but no additional growth beyond that.
- the 2050 horizon year scenario assumes no growth in SFZW beyond that in the 2040 scenario.

The same factors – as shown in table 5-4 - were applied to light and heavy vehicles in all periods and both directions.

In the without-Masterplan growth scenario, representing only "committed" land use change, SFZW was given the same PAG 5.3 zone-based growth rates as Shannon Town. This may be thought of as representing organic growth – modest increase in economic activity without major land use development.

[2] Opening year may change at subsequent stages; this is what has been modelled at Phase 2 – Option Selection.

Table 5-4: Growth applied to SFZW zones in Masterplan scenario

Masterplan scenario			
Masterplan Year	peak hour total	growth factor	application
2019	4961	1.000	
2023	6377	1.285	Assumed to apply to 2025 opening year
2028	9653	1.946	Assumed to apply to 2040 design year with no growth thereafter

5.4 Implementation of growth

A Furness procedure was used to uplift the base year matrices to these future year tripends. For this process to converge, the target row totals and target column totals must be equal. These were equalized by adjusting the totals for the zone representing the M18 junction and points beyond; this is the "external" zone from which more or less traffic will be attracted in response to increasing or decreasing imbalance between generations and attractions within the N19 corridor.

In the future networks, a new zone was introduced to represent the proposed development on a new site adjacent to the N19. Trip patterns for this zone were taken from the nearest zone – the south entrance to the SFZ at the Gateway West roundabout. In the Do-Nothing network this site has existing access onto the N19 just south of the Gateway West roundabout.

5.5 Future year matrices

The resulting numbers of trips in the future year matrices are as follows:

Table 5-5: Overall demand growth in each scenario

Committed	2019	2025	2040	2050	*2025*	*2040*	*2050*
AM late	3960	4193	4587	4663	*6%*	*16%*	*18%*
AM early	4034	4280	4654	4662	*6%*	*15%*	*16%*
Interpeak	2201	2300	2480	2581	*4%*	*13%*	*17%*
PM peak	5098	5249	5700	5707	*3%*	*12%*	*12%*
PM shoulder	3898	4018	4371	4392	*3%*	*12%*	*13%*

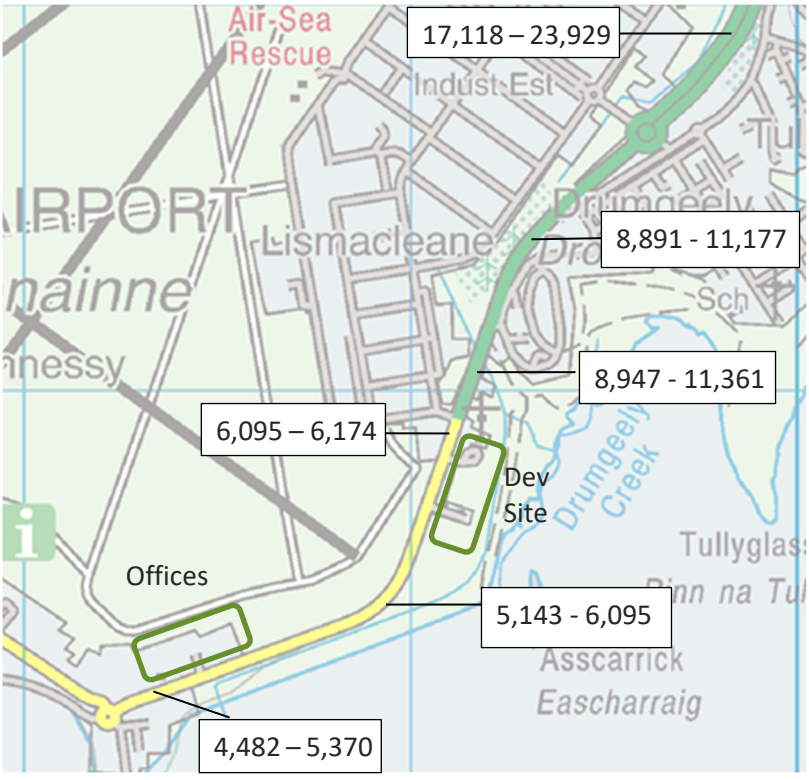
Masterplan	2019	2025	2040	2050	*2025*	*2040*	*2050*
AM late	3960	4598	5076	6037	*16%*	*28%*	*52%*
AM early	4034	4753	5231	6282	*18%*	*30%*	*56%*
Interpeak	2201	2473	2691	3110	*12%*	*22%*	*41%*
PM peak	5098	5714	6266	7312	*12%*	*23%*	*43%*
PM shoulder	3898	4366	4796	5575	*12%*	*23%*	*43%*

5.6 Forecast future year flows (Do-Nothing) AADT

Table 5-6: Forecast Future Year Flows (Committed/with Masterplan)

N19 sections	Base Year 2019	Opening Year[3] 2025	Design Year 2040	Horizon Year 2050
NE of Drumgeely Rbt	13,529	15,731 / 17,849	17,118 / 23,929	17,502 / 24,243
Drumgeely Hill to Drumgeely Rbt	6,581	8,108 / 8,165	8,891 / 11,177	9,289 / 11,443
Gateway West Rbt to Drumgeely Hill	6,601	8,155 / 8,257	8,947 / 11,361	9,330 / 11,626
Development site to Gateway West Rbt	4,142	5,470 / 4,574	6,095 / 6,174	6,558 / 6,464
Aer Lingus offices to Development site	4,142	5,470 / 4,574	6,095 / 5,143	6,558 / 5,467
Knockbeagh Point Rbt to Aer Lingus offices	3,615	4,799 / 3,985	5,370 / 4,482	5,787 / 4,774

Figure 5-1: Modelled AADT flows in design year



[3] May change at subsequent stages; this is what has been modelled at Phase 2 – Option Selection.

5.7 Convergence

In assignment models generally, the model iterates between calculating route choices as a function of journey times and journey times as a function of route choices, until some convergence condition is satisfied. This condition is intended to ensure that a stable situation has been reached that is sufficiently close to equilibrium. For large models, hundreds of iterations may be required to reach this point.

Convergence is seldom perfect and should, in general, be monitored to ensure that random "noise" in the model due to imperfect convergence is not distorting the results.

For the N19 model, because the model is small and there is minimal route choice in the network, the issue does not arise. As an illustration, **Table 5-7** shows key convergence statistics for the PM peak in the design year Do-Minimum in the Masterplan scenario.

Table 5-7: Peak hour model convergence statistics

LOOP	%FLOWS	%DELAYS	%GAP	SIM-HRS
1		24.6	3.496	1392.3
2	89.8	94.8	0.391	1234.1
3	91.6	97.8	0.099	1252.8
4	97.5	98.5	0.046	1252.2
5	99.6	100	0.017	1253.2
6	100	100	0.009	1253.0
7	100	100	0.025	1253.2

The total journey time in the simulation network reaches a stable level in iteration 3. In the same iteration, the GAP statistic (which is an indicator of the extent to which total cost has been minimized) falls below the PAG target level of 0.1%.

100% of flows and delays change by less than a threshold value by iteration 6.

6. SCHEME OPTION TESTING

6.1 Do-Minimum

The Do-Minimum baseline against which all the others are assessed, is assumed to include any necessary improvements to the internal road system within Shannon Free Zone in order to provide capacity sufficient for forecast flows, and similarly any necessary improvements to the N19 beyond the immediate study area in order to provide capacity sufficient for forecast flows.

Figure 6.1 shows the differences between the Do-Nothing (base year network) and the modelled Do-Minimum.

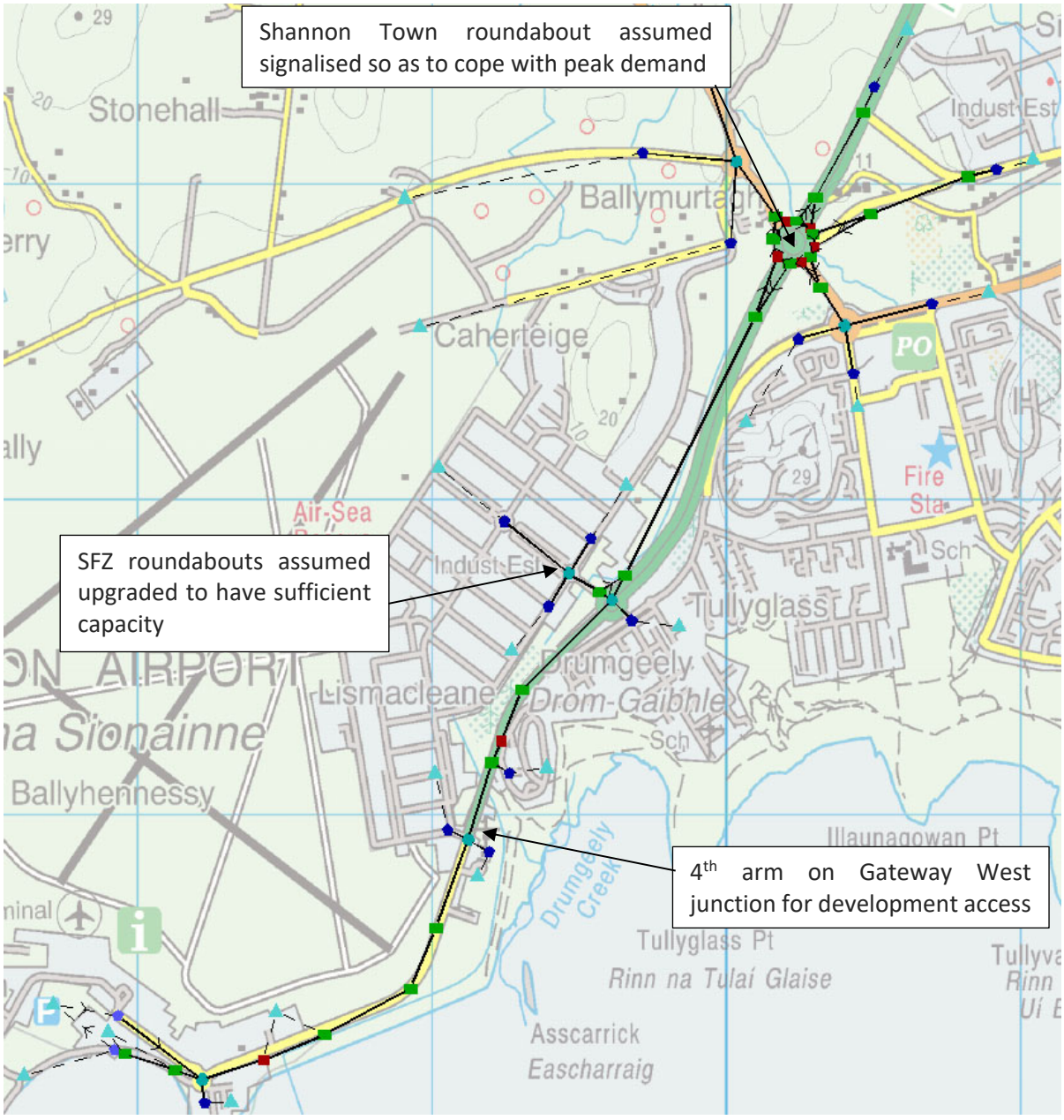


Figure 6-1: Do-Minimum network – changes from Do-Nothing

For the Masterplan scenario, all the Do-Minimum changes to the modelled road network were carried through to the other scheme options.
For the scenario representing committed development only, it was considered that these network changes are largely associated with uncommitted development, and therefore should not be included. Accordingly, for this scenario, the scheme options were assessed against a Do-Nothing baseline.

6.2 Do-Scheme Options

This section describes the initial (Stage 1) modelling of scheme options, to illustrate the use of and results from the traffic model. At this stage five broad options were considered:

Option A

An Active Travel option has been identified, consisting of provision of a footpath/cycleway along the whole length of the N19 within the study area. This is considered to have a negligible impact on road conditions for general traffic. Accordingly, Option A was not modelled. (Provision of improved pedestrian/cyclist crossings of N19 will be addressed as part of junction design).

Option B

A public transport option (Option B) has been identified, consisting of improvements to bus stops and bus services. These are considered to have a negligible impact on road conditions for general traffic. Accordingly, Option B was not modelled.

Option C

Option C consists of an improvement to the carriageway alignment and cross-section between Knockbeagh Point roundabout and Drumgeely roundabout.

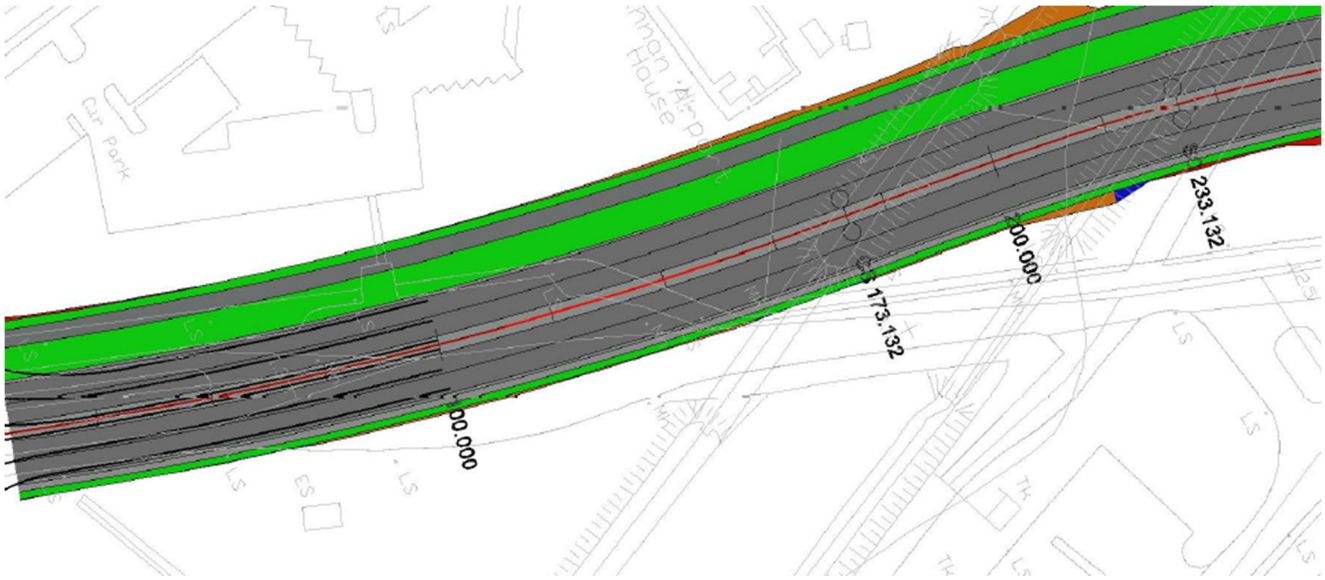


Figure 6-2: Option C – sample design

Three different alignments have been generated within the existing road corridor. The differences between these sub-options are considered to be too subtle to have any significant operational impact on traffic flows and speeds (although there may be differences in the construction impacts on traffic). The same traffic model run was therefore considered to represent all three sub-options being considered for Option C.

For this run, the section of N19 between Knockbeagh Point and Gateway West was assumed to be improved to the quality of the existing section between Gateway West and Drumgeely, and the section between Gateway West and Drumgeely was assumed to be improved to the same quality as the existing section between Drumgeely roundabout and Shannon Town roundabout.

The major junctions were left unchanged under this option. The minor junction at Drumgeely Hill was modelled as being closed to traffic, with journeys from this zone having to re-route via Drumgeely roundabout.

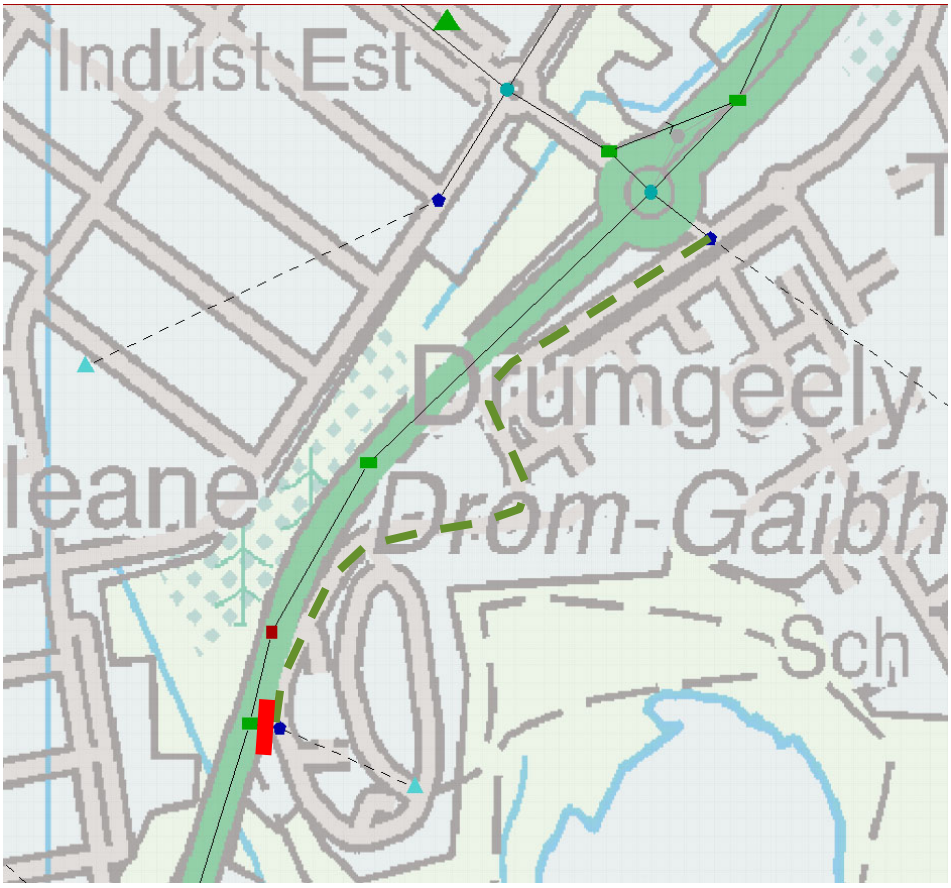


Figure 6-3: Alternative route for closure of Drumgeely Hill junction

Option D

Option D consists of a "compact" design of grade-separated junction in place of Drumgeely roundabout. A bridge would carry the N19 over the road from Shannon town to the SFZW business park, with two roundabouts giving access to low-speed slip roads.

Figure 6-4 shows the layout as modelled. **Figure 6-5** illustrates this type of junction in use elsewhere in county Clare.

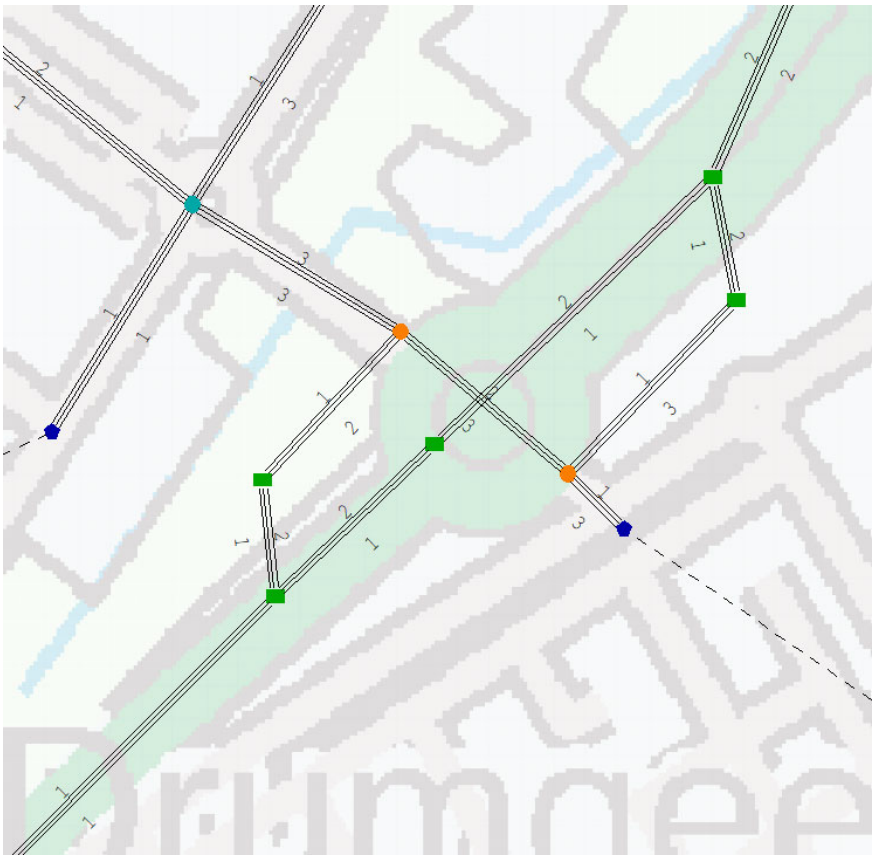


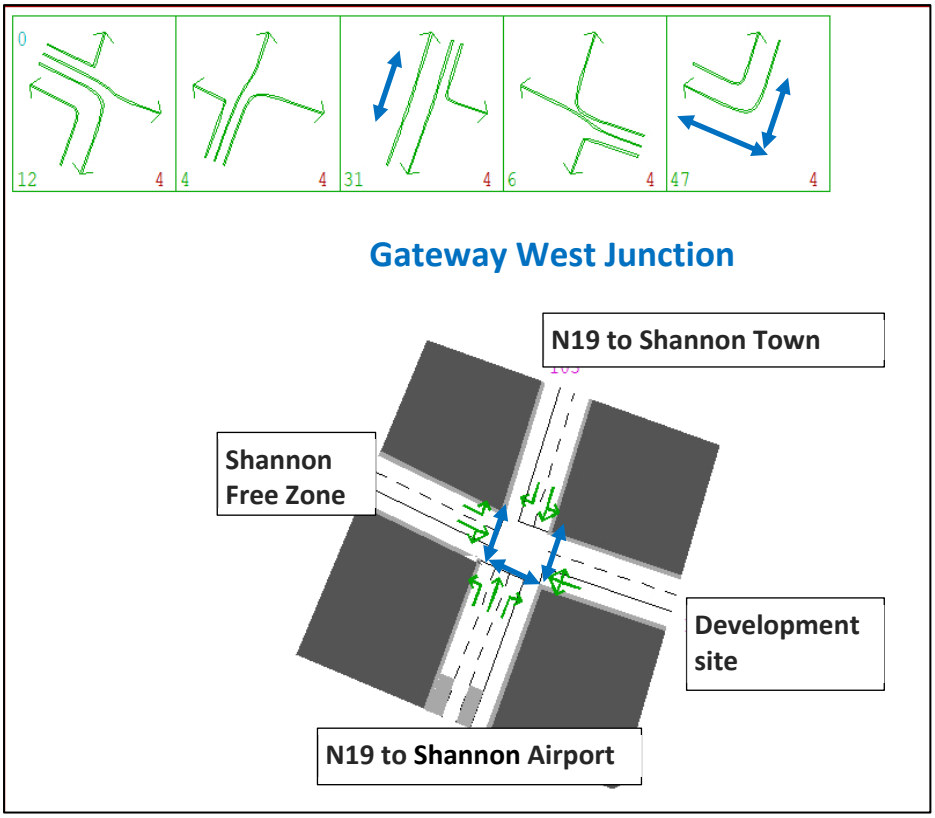
Figure 6-4: Grade-separated option as modelled in SATURN

Figure 6-5: Example of "compact" grade-separated junction elsewhere

Option E

Option E involves replacement of Drumgeely roundabout and Gateway West roundabout with signalised junctions.

At Gateway West the modelled junction is a signalised crossroads. Allowance is made for pedestrians to cross each of 3 arms of the junction in every cycle of the traffic lights, within the signal staging, so that a separate pedestrian stage is not required.



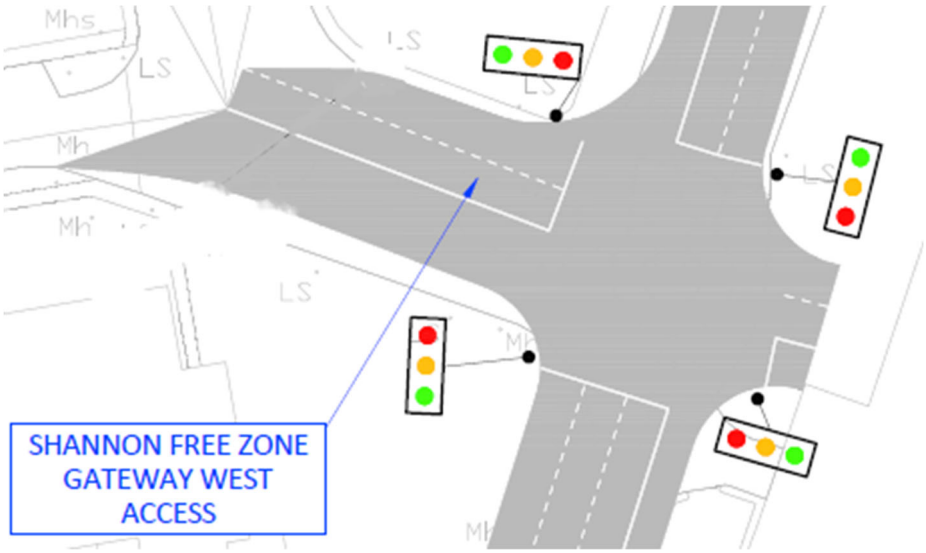


Figure 6-6: Modelled signalised junction at Gateway West

At this stage, two options were identified for what is now Drumgeely roundabout. In both cases the existing bypass lane, which allows traffic turning left from Shannon Free Zone, is widened to 2 lanes to accommodate demand.

In the first option (E1), it becomes a 4-arm signalized junction. Allowance is made for pedestrians to cross each of 2 arms of the junction in every double-cycle of the traffic lights, within the signal staging.

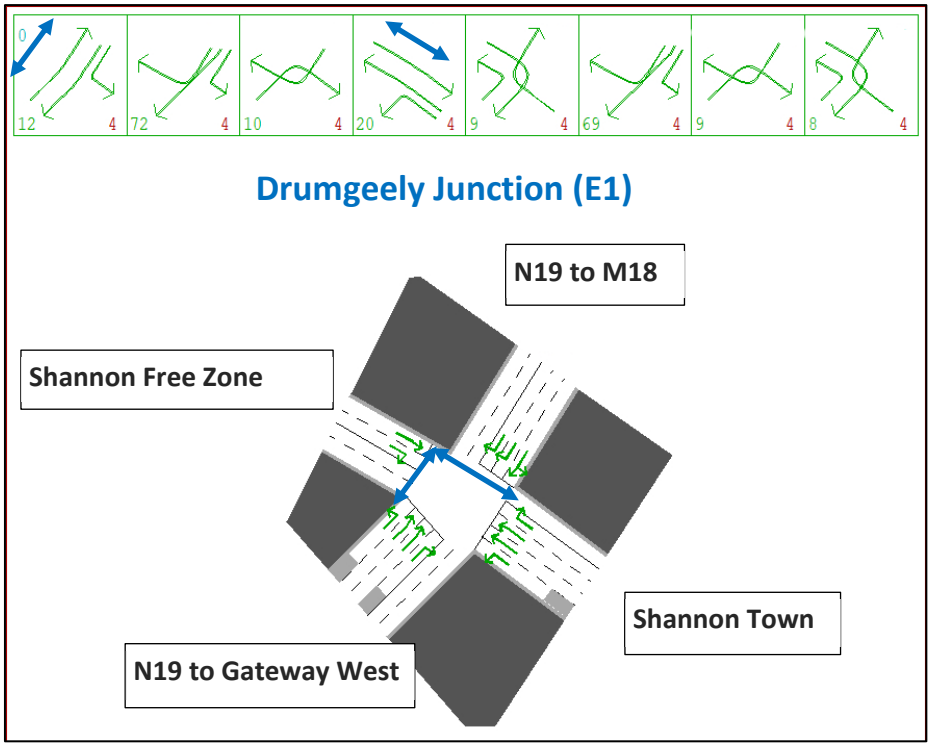


Figure 6-7: Modelled signalised junction at Drumgeely (E1)

In the second option (E2), the existing roundabout is widened to 3 lanes and signalized. A pedestrian/cyclist route crosses the middle of the roundabout as indicated in the concept sketch below.

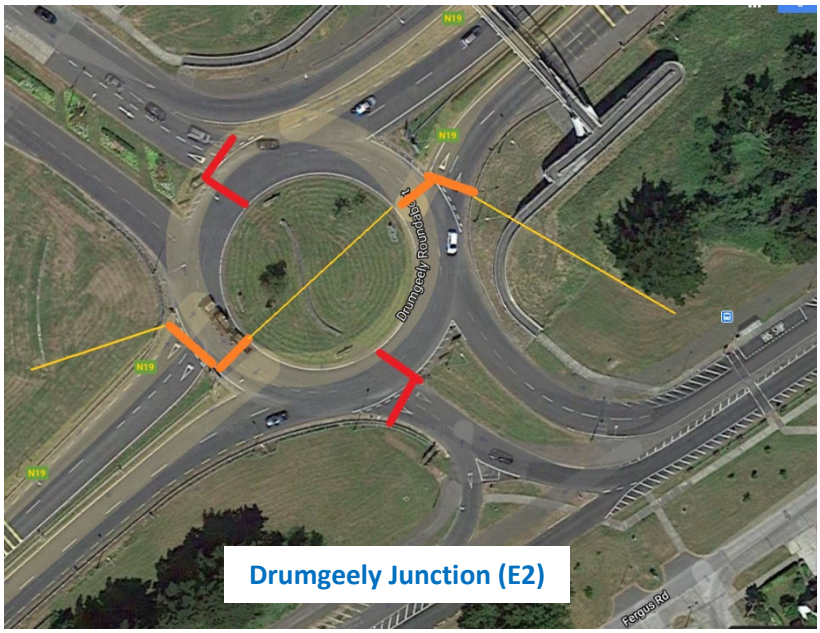


Figure 6-8: Modelled signalised junction at Drumgeely (E2)

6.3 Model Results

The tables below presents two measures of traffic impact for each option. One is the overall network journey time, counting each minute of delay as equally important no matter which traffic movement is affected. This is a proxy for the economic benefit of the scheme as measured by cost-benefit analysis.

The other is the end-to-end journey time along the N19, which is a measure of the accessibility of Shannon Airport, and also in a sense of the performance of the N19 considered as an asset whose purpose is to facilitate movement between the two endpoints. Results are presented for the design year under a central growth assumption and provide a like-for-like comparison between options.

It should be noted that the performance of traffic signals is an approximation based on limited optimisation and assumptions about the proportion of green time allocated to pedestrian movements. So undue weight should not be placed on small differences in journey times through signalised junctions.

Table 6-1: Model results for each option – Masterplan scenario

AM peak early	DM	Opt_C	Opt_D	Opt E1	Opt E2
Total network time (pcu-hours)	1558.2	1558.4	348.1	393.9	475.9
northbound N19 time (secs)	321	271	320	458	455
southbound N19 time (secs)	1754	1692	440	519	504
Average end-to-end time N19	1038	982	380	489	480
impact (network time)		*0%*	*-78%*	*-75%*	*-69%*
impact (end-to-end time)		*-5%*	*-63%*	*-53%*	*-54%*
Total trips loaded	5956	5956	5956	5956	5956
Average network speed (kph)	7.4	7.4	34.0	29.3	25.4
AM peak late	**DM**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	1074.7	1067.8	298.6	337.1	341.4
northbound N19 time (secs)	325	272	330	468	474
southbound N19 time (secs)	1401	1328	423	506	490
Average end-to-end time N19	863	800	377	487	482
impact (network time)		*-1%*	*-72%*	*-69%*	*-68%*
impact (end-to-end time)		*-7%*	*-56%*	*-44%*	*-44%*
Total trips loaded	5662	5662	5662	5662	5662
Average network speed (kph)	10.7	10.5	38.1	33.0	33.6
inter peak	**DM**	**Opt_C**	**Opt_D**	**OptE1**	**OptE2**
Total network time (pcu-hours)	110.1	102.6	112.0	131.3	134.9
northbound N19 time (secs)	329	271	324	373	408
southbound N19 time (secs)	347	285	349	403	411
Average end-to-end time N19	338	278	337	388	410
impact (network time)		*-7%*	*2%*	*19%*	*23%*
impact (end-to-end time)		*-18%*	*0%*	*15%*	*21%*
Total trips loaded	2611	2611	2611	2611	2611
Average network speed (kph)	41.6	44.7	42.0	34.9	34.9

PM peak	DM	Opt_C	Opt_D	Opt E1	Opt E2
Total network time (pcu-hours)	914.1	878.9	904.6	996.0	1041.0
northbound N19 time (secs)	831	823	934	458	455
southbound N19 time (secs)	346	292	347	519	504
Average end-to-end time N19	589	558	641	489	480
impact (network time)		*-4%*	*-1%*	*9%*	*14%*
impact (end-to-end time)		*-5%*	*9%*	*-17%*	*-19%*
Total trips loaded	7123	7123	7123	7123	7123
Average network speed (kph)	14.3	14.7	14.7	13.5	13.8
PM shoulder	**DM**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	310.7	285.7	314.9	346.1	353.0
northbound N19 time (secs)	434	328	429	502	525
southbound N19 time (secs)	348	292	350	447	452
Average end-to-end time N19	391	310	390	475	489
impact (network time)		*-8%*	*1%*	*11%*	*14%*
impact (end-to-end time)		*-21%*	*0%*	*21%*	*25%*
Total trips loaded	5708	5708	5708	5708	5708
Average network speed (kph)	34.9	37.6	35.8	31.2	31.2
Weighted average	**DM**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	*646.1*	*631.7*	*330.4*	*368.8*	*391.1*
northbound N19 time (secs)	*415.7*	*351.6*	*425.5*	*448.7*	*465.1*
southbound N19 time (secs)	*737.8*	*676.9*	*374.9*	*463.6*	*460.7*
Average end-to-end time N19	*576.8*	*514.2*	*400.2*	*456.1*	*462.9*
impact (network time)		*-2%*	*-49%*	*-43%*	*-39%*
impact (end-to-end time)		*-11%*	*-31%*	*-21%*	*-20%*

Note that the Do-Minimum end-to-end journey time is around 325-350 seconds for the interpeak and in the counter-peak direction. But this rises to a worst case of around 1750 seconds for the southbound flow in the early AM peak. The model is suggesting that in the absence of remedial action there will be severe congestion from the tidal flow of commuter traffic to the SFZW business park in the AM peak. And to a lesser extent from the reverse flow in the PM peak, although the existence of a bypass lane at the Drumgeely roundabout means that forecast congestion is lower in this direction.

This high level of forecast Do-Minimum congestion at the junctions means that the junction options show very high levels of benefit in the AM peak hours. And make the (roughly 1-minute) journey time saving from the road link improvement option (Option C) look small by comparison.

However, in the Interpeak period and PM shoulder peak hours, when traffic levels are lower, option C is the one that improves journey times. Option E worsens journey times due to the delays at traffic signals that are introduced. Option D has little impact.

Table 6-2: Model results for each option – Committed scenario

AM peak early	DN	Opt_C	Opt_D	Opt E1	Opt E2
Total network time (pcu-hours)	534.7	529.2	468.1	495.6	506.3
northbound N19 time (secs)	274	220	270	339	376
southbound N19 time (secs)	435	364	324	349	373
Average end-to-end time N19	355	292	297	344	375
impact (network time)		*-1%*	*-12%*	*-7%*	*-5%*
impact (end-to-end time)		*-18%*	*-16%*	*-3%*	*6%*
Total trips loaded	4627	4627	4627	4627	4627
Average network speed (kph)	14.4	14.7	15.7	15.6	16.0
AM peak late	**DN**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	204.9	188.8	191.1	212.9	225.5
northbound N19 time (secs)	282	222	278	353	380
southbound N19 time (secs)	366	272	337	364	384
Average end-to-end time N19	324	247	308	359	382
impact (network time)		*-8%*	*-7%*	*4%*	*10%*
impact (end-to-end time)		*-24%*	*-5%*	*11%*	*18%*
Total trips loaded	4555	4555	4555	4555	4555
Average network speed (kph)	38.2	41.9	39.3	37.0	36.3
inter peak	**DN**	**Opt_C**	**Opt_D**	**OptE1**	**OptE2**
Total network time (pcu-hours)	84.8	76.6	85.8	97.4	103.9
northbound N19 time (secs)	283	220	282	358	355
southbound N19 time (secs)	285	220	276	301	330
Average end-to-end time N19	284	220	279	330	343
impact (network time)		*-10%*	*1%*	*15%*	*23%*
impact (end-to-end time)		*-23%*	*-2%*	*16%*	*21%*
Total trips loaded	2442	2444	2444	2442	2444
Average network speed (kph)	49.5	55.3	48.9	43.6	42.4
PM peak	**DN**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	465.3	449.5	463.8	529.6	493.8
northbound N19 time (secs)	441	348	439	512	502
southbound N19 time (secs)	280	219	271	323	341
Average end-to-end time N19	361	284	355	418	422
impact (network time)		*-3%*	*0%*	*14%*	*6%*
impact (end-to-end time)		*-21%*	*-2%*	*16%*	*17%*

Total trips loaded	5664	5669	5669	5664	5669
Average network speed (kph)	18.4	19.3	19.2	16.4	18.2
PM shoulder	DN	Opt_C	Opt_D	Opt E1	Opt E2
Total network time (pcu-hours)	147.9	135.4	150.1	167.7	173.9
northbound N19 time (secs)	314	232	312	373	376
southbound N19 time (secs)	279	218	270	315	335
Average end-to-end time N19	297	225	291	344	356
impact (network time)		*-8%*	*1%*	*13%*	*18%*
impact (end-to-end time)		*-24%*	*-2%*	*16%*	*20%*
Total trips loaded	4348	4350	4350	4348	4350
Average network speed (kph)	47.7	52.5	48.4	42.5	42.2
Weighted average	**DN**	**Opt_C**	**Opt_D**	**Opt E1**	**Opt E2**
Total network time (pcu-hours)	235	224	224	248	251
northbound N19 time (secs)	309	238	306	376	385
southbound N19 time (secs)	318	249	291	325	348
Average end-to-end time N19	314	244	298	351	366
impact (network time)		*-5%*	*-5%*	*5%*	*6%*
impact (end-to-end time)		*-22%*	*-5%*	*12%*	*17%*

At the lower levels of future traffic in this scenario, the largest positive impacts are from Option C – the link improvements. Option D performs best during the busiest hour – the early AM peak – but has only small benefit outside the AM peak.
Both variants of Option E have a positive benefit in the busiest period, but a negative impact on journey times in the other modelled hours.

7. SUMMARY & INITIAL CONCLUSIONS FROM SCHEME MODELLING

A traffic model has been built, using industry-standard SATURN software, to forecast the traffic impacts of options for improvement to the N19 Shannon Airport Access Road.

Whilst the traffic data available is limited because of the timing of the project relative to the Covid-19 pandemic, sufficient existing information was available to build a model in accordance with PAG guidelines.

This section of the N19 serves two major trip destinations – Shannon Airport and the Shannon Free Zone (West) business park. The data shows that traffic to and from these locations have slightly differently-timed peaks. Accordingly, five hours of a typical weekday have been modelled, in order to capture this variation.

The results tabled above make it clear that:

- In the Masterplan forecasting scenario, there is a significant problem with forecast peak hour congestion at junctions, caused by "tidal" flow of commuter traffic to and from the Shannon Free Zone. Solving this problem has a bigger impact on overall network performance than do-measures to improve journey times on links of the N19.
- Options D and E are effective in addressing the problem. Traffic signals (Option E) tend to do so in a way that increases journey times in the less-congested time periods and in the counter-peak direction.
- Option C as modelled does not solve the congestion problem, despite having a positive impact in all time periods.
- In the Committed Development Only forecasting scenario, future traffic levels are lower, and so the model shows that there is relatively less advantage in addressing junction congestion and relatively more advantage in improving the quality of the road links.

These results were input to the Option Selection process, for consideration alongside other non-traffic aspects. That decision process is documented in the Options Appraisal Report.

The same traffic model was then used:

- at appraisal Stage 2, to test different hybrid options, informing the inputs to the Project Appraisal Matrix
- at appraisal Stage 3, to underpin the economic and environmental assessment of the Emerging Preferred Option.

APPENDIX A

GEH Tables

APPENDIX A – GEH tables

					turn		turn		AM peak late					AM peak early					Interpeak				
count#	a-node	b-node	c-node	junction	from		to	count#	model	count	diff	%diff	**GEH**	model	count	diff	%diff	**GEH**	model	count	diff	%diff	**GEH**
1	115	108	134	R472 Ballymurtagh rbt	N	to	SE	1	2.2	2	-0.2	-11.6	**0.0**	8.0	8	0.0	0.5	**0.0**	5.0	5	0.0	1.0	**0.0**
2	115	108	113	R472 Ballymurtagh rbt	N	to	S	2	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
3	115	108	114	R472 Ballymurtagh rbt	N	to	W	3	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
4	134	108	115	R472 Ballymurtagh rbt	SE	to	N	4	2.6	2	-0.6	-29.6	**0.0**	0.0	0	0.0	0.0	**0.0**	4.9	5	0.1	1.1	**0.0**
5	134	108	113	R472 Ballymurtagh rbt	SE	to	S	5	12.3	12	-0.3	-2.5	**0.1**	8.0	9	1.0	11.1	**0.3**	7.9	8	0.1	1.1	**0.0**
6	134	108	114	R472 Ballymurtagh rbt	SE	to	W	6	9.0	9	0.0	0.2	**0.0**	3.5	4	0.5	11.3	**0.0**	3.0	3	0.0	1.2	**0.0**
7	113	108	115	R472 Ballymurtagh rbt	S	to	N	7	2.0	2	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
8	113	108	134	R472 Ballymurtagh rbt	S	to	SE	8	17.7	17	-0.7	-4.2	**0.2**	10.0	10	0.0	0.5	**0.0**	8.9	9	0.1	1.0	**0.0**
9	113	108	114	R472 Ballymurtagh rbt	S	to	W	9	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
10	114	108	115	R472 Ballymurtagh rbt	W	to	N	10	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
11	114	108	134	R472 Ballymurtagh rbt	W	to	SE	11	4.0	4	0.0	0.0	**0.0**	5.0	5	0.0	0.5	**0.0**	3.0	3	0.0	1.0	**0.0**
12	114	108	113	R472 Ballymurtagh rbt	W	to	S	12	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
13	106	105	129	N19 Shannon Town rbt	N19(N)	to	E	13	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
14	106	105	109	N19 Shannon Town rbt	N19(N)	to	SE	14	17.1	17	-0.1	-0.6	**0.0**	24.7	25	0.3	1.1	**0.1**	6.1	6	-0.1	-1.5	**0.0**
15	106	105	137	N19 Shannon Town rbt	N19(N)	to	N19(S)	15	38.8	45	6.2	13.8	**1.0**	21.0	21	0.0	-0.2	**0.0**	35.6	39	3.4	8.7	**0.6**
16	106	105	134	N19 Shannon Town rbt	N19(N)	to	NW	16	8.4	10	1.6	15.5	**0.5**	6.0	6	0.0	0.0	**0.0**	5.0	5	0.0	0.0	**0.0**
17	129	105	106	N19 Shannon Town rbt	E	to	N19(N)	17	5.0	5	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**
18	129	105	109	N19 Shannon Town rbt	E	to	SE	18	5.0	5	0.0	-0.6	**0.0**	1.8	2	0.2	11.7	**0.0**	4.1	4	-0.1	-1.5	**0.0**
19	129	105	137	N19 Shannon Town rbt	E	to	N19(S)	19	16.4	19	2.6	13.8	**0.6**	10.0	10	0.0	-0.2	**0.0**	16.4	18	1.6	8.7	**0.4**
20	129	105	134	N19 Shannon Town rbt	E	to	NW	20	8.5	10	1.5	15.4	**0.5**	0.5	0	-0.5	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**
21	109	105	106	N19 Shannon Town rbt	SE	to	N19(N)	21	11.6	12	0.4	3.6	**0.1**	0.0	0	0.0	0.0	**0.0**	4.9	5	0.1	2.2	**0.0**
22	109	105	129	N19 Shannon Town rbt	SE	to	E	22	1.9	2	0.1	3.5	**0.0**	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	2.2	**0.0**
23	109	105	137	N19 Shannon Town rbt	SE	to	N19(S)	23	5.8	7	1.2	16.8	**0.5**	0.6	0	-0.6	0.0	**0.0**	1.6	3	1.4	48.0	**0.0**
24	109	105	134	N19 Shannon Town rbt	SE	to	NW	24	6.8	7	0.2	3.5	**0.1**	3.4	2	-1.4	-71.7	**0.0**	3.9	4	0.1	2.2	**0.0**
25	137	105	106	N19 Shannon Town rbt	N19(S)	to	N19(N)	25	27.3	31	3.7	11.9	**0.7**	9.7	12	2.3	19.4	**0.7**	38.1	42	3.9	9.4	**0.6**
26	137	105	129	N19 Shannon Town rbt	N19(S)	to	E	26	18.5	21	2.5	11.9	**0.6**	0.0	0	0.0	0.0	**0.0**	19.0	21	2.0	9.4	**0.4**
27	137	105	109	N19 Shannon Town rbt	N19(S)	to	SE	27	0.4	2	1.6	77.7	**0.0**	0.0	0	0.0	0.0	**0.0**	1.8	2	0.2	8.0	**0.0**

28	137	105	134	N19 Shannon Town rbt	N19(S)	to	NW	28	0.2	7	6.8	96.8	**3.6**	1.6	2	0.4	19.5	**0.0**	0.9	1	0.1	9.4	**0.0**
29	134	105	106	N19 Shannon Town rbt	NW	to	N19(N)	29	10.5	14	3.5	25.0	**1.0**	10.0	10	0.0	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**
30	134	105	129	N19 Shannon Town rbt	NW	to	E	30	11.7	12	0.3	2.6	**0.1**	6.0	6	0.0	0.0	**0.0**	7.8	10	2.2	22.3	**0.8**
31	134	105	109	N19 Shannon Town rbt	NW	to	SE	31	0.0	5	5.0	99.3	**3.1**	4.9	8	3.1	38.9	**1.2**	0.8	3	2.2	72.6	**0.0**
32	134	105	137	N19 Shannon Town rbt	NW	to	N19(S)	32	1.7	2	0.3	13.8	**0.0**	2.0	2	0.0	-0.2	**0.0**	2.2	3	0.8	25.0	**0.0**
33	116	109	117	R471 Sky Court rbt	E	to	S	33	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
34	116	109	118	R471 Sky Court rbt	E	to	SW	34	12.0	12	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**
35	116	109	105	R471 Sky Court rbt	E	to	NW	35	13.5	14	0.5	3.4	**0.1**	4.0	4	0.0	0.0	**0.0**	7.8	7	-0.8	-11.7	**0.3**
36	117	109	116	R471 Sky Court rbt	S	to	E	36	10.0	10	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
37	117	109	118	R471 Sky Court rbt	S	to	SW	37	6.0	6	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
38	117	109	105	R471 Sky Court rbt	S	to	NW	38	12.6	13	0.4	3.4	**0.1**	0.0	0	0.0	0.0	**0.0**	2.5	2	-0.5	-25.1	**0.0**
39	118	109	116	R471 Sky Court rbt	SW	to	E	39	4.0	4	0.0	0.0	**0.0**	7.0	7	0.0	0.0	**0.0**	3.0	3	0.0	0.0	**0.0**
40	118	109	117	R471 Sky Court rbt	SW	to	S	40	6.0	6	0.0	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**	3.0	3	0.0	0.0	**0.0**
41	118	109	105	R471 Sky Court rbt	SW	to	NW	41	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.2	**0.0**
42	105	109	116	R471 Sky Court rbt	NW	to	E	42	14.0	14	0.0	0.3	**0.0**	12.7	12	-0.7	-6.1	**0.2**	5.9	6	0.1	1.5	**0.0**
43	105	109	117	R471 Sky Court rbt	NW	to	S	43	8.4	5	-3.4	-67.3	**1.3**	16.7	10	-6.7	-66.5	**1.8**	5.9	6	0.1	1.2	**0.0**
44	105	109	118	R471 Sky Court rbt	NW	to	SW	44	0.3	0	-0.3	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	1.0	1	0.0	3.4	**0.0**
45	137	104	127	N19 Drumgeely rbt	N19(NE)	to	SE	45	0.0	0	0.0	0.0	**0.0**	1.7	2	0.3	16.4	**0.0**	2.0	2	0.0	0.0	**0.0**
46	137	104	123	N19 Drumgeely rbt	N19(NE)	to	N19(SW)	46	36.2	38	1.8	4.7	**0.3**	25.0	25	0.0	0.0	**0.0**	28.6	25	-3.6	-14.4	**0.7**
47	137	104	136	N19 Drumgeely rbt	N19(NE)	to	SFZW	47	26.5	25	-1.5	-6.1	**0.3**	7.0	7	0.0	0.4	**0.0**	25.3	27	1.7	6.4	**0.3**
48	127	104	137	N19 Drumgeely rbt	SE	to	N19(NE)	48	3.0	3	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	5.0	5	0.0	0.0	**0.0**
49	127	104	123	N19 Drumgeely rbt	SE	to	N19(SW)	49	3.8	4	0.2	4.7	**0.0**	3.5	2	-1.5	-77.0	**0.0**	3.7	4	0.3	8.7	**0.0**
50	127	104	136	N19 Drumgeely rbt	SE	to	SFZW	50	10.6	10	-0.6	-6.1	**0.2**	5.0	5	0.0	0.4	**0.0**	2.8	3	0.2	6.4	**0.0**
51	123	104	137	N19 Drumgeely rbt	N19(SW)	to	N19(NE)	51	25.7	23	-2.7	-11.7	**0.5**	5.5	6	0.5	9.1	**0.2**	25.7	26	0.3	1.2	**0.1**
52	123	104	127	N19 Drumgeely rbt	N19(SW)	to	SE	52	3.5	4	0.5	12.0	**0.0**	5.5	6	0.5	9.1	**0.2**	4.3	2	-2.3	-116.5	**0.0**
53	123	104	136	N19 Drumgeely rbt	N19(SW)	to	SFZW	53	1.9	2	0.1	6.6	**0.0**	0.1	0	-0.1	0.0	**0.0**	0.9	1	0.1	7.5	**0.0**
54	110	136	137	N19 Drumgeely rbt	SFZW	to	N19(NE)	54	17.8	18	0.2	1.1	**0.1**	5.8	6	0.2	3.0	**0.1**	29.1	29	-0.1	-0.5	**0.0**
55	136	104	127	N19 Drumgeely rbt	SFZW	to	SE	55	4.0	4	0.0	1.1	**0.0**	1.9	2	0.1	3.0	**0.0**	4.0	4	0.0	-0.5	**0.0**
56	136	104	123	N19 Drumgeely rbt	SFZW	to	N19(SW)	56	0.2	0	-0.2	0.0	**0.0**	0.2	0	-0.2	0.0	**0.0**	1.8	2	0.2	8.3	**0.0**
57	103	102	122	N19 Gateway W rbt	N19(N)	to	N19(S)	57	34.2	34	-0.2	-0.5	**0.0**	18.0	18	0.0	0.0	**0.0**	24.0	24	0.0	-0.2	**0.0**
58	103	102	128	N19 Gateway W rbt	N19(N)	to	SFZW	58	8.1	8	-0.1	-1.3	**0.0**	11.0	11	0.0	0.0	**0.0**	9.1	9	-0.1	-0.6	**0.0**
59	122	102	103	N19 Gateway W rbt	N19(S)	to	N19(N)	59	22.2	22	-0.2	-1.0	**0.1**	14.4	14	-0.4	-2.6	**0.1**	24.0	24	0.0	0.2	**0.0**
60	122	102	128	N19 Gateway W rbt	N19(S)	to	SFZW	60	7.0	7	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	5.0	5	0.0	0.0	**0.0**

61	128	102	103	N19 Gateway W rbt	SFZW	to	N19(N)	61	10.9	10	-0.9	-8.5	**0.3**	2.6	2	-0.6	-30.2	**0.0**	6.0	6	0.0	0.1	**0.0**
62	128	102	122	N19 Gateway W rbt	SFZW	to	N19(S)	62	9.0	9	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**
63	126	110	136	SFZW main entry rbt	NE	to	SE	63	9.0	9	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	11.0	11	0.0	0.0	**0.0**
64	126	110	124	SFZW main entry rbt	NE	to	SW	64	3.0	3	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
65	126	110	125	SFZW main entry rbt	NE	to	NW	65	3.0	3	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	3.0	3	0.0	0.0	**0.0**
66	136	110	126	SFZW main entry rbt	SE	to	NE	66	8.0	8	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**
67	136	110	124	SFZW main entry rbt	SE	to	SW	67	5.0	5	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
68	136	110	125	SFZW main entry rbt	SE	to	NW	68	26.0	26	0.0	0.1	**0.0**	8.0	8	0.0	0.0	**0.0**	21.0	21	0.0	0.0	**0.0**
69	124	110	126	SFZW main entry rbt	SW	to	NE	69	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	3.0	3	0.0	0.0	**0.0**
70	124	110	136	SFZW main entry rbt	SW	to	SE	70	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	3.0	3	0.0	0.0	**0.0**
71	124	110	125	SFZW main entry rbt	SW	to	NW	71	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
72	125	110	126	SFZW main entry rbt	NW	to	NE	72	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
73	125	110	136	SFZW main entry rbt	NW	to	SE	73	11.0	11	0.0	0.0	**0.0**	6.0	6	0.0	0.0	**0.0**	21.0	21	0.0	0.0	**0.0**
74	125	110	124	SFZW main entry rbt	NW	to	SW	74	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
75	135	103	111	Drumgeely Hill access	N19(N)	to	E	75	4.0	4	0.0	0.0	**0.0**	1.8	3	1.2	40.6	**0.0**	2.0	2	0.0	0.0	**0.0**
76	135	103	102	Drumgeely Hill access	N19(N)	to	N19(S)	76	36.3	87	50.7	58.3	**6.5**	27.0	56	29.0	51.8	**4.5**	32.1	44	11.9	27.1	**1.9**
77	111	103	135	Drumgeely Hill access	E	to	N19(N)	77	6.0	6	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
78	111	103	102	Drumgeely Hill access	E	to	N19(S)	78	6.0	6	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
79	102	103	135	Drumgeely Hill access	N19(S)	to	N19(N)	79	25.1	60	34.9	58.2	**5.4**	9.0	33	24.0	72.8	**5.3**	28.9	47	18.1	38.4	**2.9**
80	102	103	111	Drumgeely Hill access	N19(S)	to	E	80	8.0	8	0.0	0.0	**0.0**	8.0	8	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**

					turn		turn		PM peak					PM shoulder				
count#	a-node	b-node	c-node	junction	from		to	count#	model	count	diff	%diff	GEH	model	count	diff	%diff	GEH
1	115	108	134	R472 Ballymurtagh rbt	N	to	SE	1	0.0	0	0.0	0.0	**0.0**	2.1	2	-0.1	-5.2	**0.0**
2	115	108	113	R472 Ballymurtagh rbt	N	to	S	2	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
3	115	108	114	R472 Ballymurtagh rbt	N	to	W	3						0.0	0	0.0	0.0	**0.0**
4	134	108	115	R472 Ballymurtagh rbt	SE	to	N	4	10.9	6	-4.9	-81.3	**1.7**	7.0	7	0.0	0.0	**0.0**
5	134	108	113	R472 Ballymurtagh rbt	SE	to	S	5	8.3	2	-6.3	-315.3	**2.8**	6.1	8	1.9	23.4	**0.7**
6	134	108	114	R472 Ballymurtagh rbt	SE	to	W	6	7.2	0	-7.2	0.0	**3.8**	2.0	2	0.0	0.5	**0.0**
7	113	108	115	R472 Ballymurtagh rbt	S	to	N	7	7.9	8	0.1	1.2	**0.0**	0.0	0	0.0	0.0	**0.0**
8	113	108	134	R472 Ballymurtagh rbt	S	to	SE	8	0.0	0	0.0	0.0	**0.0**	17.9	17	-0.9	-5.2	**0.2**
9	113	108	114	R472 Ballymurtagh rbt	S	to	W	9						0.0	0	0.0	0.0	**0.0**
10	114	108	115	R472 Ballymurtagh rbt	W	to	N	10	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
11	114	108	134	R472 Ballymurtagh rbt	W	to	SE	11	0.0	0	0.0	0.0	**0.0**	2.1	2	-0.1	-5.2	**0.0**
12	114	108	113	R472 Ballymurtagh rbt	W	to	S	12	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
13	106	105	129	N19 Shannon Town rbt	N19(N)	to	E	13	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
14	106	105	109	N19 Shannon Town rbt	N19(N)	to	SE	14	1.8	2	0.2	9.6	**0.0**	2.1	2	-0.1	-5.6	**0.0**
15	106	105	137	N19 Shannon Town rbt	N19(N)	to	N19(S)	15	20.7	23	2.3	10.1	**0.5**	14.7	14	-0.7	-4.9	**0.2**
16	106	105	134	N19 Shannon Town rbt	N19(N)	to	NW	16	16.5	17	0.5	3.2	**0.1**	1.2	1	-0.2	-23.8	**0.0**
17	129	105	106	N19 Shannon Town rbt	E	to	N19(N)	17	0.0	0	0.0	0.0	**0.0**	4.0	4	0.0	0.0	**0.0**
18	129	105	109	N19 Shannon Town rbt	E	to	SE	18	1.8	2	0.2	9.6	**0.0**	0.1	0	-0.1	0.0	**0.0**
19	129	105	137	N19 Shannon Town rbt	E	to	N19(S)	19	5.4	6	0.6	10.1	**0.3**	8.4	8	-0.4	-4.9	**0.1**
20	129	105	134	N19 Shannon Town rbt	E	to	NW	20	1.8	2	0.2	11.4	**0.0**	5.0	2	-3.0	- 148.4	**0.0**
21	109	105	106	N19 Shannon Town rbt	SE	to	N19(N)	21	3.4	2	-1.4	-71.4	**0.0**	3.9	4	0.1	3.3	**0.0**
22	109	105	129	N19 Shannon Town rbt	SE	to	E	22	0.2	0	-0.2	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
23	109	105	137	N19 Shannon Town rbt	SE	to	N19(S)	23	1.9	2	0.1	6.2	**0.0**	8.2	1	-7.2	- 719.7	**3.4**
24	109	105	134	N19 Shannon Town rbt	SE	to	NW	24	6.3	6	-0.3	-4.4	**0.1**	5.3	5	-0.3	-6.2	**0.1**
25	137	105	106	N19 Shannon Town rbt	N19(S)	to	N19(N)	25	29.5	31	1.5	4.9	**0.3**	13.4	13	-0.4	-2.7	**0.1**
26	137	105	129	N19 Shannon Town rbt	N19(S)	to	E	26	7.6	8	0.4	4.9	**0.1**	12.3	12	-0.3	-2.5	**0.1**
27	137	105	109	N19 Shannon Town rbt	N19(S)	to	SE	27	3.4	4	0.6	14.4	**0.0**	1.1	1	-0.1	-10.6	**0.0**
28	137	105	134	N19 Shannon Town rbt	N19(S)	to	NW	28	1.9	2	0.1	4.9	**0.0**	3.6	1	-2.6	- 260.3	**0.0**
29	134	105	106	N19 Shannon Town rbt	NW	to	N19(N)	29	5.9	4	-1.9	-46.8	**0.8**	4.0	4	0.0	0.0	**0.0**

30	134	105	129	N19 Shannon Town rbt	NW	to	E	30	1.2	0	-1.2	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
31	134	105	109	N19 Shannon Town rbt	NW	to	SE	31	0.0	0	0.0	0.0	**0.0**	5.8	4	-1.8	-44.2	**0.8**
32	134	105	137	N19 Shannon Town rbt	NW	to	N19(S)	32	0.8	0	-0.8	0.0	**0.0**	10.3	0	-10.3	0.0	**4.5**
33	116	109	117	R471 Sky Court rbt	E	to	S	33	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
34	116	109	118	R471 Sky Court rbt	E	to	SW	34	2.0	2	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
35	116	109	105	R471 Sky Court rbt	E	to	NW	35	7.9	8	0.1	1.8	**0.1**	8.2	8	-0.2	-2.2	**0.1**
36	117	109	116	R471 Sky Court rbt	S	to	E	36	2.0	2	0.0	0.0	**0.0**	14.0	14	0.0	0.0	**0.0**
37	117	109	118	R471 Sky Court rbt	S	to	SW	37	4.0	4	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
38	117	109	105	R471 Sky Court rbt	S	to	NW	38	3.9	4	0.1	1.8	**0.0**	9.2	9	-0.2	-2.3	**0.1**
39	118	109	116	R471 Sky Court rbt	SW	to	E	39	4.0	4	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
40	118	109	117	R471 Sky Court rbt	SW	to	S	40	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
41	118	109	105	R471 Sky Court rbt	SW	to	NW	41	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
42	105	109	116	R471 Sky Court rbt	NW	to	E	42	3.9	4	0.1	2.0	**0.0**	0.0	0	0.0	0.0	**0.0**
43	105	109	117	R471 Sky Court rbt	NW	to	S	43	0.3	0	-0.3	0.0	**0.0**	7.0	7	0.0	-0.2	**0.0**
44	105	109	118	R471 Sky Court rbt	NW	to	SW	44	2.9	3	0.1	3.2	**0.0**	2.0	2	0.0	-1.7	**0.0**
45	137	104	127	N19 Drumgeely rbt	N19(NE)	to	SE	45	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
46	137	104	123	N19 Drumgeely rbt	N19(NE)	to	N19(SW)	46	23.0	23	0.0	0.1	**0.0**	24.7	27	2.3	8.5	**0.5**
47	137	104	136	N19 Drumgeely rbt	N19(NE)	to	SFZW	47	5.8	6	0.2	3.4	**0.1**	14.9	14	-0.9	-6.3	**0.2**
48	127	104	137	N19 Drumgeely rbt	SE	to	N19(NE)	48	2.0	2	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
49	127	104	123	N19 Drumgeely rbt	SE	to	N19(SW)	49	4.0	4	0.0	0.1	**0.0**	2.1	2	-0.1	-4.8	**0.0**
50	127	104	136	N19 Drumgeely rbt	SE	to	SFZW	50	1.9	2	0.1	3.4	**0.0**	2.1	2	-0.1	-6.3	**0.0**
51	123	104	137	N19 Drumgeely rbt	N19(SW)	to	N19(NE)	51	31.0	31	0.0	0.0	**0.0**	19.7	25	5.3	21.1	**1.1**
52	123	104	127	N19 Drumgeely rbt	N19(SW)	to	SE	52	5.7	4	-1.7	-43.0	**0.8**	2.1	2	-0.1	-4.6	**0.0**
53	123	104	136	N19 Drumgeely rbt	N19(SW)	to	SFZW	53	0.3	0	-0.3	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
54	110	136	137	N19 Drumgeely rbt	SFZW	to	N19(NE)	54	9.4	10	0.6	5.9	**0.2**	8.6	17	8.4	49.2	**2.3**
55	136	104	127	N19 Drumgeely rbt	SFZW	to	SE	55	3.8	4	0.2	5.9	**0.0**	5.2	7	1.8	26.1	**0.7**
56	136	104	123	N19 Drumgeely rbt	SFZW	to	N19(SW)	56	1.9	2	0.1	5.9	**0.0**	0.2	4	3.8	95.3	**0.0**
57	103	102	122	N19 Gateway W rbt	N19(N)	to	N19(S)	57	27.9	28	0.1	0.4	**0.0**	20.5	25	4.5	18.2	**1.0**
58	103	102	128	N19 Gateway W rbt	N19(N)	to	SFZW	58	0.0	0	0.0	0.0	**0.0**	6.5	8	1.5	18.3	**0.5**
59	122	102	103	N19 Gateway W rbt	N19(S)	to	N19(N)	59	32.0	32	0.0	0.0	**0.0**	15.9	19	3.1	16.1	**0.7**
60	122	102	128	N19 Gateway W rbt	N19(S)	to	SFZW	60	8.0	8	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
61	128	102	103	N19 Gateway W rbt	SFZW	to	N19(N)	61	5.0	5	0.0	0.0	**0.0**	4.2	5	0.8	16.1	**0.0**
62	128	102	122	N19 Gateway W rbt	SFZW	to	N19(S)	62	2.0	2	0.0	0.0	**0.0**	5.0	5	0.0	0.0	**0.0**

63	126	110	136	SFZW main entry rbt	NE	to	SE	63	6.0	6	0.0	0.0	**0.0**	1.0	1	0.0	0.2	**0.0**
64	126	110	124	SFZW main entry rbt	NE	to	SW	64	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
65	126	110	125	SFZW main entry rbt	NE	to	NW	65	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
66	136	110	126	SFZW main entry rbt	SE	to	NE	66	4.0	4	0.0	0.0	**0.0**	8.0	8	0.0	0.0	**0.0**
67	136	110	124	SFZW main entry rbt	SE	to	SW	67	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
68	136	110	125	SFZW main entry rbt	SE	to	NW	68	4.0	4	0.0	0.0	**0.0**	9.0	9	0.0	0.0	**0.0**
69	124	110	126	SFZW main entry rbt	SW	to	NE	69	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
70	124	110	136	SFZW main entry rbt	SW	to	SE	70	0.1	0	-0.1	0.0	**0.0**	2.0	2	0.0	-1.2	**0.0**
71	124	110	125	SFZW main entry rbt	SW	to	NW	71	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
72	125	110	126	SFZW main entry rbt	NW	to	NE	72	0.0	0	0.0	0.0	**0.0**	2.0	2	0.0	0.0	**0.0**
73	125	110	136	SFZW main entry rbt	NW	to	SE	73	9.0	9	0.0	0.0	**0.0**	11.0	11	0.0	0.3	**0.0**
74	125	110	124	SFZW main entry rbt	NW	to	SW	74	0.0	0	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**
75	135	103	111	Drumgeely Hill access	N19(N)	to	E	75	2.9	3	0.1	2.4	**0.0**	1.0	1	0.0	0.0	**0.0**
76	135	103	102	Drumgeely Hill access	N19(N)	to	N19(S)	76	25.9	62	36.1	58.2	**5.4**	26.0	26	0.0	0.0	**0.0**
77	111	103	135	Drumgeely Hill access	E	to	N19(N)	77	2.0	2	0.0	0.0	**0.0**	1.7	1	-0.7	-70.2	**0.0**
78	111	103	102	Drumgeely Hill access	E	to	N19(S)	78	2.0	2	0.0	0.0	**0.0**	1.0	1	0.0	0.0	**0.0**
79	102	103	135	Drumgeely Hill access	N19(S)	to	N19(N)	79	35.0	77	42.0	54.6	**5.6**	20.1	19	-1.1	-5.9	**0.3**
80	102	103	111	Drumgeely Hill access	N19(S)	to	E	80	2.0	2	0.0	0.0	**0.0**	0.0	0	0.0	0.0	**0.0**

APPENDIX B

Sensitivity Test on Network Extent

APPENDIX B – Sensitivity test on network extent

The modelling work documented in this report assumes that traffic from each area of land-use served by the N19 will continue to join the N19 in future at the same location that it does at present. This is a simplifying assumption appropriate for the Phase 2 model built on existing available traffic count data.

In order to assess whether this assumption is valid, a sensitivity test was undertaken. The network was expanded to include route choices between different N19 access points. And the zones of the model were subdivided to represent land-uses at different distances from these access points.

Of the three access points to Shannon Free Zone West (SFZW), the main access and southern access have the appearance of public roads, whilst the northern entrance has the appearance of a gated private property.

Figure B1: North entrance to SFZW

Accordingly, the main roads in the south of the zone have been coded in the model as available for public use, whereas the route to the north entrance is represented by centroid connectors only. So that land uses in the northern part of the zone have the choice of using the northern entrance, depending on the junction delays encountered when joining N19. But traffic from R472(N) to the airport (for example) is modelled as not having the choice of "rat-running" through SFZW.

Figure B2 shows the extent of the sensitivity test network.

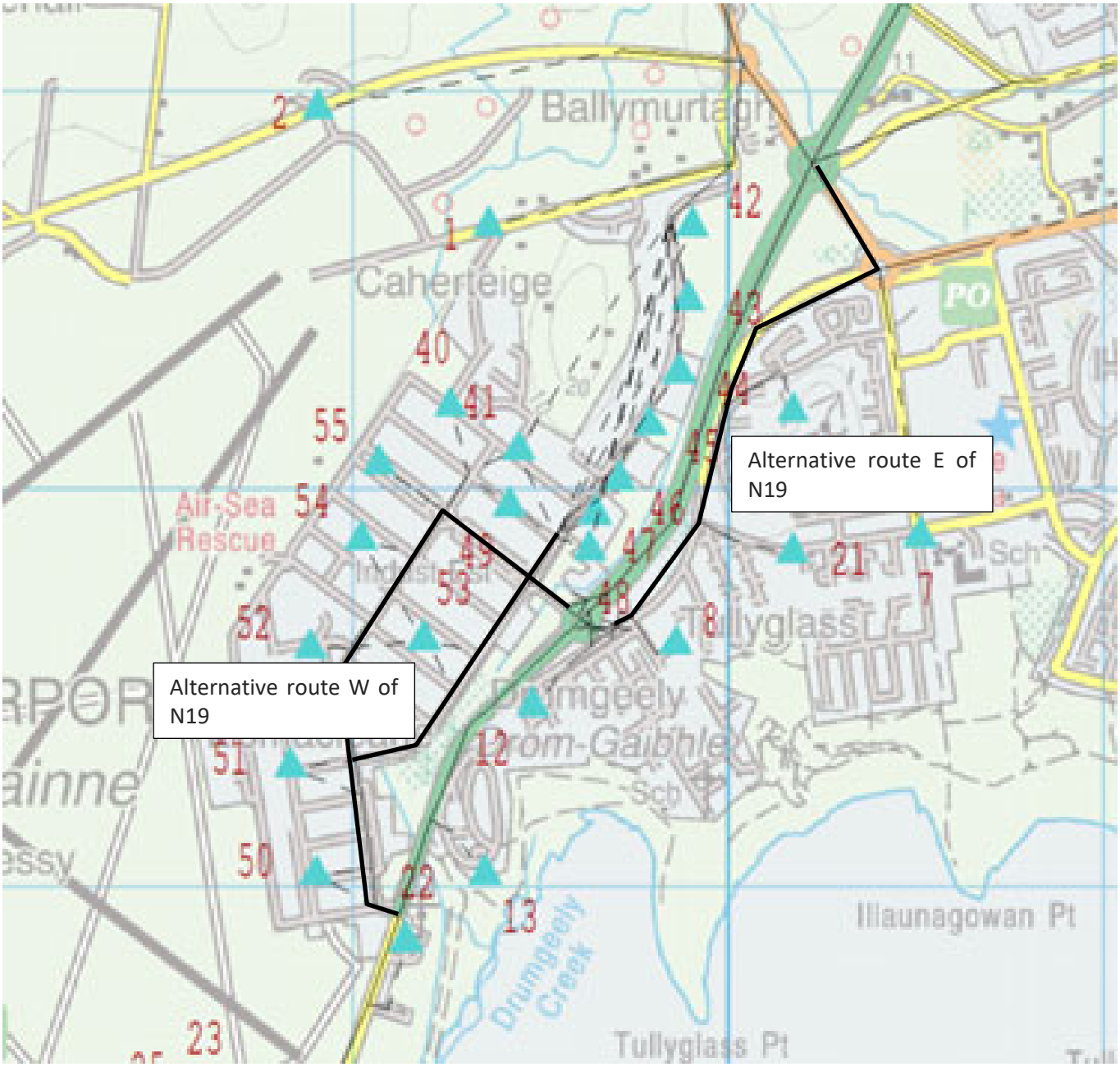


Figure B2: Model network for sensitivity test

The test used the 2050 High growth Do-Minimum network, as being likely to be the most congested network. As an indicative measure to represent the possible extent of easing of congestion due to the scheme, saturation flows at Drumgeely roundabout were doubled. The following table shows the scale of impact of this measure on the volumes of traffic using each N19 access point.

	pcu 2-way AM			
Access	DM	DS	*%diff*	diff
SFZW North	496	451	*-9%*	-45
SFZW Main	2193	2237	*2%*	44
SFZW South	596	604	*1%*	8
Drumgeely Road at Drumgeely Rbt	731	737	*1%*	6
R472(E) at Shannon Town Rbt	608	606	*0%*	-2
	pcu 2-way PM			
Access	DM	DS	*%diff*	diff
SFZW North	298	301	*1%*	3
SFZW Main	2220	2224	*0%*	4
SFZW South	638	632	*-1%*	-6
Drumgeely Road at Drumgeely Rbt	1016	1018	*0%*	2
R472(E) at Shannon Town Rbt	1278	1263	*-1%*	-15

The results show that the impact of allowing additional route choice within the model is minimal (<=2%) except in one case where it is small (<50 pcu/hour using the north access).

It was concluded that the impacts are small enough that the Phase 2 model (without the additional route choice) remains valid, but that it may be worthwhile to include the additional route choice when rebuilding the model at Phase 3.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