Appendix B

Appendix B – Traffic Model Verification Note

Public

1 Overview

1.1 Background

A strategic traffic model for Cookstown and its surrounding area was developed by WSP to assess the likely impacts of the proposed A29 Cookstown Bypass scheme.

The A29 Cookstown Bypass traffic model was built with a 2019 base, using survey data collected from Automatic Traffic Counters (ATCs), Manual Classified Counts (MCCs), Automated Number Plate Recognition (ANPR), Car Park Interview and Roadside Interview surveys (RSIs) undertaken between March 2019 and April 2019. The A29 Cookstown Bypass Local Model Validation Report (Ref: 718314-2700-R-0004 – November 2019) documents base model development and validation.

The base model was used to derive a set of traffic forecasts for the proposed scheme opening year 2025 and design year 2040. These forecasts, reported in A29 Cookstown Bypass Traffic Forecasting Report (718314-0000-R-022 - Jan 2020), informed the environmental and economic assessments of the A29 Cookstown Bypass scheme at SAR2 stage. Since the development of SAR2 traffic forecasts, the Department for Transport (DfT) has continued to provide updates to guidance and parameters to be used in transport modelling and appraisal, as part of its regular TAG releases.

At SAR3 stage, traffic forecasts were updated to reflect the refined scheme design and programme, and to incorporate the various parameter and guidance updates in line with TAG available at the time of model forecast development.

Following the unexpected event of Covid-19 pandemic, in April 2023, the DfT issued guidance on accounting for the Covid pandemic in traffic models. To better understand the uncertainties and the confidence in the A29 Cookstown traffic model's ongoing use at SAR3, DfI commissioned WSP to undertake a model verification exercise against post-Covid traffic data collected in autumn 2023.

This Technical Note presents the results of this verification exercise which uses traffic data collected in September and October 2023 and serves as a further verification step, specifically focussing on the model's ability to forecast the post-pandemic traffic volumes along the A29 corridor and the immediate area of the proposed scheme's influence.

2 Verification Approach

2.1 Model Forecasts

The traffic model forecasts which informed the SAR3 assessment were developed in line with relevant TAG units applicable at the time of model forecast development in May 2022. They relied on TEMPRO-NI v7.2 growth projections for Northern Ireland, together with data from Road Traffic Forecasts 2018 (RTF18) and information on local development applications from Mid Ulster Planning Portal, to derive an estimate of future traffic demand in the model area.

TEMPRO-NI is a software system developed to predict growth in travel demand in Northern Ireland, consistent with the National Tripend Model (NTEM) / TEMPRO system developed by the DfT, for transport planning in Great Britain. TEMPRO-NI uses the same software as TEMPRO for GB, however the underlying input data is bespoke to Northern Ireland. It builds up the predictions of trip totals from a range of demographic inputs including forecasts of employment, household and population and car ownership, through a series of sub-models. At SAR3 model forecast development stage, these forecasts were still based on pre Covid-19 estimates, with the updated TEMPRO-NI v8.0 only becoming available from July 2023.

The DfT and DfI both recognise the need for proportionality in traffic forecasting. In response to the uncertainties caused by the pandemic, within TAG Unit M4 (May 2023) Appendix B the DfT has set out possible options for accounting for Covid-19 in the models developed pre pandemic. The most robust method suggested in TAG Unit M4 (May 2023) Appendix B involves creating a forecast to the present day and comparing this forecast to locally observed traffic data to check the model against observations to verify its suitability. Within the guidance, it is acknowledged that full alignment to validation standards is not expected, but that some level of suitability is required. This was precisely the approach adopted to verify the A29 Cookstown Bypass model and its forecasting assumptions.

A new Do-Minimum 2023 network was created from the existing 2027 Do-minimum network by updating the generalised cost parameters in line with TAG Databook version v1.21 May 2023. A review of the development log revealed no proposed changes to the highway network in Cookstown between 2023 and 2027 networks. The Do-Minimum does not include the proposed A29 Cookstown Bypass scheme and therefore is the closest match to current network structure.

A new Do-Minimum 2023 forecast demand scenario was developed for the model verification purposes. A linear interpolation between the Base 2019 matrix and the Do-Minimum 2027 matrix developed for the SAR3 assessment was applied to produce the 2023 demand matrix. The Do-Minimum 2027 matrix includes all the planned development proposals that were forecast to be completed by 2027. The 2023 demand building methodology therefore assumes a linear build out profile for all planned developments.

Table 1 displays the matrix totals for all user classes for the 2019 model, the 2027 forecast model and the 2023 interpolated matrix.

Table 1 - Matrix Totals by User Class for Base 2019, Forecast 2027 and Interpolated 2023

User Class	AM			IP			PM		
	2019	2027	2023	2019	2027	2023	2019	2027	2023
Car - Commute	3236	3521	3378	680	740	710	2243	2438	2340
Car - Business	594	648	621	334	363	349	391	426	408
Car - Other	1859	2077	1968	3687	4153	3920	3889	4348	4118
LGV	529	581	555	488	537	512	680	747	713
HGV	467	464	466	547	543	545	338	336	337
Total	6685	7291	6988	5736	6336	6036	7540	8294	7917

The interpolated 2023 forecast demand matrix was assigned to the 2023 model network to produce the 2023 forecast scenario, which was benchmarked against the observed data collected in September and October 2023.

2.2 Observed Traffic Data

Collecting data plays a crucial role in transport analysis, and within TAG Unit M1.2, Automatic Traffic Counts (ATC) are recognised as a non-intrusive method for gathering observed traffic data essential for traffic model development, calibration, and validation. The ATC utilises pneumatic tubes to count vehicles and the locations of ATCs commissioned in 2023 are shown in Figure 1 and listed in Table 2 .

TAG Unit M1.2 para 3.3.7 states –

"Neutral periods are defined as Mondays to Thursdays from March through to November (excluding August), provided adequate lighting is available, and avoiding the weeks before/after Easter, the Thursday before and all of the week of a bank holiday, and the school holidays. Surveys may be carried out outside of these days/months, ensuring that the conditions being surveyed (e.g., traffic flow) are representative of the transport condition being analysed/modelled."

Throughout the survey duration, the contracted surveyor regularly inspected the pneumatic tubes, addressing any incidents related to their installation and operation, such as malfunction due to an unusual hit or contact with vehicles, or instances of vandalism to the equipment. These incidents were documented and flagged for further analysis to verify the accuracy of the data collected during the suspected incident period.

The 2023 surveys were conducted in and around Cooktown area during a 3-week period between the 25th of September and 15th of October 2023 and thus represent a neutral month.

ATCs captured traffic entering and exiting the Cookstown area as well as traffic within Cookstown and along the A29 corridor at 21 sites. The contractors had noted incidents of severe weather, including localised flooding in Cookstown, which had resulted in data loss at some sites. Nonetheless, consistent data, covering a period of at least 2 weeks and hence suitable for the model verification process, was collected at all locations except for site RSI 4 where only a single week of useable data was collected. All data was cleaned, verified and analysed, adopting the same methodology used to develop the 2019 Base model and detailed in the A29 Cookstown Traffic Data Collection Report 718314-2700-R-0003 A29 DCR (July 2020), to derive the 2023 observed flows used to benchmark the 2023 model forecasts.

Table 2 – A29 Cookstown ATC Site Locations.

Site	Location	Easting	Northing	Data Period
ATC 2	Westland Road	280408	378791	25th Sep-15th Oct
ATC 3	A29 Oldtown Street	281016	378737	25th sep-15th Oct
ATC 4	East Circular Road	281572	378781	25th sep-15th Oct
ATC 6	Westland Road South	280214	377796	25th sep-15th Oct
ATC 7	A29 Chapel Street	281116	377781	25th sep-15th Oct
ATC 8	Molesworth Road	281953	377858	25th sep-15th Oct
ATC 10	Sandholes Road	280424	376412	25th sep-15th Oct
ATC 11	A29 Dungannon Road	281241	376546	25th sep-15th Oct
ATC 13	A29 Moneymore Road	281898	379406	25th sep-15th Oct
ATC 22	A505 Drum Road	280747	377063	25th sep-15th Oct
ATC 23	Sweep Road	280763	376982	25th sep-15th Oct
ATC 24	Old Coagh Road	281099	378537	25th sep-15th Oct
ATC 25	B73 Molesworth Street	281257	378270	25th sep-15th Oct
ATC 26	Fountain Road	281269	377561	25th sep-15th Oct
RSI 2	B73 Coagh Road	282286	378260	25th sep-15th Oct
RSI 3	Clare Lane	282469	377686	25th sep-15th Oct
RSI 4	B520 Tullywiggan Road	281358	376145	9th Oct-15th Oct
RSI 5	A29 Dungannon Road	281233	376118	25th sep-15th Oct
RSI 7	A505 Drum Road	279765	376967	25th sep-15th Oct
RSI 8	Orritor Road	279920	378572	25th sep-15th Oct
RSI 9	B162 Lissan Road	280345	379504	25th sep-15th Oct

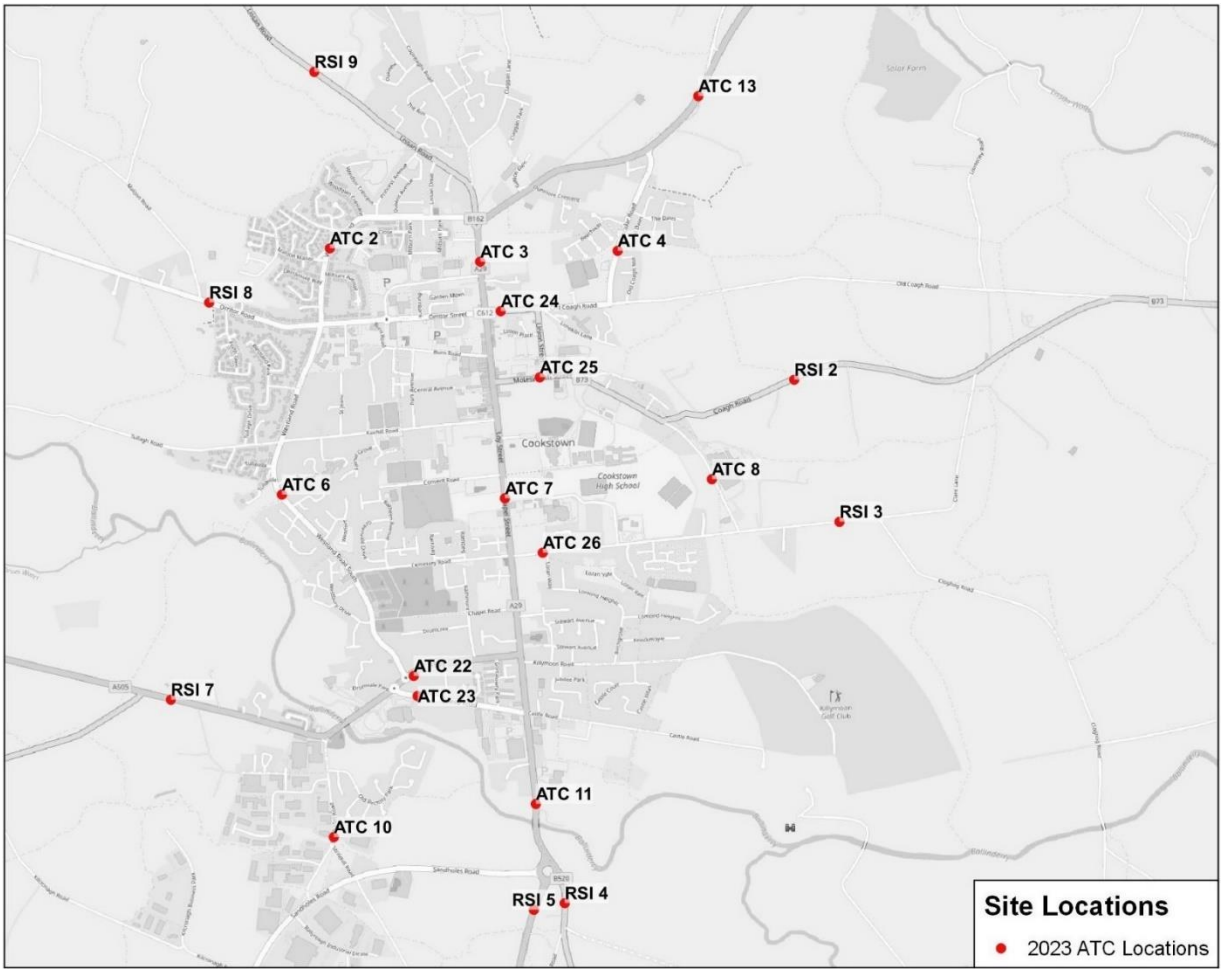

Figure 1 – A29 Cookstown 2023 ATC Survey Site Locations

2.3 Verification Methodology

The model verification methodology compared the two-way Do-Minimum 2023 model forecasts against the equivalent observed traffic count data. Various statistical analyses were performed by comparing counts at individual sites and Cookstown as a whole.

3 Verification Results

This section presents the comparisons between the modelled and observed flows for 2023. The data is shown in three parts: sites that are located along the existing A29 (A29), sites that capture traffic moving in and out of the Cookstown (Town centre) and sites that monitor traffic in the surrounding area (Outer Boundary).

3.1 Model Verification

The model verification compares the 2023 Do-Minimum forecast modelled flows against the observed ATC count data. The observed and modelled two-way flows in vehicles per hour are presented in Table 3 to Table 5. These tables also include the flow difference, percentage difference and GEH (a statistic for comparing modelled and observed traffic flows).

Table 3 - Two-way Modelled vs Observed flows, Difference (veh/h), Percentage Difference and GEH Statistic – AM Peak

Site Section		AM Peak				
		Observed	Modelled	Difference	% Difference	GEH
Outer Boundary	RSI_ATC02	184	164	-21	-11%	2
	RSI_ATC03	402	492	89	22%	4
	RSI_ATC04	438	518	80	18%	4
	RSI_ATC07	745	754	9	1%	0
	RSI_ATC08	346	368	22	6%	1
	RSI_ATC09	274	328	54	20%	3
Town Centre	ATC02	885	934	49	6%	2
	ATC04	348	444	96	28%	5
	ATC06	1213	1308	95	8%	3
	ATC08	473	404	-69	-15%	3
	ATC10	618	760	141	23%	5
	ATC22	347	535	188	54%	9
	ATC23	551	358	-193	-35%	9
	ATC24	397	384	-13	-3%	1
	ATC25	497	528	31	6%	1
	ATC26	532	572	40	8%	2
A29	ATC03	1039	1131	92	9%	3
	ATC07	973	1130	156	16%	5
	ATC11	1188	1345	157	13%	4
	ATC13	1422	1434	12	1%	0
	RSI_ATC05	946	1036	89	9%	3

Table 4 - Two-way Modelled vs Observed flows, Difference (veh/h), Percentage Difference and GEH Statistic – Inter Peak

Site Section		Inter Peak				
		Observed	Modelled	Difference	% Difference	GEH
Outer Boundary	RSI_ATC02	154	120	-34	-22%	3
	RSI_ATC03	240	287	46	19%	3
	RSI_ATC04	404	438	34	8%	2
	RSI_ATC07	557	550	-7	-1%	0
	RSI_ATC08	249	284	35	14%	2
	RSI_ATC09	212	212	0	0%	0
Town Centre	ATC02	601	741	139	23%	5
	ATC04	261	494	233	89%	12
	ATC06	955	1089	134	14%	4
	ATC08	375	285	-90	-24%	5
	ATC10	452	439	-13	-3%	1
	ATC22	294	381	86	29%	5
	ATC23	516	476	-40	-8%	2
	ATC24	455	341	-114	-25%	6
	ATC25	488	663	174	36%	7
	ATC26	455	426	-29	-6%	1
A29	ATC03	1002	833	-169	-17%	6
	ATC07	967	1077	110	11%	3
	ATC11	1017	1180	163	16%	5
	ATC13	1108	1114	5	0%	0
	RSI_ATC05	764	815	51	7%	2

Table 5 - Two-way Modelled vs Observed flows, Difference (veh/h), Percentage Difference and GEH Statistic – PM Peak

Site Section		PM Peak				
		Observed	Modelled	Difference	% Difference	GEH
Outer Boundary	RSI_ATC02	193	195	1	1%	0
	RSI_ATC03	456	493	36	8%	2
	RSI_ATC04	562	621	59	10%	2
	RSI_ATC07	886	878	-7	-1%	0
	RSI_ATC08	384	439	55	14%	3
	RSI_ATC09	330	309	-21	-6%	1
Town Centre	ATC02	924	1066	142	15%	5
	ATC04	354	558	205	58%	10
	ATC06	1277	1432	155	12%	4
	ATC08	518	451	-67	-13%	3
	ATC10	518	723	204	39%	8
	ATC22	355	651	296	83%	13
	ATC23	698	501	-196	-28%	8
	ATC24	528	430	-97	-18%	4
	ATC25	493	642	149	30%	6
	ATC26	597	578	-19	-3%	1
A29	ATC03	1261	1217	-43	-3%	1
	ATC07	1080	1195	115	11%	3
	ATC11	1166	1226	60	5%	2
	ATC13	1530	1549	19	1%	0
	RSI_ATC05	830	861	31	4%	1

Table 3 to Table 5 show that, most of the counts achieve GEH less than 5.0 (around 76% of counts across all time periods). GEH 5.0 is a threshold normally recommended by TAG when calibrating and validating the base model. Noting that the results presented here are from a model verification exercise rather than from recalibration and revalidation of the existing model, the 76% compliance can be considered as strong evidence of model's good performance. If the GEH threshold is relaxed to 10.0, nearly all the counts (approximately 95% across all time periods) would lie within GEH 10.0 band, demonstrating that across the model the forecast flows show a good correlation with observed data.

Understandably, there are some locations where model forecasts show a relatively high discrepancy (GEH exceeding 10.0) when compared to the 2023 survey data. Model performance at these locations was investigated to ascertain the extent to which it had the potential to unduly affect the assessment and appraisal of the proposed scheme. The two locations where GEH 10 is exceeded in 2023 verification were at ATC04 and ATC22.

ATC04 is located on East Circular Road and the model is seen to generally overestimate traffic using this route. However total traffic entering Cookstown from the north is controlled at ATC13 (located further north on A29 Moneymore Road) which shows a very close match to the observed 2023 volumes. This implies that the discrepancy at ATC04 is likely to be a localised routeing choice within the model and is therefore not likely to affect the model's overall ability to robustly assess the impacts of the proposed scheme.

The model is shown to overestimate flows at site ATC22 (Drum Road), particularly in the AM and PM peak periods, but to underestimate traffic using the parallel route through ATC23 along Sweep Road. This indicates a very localised routeing impact and across both sites combined the model shows a very good match to the observed flows in all time periods.

As implied in TAG Unit M4 (May 2023) Appendix B, there is no expectation for the model forecast to achieve the same level of compliance expected of a calibrated and validated base model. However, the high level of compliance achieved by the model along with the analysis of notable outliers, as reported above, provides a high level of assurance that the model is a suitable tool for forecasting the likely effects of the proposed scheme.

To further understand the network wide performance, a series of scatter plots comparing modelled flows to observed flows across the three different time periods has also been prepared and presented below (Figure 2 to Figure 4). Each of the different count sets is highlighted separately and a line of best fit has been applied assessing all the counts as a whole. The R^2 value has been calculated to demonstrate the correlation between modelled flows and observed counts.

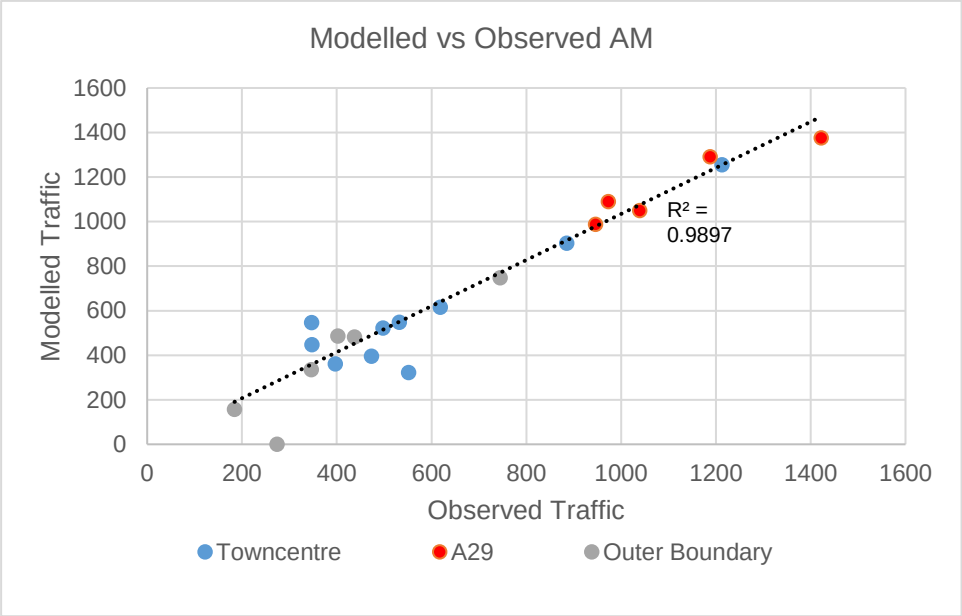

Figure 2 – Two-way Flow Model vs Observed data 2023 - AM Peak

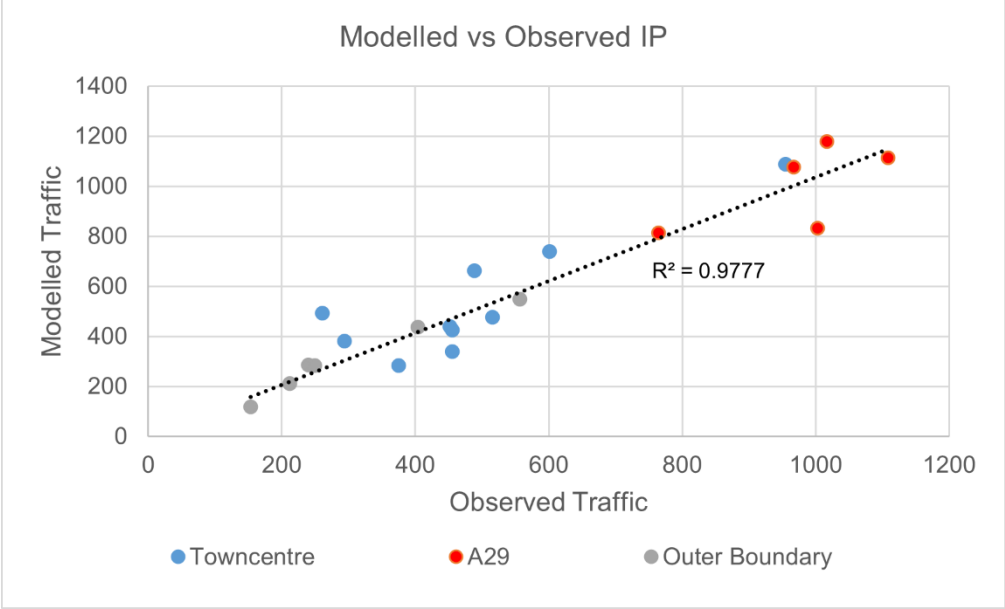

Figure 3 – Two-way Flow Model vs Observed data 2023 - IP Average

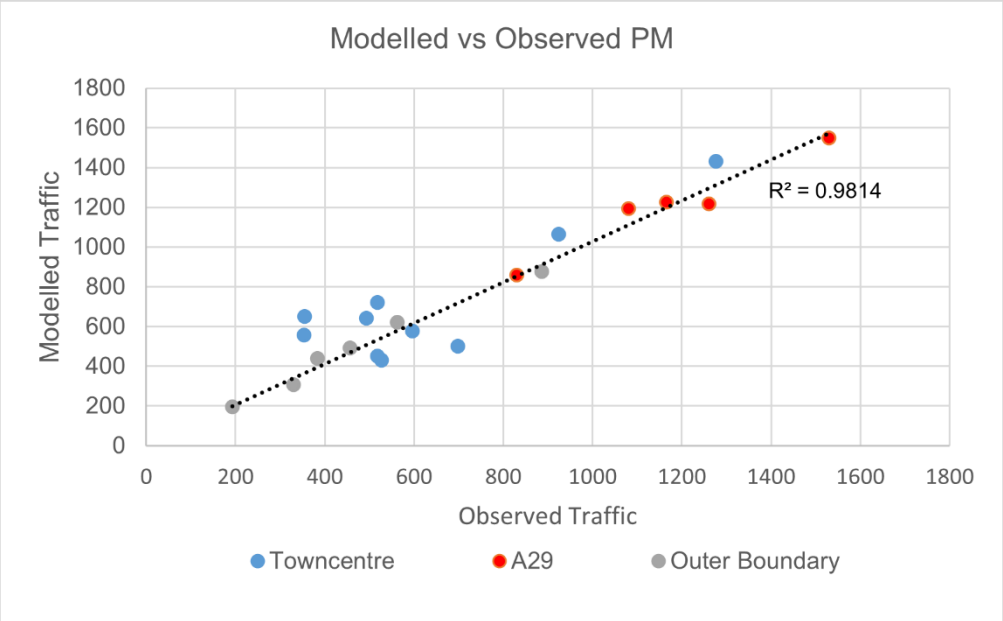

Figure 4 – Two-way Flow Model vs Observed data 2023 – PM Peak

Figure 2 to Figure 4 shows a consistent trend and a high level of correlation across all three peak periods with the R^2 statistic close to 1.0, ranging between 0.9897 in the AM peak and 0.9777 in the inter-peak. This shows that there is slight variation between the modelled and observed flows but generally the dataset as a whole has a close match. The inter-peak shows slightly more variation when compared to the AM and PM peaks. The Town centre sites tend to have more variable results across all three time periods when compared to the A29 sites and Outer Boundary sites.

Screenline Verification

For validation of the trip matrix, TAG advises that comparisons of modelled flows and counts should be taken at screenline level. Screenlines are typically comprised of 5 or more links capturing traffic along a particular axis or between sectors. However due to the number of sites surveyed in 2023, number of sites per screenline was limited. A set of mini-screenlines were developed using 2023 counts as shown in Figure 5.

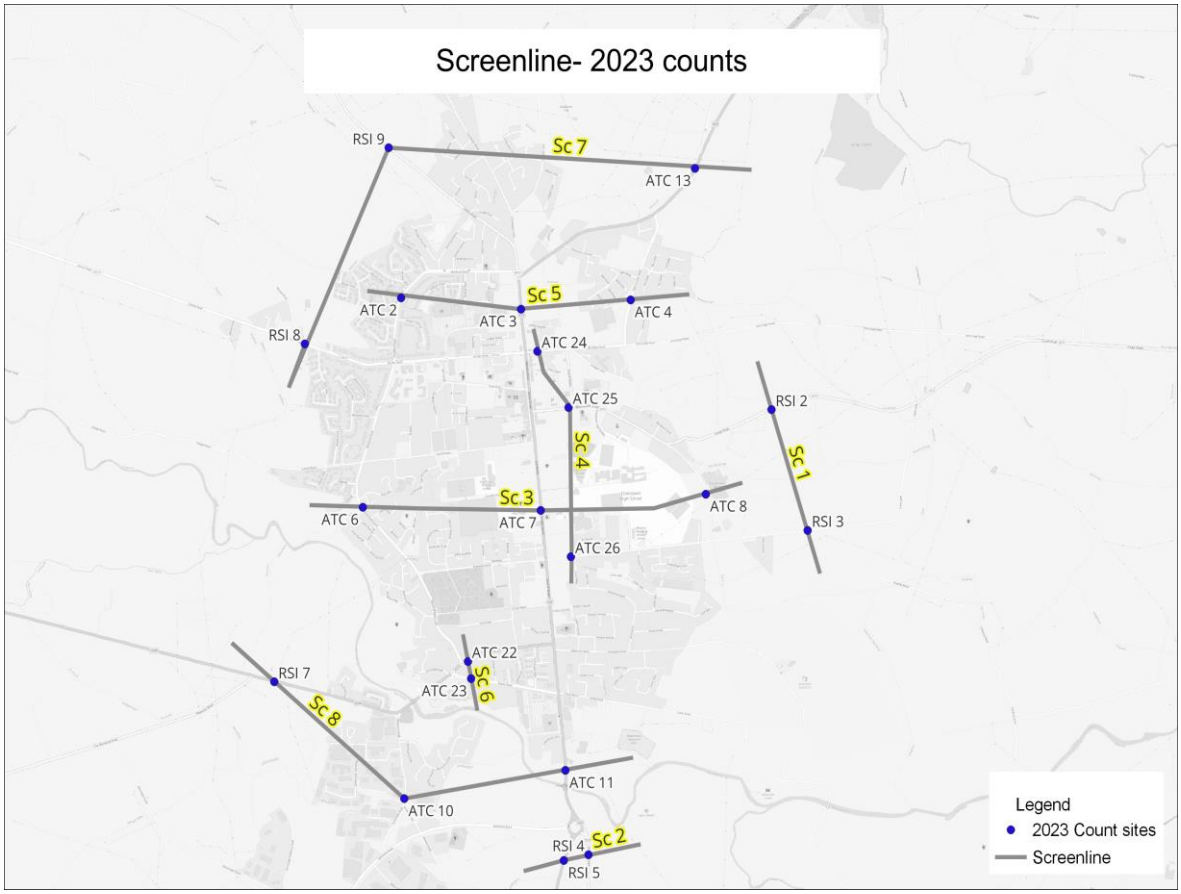

Figure 5 - Revised Screenline with 2023 counts

Table 6 Table 8 show the verification results at the mini-screenline level for AM peak, Inter peak and PM peak respectively. Whilst the GEH criteria is not usually used for screenline validation, in models with relatively low flows such as Cookstown where a small absolute difference can cause a disproportionately large percentage change, the GEH provides a useful measure of the goodness of fit. It can be seen that across all time periods, most of the mini-screenlines fall well within GEH of 4, and only a few screenlines exceed GEH of 5.

The model overestimates traffic on Screenline 5 Inbound mainly due to relatively high volume of rat running traffic along East Circular Road.

Figure 6 to Figure 8 shows the calibration and validation statistics of the sites along the screenlines, and this trend is in line with the results from the inherited Base model 2019. While many of the screenlines do not pass the 5% flow criteria, the absolute differences in total screenline flows are less than 200 vehicles and most of the screenlines fall within GEH of 4 criteria, across all modelled time periods.

Table 6 – Two-way Screenline Flow Verification (veh/h)- AM

Screenline	Observed	Modelled	Mod - Obs	% Diff	GEH
1	587	655	69	12%	2.8
2	1384	1553	169	12%	4.4
3	2659	2842	182	7%	3.5
4	1426	1484	58	4%	1.5
5	2273	2509	237	10%	4.8
6	899	894	-5	-1%	0.2
7	2042	2130	88	4%	1.9
8	2551	2859	308	12%	5.9

Table 7 – Two-way Screenline Flow Verification (veh/h)- IP

Screenline	Observed	Modelled	Mod - Obs	% Diff	GEH
1	394	407	13	3%	0.6
2	1169	1253	84	7%	2.4
3	2297	2452	155	7%	3.2
4	1399	1429	31	2%	0.8
5	1865	2068	203	11%	4.6
6	810	857	46	6%	1.6
7	1570	1610	40	3%	1.0
8	2025	2169	143	7%	3.1

Table 8 – Two-way Screenline Flow Verification (veh/h)- PM

Screenline	Observed	Modelled	Mod - Obs	% Diff	GEH
1	650	688	38	6%	1.5
2	1392	1482	90	6%	2.4
3	2874	3077	203	7%	3.7
4	1618	1650	33	2%	0.8
5	2539	2842	303	12%	5.8
6	1053	1152	100	9%	3.0
7	2243	2296	53	2%	1.1
8	2570	2827	256	10%	4.9

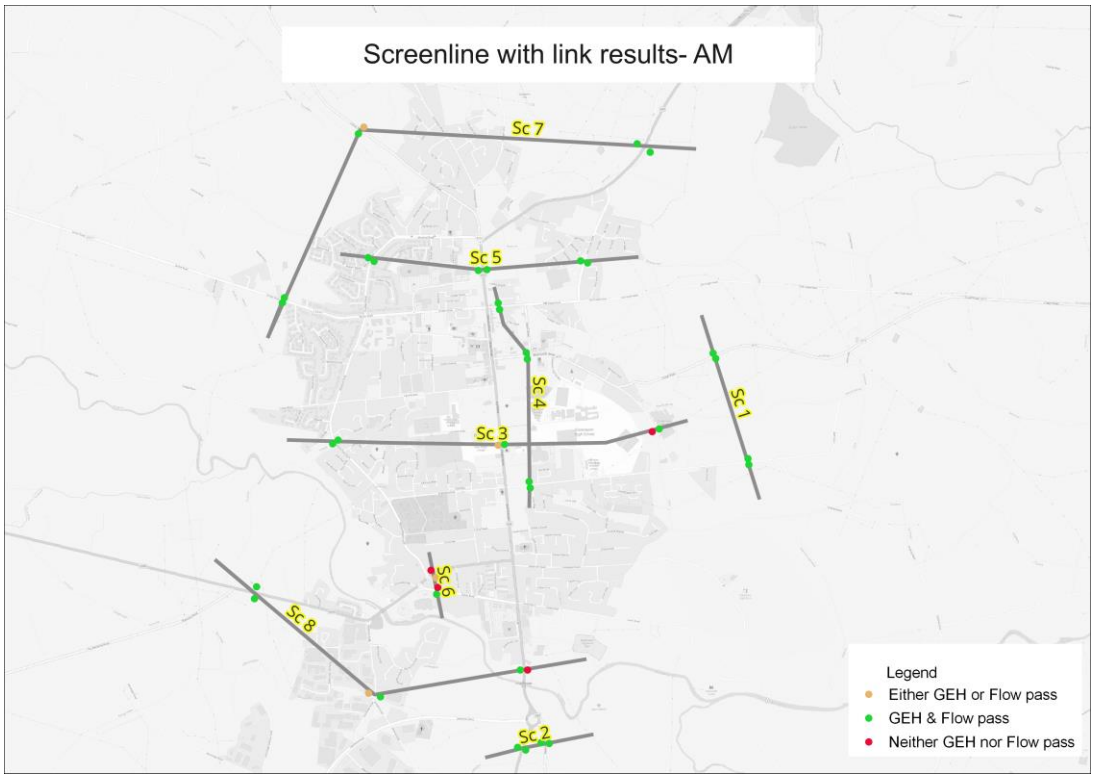

Figure 6 - Screenline with link results for GEH/Flow- AM

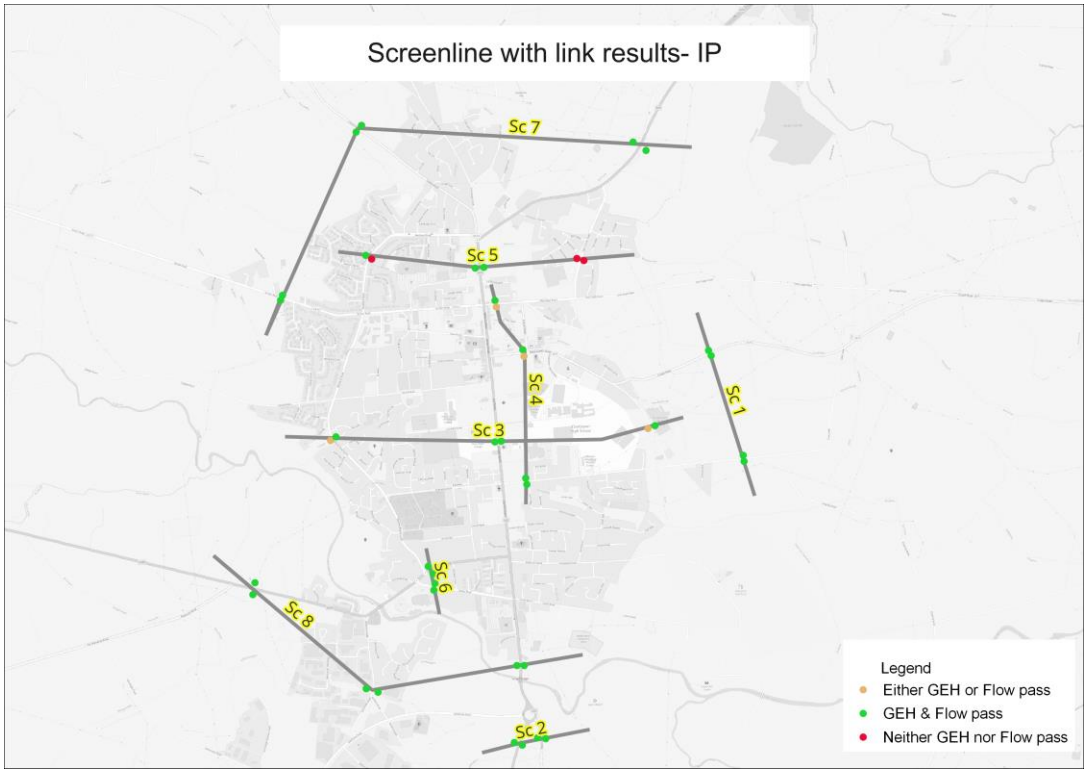

Figure 7 - Screenline with link results for GEH/Flow- IP

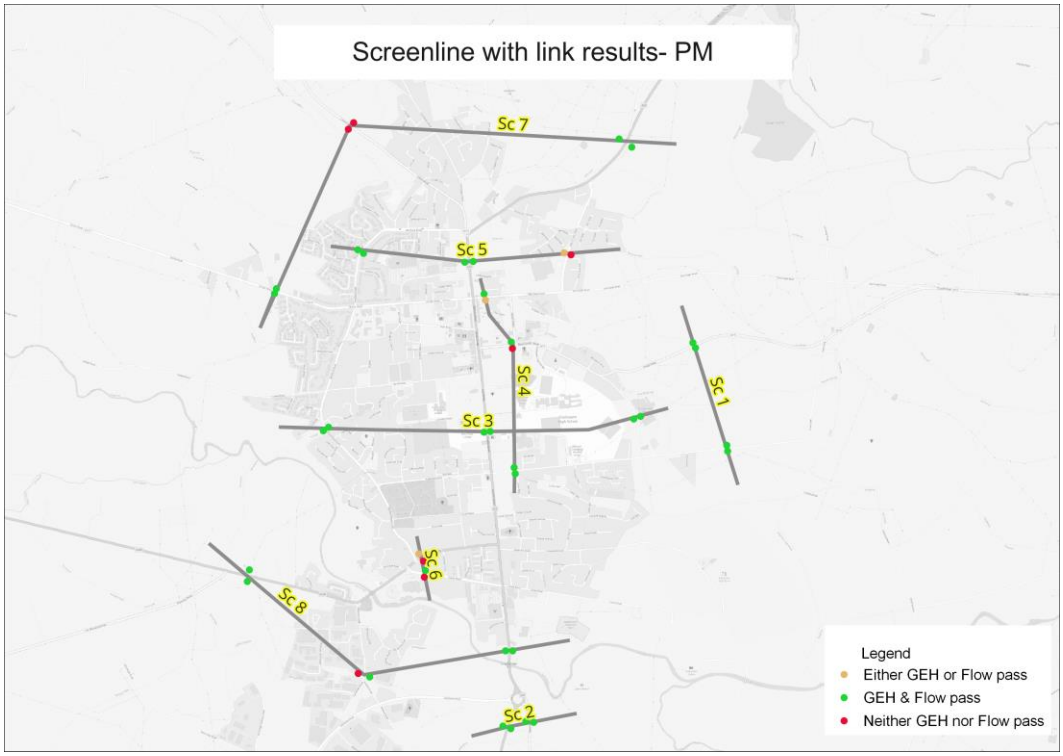

Figure 8 - Screenline with link results for GEH/Flow- PM

Overall, the model performance is considered to be good with the majority of modelled flows being within a reasonable tolerance levels of the observed and in many cases exceeding the TAG criteria for model validation.

3.2 Emerging Impacts of Covid Pandemic

A comparison was made between historical 2019 count data and 2023 ATC survey data to assess the effect Covid has had on travel behaviour and traffic volumes specifically in the Cookstown area. For this analysis the Outer boundary and Town centre count sets were obtained from the 2019 ATC and RSI surveys. The 2019 count data from AM, IP, and PM peak average weekday (Mon-Thur) was compared to the 2023 data used for the model verification process for each of the different count sets so that differences in traffic volumes can be observed in the different locations within Cookstown. These results are summarised in Table 9.

Table 9 - Average Weekday Two-way 2019 Flows Compared to 2023 Across All Sites

Year	AM	IP	PM
2019	14185	11563	15123
2023	13821	11528	14939
Difference	-364	-35	-185
Percentage Difference	-2.6%	-0.3%	-1.2%

Table 10 - Average Weekday Two-way 2019 Flows % difference compared to 2023 Across All Sites

Location	AM	IP	PM
A29	-4.4%	0.3%	-0.8%
Town Centre	-0.2%	-1.1%	-0.8%
Outside Boundary	-3.9%	0.2%	-3%

A comparison of the total flows to indicate a general effect on each area of Cookstown Area shows that throughout the town traffic has decreased when compared to an equivalent 2019 survey period. The Town centre has seen the least reduction of about 1% traffic volume. IP peak is seen to have steady levels of traffic. As the counts move towards the outer regions of Cookstown this reduction Ais significant the Outer Boundary sites show a 3%-4% reduction, and the A29 sites also show a 4% reduction mainly in the AM Peak.

The flow difference observed between 2019 and 2023 is consistent with Department for Infrastructure (DfI) observations across Northern Ireland. The flows observed by DfI have continued to increase from 2022 to a similar level or above the pre-pandemic baseline. The increase in traffic flows beyond 2023 could mean that model forecast flows will better represent observed flows in forecast years as traffic trends continue to align with the pre-pandemic DfI projections. This means that as demand levels return to expected projections the verification of the model will continue to improve and the forecast becomes increasingly more representative of future demand levels.

Furthermore, it is expected that use of the updated TEMPro v8 growth projections in forecast development, which consider changes in traffic demands since the pandemic, could result in closer match to observed flows for the 2023 observed count data.

3.3 Implications of verification exercises

The findings of the 2023 model verification assessment show that across all explicitly modelled time periods the model provides a good match with the 2023 observed traffic count data when looking at total traffic volume. Understandably, when compared to observed 2023 flow data, the forecast model flows are slightly overestimated. Despite this variation the model nonetheless shows a close representation of the 2023 observed flows and provides strong indication that the traffic model would continue to provide a good representation of expected traffic conditions in the future for the ongoing assessment of the A29 Cookstown Bypass Scheme.

4 Summary and Conclusions

This 2023 model verification was undertaken as part of the continuous monitoring and assessment of the A29 Cookstown Bypass Scheme traffic model performance. A fixed demand linear interpolation 2023 demand forecast was developed using the 2019 base model and the 2027 Do-Minimum forecast developed using the forecasting assumptions applicable in Dec 2022 and consistent with those used to inform the scheme SAR3 assessment. This interpolated 2023 forecast model was compared to observed traffic data gathered from the Cooktown ATC 2023 traffic survey between 25th September and 15th October 2023. These counts consisted of 21 Automatic Traffic Counts (ATCs) along the A29 and in Cookstown Town Centre.

Historical 2019 data was also used to note the effect the Covid-19 pandemic has had on traffic patterns and overall traffic levels in Cookstown. This showed that throughout the entirety of Cookstown in 2023, traffic levels had not yet reached pre-pandemic levels, being between 1% and 3% lower.

The findings of the verification assessment show that across all explicitly modelled peak time periods the model provides a relatively good match against most of the 2023 observed traffic count data for the total volume, particularly considering that the forecasting assumptions underpinning the 2023 model forecast are based on the pre-covid assumptions of traffic demand growth. It should be noted that the results presented here are from a model verification exercise rather than from recalibration and revalidation of the existing model.

The DfT has now published revised demand growth assumptions, available through TEMPro v8, NRTP 2022 and the DfI has released the equivalent TEMPro-NI v8 demand forecasts. TEMPro v8 forecast growth assumptions are generally lower than the demand assumptions used in the forecast model development, and it is expected that their use in the forecasting methodology could provide a closer match between the traffic model forecasts and observed traffic volumes post Covid.

This exercise has verified the model's continuing use as a forecasting tool, but the discrepancies have revealed a possible opportunity to improve the model's forecasting ability through the application of the most up to date forecasting assumptions, as issued by the DfT and DfI. A further model verification using updated TEMPro v8 and NRTP 2022 growth projections, which consider changes in traffic demands since the pandemic, could likely to result in better and improved outcome. This additional verification could provide a useful insight into not just the model's performance but could also provide confidence for ongoing use of the model for any future forecasting work.

Nonetheless, as the model provides a relatively close match against total traffic volumes in 2023, it is reasonable to expect that any forecasts created for 2027 and 2042 would provide a reasonable representation and baseline for assessing the impact of the A29 Bypass Scheme on traffic patterns and the economic impact of introducing the scheme.

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