Adran Seilwaith yr Economi
Department for Economic Infrastructure

Llywodraeth Cymru
Welsh Government

THE CHESTER TO BANGOR TRUNK ROAD (A55) (JUNCTIONS 16 AND 16A IMPROVEMENT REALIGNMENT AND SLIP ROADS) ORDER 202-

THE CHESTER TO BANGOR TRUNK ROAD (A55) (JUNCTIONS 16 AND 16A IMPROVEMENT REALIGNMENT AND SLIP ROADS) (SIDE ROADS) ORDER 202-

THE WELSH MINISTERS (THE CHESTER TO BANGOR TRUNK ROAD (A55) (JUNCTIONS 16 AND 16A IMPROVEMENT REALIGNMENT AND SLIP ROADS)) COMPULSORY PURCHASE ORDER 202-

PROOF OF EVIDENCE

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WELSH GOVERNMENT

DOCUMENT REFERENCE: WG 1.03.02

Contents

1. Author

1.1 My name is Nigel Roberts. I am a Chartered Engineer, Member of The Institution of Civil Engineers and Member of the Chartered Institute of Logistics and Transport. I have a first Degree in Engineering Geology and Geotechnics and a Masters Degree in Transport Engineering and Planning. I have 35 years, in both the Public and Private sectors, of Transport project appraisal and analytical assessment.

1.2 My relevant highways experience includes the following projects:

a) Technical Advisor to Welsh Government for A55 Third Menai Crossing; A55/A494 Deeside Corridor Improvement; A483 Wrexham Bypass Improvements; A487 Caernarfon and Bontnewydd Bypass.

b) Parkside Link Road Appraisal.

c) A465 Heads of The Valleys Improvements.

1.3 I am the Transport and Economics Witness for the A55 Junctions Improvements scheme. My role involves the key tasks of:

a) Traffic Modelling

b) Traffic Forecasting

c) Transport Economic Appraisal

2. Introduction

2.1 The project for improvements at Junction 15 and 16 has developed so that it encompasses Junctions 14 and 16A as well. Furthermore, the two sets of junctions, namely Junctions 14 and 15 to the west at Llanfairfechan, and Junctions 16 and 16A to the east at Dwygyfylchi and Penmaenmawr, are being treated under different sets of draft Orders and Environmental Statements. This proof of evidence addresses Junctions 16 and 16A, at Penmaenmawr, hereby referred in this proof of evidence as the 'Scheme' or the 'J16 Scheme' as appropriate.

2.2 My Proof of Evidence provides an overview of the traffic assessment and transport economic appraisal aspects of the Junction 16 Scheme and sets out the reasons for the proposed environmental mitigation.

2.3 The opinions expressed are my own unless I state otherwise. I have been assisted by colleagues from within the project team in the various tasks that are reported in this document. Colleagues are also presenting evidence within their specialist expertise. Where a topic is covered in detail by the proof of evidence of another specialist, I provide a cross reference to the relevant proof.

2.4 It is not my intention to reproduce large sections of text from the guidance and published technical documents, but simply to cross refer to, or highlight key procedural and technical matters that are pertinent to the assessment of the published Scheme. Consequently, I will refer in this Proof of Evidence to supporting material contained within these documents where relevant.

2.5 My Proof of Evidence covers traffic and economic appraisal and is structured in the following manner:

Part 3 Scope and Purpose of this Proof of Evidence

Part 4 Relevant Policy and Guidance

Part 5 Existing Conditions

Part 6 Overview of Traffic Model

Part 7 Base Year Traffic Model

Part 8 Traffic Forecasting

Part 9 Economic Appraisal

Part 10 Objections to the Scheme

Part 11 Alternatives to the Scheme

Part 12 Conclusion and Declaration

Part 13 Appendices (Separate Volume – WG 1.03.03)

Links with other Proofs of Evidence

2.6 I will rely on the following expert witnesses to cover their respective specialist fields:

Jonathan Bayliss – Highway Design (WG 1.05)

Craig Barson – Noise assessment (WG 1.09)

Graham Harker - Air Quality assessment (WG 1.10)

3. Scope and Purpose of this Proof of Evidence

3.1 In this proof of evidence, I provide details of key aspects of the traffic data analysis, traffic modelling and economic appraisal that has been undertaken for the Scheme.

3.2 My evidence is thus presented in the following structure:

a) A summary of existing conditions along the A55;

b) An overview of the strategic traffic model used to assess the impacts ofthe Scheme;

c) A summary of the development of the base year traffic model;

d) A summary of the traffic forecasting methodology;

e) An outline of the economic appraisal undertaken for the Scheme; and

f) Responses to the traffic related objections to the Scheme received to date.

4. Relevant Policy and Guidance

4.1 Throughout my evidence, I will refer to guidance on transport appraisal provided by both the Welsh Government and the UK Department for Transport. The primary reference document for transport modelling and economic appraisal in the UK is the web-based Transport Analysis Guidance (TAG) [1]. The Welsh Government's equivalent guidance is the Welsh Transport Appraisal Guidance (WelTAG) (Document Reference WG 4.01.36).

4.2 WelTAG forms the overarching guidance document for the planning and appraisal of transport proposals in Wales. In relation to technical matters of methodology, WelTAG refers appraisers to TAG guidance and data sources.

4.3 Relevant Documents

a) Traffic and Accident Data Report (Document Reference WG 4.05.05)

b) Assignment Model Validation Report (Document Reference WG 4.05.01)

c) Traffic Forecasting Report (Document Reference WG 4.05.02)

d) Economics Report (Document Reference WG 4.05.04)

e) TAG Data Book, May 2021 (Document Reference WG 4.05.06)

f) TAG Unit M3.1 – Modelling (Document Reference WG 4.05.07)

g) TAG Unit M2 – Variable Demand Modelling (Document Reference WG 4.05.08)

h) TAG Unit A1.1 – Cost Benefit Analysis (Document Reference WG 4.05.09)

[1] Access online at: https://www.gov.uk/guidance/transport-analysis-guidance-tag

5. Existing Conditions

Overview

5.1 The A55, passing Penmaenmawr, forms part of the strategic Route network, along the North Wales coast, linking Chester with Holyhead. It is of dual carriageway standard throughout with the exception of the Britannia Bridge crossing and its approaches. All junctions along the route are of grade-separated form with the exceptions of Junctions 15 and 16 that are at-grade roundabouts.

Traffic Flows

5.2 Average traffic flows between Junction 15a and Junction 16 were around 32,700 vehicles for the 24-hour day, combined directional flows, in the Base Year for appraisal of 2016. and 36,600 vehicles, combined directional flows, over a 24-hour period, between Junctions 16 and 16a.

5.3 Analysis of the traffic data shows peaks in traffic movements during the morning and evening. The actual peak hours within these periods are 0800-0900 in the morning and 1700-1800 hours in the evening. These are standard peak periods, during the average weekdays, and are influenced by journeys to work and education.

5.4 Traffic flows have a less peaky distribution at weekends where travel, generally, is for recreational purposes. During these times traffic levels are at their highest throughout the afternoon and early evening.

Seasonality of Traffic

5.5 Due to the A55 being a recreational route, traffic flows are seasonal. Lower than average flows are observed throughout the Winter months and higher than average flows observed during the summer months and at Bank Holiday periods.

5.6 Automatic Traffic Count data (ATC) was obtained from Transport for Wales (TfW) from a site at Penmaenbach on A55. The data was split for different vehicle types, hourly flows, daily flows, monthly flows and yearly flows. Different summaries were obtained for the differing directions of travel in order to determine if there was any noticeable tidality in the data.

5.7 Analysis of the ATC data confirmed that traffic flow levels were seasonal, with the highest flows being observed in August. When compared to average monthly traffic flow levels, the data showed that flows in August were 22% (percent) higher for eastbound traffic and 21% higher for westbound traffic.

Tidality of Traffic

5.8 On A55, traffic flows are greater to the east of Penmaenmawr than to the west. This represents a greater number of travellers heading to destinations

further east, such as the Llandudno area and further afield towards St Asaph and Deeside. Fewer journeys are made to Bangor, Caernarfon and Angelsey.

5.9 However, there is an even distribution to the tidality of traffic movements in the morning peak period and a marked westbound tidality, in the evening. Traffic flows are more evenly balanced during the Inter Peak period between the morning and evening peaks.

Vehicle Type Split

5.10 The vehicle type percentage split on A55 is Car 76%, Light Goods Vehicle (LGV) 13% and Heavy Goods Vehicle (HGV)11%, based on an assessment of 24-hourly flows. The proportions are representative of average conditions for a route of this nature.

Historic Traffic Growth

5.11 The historic 20-year long-term growth trend averages around 1.5% per year. Within this there are periods of reduced and negative growth, corresponding to times of economic slowdown, and periods of higher growth, experienced when economic activity recovers. The underlying trend, however, is the 1.5% yearly growth.

Accidents

5.12 Figure 1 presents a plot of the collated accident data by severity within the A55 study area over the five-year period from 2014 to 2018.

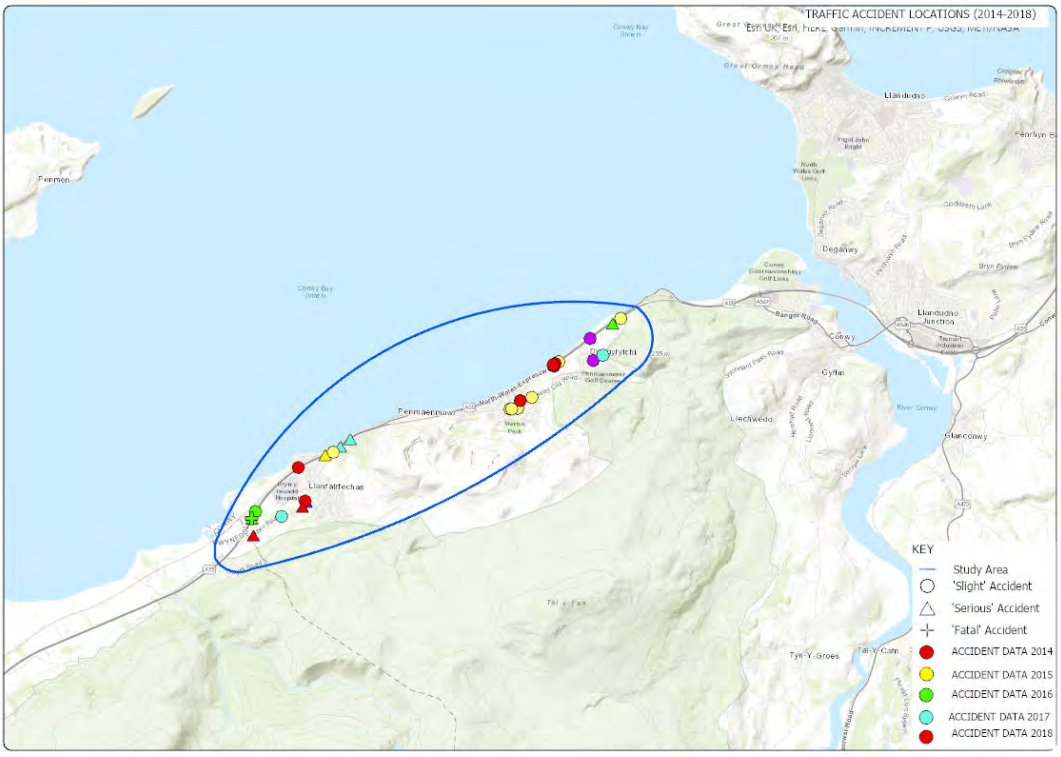

Figure 1: Accidents by Severity (2014-2018) (Accident Data © data.gov.uk)

5.13 Table 1 presents a summary of five years accident data (2014 to 2018) for the study area split between accident severities; fatal, serious and slight.

Table 1: Accident Data by Year and Severity

Year	Severity			Total Casualties	Total Accidents
	Slight	Serious	Fatal		
2014	6	2	0	10	8
2015	8	1	0	14	9
2016	2	2	1	7	5
2017	2	2	0	4	4
2018	3	0	0	3	3
Total	21	7	1	38	29

5.14 Analysis of the data has revealed during this time there have been 29 accidents. Of these, one accident was recorded as fatal, seven accidents were serious and 21 were slight.

5.15 The data indicates that there is a grouping of accidents on A55 in the vicinity of Junction 16 and also through the centre of Penmaenmawr.

Public Transport

5.16 Four bus services 5, 75, A55 and X5 serve Llanfairfechan, Penmaenmawr and Dwygyfylchi and are summarised in Table 2.

Table 2: Bus Services in the Study Area[2]

[2] Source: http://www.conwy.gov.uk/en/Resident/Parking-Roads-and-Travel/Public-Transport/Assets-Bus-pass/documents/Bus-Information/Conwy- Public-Transport-Guide-2018.PDF

Service	Bus Route	Frequency		
		Monday to Friday	Saturday	Sunday
5	Llandudno-Conwy-Bangor-Caernarfon	30 mins (from 06:30 to 19:50), 60 mins (from 19:50 to 23:50)		60 mins (from 09:08 to 22:20)
X5	Llandudno-Conwy-Bangor-Caernarfon	30 mins (from 07:15 to 18:25)		60 mins (from 10:38 to 19:38), last service at 23:30
A55	Llandudno-Conwy-Bangor-Caernarfon	Only one service leaving at 08:38 from the Bont Newydd bus stop		N/A
75	Llanfairfechan-Llandudno	Two services (09:58, 13:46)		N/A

5.17 Service 75 is a smaller vehicle providing limited services for Pendalar.

5.18 Bus services 5 and X5 access Dwygyfylchi at Junction 16A, passing through Penmaenmawr. The services continue onto the A55 via Junction 15A and access Llanfairfechan from Junction 15 before re-entering the A55 via Junction 14.

5.19 The eastbound route of bus services 5 and X5 accesses Llanfairfechan at Junction 14, continues onto the A55 at Junction 15, and accesses Penmaenmawr via Junction 15A. The services then exit Dwygyfylchi via Junction 16A and then travel west along A55 using the Junction 16 roundabout to turn around to head east.

5.20 The westbound and eastbound routes of the A55 bus service are the same for both directions. Buses access/exit Llanfairfechan at Junction 14 and Junction 15, continuing onto the A55. The service accesses/exits Penmaenmawr at Junction 15A and finally accesses/exits the A55 via Junction 16.

5.21 With regards to the bus service 75, it accesses/exits Llanfairfechan at Junction 14 and Junction 15, continues onto the A55, accesses/exits Penmaenmawr via Junction 15A and finally enters/exits Dwygyfylchi from Junction 16A.

5.22 Railway stations are located in Llanfairfechan and Penmaenmawr and are served by Arriva Trains Wales with services to Chester via Colwyn Bay, Rhyl, Prestatyn and Flint from 05:55 hrs to 23:59 hrs. Passenger services run between Holyhead and Crewe approximately every two hours during the week and on Saturdays. These do not call at Llanfairfechan and

Penmaenmawr. There are around four stopping services on a Sunday. There are no bus services connecting to either train station.

6. Overview of Traffic Model

Purpose of the Traffic Model

6.1 The A55 Transport Model (A55TM) is used to understand current traffic conditions in the area, to provide evidence for the planning of changes to the transport network and to produce traffic forecasts that are used in the detailed economic, social and environmental appraisal of proposed interventions in the transport system.

6.2 The primary purpose of the model is to test the impact of the junction improvements on the A55 and local highway network.

6.3 The methodology used to build, calibrate and validate the base year SATURN traffic assignment model, that was used to assess the changes to the highway network as a result of the proposed junction improvements, is described in the following sections.

Relevant Guidance

6.4 The model has been developed in accordance with the Department for Transport's (DfT) Transport Assessment Guidance (TAG) and the Welsh Government's Welsh Transport Assessment Guidance (WelTAG) (Document Reference WG 4.01.36). TAG Unit M3.1 'Modelling' (Document Reference WG 4.05.07) forms the main guidance for the model building process and TAG Unit M2 'Variable Demand Modelling' (VDM) (Document Reference WG 4.05.08) forms the guidance for assessing the need for VDM.

Software

6.5 The 'Industry Standard' traffic assignment software, SATURN Version 11.2.05 has been used to develop the Base Traffic Model and undertake the traffic forecasting assessments. Outputs from the SATURN modelling assessments were incorporated as inputs to the economic appraisal of the scheme improvements, using the DfT software TUBA.

Assessment of the Need for Variable Demand Modelling

6.6 The transport modelling for A55 improvement schemes has considered the need for variable demand modelling for traffic forecasting and economic appraisal. The guidance and criteria shown in TAG Unit M2 'Variable Demand Modelling' (Document Reference 4.04.08) was used to determine a suitable test.

6.7 A comparison of Scheme benefits derived from a fixed demand model and an elastic demand model was made to satisfy this comparison.

6.8 The elastic assignments were carried out using SATURN with the power function set as -0.5, for LGV's and HGV's, as recommended in the User Manual. For the User Classes, Car Employers Business, Car Commute and

Car Other, power functions of -0.6, -0.22 and -0.41 respectively, were applied as suggested in WebTAG Unit M2 'Variable Demand Modelling', Table A1. The elastic assignments were undertaken for each time period and the same user classes as the fixed demand assignments.

6.9 Both the fixed demand and the elastic demand assignments were fed into a Transport User Benefit Analysis (TUBA) appraisal to determine the respective scheme benefits for the opening and design years of the scheme. TUBA Version 1.9.14 was used for the appraisal. A summary of the outputs from the appraisal is shown in Table 3.

Table 3: Comparison of Scheme Benefits (£1,000)

	Fixed Demand	Elastic Demand	Difference	% Change
First Scheme Year 2022	£240	£241	£1	0.0%
Design Year 2037	£269	£295	£26	9.6%

6.10 The TAG guidelines suggest it will be acceptable in general to use a fixed demand assessment where the resulting difference in suppressed/induced traffic when using the demand model does not change benefits resulting from a scheme by more than 10% in the first scheme year (2022) and 15% in the forecast year (2037) relative to a fixed demand case.

6.11 The comparison in Table 3 demonstrates that the elastic demand in the model is not sufficiently large to exceed the TAG criteria in either the First Scheme Year (2022) or the Design Year (2037). Thus, the requirement for the use of a variable demand model for the A55 appraisal has not been determined.

6.12 As such the fixed demand model format was used to assess the forecasting and economic appraisals for the A55 improvement schemes.

Traffic Data Collection

6.13 The principal sources of data used in the development of the traffic model consist of:

a) Roadside Interviews (RSIs)

b) Automatic Number Plate Recognition (ANPR) Surveys

c) Manual Classified Turning Counts (MCCs)

d) Automatic Traffic Counts (ATCs)

e) Link Count Data

f) Journey Time Surveys

g) Signal Junction Data

h) Trafficmaster Journey Time Data

Automatic Traffic Counts (ATC's)

6.14 Five temporary ATCs were undertaken on key links within the study area between 23 April 2016 and 6 May 2016, covering the period when the RSIs were undertaken.

6.15 The summarised continuous ATC data was used to calculate average weekday factors for the three modelled time periods (AM Peak, Inter Peak and PM Peak) for the three vehicle types (Cars, Light Goods Vehicles and Heavy Goods Vehicles) in the model. These factors were applied to the MCC data to convert it into average weekday flows.

6.16 Two additional ATCs were recorded as part of the RSIs in both the survey interview and non-interview directions. The purpose of this was to record the trip distribution at each RSI site and to factor this distribution to the traffic volume at each site in the given interview direction.

Roadside Interview Surveys RSI's

6.17 Table 4 identifies the two RSIs that were undertaken on Wednesday 27th April 2016 between 07.00 and 19.00 at Aber Road in Llanfairfechan (interviewing vehicles travelling Eastbound) and at Conway Road in Penmaenmawr (interviewing vehicles travelling Westbound) to collect origin and destination data within the study area.

Table 4: RSI Survey Locations

Site	Location	Survey Direction
RSI 1	Aber Road, Llanfairfechan	Eastbound
RSI 2	Conway Road, Penmawnmawr	Westbound

6.18 The RSI data has been used to construct the observed matrices and provide a reliable source of the origin-destination movements of trips travelling in and around the A55 J15 and J16.

Manual Classified Counts (MCC's)

6.19 Twenty-two manual classified turning counts (MCCs) shown in Table 5 were undertaken over a 12-hour period (07:00 to 19:00) on a single neutral weekday, Tuesday 26 April 2016, on a different day to when the RSIs were undertaken.

Table 5: MCC Survey Locations

Site	Junction Type	Junction Roads
MCC 1	3-Arm Priority	A55 J14, E/B Exit and Entry

Site	Junction Type	Junction Roads
MCC 2	3-Arm Priority	Aber Road A55 Access Road (J14 W/B on and off)
MCC 3	4-Arm Signal	Penmaenmawr Road / Station Road / Village Road
MCC 4	3-Arm Priority	Station Road / Plas Gwyn Road
MCC 5	3-Arm Priority	Caradog Place / Promenade / Car Park Entrance
MCC 6	3-Arm Priority	Penmaenmawr Road / Shore Road East
MCC 7	3-Arm Roundabout	A55 Junction 15
MCC 8	3-Arm Priority	High Street / Chapel Street
MCC 9	3-Arm Priority	Bangor Road / A55 Access Road (J15A E/B off)
MCC 10	4-Arm Priority	Bangor Road / Esplanade / St David's Road
MCC 11	3-Arm Priority	Bangor Road / Celyn Street
MCC 12	4-Arm Priority	Bangor Road / Brynmor Terrace / Pant-Yr-Afon / Fernbrook Road
MCC 13	3-Arm Priority	Pant-Yr-Afon / Ffordd Hen Conwy
MCC 14	3-Arm Priority	Ffordd Hen Conwy / Church Road
MCC15	4-Arm Staggered Priority	Conway Road / Station Road East
MCC 16	3-Arm Roundabout	A55 Junction 16
MCC 17	3-Arm Priority	Ffordd Hen Conwy / Treforris Road
MCC 18	3-Arm Priority	Ysguborwen Road / Gogarth Avenue
MCC 19	4-Arm Priority (split junction)	Ysguborwen Road / Glan-Yr-Afon Road / Old Mill Road
MCC 20	A55 J16A Westbound on and off slips	A55 W/B / A55 J16A
MCC 21	4-Arm Priority	A547 / A55 J17 (E/B slip roads)
MCC 22	4-Arm Priority	A547/A55 J17 (W/B slip roads)

6.20 The model is calibrated at a five-user class level and all MCC data was segmented into the five modelled user classes: Car – Work purpose, Car – Commute, Car – Other purpose, LGVs and HGVs. The car user class was split into Car Work, Car Commute and Car Other purposes by factoring according to the relative proportion of these trip purposes in the RSI data.

6.21 All the MCCs presented in Table 5 have been used in the model to create and calibrate the model for the three peak period prior matrices for five modelled user classes.

Journey Time Surveys

6.22 The journey time surveys were used to validate the travel times in the model. On the routes surveyed, several observations were made of travel times during each of the modelled time periods. These times were then compared to the modelled journey times to determine compatibility. Where differences were greater than the TAG validation criteria, the modelled link capacities were adjusted to better reflect the actual journey times.

6.23 The Trafficmaster journey time data represented observations of journeys through the modelled area in April, May and June 2016. This dataset contained many more observations of trip movements and journey times than the individual journey time surveys. It has been used to complement the journey time surveys and further validate the journey times along the A55.

7. Base Year Traffic Model

Time Periods

7.1 In accordance with TAG Unit M3.1 'Modelling' (Document Reference WG 4.05.07), the model assesses the AM and PM peak periods and an average inter-peak hour. The peak periods were modelled as a single peak hour and are as follows:

a) AM peak hour – 08:00 to 09:00

b) PM peak hour – 17:00 to 18:00

c) Inter-peak hour – one-hour average between 10:00 to 16:00

7.2 These peak hours were determined from assessment of the observed two-week ATC count data recorded across the study network and detailed within the Traffic and Accident Data Report (TADR) (Ref A55J15J16-RAM-60-XX-RP-T-0001). (Document Reference WG 4.05.05)

7.3 Within the data, it was observed that the peak period in the morning was between 07:00 and 10:00 and the actual peak hour was 08:00 to 09:00. In the evening, the peak period was 16:00 to 19:00, within which the peak hour was determined as 17:00 to 18:00. For the inter peak period, the data showed that inter peak conditions prevailed between 10:00 and 16:00. The modelled inter peak hour was taken as an average of the six hours in the inter peak period.

Traveller Types

7.4 Traffic demand in the model is segmented at a five-user class level:

1. Class 1 – Car – Employers Business (or Car Work)
2. Class 2 - Car – Commute
3. Class 3 – Car – Other
4. Class 4 - Light Goods Vehicles (LGVs)
5. Class 5 – Other Goods Vehicles (OGVs) / Heavy Goods Vehicles (HGVs) / PSVs

7.5 The rationale for splitting the demand in this fashion is that the user classes have quite different values of time and/or vehicle operating costs. The values affect their choice of routes in the highway model, their response to changes in costs in the demand model, and the economic evaluation of time savings in the cost benefits analysis.

7.6 Demand in the SATURN traffic assignment is expressed in terms of Passenger Car Units (PCU). For the purposes of assignment in SATURN, the heavy vehicle volumes were factored by 2.4 to represent equivalent PCU

values, (i.e. 1 HGV =2.4 cars). The PCU factor for HGVs has been calculated using local classified count data and is consistent with guidance given in TAG, being between the values of 2.0 and 2.5 suggested for 'Rigid' and 'Articulated' HGVs in TAG unit M3.1.

Road Network

7.7 The base SATURN network was developed using site observations, Ordnance Survey (OS) Mapping, Geographical Information System (GIS) analysis and traffic information obtained from the local highway authorities.

7.8 Within the study area, all significant junctions are fully simulated, and all links are coded to give a representation of their length, speed, capacity and traffic flow classifications. This level of detail reflects the significance of the key links and junctions in route choice decisions through the study network.

7.9 The modelled highway network for this transport model represents the main strategic and local road network links within the fully modelled area and includes major 'A' roads, other 'A' roads, 'B' roads and minor roads. This network is shown on Figure 2.

Figure 2: Network Plan (OS Mapping)

Trip Matrices

7.10 Study trip matrices for Cars (Work, Commute and Other), LGV's and HGV's in the AM, Inter and PM Peak hours have been constructed from the observed manual counts shown in Figure 3. The count data represents a comprehensive set of 'control' data throughout the study area. The internal study area was divided into three distinct areas and cordon matrices derived

from the count data for each. These three areas were Llanfairfechan, Penmaenmawr and a A55 cordon and are shown in Figure 4.

7.11 The three cordon matrices were then merged, ensuring no double counting at the interface between A55 cordon and both the Llanfairfechan and Penmaenmawr cordons. The output from this process is a final 50x50 zonal study prior matrix.

7.12 The study matrix was then assigned to the network and modelled link flows compared to observed flows to determine whether matrix estimation would be required to fill in any gaps in the data. A very good match was obtained between the modelled prior matrix and the observed flows and matrix estimation was not required.

Figure 3: Matrix Calibration Count Sites

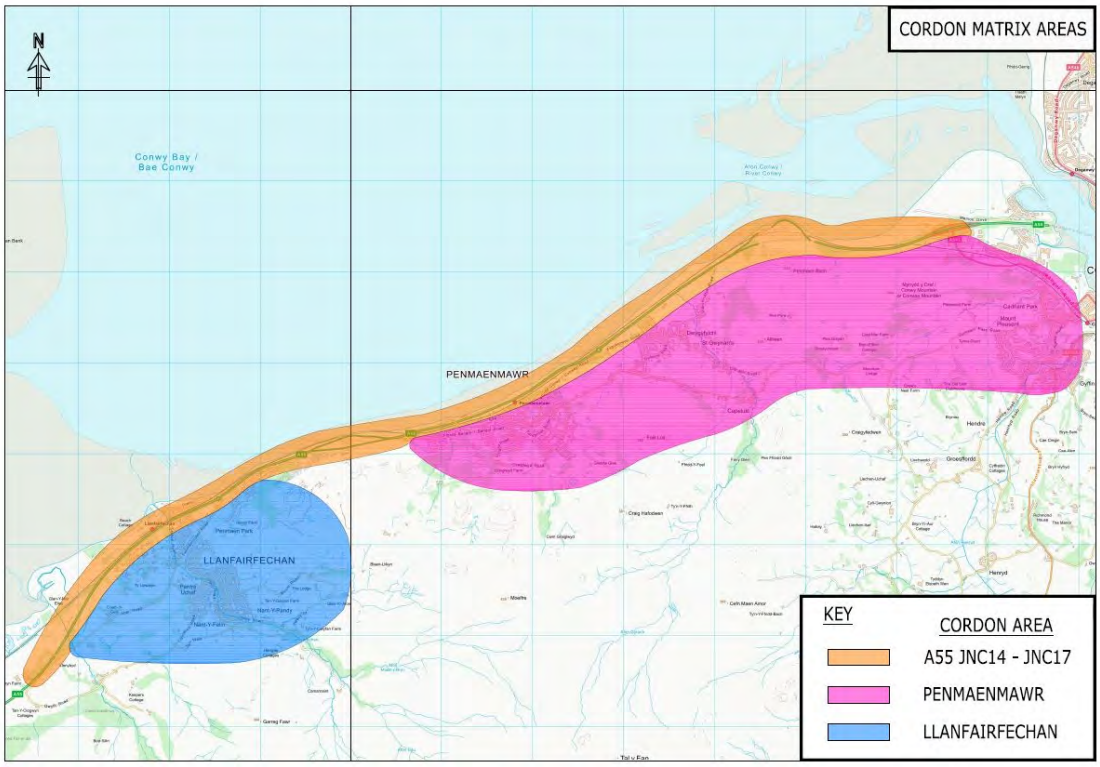

Figure 4: Cordon Matrix Areas
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Base Trip Matrices

7.13 For summary and display purposes, the final 50x50 base zone study matrices were aggregated into 5x5 sector matrices. The sectors were defined as the main groups of zones within Llanfairfechan, Penmaenmawr, Conwy and external areas to the east and west of the main study area. The 5x5 sectors are described in Table 6 and are shown graphically in Figure 5.

Table 6: 5x5 Sector Matrix Descriptions

Sector Matrix Descriptions		
1	Llanfairfechan Sector	Internal Sector
2	Penmaenmawr Sector	Internal Sector
3	Conwy Sector	Internal Sector
4	External East Sector	External Sector
5	External West Sector	External Sector

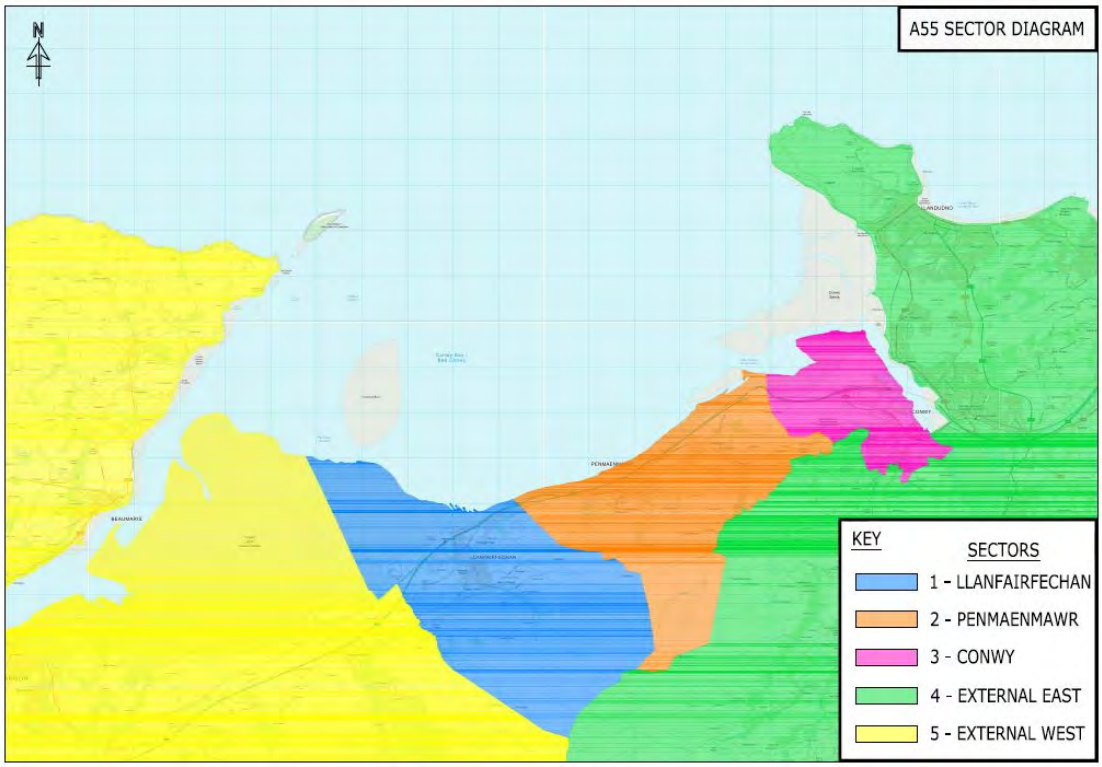

Figure 5: 5x5 Sector Matrix Areas
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7.14 Details of these individual sector matrix trips can be seen in the Assignment Model Validation Report (AMVR) (Document Reference WG 4.05.01). Tables 5.5 to 5.19 of this document present a summary of the inter-sector trips between the three internal sector zones (sector Zones 1 to 3) and the two external sector zones (4 to 5). These inter-sector trips have been summarised into the following three categories: trips to/from the three internal zones, trips to/from the internal and external zones and trips to/from the external zones.

Model Convergence

7.15 Convergence of the model is important in providing consistent and robust model results. The assignment procedure is an iterative process, run in many loops until the difference in calculated values between successive loops is negligible. At this point the model is 'stable' and can provide confidence that any differences reported by the model between a 'Do-Minimum' and a 'Do-Something' scenario are real, rather than relating to differing degrees of model instability.

7.16 Guidance on the degree of model convergence for a User Equilibrium Assignment, outlined in TAG Unit M3.1 (Document Reference WG 4.05.07), Section 3.3.5, states the main measure of the convergence of a traffic assignment is the Delta statistic, or %GAP. This is the difference between the costs along chosen routes and those along the minimum cost routes,

expressed as a percentage of the minimum costs. TAG recommends a guideline target for the %GAP value of 0.1% or less.

7.17 Additionally, the guidance suggests that there should be four consecutive assignment iterations where more than 98% of modelled flows change by less than 1%.

7.18 Table 7 shows the level of convergence achieved by the model for each time period. The results indicate that the model achieves a very good level of convergence for all measures tested and complies with the criteria set out in TAG.

Table 7: Model Convergence Statistics

	AM Peak	Inter Peak	PM Peak
No. of Iterations	13	58	24
%GAP	0%	0.00003%	0%
Flow change <1% (final)	100%	100%	100%
Flow change <1% (final-1)	100%	100%	100%
Flow change <1% (final-2)	100%	99.71%	100%
Flow change <1% (final-3)	100%	99.71%	100%

Traffic Flow Calibration

7.19 The method for checking model calibration and validation is to compare observed flows with modelled flows against TAG criteria using Design Manual for Roads and Bridges (DMRB) and Geoffrey E Havers statistic (GEH) statistical comparison. These comparisons are presented in terms of percentage or absolute difference in modelled flows and GEH. GEH is a form of chi square test that incorporates both relative and absolute errors.

7.20 These criteria are described in TAG Unit M3.1, Section 3.2.7 and are reproduced in Table 8.

Table 8: Link Flow Validation Criteria

Criteria	Description of Criteria	Acceptability Guideline
1	Individual flows within 100 vehicles of counts for flows less than 700 vehicles	>85% of cases
	Individual flows within 15% of counts for flows from 700 to 2,700 vehicles	>85% of cases

Criteria	Description of Criteria	Acceptability Guideline
	Individual flows within 400 vehicles of counts for flows more than 2,700 vehicles	>85% of cases
2	GEH <5 for individual flows	>85% of cases

7.21 The counts used for comparison for the model calibration are shown in Figure 6 (see below). Details of the calibration summaries can be found in the AMVR (Document Reference WG 4.05.01). Tables 7.3 to 7.5, of that document, show the comparison of the observed traffic flows with the modelled flows for the AM, Inter and PM peaks respectively.

7.22 Summary statistics for total vehicles are shown in the following tables.

Table 9: AM Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows less than 700	100%		Yes
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total flows	100%	85.7%	Yes

7.23 The above summary shows that the calibration of the AM Peak model passes the TAG acceptability requirements.

Table 10: Inter Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows less than 700	100%		Yes
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total flows	100%	87.8%	Yes

7.24 The above summary shows that the calibration of the Inter Peak model passes the TAG acceptability requirements.

Table 11: PM Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows less than 700	100%		Yes

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total Flows	100%	85.4%	Yes

7.25 The above summary shows that the calibration of the PM Peak model passes the TAG acceptability requirements.

Figure 6: Traffic Counts Used in Link Flow Calibration
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Traffic Flow Validation

7.26 Details of the count validation comparisons can be found in the Assignment Validation Report (Document Reference WG 4.05.01). Summary statistics are shown below to demonstrate acceptance of the model criteria.

Figure 7: Traffic Counts Used in Link Flow Validation
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7.27 Summary statistics for total vehicles are shown in Tables 12 to 14.

Table 12: AM Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	**Compliance with GEH Criteria**	**Pass Criteria ?**
Flows less than 700	100%		Yes
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total flows	100%	95.45%	Yes

7.28 The above summary shows that the validation of the AM Peak model passes the TAG acceptability requirements.

Table 13: Inter Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	**Compliance with GEH Criteria**	**Pass Criteria ?**
Flows less than 700	100%		Yes

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total Flows	100%	95.45%	Yes

7.29 The above summary shows that the validation of the Inter Peak model passes the TAG acceptability requirements.

Table 14: PM Peak Total Vehicle Summary Statistics

	Compliance with DMRB Criteria	Compliance with GEH Criteria	Pass Criteria ?
Flows less than 700	100%		Yes
Flows between 700 and 2700	100%		Yes
Flows greater than 2700	100%		Yes
Total Flows	100%	95.45%	Yes

7.30 The above summary shows that the validation of the PM Peak model passes the TAG acceptability requirements.

Journey Time Validation

7.31 Journey time data was obtained by journey time surveys undertaken for Welsh Government and described in the Traffic and Accident Data Report (Document Reference WG 4.05.05). Three routes were surveyed consisting of A55 between Junctions 14 and 17; the local route through Llanfairfechan and the local route through Penmaenmawr. The routes surveyed are shown on the plan below.

7.32 The journey time validation criteria adopted for the comparison was set as the TAG Unit M3.1 (Document Reference WG 4.05.07), Section 3.2.10 criteria which states that modelled journey times should be within 15% of observed journey times for at least 85% of routes, or within 1 minute of the observed times.

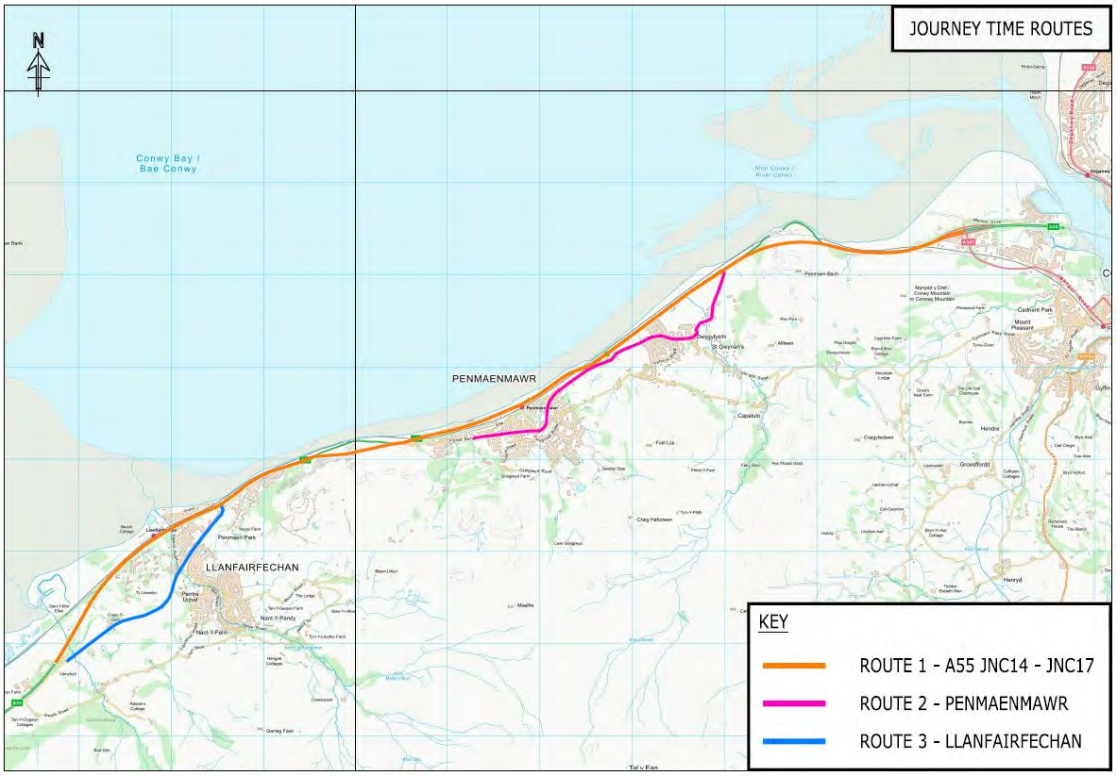

Figure 8: Journey Time Validation Routes
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7.33 The tables below (Tables 15 to 17) show the journey time validation for the three routes in the local model area.

Table 15: AM Peak Journey Time Validation

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:33	8:25	-0:08	-1.6%	Y
A55	WB	7:35	7:29	-0:06	-1.3%	Y
Route 2	EB	4:26	4:31	0:05	1.9%	Y
Penmaenmawr	WB	3:34	3:47	0:13	6.1%	Y
Route 3	EB	2:25	2:38	0:13	8.9%	Y
Llanfairfechan	WB	2:52	2:41	-0:11	-6.4%	Y

Table 16: Inter Peak Journey Time Validation

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:43	8:17	-0:26	-5.9%	Y
A55	WB	7:50	7:21	-0:29	-5%	Y
Route 2	EB	4:29	4:25	-0:04	-1.5%	Y
Penmaenmawr	WB	3:21	3:48	0:27	13.4%	Y
Route 3	EB	2:31	2:37	0:06	4%	Y
Llanfairfechan	WB	2:39	2:40	0:01	0.0%	Y

Table 17: PM Peak Journey Time Validation

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
Route 1	EB	8:35	8:29	-0:06	-1.2%	Y
A55	WB	8:22	7:31	-0:51	-10.1%	Y
Route 2	EB	4:42	4:25	-0:17	-6%	Y
Penmaenmawr	WB	3:30	3:58	0:28	13.3%	Y
Route 3	EB	2:41	2:38	-0:03	-1.9%	Y
Llanfairfechan	WB	2:35	2:45	0:10	6.4%	Y

7.34 The journey times for all time periods demonstrate that all modelled journey times are within 85% of the observed journey times and no modelled times are in excess of one minute difference to the observed times. These are the TAG acceptability criteria. The model shows a good fit with the observed journey times and all modelled times satisfy these TAG criteria.

7.35 The A55 Route 1 modelled journey times were also compared to Trafficmaster observed data, as shown in Table 18.

Table 18: A55 Journey Time Validation (Trafficmaster)

Route	Direction	Observed Journey Time (mm:ss)	Modelled Journey Time (mm:ss)	Difference (mm:ss)	% Difference	Validation
A55	EB	8:15	8:25	0:10	2%	Y
AM Peak	WB	7:18	7:29	0:11	2.5%	Y
A55	EB	8:14	8:17	0:03	0.6%	Y
Inter Peak	WB	7:17	7:21	0:04	0.9%	Y
A55	EB	8:10	8:29	0:19	3.9%	Y
PM Peak	WB	7:13	7:31	0:18	4.1%	Y

7.36 This data comparison shows a high degree of compatibility across all time periods and shows that there is a very good fit between the modelled and observed data and all the TAG criteria are met.

7.37 Additional checks were made on the model routeing to demonstrate sensible and logical route choice for all trip movements. A number of discrete origin-destination (OD) pairs were chosen to represent all key movements within the modelled area. The route paths between these OD pairs were viewed using the 'Forest' option within SATURN and demonstrated logical routeing patterns through the modelled network. This exercise confirmed that the model was showing a realistic and logical series of travel patterns through the network.

Fitness for Purpose

7.38 The results demonstrate that the model performs well against WelTAG and TAG criteria in terms of:

a) Convergence

b) Observed and modelled link lengths

c) Journey times

d) Calibration of flows

e) Validation of flows

7.39 Based on the results detailed in this report it can be concluded that the A55TM is a sufficiently robust model that reflects the existing situation in terms of flows and journey times and is suitable for assessing the impact of the new scheme, environmental assessment and economic cost benefit analysis. It gives a good comparison between observed and modelled data and is fit for the purpose of appraising A55 Junctions 15 and 16 improvement options.

7.40 Diagrams showing the 2016 Base traffic flows are included in Appendix A.

8. Traffic Forecasting

Overview of Methodology

8.1 In order to account for uncertainty in the calculations of background traffic, traffic forecasts were prepared considering three forecasting assessment scenarios:

a) Core Scenario – The core scenario considers the mostly likely estimates of traffic growth as described in Section 5 and the most likely estimate of trip generation for the committed developments within the A55TM study area.

b) Low Growth Scenario – This scenario presents a lower estimate of traffic growth within the A55TM study area calculated according to TAG guidance (Unit M4: 'Forecasting and Uncertainty', Document Reference WG 4.05.10) and considers the most likely estimate of trip generation for the committed developments within the study area.

c) High Growth Scenario –This high growth scenario presents a higher estimate of traffic growth within the study area calculated according to TAG guidance (Unit M4) and considers the most likely estimate of trip generation for the committed developments within the study area.

8.2 Traffic forecasts were produced for three peak periods; AM, Inter Peak and PM peaks, for each forecast year (2022, 2037 and 2051), for each scenario (core, low and high growth scenarios).

8.3 The outputs from the forecasting process include:

a) Assigned flows for the three scenarios (core, low and high growth scenarios) for the forecast years (2022, 2037 and 2051) for the 'Do-Minimum' (DM) and 'Do-Something' (DS) transport networks; and

b) An assessment of the highway impacts as a result of the three scenarios.

Do Minimum Network

8.4 It was determined through liaison with Welsh Government (WG) and Local Highway Authorities (Conwy, Gwynedd and Denbighshire) that no local highway improvement schemes were planned in the study area during the modelled assessment period and therefore the '"Do Minimum"' network remains the same as the validated 2016 base year network.

Do Something Network - A55 Improvement Options

8.5 The ''Do Something'' network models were developed by editing the '"Do Minimum"' network to incorporate the preferred junction improvement scheme for Junction 16. Table 19 presents a summary description of the

improvement scheme. The detail of the improvement proposal is discussed in the Proof of Evidence presented by Jonathan Bayliss (Document Reference WG 1.05.02).

Table 19: A55 Junction 16 Improvement Scheme

Junction	Model Ref	Scheme Ref	Improvement Scheme Description
16a / 16	J16 Preferred Option	Option A Preferred	Four-way movement with bridge across A55 at J16a. Westbound on/off slips at J16. Extended Link road linking to Glan-Yr-Afon Roadd and Ysguborwen Road. Traffic Calming through Dwygyfylchi.

Traffic Growth

8.6 Having assessed all the planned development sites in the neighbouring councils of Denbighshire, Gwynedd and Anglesey, it was ascertained that the majority of trips generated in these areas would not enter, exit or pass through the model and the remainder were included in TEMPro growth assumptions. Traffic growth within the model has therefore been determined as being equivalent to TEMPro growth.

8.7 Five development sites are shown in Table 20 and lie within the study area. The other sites have not been modelled explicitly due to their size and location and it was ascertained that trips associated with these developments would be accounted for within the TEMPro growth assumptions.

Table 20: Committed Developments included within Model

No.	Reference	Development	Location
1	CONRES001	Residential	Sychnant Pass Road, Conwy
2	CONRES002	Residential	Penmaenmawr Road, Llanfairfechan
3	CONRES003	Residential	Conway Road, Penmaenmawr
4	CONRES004	Residential	Penmaenmawr Road, Llanfairfechan
5	CONRES005	Residential	Ysguborwen Road, Dwygyfylchi

Traffic Forecast Growth Rates

8.8 In order to calculate opening, design and horizon year flows for the core scenario, base year traffic matrices presented in the AMVR (Document Reference WG 4.05.01) have been factored to first scheme year 2022, design year 2037 and horizon year 2051 using TEMPro Version 7.2 growth forecasts for North Wales (Region) for cars and the National Transport Model (NTM) forecast (Scenario 1, North Wales, S1 SRN-Local Table 3) for LGV and HGV growth.

8.9 These rates were derived for the same three peak periods as those used in the Base Model and corresponded to:

1. AM Peak – 08:00-09:00
2. Average Inter Peak – 10:00-16:00
3. PM Peak – 170:0-18:00

8.10 The forecast matrices were further disaggregated by vehicle type into five user classes, representing:

1. Car Employer's Business (or Car Work)
2. Car Commute
3. Car Other
4. Light Goods Vehicles (LGVs)
5. Heavy Goods Vehicles (HGVs)

8.11 The Base Model year for the A55TM was 2016, which represents the period of the traffic data collection, and growth rates were calculated for cars (work, commute and other), LGV's and HGV's from 2016 to 2022, from 2022 to 2037 and from 2037 to 2051. These growth rates are estimated as being the most likely levels of traffic growth for the study area and represents the traffic growth for the core scenario.

8.12 Table 21 shows the core scenario growth rates derived for the A55TM for cars from 2016 to 2022, from 2022 to 2037 and from 2037 to 2051.

Table 21: TEMPro Car Growth Rates

Car Growth Rates	AM Peak	Inter Peak	PM Peak
2016-2022	1.050	1.056	1.048
2022-2037	1.080	1.081	1.079
2037-2051	1.065	1.050	1.059

8.13 In line with TAG guidance, Unit M4,S 7.4.11, the TEMPro car growth rates have been adjusted to take account of the fixed demand nature of the forecasting model. These adjustments have been made for income and fuel price, with the adjustment factors being calculated from values in the TAG data book, Table M 4.2.1. These factors are presented in Table 22.

Table 22: Income and Fuel Adjustment Factors

Period	Income	Fuel	Combined Income and Fuel Factor
2016-2022	1.006	1.007	**1.013**
2022-2037	1.038	1.011	**1.049**

Period	Income	Fuel	Combined Income and Fuel Factor
2037-2051	1.026	0.992	**1.018**

8.14 Table 23 presents the adjusted core scenario TEMPro car growth rates. TEMPro rates presented in Table 21 have been factored by a combined income and fuel factor for each time period (AM, Inter Peak and PM peak) from base year to opening, design and horizon years. These rates have been used to factor base year matrices to opening, design and horizon years.

Table 23: Adjusted TEMPro Car Growth Rates

Adjusted Car Growth Rates	AM Peak	Inter Peak	PM Peak
2016-2022	1.063	1.070	1.061
2022-2037	1.134	1.134	1.132
2037-2051	1.084	1.069	1.078

8.15 Table 24 shows the core scenario growth rates derived for the A55TM for LGVs from 2016 to 2022, from 2022 to 2037 and from 2037 to 2051.

Table 24: LGV Growth Rates

LGV Growth Rates	AM Peak	Inter Peak	PM Peak
2016-2022	1.166	1.166	1.166
2022-2037	1.322	1.322	1.322
2037-2051	1.212	1.212	1.212

8.16 Table 25 shows the core scenario growth rates derived for the A55TM for HGVs from 2016 to 2022, from 2022 to 2037 and from 2037 to 2051.

Table 25: HGV Growth Rates

Heavy Vehicle Growth Rates	AM Peak	Inter Peak	PM Peak
2016-2022	1.048	1.048	1.048
2022-2037	1.119	1.119	1.119
2037-2051	1.110	1.110	1.110

Forecast Traffic Flows

8.17 Generalised Cost values for the Pence per Minute (PPM) and Pence per Kilometre (PPK) parameters were derived from the method set out in TAG Unit A1.3 and incorporated values from the latest TAG Data Book – May 2021. The values are both expressed in 2010 prices and in perceived costs, reflecting the users 'awareness' of indirect taxation. The values of PPM were taken from WebTAG Data Book Table A1.3.6 for all purposes except Car

Work which was calculated from a combination of Table A1.3.2 (Value of Time per Person) and Table A1.3.3 (Car Occupancies). Values of PPK were calculated from Tables A1.3.12 (fuel costs - work), A1.3.13 (fuel costs non-work) and Table A1.3.14 (non-fuel costs).

8.18 The generalised cost parameters used in the model and calculated for the forecast years of 2022, 2037 and 2051, determined by both time period and user class are shown in Tables 26, 27 and 28.

Table 26: Generalised Cost Parameter Values 2022

User Class	AM Peak		Inter Peak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
Car Work	32.64	9.63	32.37	9.63	31.82	9.63
Car Commute	20.63	7.53	20.96	7.53	20.70	7.53
Car Other	14.23	7.53	15.16	7.53	14.90	7.53
LGV's	26.15	10.52	26.15	10.52	26.15	10.52
HGV's	26.42	30.81	26.42	30.81	26.42	30.81

Table 27: Generalised Cost Parameter Values 2037

User Class	AM Peak		Inter Peak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
Car Work	40.34	9.11	40.00	9.11	39.33	9.11
Car Commute	25.49	6.94	25.90	6.94	25.58	6.94
Car Other	17.59	6.94	18.73	6.94	18.42	6.94
LGV's	32.32	10.60	32.32	10.60	32.32	10.60
HGV's	32.65	29.15	32.65	29.15	32.65	29.15

Table 28: Generalised Cost Parameter Values 2051

User Class	AM Peak		Inter Peak		PM Peak	
	PPM	PPK	PPM	PPK	PPM	PPK
Car Work	48.66	8.96	48.25	8.96	47.44	8.96
Car Commute	30.74	7.01	31.24	7.01	30.85	7.01
Car Other	21.21	7.01	22.59	7.01	22.21	7.01
LGV's	38.98	10.44	38.98	10.44	38.98	10.44
HGV's	39.37	29.33	39.37	29.33	39.37	29.33

8.19 The resulting assignment forecast flows, with and without the improvement scheme are presented in Table 29 for 2022, 2037 and 2051. The flows are presented as AADT flows at the Traffic Forecast Sites near Junction 16. Traffic flow diagrams are shown in Appendix B.

Table 29: Traffic Forecasts – Junction 16 Preferred Option – Core Scenario

J16 Preferred Option	2016	2022				2037				2051			
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS001	34251	37066	37066	0	0	42933	42933	0	0	47241	47241	0	0
TFS002	1481	1551	1552	0	0	1668	1668	0	0	1742	1745	3	0
TFS003	1995	2170	2172	2	0	2440	2440	0	0	2621	2621	0	0
TFS004	30775	33345	33343	-2	0	38825	38824	0	0	42879	42875	-3	0
TFS005	1148	1248	1248	0	0	1444	1444	0	0	1584	1584	0	0
TFS006	1148	1248	1248	0	0	1444	1444	0	0	1584	1584	0	0
TFS007	3476	3722	3723	2	0	4108	4108	0	0	4363	4366	3	0
TFS008	3764	4167	4168	1	0	4865	4865	0	0	5355	5352	-3	0
TFS009	3828	4320	4318	-2	0	5170	5170	0	0	5794	5791	-3	0
TFS010	5306	5985	5983	-2	0	7101	7101	0	0	7919	7916	-3	0
TFS011	35079	38084	38084	0	0	44107	44107	0	0	48522	48522	0	0
TFS012	35079	38084	38084	0	0	44107	44107	0	0	48522	48522	0	0
TFS013	1181	1271	1271	0	0	1465	1465	0	0	1600	1600	0	0
TFS014	1063	1158	1280	122	11	1274	1477	203	16	1284	1622	338	26
TFS015	32736	35576	35459	-117	0	41277	41074	-203	0	45517	45191	-326	-1
TFS016	1070	1369	2869	1500	110	1591	3317	1726	108	1742	3639	1897	109

J16 Preferred Option	2016	2022				2037				2051			
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS017	3975	4321	4669	348	8	4985	5388	403	8	5458	5901	443	8
TFS018	36644	39782	37259	-2523	-6	46120	43145	-2975	-6	50823	47452	-3370	-7
TFS019	18775	20402	20596	194	1	23631	23795	164	1	26063	26130	67	0
TFS020	1280	1350	1346	-5	0	1556	1556	0	0	1722	1709	-12	-1
TFS021	457	497	266	-231	-46	516	317	-199	-39	473	356	-117	-25
TFS022	346	348	169	-179	-51	342	201	-142	-41	268	225	-43	-16
TFS023	735	928	576	-352	-38	1084	662	-422	-39	1187	634	-553	-47
TFS024	713	920	955	35	4	1067	1101	33	3	1174	1114	-59	-5
TFS025	18583	20300	20304	5	0	23557	23557	0	0	25934	25934	0	0
TFS026	2486	2662	2779	117	4	3006	3209	203	7	3198	3524	326	10
TFS027	N/A	N/A				N/A				N/A			
TFS028	112	150	2751	2601	1736	175	3181	3006	1719	206	3579	3372	1635

8.20 The above table reflects the “Do Something” network changes around Junction 16 and Junction 16A. In this scenario there are no changes to the ‘Do Minimum’ network around Junction 15 and therefore no traffic changes are shown for this area of the network.

8.21 The comparison between ‘Do Minimum’ and “Do Something” scenarios show similar patterns of change for all forecast years modelled and this manifests itself as a rerouting of local traffic accessing the A55. The major change in the network relates to replacing the all-movements junction at Junction 16 with a restricted movements junction plus an all-movements junction at Junction 16A. The two are connected in the ‘Do Something’ scheme by a Link Road running parallel to A55.

8.22 The main changes in local traffic routing consist of traffic travelling eastbound from A55 West to Penmaenmawr East and Dwygyfylchi exiting at Junction 15A and travelling through the town, instead of continuing to Junction 16. Traffic from Penmaenmawr East travelling eastbound to A55 East (Conwy, Llandudno etc.) continues along the Link Road to Junction 16A to reach A55. This is due to Junction 16 not accommodating these movements in the Do Something scheme. These changes in traffic flows manifest themselves as increases in traffic at site TFS016 (Conwy Road) and decreases on A55 at the parallel site TFS018.

8.23 Traffic travelling between Junction 16 and 16A bypasses Dwygyfylchi and uses the Link Road. There is a redistribution of local traffic movements in Dwygyfylchi to enable traffic wishing to travel east on A55 to reach Junction 16A instead of Junction 16, as currently.

8.24 In general terms, the ‘‘Do Something’’ options make the A55 corridor more attractive for through traffic by removing the existing at-grade roundabouts and the inherent junction delays caused by vehicles needing to slow down to negotiate the intersections. Therefore, no reassignment away from the A55 with either of the forecast improvement options is shown in the modelling.

8.25 However, this is not the same for side road traffic which still accesses the strategic route through controlled junctions. The proposed improvements do, however, reduce the constraint for entry and access speeds are increased slightly, reducing delay.

Low and High Growth Forecasts

8.26 Table 30 below presents the traffic growth uncertainty factors applied to the 2022, 2037 and 2051 core scenario matrices to account for the uncertainty of low and high growth estimates of background traffic within the model. These factors were calculated by applying the formula in TAG Unit M4 to each forecast year and subtracting or adding from the base growth of 1 in line with TAG guidance.

8.27 These factors were applied to the Core Scenario matrices and assigned to the forecast model networks to produce traffic flow forecasts.

Table 30: Low and High Growth Uncertainty Factors

Forecast Year	**No. of Forecast Years from Base Year (Y)**	**SQRT (Y) x (P) P=0.025**	**Low Growth Factor**	**High Growth Factor**
Base Year (2016)	1	0.025		
Opening Year (2022)	6	0.0612	0.9388	1.0612
Design Year (2037)	21	0.1146	0.8854	1.1146
Horizon Year (2051)	36	0.150	0.850	1.150

8.28 The resulting assignment forecast flows, with and without the improvement scheme are presented in Table 31 for 2022, 2037 and 2051 Low Growth and Table 32 for High Growth. The flows are presented as AADT flows at the Traffic Forecast Sites near Junction 16. Traffic flow diagrams are shown in Appendix B.

Table 31: Traffic Forecasts – Junction 16 Preferred Option – Low Growth Scenario

J16 Preferred Option	2016	2022				2037			2051				
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS001	34251	34798	34798	0	0	38013	38013	0	0	40155	40155	0	0
TFS002	1481	1498	1496	-2	0	1552	1552	0	0	1585	1585	0	0
TFS003	1995	2044	2044	0	0	2155	2155	0	0	2202	2202	0	0
TFS004	30775	31256	31258	2	0	34306	34306	0	0	36368	36368	0	0
TFS005	1148	1171	1171	0	0	1279	1279	0	0	1346	1346	0	0
TFS006	1148	1171	1171	0	0	1279	1279	0	0	1346	1346	0	0
TFS007	3476	3542	3540	-2	0	3706	3707	0	0	3787	3787	0	0
TFS008	3764	3877	3879	2	0	4227	4227	0	0	4422	4422	0	0
TFS009	3828	4008	4010	2	0	4509	4508	0	0	4846	4846	0	0
TFS010	5306	5570	5572	2	0	6218	6218	0	0	6653	6653	0	0
TFS011	35079	35754	35754	0	0	39052	39052	0	0	41244	41244	0	0
TFS012	35079	35754	35754	0	0	39052	39052	0	0	41244	41244	0	0
TFS013	1181	1193	1193	0	0	1298	1298	0	0	1360	1360	0	0

J16 Preferred Option	2016	2022				2037				2051			
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS014	1063	1087	1202	115	11	1002	1308	305	30	1055	1379	324	31
TFS015	32736	33403	33289	-115	0	36672	36367	-305	-1	38736	38412	-324	-1
TFS016	1070	1285	2693	1408	110	1409	2937	1528	108	1491	3093	1602	107
TFS017	3975	4056	4383	327	8	4414	4770	356	8	4639	5015	376	8
TFS018	36644	37352	34978	-2373	-6	40960	38201	-2760	-7	43236	40334	-2902	-7
TFS019	18775	19154	19335	182	1	21048	21068	20	0	22190	22211	21	0
TFS020	1280	1263	1263	0	0	1378	1378	0	0	1453	1453	0	0
TFS021	457	462	250	-212	-46	332	281	-51	-15	355	303	-52	-15
TFS022	346	322	159	-164	-51	178	178	0	0	191	191	0	0
TFS023	735	871	541	-330	-38	960	586	-374	-39	1019	542	-477	-47
TFS024	713	864	897	33	4	945	974	29	3	998	951	-47	-5
TFS025	18583	19062	19063	1	0	20857	20857	0	0	22044	22044	0	0
TFS026	2486	2494	2609	115	5	2536	2842	305	12	2671	2995	324	12

J16 Preferred Option	2016	2022				2037				2051			
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS027	N/A	N/A	2583	N/A	N/A	N/A	2816	N/A	N/A	N/A	3038	N/A	N/A
TFS028	112	140	92	-49	-35	155	104	-51	-33	165	112	-52	-32

Table 32: Traffic Forecasts – Junction 16 Preferred Option – High Growth Scenario

J16 Preferred Option	2016	2022				2037			2051				
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS001	34251	39335	39335	0	0	47853	47853	0	0	54328	54328	0	0
TFS002	1481	1606	1606	0	0	1779	1781	2	0	1911	1885	-26	-1
TFS003	1995	2296	2296	0	0	2720	2720	0	0	3064	3081	16	1
TFS004	30775	35433	35433	0	0	43354	43352	-2	0	49352	49362	10	0

J16 Preferred Option	2016	2022				2037			2051				
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS005	1148	1324	1324	0	0	1609	1609	0	0	1823	1841	18	1
TFS006	1148	1324	1324	0	0	1610	1609	0	0	1823	1841	17	1
TFS007	3476	3902	3902	0	0	4499	4501	2	0	4976	4966	-10	0
TFS008	3764	4454	4455	0	0	5503	5501	-2	0	6302	6329	27	0
TFS009	3828	4632	4633	0	0	5843	5841	-2	0	6707	6700	-6	0
TFS010	5306	6398	6399	0	0	7995	7993	-2	0	9152	9165	13	0
TFS011	35079	40415	40415	0	0	49162	49162	0	0	55801	55801	0	0
TFS012	35079	40415	40415	0	0	49162	49162	0	0	55801	55801	0	0
TFS013	1181	1349	1349	0	0	1633	1633	0	0	1839	1848	9	1
TFS014	1063	1229	1358	129	11	1479	1646	167	11	1675	1895	220	13
TFS015	32736	37752	37629	-123	0	45916	45781	-135	0	52040	51940	-100	0
TFS016	1070	1452	3044	1592	110	1742	3697	1956	112	1849	4185	2336	126
TFS017	3975	4585	4955	370	8	5557	6005	449	8	6143	6786	643	10
TFS018	36644	42216	39539	-2676	-6	51346	48089	-3257	-6	58115	54540	-3574	-6

J16 Preferred Option	2016	2022				2037			2051				
Traffic Forecast Sites	Base AADT	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference	DM AADT	DS AADT	Difference to DM	% Difference
TFS019	18775	21651	21857	206	1	26279	26522	242	1	29418	30019	601	2
TFS020	1280	1434	1428	-6	0	1766	1734	-32	-2	2086	1966	-121	-6
TFS021	457	528	282	-246	-47	667	353	-314	-47	983	439	-543	-55
TFS022	346	370	179	-191	-52	441	224	-217	-49	704	289	-416	-59
TFS023	735	985	612	-374	-38	1177	725	-451	-38	1468	720	-749	-51
TFS024	713	976	1014	37	4	1190	1214	24	2	1576	1272	-304	-19
TFS025	18583	21541	21547	6	0	26256	26256	0	0	29822	29824	1	0
TFS026	2486	2825	2949	123	4	3442	3577	135	4	3982	4082	100	3
TFS027	N/A	N/A	2919	N/A	N/A	N/A	3558	N/A	N/A	N/A	4124	N/A	N/A

8.29 Appendix B presents drawings showing the AM peak, Inter Peak, PM peak and AADT ‘‘Do Something’’ modelled flows for the low and high growth scenarios.

8.30 The above tables reflect the “Do Something” network changes around Junction 16. In this scenario there are no changes to the ‘Do Minimum’ network around Junction 14/15 and therefore no traffic changes are shown for this area of the network.

8.31 The comparison between ‘‘Do Minimum’’ and ‘‘Do Something’’ scenarios show similar patterns of change for all forecast years modelled and this manifests itself as a rerouting of local traffic accessing the A55. The major change in the network relates to replacing the all-movements junction at Junction 16 with a restricted movements junction, plus an all-movements junction at Junction 16A. The two are connected in the ‘‘Do Something’’ scheme by a Link Road running parallel to A55.

8.32 The main changes in local traffic routing consist of traffic travelling from A55 West to Penmaenmawr East exiting at Junction 15A and travelling through the town, instead of continuing to Junction 16. Traffic from Penmaenmawr East travelling to A55 East continues along the Link Road to Junction 16A to reach A55.

8.33 Traffic travelling between Junction 16 and 16A bypasses Dwygyfylchi and uses the Link Road. There is a redistribution of local traffic movements in Dwygyfylchi to enable traffic wishing to travel east on A55 to reach Junction 16A instead of Junction 16, as currently.

9. Economic Appraisal

Overview

9.1 This section describes the economic appraisal that has been undertaken for the 'Do Something' Core Scenario, Low Growth Scenario and High Growth Scenario for economic growth. This appraisal has been carried out by following the guidance in WebTAG Unit A1.1 'Cost Benefit Analysis (Document Reference 4.05.09) and uses Transport User Benefit Appraisal (TUBA) software Version 1.9.14. TUBA has been used to compare the preferred improvement scheme against the 'Do Minimum' over a 60-year appraisal period.

9.2 This version of TUBA uses economic parameter values from TAG Data Book, May 2021 (Document Reference WG 4.05.06) and is an update to that used in the appraisal presented in the Environmental Statement. These values represent the DfT's latest assessment of future GDP growth and changes to the composition of vehicle fleets, fuel costs and emissions.

9.3 A detailed description of the economic appraisal can be found in the Economic Report (Document Reference WG 4.05.04).

Assessment Period

9.4 The WebTAG recommended assessment period of 60 years has been adopted. The scheme is due for implementation during 2023. In order to be proportionate in the modelling effort for the assessment, the economic appraisal has been based on traffic modelling for 2022, 2037 and 2051 where data is readily available from SATURN. Data from the SATURN models for the Core Scenario, Low Growth and High Growth were input to the TUBA assessments. These results were then interpolated and extrapolated accordingly (in the modelling and assessment tools) to obtain economic benefits for all other years, which are then discounted to 2010. Discounting is the reverse of inflation and factors the price of a commodity at the current year to its equivalent in the price base year of 2010.

Modelled Time Periods

9.5 The traffic modelling has been undertaken for the following weekday time periods:

a) AM Peak (08:00–09:00)

b) Inter Peak (Average Hour 10:00–16:00)

c) PM Peak (17:00–18:00)

9.6 For assessment, time period factors are used to convert the model outputs to be representative of annual totals as described below.

Model Inputs

9.7 SATURN model assignments were run for both 'Do Minimum' and 'Do Something' scenarios for the Junction 16 Preferred Scheme for 2022, 2037 and 2051. Traffic volumes, time and distance skims from these assignments were passed through to the economic appraisal in TUBA.

Annualisation

9.8 Economic appraisal requires a consideration of the benefits to all road users, many of which will not be travelling at times represented by the transport model. Benefits per vehicle vary throughout the day and throughout the year to the extent that traffic levels impact on the benefit per vehicle.

9.9 The calculation of total benefits to all transport users over the 60-year appraisal period requires the calculation of annualisation factors to quantify the way in which the scheme might affect those travelling during weekdays outside of the modelled hours or on weekends and public holidays. Factors for annualisation are utilised to growth the produced results from the modelled periods to represent all hours during the year.

9.10 For the calculation of the annualisation factors, traffic data covering the whole of 2017 were used from the Traffic Wales permanent count site 17, located on the A55 at Conwy Crossing. The factors were calculated in line with the guidance set out in WebTAG Unit A1.3 (Document Reference WG 4.05.11) Section 9.1.1. Separate factors were calculated for the three modelled periods based on the assumption that each modelled period will represent days and times as follows:

a) AM Peak: weekdays between 07:00 and 10:00

b) Inter Peak: weekdays between 10:00 and 16:00 (off-peak evenings, weekends and public holidays)

c) PM Peak: weekdays between 16:00 and 19:00

9.11 For 2016 there were 253 weekdays and 104 weekend days. The weekday daytime 12-hour period (07:00 to 19:00) can be represented directly by the weekday models (AM, Inter-Peak and PM). The weekday off peak and weekends will be represented by the inter peak model.

9.12 Given that the AM and PM models cover the peak hours, i.e. 08:00 to 09:00 and 17:00 to 18:00, as opposed to the extended AM and PM peak periods (07:00 to 10:00 and 16:00 to19:00), the flows have been multiplied by 2.565 and 2.676 respectively to account for the total period flows. These flows were ascertained through comparing peak hour and period totals from the model ATC count data.

9.13 The permanent count site was used to determine a factor between the average Inter Peak flows and average Off Peak flows and the average weekend flows. These were then multiplied by 253 to determine the annualization factors for these periods.

9.14 A summary of the final annualisation factors for the modelled time periods, AM Peak, Inter Peak and PM Peak are shown in Table 33. The table also shows the weekday annualisation factors, Off Peak annualisation factors and weekend annualisation factors.

Table 33: Annualisation Factors

Time Period	Annualisation Factor	Weekday Factor	Off Peak Factor	Weekend Factor
AM Peak	675	675		
Inter Peak	3187	1467	366	1354
PM Peak	677	677		

Construction Costs

9.15 Construction costs have been calculated by experienced highway cost consultants. Scheme costs and the allocation of Risk have been reviewed and agreed with Welsh Government and their advisors. The proportion of risk attached to the scheme costs is 8.5%. Scheme costs are based on current prices in late 2019.

9.16 The total estimated scheme cost of Junction 16 Preferred Option Mitigated (excluding VAT) is £23.108m. The elements allowed for in the scheme cost are described as follows.

9.17 Main construction works – the Cost Consultant defined the scope of works for Junction 16 Preferred Scheme and built up the cost of £13.168m. This allows for all activities to construct the scheme, such as site clearance, earthworks, structures, roadworks and landscaping and included Traffic Management costs during construction.

9.18 Contractor's Risk Allowance and Fee account for £1.628m.

9.19 Works by other authorities – the utility diversions required to allow the construction of the scheme and de-trunking costs were estimated at £0.740m due to the complex junction arrangement and likelihood of diversion requirements.

9.20 To allow for the compulsory purchase of land and compensation payments to land and property owners during construction, and the impact of the completed highway, a value of £0.500m has been established using market prices.

9.21 Preparation and supervision – as part of the scheme delivery, costs of £4.775m have been allowed for Key Stage 3, Key Stage 4 and Employer's Agent professional fees.

9.22 To allow for the Welsh Government's risks during the delivery of the scheme a sum of £2.296m has been calculated.

Primary Outputs of the Economic Appraisal

9.23 This section presents the Transport User Benefit Appraisal (TUBA), Transport Economic Efficiency (TEE) and Wider Economic Benefits for the preferred improvement scheme at Junction 15. TUBA Version 1.9.14 was used for the economic appraisal.

9.24 The analysis uses transport modelling results from SATURN that reflect travel time and traffic reassignment impacts of the preferred improvement option. The summary of the TUBA assessment is shown in the Table 34.

Table 34: TUBA Appraisal Summary Table – Junction 16 Preferred Scheme (Core Scenario)

TUBA Appraisal Summary Table (£1,000 2010 prices discounted to 2010)	**Junction 16 Preferred Scheme**
Land Costs in 2019 prices	£500
Scheme Costs in 2019 prices	£23,108
Analysis of Monetised Costs and Benefits (AMCB)	
Greenhouse Gases	-£174
Economic Efficiency: Consumer Users, Commuting	£4,610
Economic Efficiency: Consumer Users, Other	£4,355
Economic Efficiency: Business Users and Providers	£7,122
Wider Public Finances (Indirect Taxation Revenues)	£285
Value for Money Summary	
Present Value of Costs (PVC)	£15,207
Present Value of Benefits (PVB)	£16,198
Net Present Value (NPV)	£991
Benefit to Cost Ratio (BCR)	**1.065**

9.25 The summary of the preferred junction improvement shows the scheme produces a slight increase in Greenhouse Gas emissions and provides a slight benefit for Indirect Tax Revenues for the government.

9.26 Transport User Benefits are £4.610m for Commuters, £4.355m for Other users and £7.122m for Business Users.

9.27 Discounted scheme costs are £15.207m for Junction 16. These include an element of cost savings for maintenance of the highway infrastructure during the appraisal period. The higher specification of the scheme design will require less ongoing maintenance, particularly for central reserve, where concrete barriers are to be provided. These cost reductions account for £0.42m (2019 prices).

The benefits for the Junction 16 improvement amount to £16.198m. This represents an increase of £0.991m compared to the scheme costs and results in an initial Benefit to Cost Ratio (BCR) of 1.065.

Impacts during Construction and Maintenance

9.28 This section presents the assessment of the total cost of travel delays during the construction period for the improvement option and any major road maintenance works. The DfT program QUADRO (Queues and Delays at Roadworks), Version 4 Release 16, was used to carry out the economic appraisal of travel delay costs.

Maintenance Works

9.29 The impact of travel delays due to planned maintenance works along A55 for the duration of the economic appraisal was considered. The maintenance regime for the existing A55 would, essentially, be the same as for the route with improvements included except that with the new scheme, maintenance is likely to be required less frequently. Thus, the appraisal considers differences between the two scenarios, and includes these slight benefits in the Quadro assessment.

Delays during Construction (Core Scenario)

9.30 Throughout the construction phase there will be restrictions for side road traffic entering and leaving the A55 and speed restrictions through the Traffic Management section of the works. Table 35 provides details of the duration and nature of these Traffic Management arrangements. These Traffic Management proposals have been derived by experienced highway construction specialists.

Table 35: Traffic Management Details - Junction 16 Preferred Scheme

Traffic Movement	TM Duration	TM Length	TM Speed Restriction
A55 eastbound	104 weeks	4 km	80 kph
A55 westbound	104 weeks	4 km	80 kph

9.31 Table 36 shows the QUADRO economic appraisal summary (Core Scenario) for the preferred scheme at Junction 16, based on its Traffic Management configurations during the construction period.

Table 36: Economic appraisal of construction delays for Preferred Scheme (Core Scenario)

Construction Travel Delay Costs (£1,000)	
	J16 Preferred Scheme
Construction Travel Delay Costs	£495

Accident Appraisal

9.32 The COBALT (Cost and Benefit to Accidents – Light Touch) program has been used to derive the accident benefits of the improvement scheme. The most recent economic parameter data, Version 2020.1, has been used in the assessment. COBALT compares the predicted numbers of accidents with and without a scheme and converts them into monetary values by multiplying the numbers of accidents by their monetised costs. The benefits for each year are discounted to 2010 prices and summed over the 60-year assessment period.

9.33 Observed accident rates for the study area were calculated in COBALT from personal injury accident (PIA) data for the five-year period from 2014 to 2018. This was the most up-to-date information available at the time of undertaking the analysis. The data was obtained from the STATS19 database (www.datagov.uk).

Accident Benefits Results (Core Scenario)

9.34 Table 37 shows the predicted number of accidents and casualties over the 60-year appraisal period for the study area for the preferred scheme and summarises the accident benefits to be gained from the improvement.

Table 37: Core Scenario Summary of Accident Benefits

Summary of Accident Benefits	**J16 Preferred Scheme**
Total accidents saved by Scheme	34.2
Fatal	0.7
Serious	4.3
Slight	42.5
Total accident benefits saved by Scheme	£1,583

9.35 Table 38 indicates with the construction of the Junction 16 improvement works, there is a resulting reduction in accidents within the study area of 34, over a 60-year period.

9.36 Through the removal of the roundabout the speed and flow per lane should become more consistent. In addition, the new junction would be designed in accordance with design standards, street lighting and clear signage would

also be present. Fear of potential accidents would reduce due to the removal of the roundabout, and its associated traffic movements.

Wider Economic Benefits

9.37 The guidance in TAG Unit A2.1 (Document Reference WG 4.05.12), 4.1.8 has been used to calculate these Wider Economic Benefits. The Unit suggests these benefits can be estimated as a proportion of total user benefits for business journeys, calculated as a 10% uplift to business user benefits. These impacts are calculated from the business user benefits in the Transport Economic Efficiency (TEE) analysis. Thus, for each option, the Wider Economic Benefits have been taken from the TUBA analysis, as 10% of the overall business user benefits.

9.38 The Wider Economic Benefits for the Preferred Scheme for Junction 16 (Core Scenario) are shown in Table 9.6 and show a positive impact on user benefits.

Table 38: Wider Economic Benefits – Junction 16 (Core Scenario)

Imperfectly Competitive Market Benefits (£1,000)	
	J16 Preferred Scheme
10% Business User Benefits	£712

Economic Appraisal Results

9.39 This section brings together all the different aspects of the economic appraisal for the improvement option and presents a final Value for Money (VfM) Statement.

9.40 The full economic assessment for the scheme at Junction 16 is summarised in Table 38.

9.41 The tables summarise the outputs from TUBA, COABLT and QUADRO and form the basis for the VfM statement. The full VfM assessment includes:

a) Wider economic benefits

b) Construction delay costs

c) Accident saving benefits

d) Journey time benefits

e) Indirect Tax benefits

9.42 Table 39 presents the summary economic assessment for the preferred improvement scheme at Junction 16 (Core Scenario). All costs are discounted to 2010 prices in multiples of a thousand pounds. Positive values in the tables indicate a benefit and negative values indicate a disbenefit.

Table 39: Value for Money Statement – Junction 16 Preferred Scheme (Core Scenario)

	J16 Preferred Scheme
Benefits	
Wider Economic Benefits	£712
Accident Benefits	£1,583
Travel Time Benefits	£15,220
Vehicle Operating Costs	£867
Carbon Emissions Costs	-£174
Indirect Tax Benefits	£285
Construction Delay	-£495
Present Value of Benefit (PVB)	**£17,998**
Costs	
Scheme costs	£15,207
Present Value of Costs (PVC)	**£15,207**
Net Present Value (NPV)	£2,791
Benefit to Cost Ratio (BCR)	**1.184**

9.43 The addition of Wider Economic Benefits, Accident Benefits and Construction Delay costs, give an additional £1.800m benefits to the Junction 16 Preferred Scheme. The overall scheme benefits rise to £17.998m, compared to the scheme costs of £15.207m. This produces a Net Present Value (NPV) of £2,791m and a BCR of 1.184. Under the DfT's Value for Money Categorisation, this represents Low Value for Money for the Core Scenario assumptions.

Sensitivity Analysis

9.44 The same economic appraisal process has been carried out for the Low and High economic growth scenarios. The Value for Money statement for this scenario is shown below, alongside the Core Scenario.

9.45 Table 40 summarises the outputs from TUBA, COABLT and QUADRO and form the basis for the VfM statement. The full VfM assessment includes:

a) Wider economic benefits

b) Construction delay costs

c) Accident saving benefits

d) Journey time benefits

e) Indirect Tax benefits

9.46 All costs are discounted to 2010 prices in multiples of a thousand pounds. Positive values in the tables indicate a benefit and negative values indicate a disbenefit.

Table 40: Value for Money Statement – Junction 16 Preferred Scheme Scenarios

	J16 Preferred Scheme Low Growth	J16 Preferred Scheme Core Scenario	J16 Preferred Scheme High Growth
Benefits			
Wider Economic Benefits	£447	£712	£1,632
Accident Benefits	£1,072	£1,583	£1,933
Travel Time Benefits	£8,668	£15,220	£38,605
Vehicle Operating Costs	£1,063	£867	£456
Carbon Emissions Costs	-£12	-£174	-£653
Indirect Tax Benefits	£21	£285	£1,006
Construction Delay	-£462	-£495	-£533
Present Value of Benefit (PVB)	**£10,797**	**£17,998**	**£42,446**
Costs			
Scheme costs	£15,207	£15,207	£15,207
Present Value of Costs (PVC)	**£15,207**	**£15,207**	**£15,207**
Net Present Value (NPV)	-£4,409	£2,791	£27,239
Benefit to Cost Ratio (BCR)	**0.710**	**1.184**	**2.791**

9.47 For the Low Growth scenario, the overall scheme benefits rise to £10.797m, compared to the scheme costs of £15.207m. This produces a Net Present Value (NPV) of -£4.409m and a Benefit-Cost Ratio (BCR) of 0.710. Under the DfT's Value for Money Categorisation, this represents Poor Value for Money.

9.48 For the High Growth scenario, the overall scheme benefits rise to £42.446m, compared to the scheme costs of £15.207m. This produces a Net Present Value (NPV) of £27.239m and a BCR of 2.791. Under the DfT's Value for Money Categorisation, this represents High Value for Money.

9.49 The Low and High Growth scenarios represent the overall range of scheme performance against changes in economic growth assumptions. However, the Core Scenario assumptions are considered to be the most likely set of economic conditions to occur and the performance of the scheme against these is considered to be the key economic performance indicator by Welsh Government.

9.50 Under these conditions the Junction 16 Improvement demonstrates Low Value for Money.

10. Objections to the Scheme

10.1 Objections have been made that raise matters that fall within the scope of my proof of evidence or that of one of my colleagues. I will address each and where appropriate I will refer to the proofs of others. The objections received, and addressed, are listed below. The main points relating to the impact of traffic flows are addressed with the responses below.

Objection

10.2 *The Scheme will not decrease the number of vehicles using the A55 daily or seasonally. No evidence is presented which demonstrates that the current roundabout causes more delays than say the Britannia Bridge, 50mph limit at Colwyn Bay or the 30mph limit at Penmaenbach Headland. In any case, traffic volumes are likely to reduce as a result of the changes to the economic landscape (Brexit and COVID-19).*

Response

10.3 The existing 'At-grade' roundabout accommodates conflicting traffic movements at a single point. For these movements to be operated in a safe manner, all traffic has to reduce speed, below the 'free-flow' speed. The reduction in speed is variable based on the degree of conflict between movements. Thus, there is delay to all traffic over a length on the approach to the junction, where traffic is decelerating/queueing and on the exit to the junction where traffic is accelerating up to the free flow speed.

10.4 The proposed junction is 'grade-separated' and conflicting turning movements are segregated. Traffic on the strategic route can travel at 'free-flow' speeds through the junction and incur no delay. Thus, overall, there is a reduction in journey time for travel through the junction and its approaches. This provides a benefit to all users of the highway in this area.

10.5 There is no doubt that Brexit and Covid have had a short-term impact on traffic levels and in all likelihood, there will be some longer-term impacts as well. Interim observations suggest that traffic levels are at a similar level as shown before the pandemic, but the make-up of traffic is different. There has been a reduction in the frequency of travel to work, as more working from home has taken place. However, there has been an increase in work travel by car as people have migrated from Public Transport. Additionally, recreation travel has increased as people holiday in the UK. How this is reflected in population growth, employment growth, social wellbeing and mobility, and ultimately long-term traffic growth, is difficult to say at present. There is, however, no reason to suspect that there will be a significant downturn in traffic volumes.

Objection

10.6 *The scheme will increase journey times for residents.*

Response

10.7 The existing 'At-grade' roundabout accommodates conflicting traffic movements at a single point. For these movements to be operated in a safe manner, all traffic has to reduce speed, below the 'free-flow' speed. The reduction in speed is variable based on the degree of conflict between movements. Thus, there is delay to all traffic over a length on the approach to the junction, where traffic is decelerating/queueing and on the exit to the junction where traffic is accelerating up to the free flow speed.

10.8 The proposed junction is 'grade-separated' and conflicting turning movements are segregated. Traffic on the strategic route can travel at 'free-flow' speeds through the junction and incur no delay. Thus, overall, there is a reduction in journey time for travel through the junction and its approaches. This provides a benefit to all users of the highway in this area, including local residents.

10.9 The proportion of local traffic on A55 between Penmaenmawr, junction 16 and Junction 16A, is around 15%. The remaining 85% is through traffic. The analysis undertaken shows that there are overall journey time benefits for traffic, with the scheme improvement. The greater benefits are gained by through traffic on A55 with local traffic experiencing a marginal benefit.

10.10 The improvement scheme does, overall, meet the objectives set out.

Objection

10.11 *The scheme will increase accidents.*

Response

10.12 The scheme assessment analyses all changes to traffic conditions within the area of impact of the scheme. This is the area within which traffic flows and highway conditions change as a result of building the scheme. The number of accidents occurring on the highway are directly related to the traffic flow and its characteristics. Therefore, it is appropriate to consider all of these changes in the scheme appraisal. Indeed, it is recommended in Transport Scheme Appraisal Guidance (TAG) that this wider analysis is undertaken.

10.13 In both the construction and operation cases there will be a removal of potential conflict between vehicles making turning manoeuvres thereby reducing the potential for accidents not increasing them.

10.14 There is a length of around 300m of A55 where traffic speeds will increase to 'free flow' speed levels, on completion of the improvement. This is the length of carriageway where traffic currently decelerates on the approach to the at-grade roundabout and then accelerates when leaving the junction. Average

speeds for this section are currently lower than the free-flow speed. The increase in vehicle speed along this short section of carriageway will not dramatically increase accidents.

10.15 The removal of conflicting vehicle movements through segregation of the junction will provide the greatest benefit to accident reduction. Where these movements do occur, it will be in a safer and controlled environment, removed from the main A55 carriageway.

11. Alternatives to the Scheme

11.1 Insufficient information was available with respect to a potential alternative arrangement at the Puffin Café / Shell Orme Services between Junctions 16 and 16A, at the time of writing.

12. Conclusion and Declaration

12.1 My proof of evidence includes facts which I regard as being relevant to the opinions which I have expressed, and the Inquiry's attention has been drawn to any matter which would affect the validity of that opinion.

12.2 In my opinion the Traffic and Economic Assessment, has been carried out and published in accordance with legislation and professional guidance.

12.3 In my opinion the development of measures to mitigate the transport effects of the Scheme are effective, justifiable and achievable.

12.4 I believe the facts I have stated in this proof of evidence are true and that the opinions expressed are correct.

12.5 I understand my duty to the Inquiry to assist it with matters within my expertise and believe that I have complied with that duty.