A55 / A494 NETWORK RESILIENCE STUDY

WELTAG STAGE 1 REPORT

October 2017

Asiant Cefnffyrdd Gogledd a Chanolbarth Cymru
North & Mid Wales Trunk Road Agent

Yn gweithio ar ran
Llywodraeth Cymru
Working on behalf of the
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BACKGROUND

On the 28th April 2017 the Cabinet Secretary for Economy and Infrastructure announced that a commission to investigate options to improve journey times, reliability and the resilience of the A55 corridor from Holyhead to Post House would be undertaken. This would include associated routes such as the A494 corridor from the Ewloe Interchange to Drome Corner, Strategic Diversion Routes (SDRs) and Tactical Diversion Routes (TDRs).

WSP have been commissioned by the North and Mid Wales Trunk Road Agent (NMWTRA) to undertake a WelTAG Stage One Study to improve resilience of the A55/ A494 dual carriageway network in North Wales.

CURRENT PERFORMANCE

In recognition of the strategic importance of the route, the current approach to managing the A55 / A494 exceeds the statutory requirements for a rural dual carriageway and adopts a number of provisions that would normally be associated with motorway management, e.g. Traffic Management Centre and Traffic Officer Service. Current performance levels consistently meet or exceed standards.

During normal operating conditions the route performs well with some localised congestion during peak traffic flows. The route however is vulnerable during incidents or significant road work events due to a combination of topographical and infrastructure constraints and lack of viable diversion routes. The route runs close to capacity during normal traffic flows and is above capacity at peak times.

STUDY FINDINGS AND RECOMMENDATIONS

Please note that this study looks at many options. Any of these options, if taken forward will need the involvement and agreement from other stakeholders, for example and not limited to, police, emergency services, local authorities, land owners, third parties, interested groups and the public. All options will require close working with these groups, before any schemes or projects are confirmed and will need to follow all the statutory processes.

This WelTAG report presents the development, appraisal and evaluation of transport related projects to improve resilience on the A55/A494 and has been undertaken with the involvement of key stakeholders including Welsh Government and NMWTRA. The appraisal of options has been undertaken in accordance with the Welsh Government's latest draft version of WelTAG [December 2016][1].

In total 33 unique problems have been identified across the study area and these have been grouped into a number of key themes.

- → Communication
- → Network Asset Management
- → Network Capacity and Demand
- → Network Incident Management
- → Diversion Routes
- → Environment
- → Sustainable Travel
- → Future Proofing

[1] https://consultations.gov.wales/consultations/welsh-transport-appraisal-guidance-2017

Based on these themes, a set of objectives were defined for the study to ensure that the options which have been developed positively contribute to resolving the problems identified.

A long list of options has been developed and a number of these were sifted out at an early stage as they were either unviable or merged with similar options. 91 options were appraised against the WelTAG areas and objectives. The appraisal has shown differing impacts across all the appraisal criteria. As the WelTAG study area includes the A55 / A494 corridor, many of the options provide localised benefits, though these benefits are considered to be neutral in the context of the corridor.

The options have been broken down into differing implementation time periods. Based on the following durations:

- Quick wins: 0-6 months
- Short: 6-18 months
- Medium: 18-30 months
- Long: greater than 30 months

Options that were deemed as Quick Wins have been considered viable with benefits to resilience and the travelling public. These options are:

- Wireless CCTV
- Incident Detection Software
- Traffic Officer coverage extended hours
- Addition Traffic Officer Unit
- Roads Timetable
- Free Vehicle Recovery
- Additional mobile VMS
- Communications Manager
- Performance Analysis
- Average Speed enforcement on Rhuallt Hill.

It is therefore proposed that these options are prioritised for development immediately to enable implementation within 6 months.

The remaining short, medium and long term options are grouped under the identified themes. All of these options have been considered viable with benefits to resilience and the travelling public and are therefore recommended to be taken forward for further consideration during WelTAG Stage 2.

It is acknowledged that a number of the short/medium and long term options have synergies. For example, Expressway options incorporate several other options such as VMS and concrete barriers. Therefore is it is recommended that these options are reviewed at the beginning of the next stage to identify potential option packaging to provide further cumulative benefits. This should be undertaken via a stakeholder workshop to ensure that there is stakeholder buy in to future option packages.

THIS REPORT IS ALSO AVAILABLE IN WELSH

1 INTRODUCTION

1.1 BACKGROUND

On the 28th April 2017 the Cabinet Secretary for Economy and Infrastructure announced that a commission to investigate options to improve journey times, reliability and the resilience of the A55 corridor from Holyhead to Post House would be undertaken. This would include associated routes such as the A494 corridor from the Ewloe Interchange to Drome Corner, strategic diversion routes and tactical diversion routes. The first stage of the study is to be completed late summer 2017.

WSP have been commissioned by the North and Mid Wales Trunk Road Agent (NMWTRA) to undertake a WelTAG Stage One Study to improve resilience of the A55/ A494 dual carriageway network in North Wales. The aim of the study is to identify and describe the level and nature of potential improvement opportunities at strategic locations relevant to the Trunk Road Network. This will identify a list of options, which will collectively improve journey time reliability and the resilience of the A55/A494 Trunk Road Network including the Public Finance Initiative (PFI) Design, Build, Finance & Operate (DBFO) Section of the A55 (West of J11, Llandygai) managed by UK Highways A55 Limited (DBFO Co.)

The appraisal of options has been undertaken in accordance with the Welsh Government's latest draft version of WelTAG (December 2016). This WelTAG report presents the development, appraisal and evaluation of transport related projects and has been undertaken with the involvement of key stakeholders. This report presents the Stage One: Strategic Outline Case of the WelTAG process and is further supported by the WelTAG Impact Assessment Report (IAR).

The National Transport Finance Plan 2015 includes details of proposed schemes in the Welsh Government's forward programme. These include major projects to improve capacity on the A55/A494 Network between 2015 and 2020, these schemes along with other schemes currently identified are listed below:

- A55 Abergwyngregyn to Tai'r Meibion Improvement.
- A55 3rd Menai Crossing
- A55 Tunnels
- A55/A494/A548 Deeside Corridor
- A55 J15 (Llanfairfechan) and J16 (Puffin Roundabout) Improvements
- A55 J1 to Kingsland Improvement
- A494 Queensferry River Bridge Replacement

The appraisals of these schemes have been excluded from this study but this study will consider potential shorter term improvements at these locations if appropriate.

1.2 PREVIOUS WORK

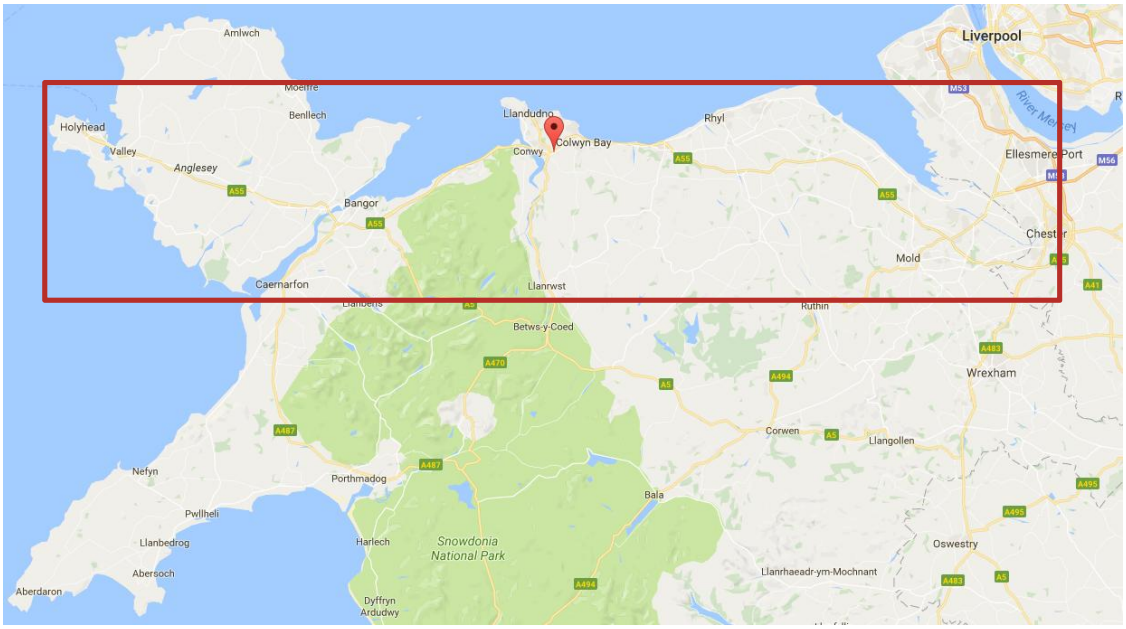
In 2013, the Minister for Economy, Science and Transport, Edwina Hart's written statement (dated 10th July 2013) included a commitment to improve the efficiency of the network across A55/A494 dual carriageways between J11 (Llandygai) and Welsh/English Borders in the east by introducing emergency verge refuges. Since then several pieces of work have been commissioned and undertaken by the partnering authorities and private sector consultants.

Between September 2014 and March 2015 a series of physical improvement works were constructed as a result of the A55 /A494 Network Resilience Phase 2 Feasibility Report and detailed design stage. The improvements were intended to maintain/improve traffic flow on the dual carriageway network during and after significant incidents. This included the installation of 34 Sologuard Gates/Emergency Crossing Points (ECP) and the construction of 8 hardened verges at strategic locations between A55 J11 (Llandygai) to the West and the Welsh/English borders to the east. The works also included closure of 12 laybys with road markings.

1.3 STUDY AREA

The proposed study area covers the four principal corridors below:

- A55 J1 (Kingsland) to Welsh/English Border at J36a (Broughton)
- A494 (A550) Ewloe to Welsh/English Border at Deeside Park Junction
- A55/A494 Strategic Diversion Routes
- A55/A494 Tactical Diversion Routes



Map Data ©2017 Google

1.4 CURRENT PERFORMANCE

In recognition of the strategic importance of the route, the current approach to managing the A55 / A494 exceeds the statutory requirements for a rural dual carriageway and adopts a number of provisions that would normally be associated with motorway management, e.g. Traffic Management Centre and Traffic Officer Service.

During normal operating conditions the route performs well, albeit with some localised congestion during peak traffic flows. The route however is vulnerable during incidents or significant road work events due to a combination of traffic volume, topographical and infrastructure constraints and lack of viable diversion routes. Sections of the route run close to capacity during normal traffic flows and are above capacity at peak times.

1.5 WELTAG STAGE ONE: STRATEGIC OUTLINE CASE

The WelTAG guidance states that the purpose of the Stage One: Strategic Outline Case is to 'understand the issue of concern, explore its context and to present a wide list of possible solutions, with sufficient clarity and depth for the review group to be able to decide whether there are any possible solutions within the transport sector that are worth pursuing and to select a short list of options for more detailed consideration'. As such, this Stage One: Strategic Outline Case report:

- Identifies the issue that needs addressing supported by evidence;
- Establishes objectives;
- Develops a long list of possible solutions, including non-transport interventions;
- Assesses a long list of options against the objectives;
- Assesses a long list of options against the impacts criteria; and
- Selects a short list of options to take forward to the next stage.

This Stage One report follows the principle of proportionate appraisal. It presents a largely qualitative appraisal, whilst providing stakeholders and decision makers with greater information and understanding of the problems and potential options. In accordance with the WelTAG guidance the significance and scale of the impacts throughout the assessment has been appraised using a seven-point scale, as presented in Table 1-1.

Table 1-1: WelTAG Seven-Point Assessment Scale

Large beneficial	**+++**
Moderate beneficial	**++**
Slight beneficial	**+**
Neutral	**0**
Slight adverse	**-**
Moderate adverse	**--**
Large adverse	**---**

1.6 REPORT STRUCTURE

The structure of this report is as follows:

- Chapter 2 presents the Strategic Case for the Study; including the context of the study, objective development, and the development of the options.
- Chapter 3 presents the Transport Case for the Study; this includes the appraisal of the options.
- Chapter 4 presents the Delivery Case for the Study.
- Chapter 5 presents the Financial Case for the Study.
- Chapter 6 presents the Commercial Case for the Study.
- Chapter 7 concludes this report, providing recommendations for further work.

2 STRATEGIC CASE

2.1 CASE FOR CHANGE

2.1.1 POLICY CONTEXT

This section provides a brief summary of relevant transport, environmental, economic, and development policies / plans that are pertinent to the A55 / A494 WelTAG Stage 1 Study. The policies set out below are those that will be used to asses against any transport proposals along the corridor. There are a number of overarching policies and plans which set the context for the A55 / A494 WelTAG Stage 1 Study. The Welsh Government has powers on many aspects such as transport and highways, town planning, environment and heritage. The national policies and plans then shape and guide respective regional and local plans and policies. Reference is made to them as appropriate.

NATIONAL SUMMARY

National policies suggest that any proposals associated with the A55/A494 should not have an impact on sustainable accessibility, must improve or not affect economic connectivity, and be built with environmental conservation in mind. Planning Policy Wales, the Wales Transport Strategy – 2008 Connecting the Nation, and the Transport Investment Strategy set out their ambition to enhance international connectivity to encourage economic growth. The plans also identify their more local desire to integrate new development with key land uses and to better connect communities.

The Wales Spatial Plan, along with the National Planning Policy Framework, Wales Transport Strategy, and Planning Policy Wales look to minimise the need to travel using privately owned vehicles, and draw particular attention to improving alternative modes of transport. The Active Travel (Wales) Act and Wales Transport Strategy both look to achieve higher levels of walking and cycling by promoting them as a mode of transport.

The Well-being of Future Generations (Wales) Act strives to improve the social, economic, environmental and cultural well-being of Wales. Its goals are to make Wales a more equal nation; which is prosperous and innovative; uses a fair share of natural resources; develops communities that are safe, cohesive and resilient; where the people participate in a shared culture, with a thriving living Welsh language; and are healthier.

REGIONAL SUMMARY

Like the Wales Transport Strategy, the Moving North Wales Forward Plan looks to improve the integrated transport network in order to encourage economic growth. Furthermore, the document expresses that its goal is to provide a modern, high quality transport system, which is fundamental to achieving economic growth, similarly to Highways England's Road Investment Strategy. In addition, the plan shares the same ambitions as Planning Policy Wales in wanting the region to be a competitive and connected component of the Northern Powerhouse.

The North Wales Joint Local Transport Plan brings attention to safeguarding their rural communities and ensuring there are sufficient connections between them, larger towns, and transport networks. This is also expressed at a national level through legislation such as the Wellbeing for Future Generations (Wales) Act.

LOCAL SUMMARY

The A55/A494 passes through a number of Local Authorities that share the same priority as national and regional Plans; to expose the potential for economic opportunity by improving both the public transport and walking & cycling networks.

A number of Unitary and Local Development Plans, such as Flintshire share the view of striving to improve or develop smart transport networks with the intention of growing sustainable accessibility to jobs and services. In addition, the plans have an interest to ensure that the best effort has been made to increase travel by sustainable modes, particularly by means of walking & cycling networks. In order to do so, they seek to integrate land uses, make use of existing infrastructure, and to make improvements on pinch points rather than creating a new solution all together.

2.1.2 ECONOMY

North Wales plays an important part in the Welsh economy. In total, the six counties that are situated in North Wales comprise approximately 20% of all of Wales' economic activity. Economic activity in North Wales is weighted towards the north east, with the exception of Gwynedd (which includes the towns of Bangor and Caernarfon).

There are numerous proposed developments in North Wales that are likely to encourage economic growth and support new jobs. The developments are located along the key corridor of the A55/A494. Such developments include Wylfa Newydd Power Station, Deeside Enterprise Park, and residential and employment development at Abergele. This is supported by the Unitary and Local Development Plans in North Wales that have a clear trend in development being focussed adjacent to the A55/A494 in key settlements such as the 3,300 homes proposed for Bodelwyddan. These specify that development should be located in highly accessible locations and make use of the existing key transport corridor (A55).

2.1.3 INFRASTRUCTURE

ROAD CLASSIFICATION

The entire length of the A55 between Holyhead and the Welsh/English borders is two lane all-purpose dual carriageway (D2AP), with the exception of a short section of road between J8 (Ael y Bowl) to J9 (Treborth) over Britannia Bridge, which is wide single carriageway (WS2). The A494 between J34 (Ewloe) of the A55 and the Welsh/English borders is all D2AP with the exception of a stretch reaching from just south of Drome Corner junction to Deeside Park junction which is 3 lane all-purpose dual carriageway (D3AP).

SIGNAGE

In regards to the distribution of a total of 20 VMS and 93 Matrix signs throughout the A55 and A494 corridor, the majority are located between J15 (Llanfairfechan) and J18 (Llandudno) on approach to, and in, the A55 Tunnels.

BRIDGES

Traffic crossing the Britannia Bridge is currently limited to 50mph, and the bridge is subject to partial or complete closure in the event of high winds. The bridge is also a single carriageway, which has the potential risk of capacity issues during periods of high demand.

TUNNELS

There are three tunnelled sections of the A55 route, these consist of the Conwy, Penmaenbach (limited to 30mph in the eastbound direction), and Pen-y-clip (westbound only). Lane control exists on the approach to each of these sections of the route to enable bi-directional flow for routine maintenance and in the event of a long duration incident which results in carriageway closure.

CCTV

A total of 74 CCTV cameras are located across the length of the A55 (within Wales), with a further 5 CCTV cameras located along the A494. A large proportion of these CCTV cameras are situated within the Pen-Y-Clip Tunnel (11 cameras), Penmaenbach Tunnel (12 cameras), and Conwy Tunnel (15 cameras). Along the remainder of the A55, the CCTV cameras are spread out more sparsely.

CCTV along the A55 is controlled and monitored by the Control Room Operators in the Conwy Traffic Management Centre.

MOBILE PHONE COVERAGE & EMERGENCY TELEPHONES

Table 2-1 shows that overall, the A55/A494 route is rated as 'likely to have good coverage' on the four mobile phone networks (EE, O_2, Vodafone and Three). Calls to emergency services are able to use any available network and therefore the whole of the route is likely to have good coverage, with the exception of the tunnels where emergency telephones and CCTV are present. However, calls to breakdown services may be limited due to dropouts and are dependent on network coverage in certain locations.

Table 2-1 Mobile Phone Coverage

LOCATION	NETWORK SIGNAL (VOICE)				EMERGENCY PHONE PROVISION DISTANCE FROM SIGNAL DROPOUT	
	Vodafone	O_2	EE	Three	EASTBOUND	WESTBOUND
A55, north of J33B (Ewloe Green)					No provision	No provision
A55 J32A (Halkyn) to J33 (Northop)					No provision	No provision
A55, west of J30 (Travellers Inn)					0.9km	0.8km
A55, J23 (Llanddulas) to J23A (Pensarn)					2.4km	2.2km
A55 J22 (Old Colwyn) to J23 (Llanddulas)					1.8km	1.8km
A55 In proximity to J15 (Llanfairfechan)					0.3km	0.3km
A55, west of J10 (Caernarfon Road)					No provision	No provision
A55, east of J10 (Caernarfon Road)					1.5km	1.5km
A55, north of J7 (Cefn Du) and J8 (Llanfairpwllgwyngyll)					No provision	No provision
A55, east of J7 (Cefn Ddu)					No provision	No provision
A55, J5 (Treban) to J6 (Llangefni)					0.5km	0.5km
A55, J4 (Dalar Hir) to J5 (Treban)					1.1km	1.1km
A55, J3 (Pen Caledog) to Four Mile Bridge					No provision	No provision
A55, east of J2 (Ty Mawr) to Four Mile Bridge					1km	1.1km

- Likely to have good coverage,
- May experience some signal problems
- Reliable signal unlikely

HARD-SHOULDER, HARDENED VERGES, LAY-BYS, ROADSIDE SERVICE STATIONS & WELFARE PROVISION

There is a lack of hard shoulder provision along the A55, with the exception of some short lengths in the Colwyn Bay area. There is also additional sections at varying intervals of hardened verge predominantly in the eastern area. Lay-bys are located at varying intervals, typically ranging between 2km and 7km apart. Indicative investigations show that the intervals vary between counties, with the shortest distance between lay-bys being on Anglesey, and the longest being along the coast in Conwy. There are a number of service station areas on or adjacent to the A55 comprising restaurants, shops, toilets and fuel filling stations.

NON-MOTORISED USER CROSSING PROVISION

There are approximately 133 locations where NMUs are able to cross the A55 and A494 route via bridges, subways and tunnels, and grade separated junctions. The crossings include 23 active travel routes, 27 public rights of way, and 22 local and strategic cycle routes. 18 of these crossings are at grade.

DIVERSION ROUTES

There are a number of Strategic Diversion Routes (SDRs) and Tactical Diversion Routes (TDR) along the A55 and A494 corridor. SDRs include trunk to trunk road diversion routes while TDRs are diversions via the county road network. Several of these routes are not suitable diversion routes and do not have the capacity to support the volume of traffic currently accommodated by the A55 and four of these are significantly longer than the corresponding A55 closure length. Table 2-2 illustrates some of the issues experienced along 5 key diversion routes.

Table 2-2: Examples of Diversion Routes

A55 J9-J11 SDR 17 (A5/A487)	A55 J11-19 SDR 18 (A5/A470)	A55 J17-J18 A547&A546 (Conwy)	A55 J20-J21 A547&B5113 (Colwyn Bay)	A55 J33-J33b A5119&A494 (Northop)
70 miles	**36 miles**	**2.9 miles**	**1.3 miles**	**11.7 miles**
67 miles longer than closure	Also used as tactical diversion route	100% of diversion route with speed limit of 30/40mph	100% of diversion route with speed limit of 30/40mph	2.8 miles longer than closure
43 sections of on-street parking	21 miles longer than closure	4 pedestrian crossings	10 sections of on-street parking	10 pedestrian crossings
9 pedestrian crossings	25 sections of on-street parking	2 restricted heights	4 sets of traffic lights	2 sets of traffic lights
2 narrow roads	5 pedestrian crossings	Goes through Conwy	Goes through Colwyn Bay	Goes through Northop
1 restricted height	4 narrow roads			

2.1.4 ROUTINE MAINTENANCE, UPGRADE AND RENEWAL

DELIVERY OF A55/A494 MAINTENANCE WORKS

Works to be undertaken along the A55/A494 corridor range from major capital projects to routine maintenance and network recovery. Other than emergency interventions, maintenance works will be either routine cyclic maintenance or upgrade / renewal. To the west of J11 (Llandygai), the A55 is maintained by DBFO Co. and as a result the design and operating standards are fixed to 1998. To the east of J11 (Llandygai), the road is maintained by NMWTRA under a different arrangement.

The challenge applied to all A55/A494 programmes and projects operated by NMWTRA is *"why the proposed works can't be delivered overnight?"* This approach ensures that any daytime disruption is restricted to as short a duration as possible unless there are justifiable factors e.g. safety, noise affecting adjacent communities or Welsh Government embargo periods. An example of this is the tunnel maintenance programme which is undertaken during night time closures.

Operational experience has shown that up to 4 sites can be concurrent on the network on any given night without undue disruption or congestion. The number of sites on a night will be dependent upon the nature and complexity of concurrent projects and associated traffic management. The impact of day time roadworks west of J11 (Llandygai) i.e. DBFO section is generally minimal due to lower traffic flows.

Table 2-3 provides a summary of the maintenance work completed in 2016/17 including the DBFO section.

Table 2-3: Summary of Maintenance Works

SUMMARY OF WORKS 2016-17	DURATION	TRAFFIC IMPACT
East of Junction 11		
All works (including external parties) undertaken overnight (does not account for multiple sites)	336 nights	Minimal
Upgrade / Renewal Works (including external parties) undertaken during the daytime	79 days	Minimal (off peak) Moderate to severe (at peak times dependent upon location and season)
Maintenance Works undertaken during the daytime (due to site constraints or other factors)	4 days	Minimal (off peak) Moderate (at peak times)
West of Junction 11 (DBFO Section)		
All works (including external parties) undertaken overnight (does not account for multiple sites)	0 nights	N/A
Upgrade / Renewal Works (including external parties) undertaken during the daytime	33 days	Minimal
Maintenance Works undertaken during the daytime (due to site constraints or other factors)	45 days	Minimal (J1 (Holyhead) to J7 (Cefn Du)) Minimal (off peak), Moderate (at peak times) (J7 (Cefn Du) to J11 (Llandygai))

ROUTINE CYCLIC MAINTENANCE

The annual Routine cyclic maintenance work programme by NMWTRA and DBFO Co. includes revenue activities such as grass cutting, gully emptying, weed spraying and inspection. There are other planned programmes of routine maintenance work which are undertaken e.g. safety fence re-tensioning, carriageway patching, soft estate works and drainage.

Table 2-4: Summary of Routine Cyclic Maintenance by NMWTRA

PROGRAMME	DURATION	VALUE
Routine Cyclic Maintenance	71 discrete site locations over 39 nights (typically 20:00 – 06:00hrs) between April and July 2017	£500k
Safety Fence Re-tensioning This is undertaken separately from the routine cyclic maintenance work programme for logistical reasons.	45 nights (typically 20:00 – 06:00hrs) between 1st April and 10th November, 2016.	£200k

UPGRADE / RENEWAL

Upgrade / Renewal works by NMWTRA and DBFO Co. are discrete capital projects or programmes that are undertaken to replace degraded or life expired assets. This will include external parties such as Network Rail and utilities. The works contract and specifications will include requirements for 24 hour working by contractors where it is unsafe or impracticable to undertake the works overnight only and in order to minimise daytime disruption. Examples of such works undertaken by NMWTRA in 2016-17 are illustrated in Table 2-5

Table 2-5: Summary of Upgrade/Renewal Works by NMWTRA

PROJECT	DURATION	VALUE
Street Lighting Asset Renewal Programme Replacement of life expired street lighting columns and associated assets.	104 nights (20:00 – 06:00hrs) between July 2016 and January 2017	£1.95m
Rhuallt Hill Re-surfacing Project Carriageway surfacing and drainage works	27 nights (20:00 – 06:00hrs) between January & February 2017	£1.34m
A55 Kneeshaw Lupton Overline Bridge Project Construction of new Western Crossover, near Rainbow Bridge	10 days (24 hour) March-April 2017	£400k

2.1.5 COMMUNICATIONS

The primary means of contact with the customer for operational matters is the Traffic Wales service which operates a web site, information line (0300 123 1213), email service, social media accounts [10,000 tweets; 9,000 followers] and a smart phone app. On-route information is provided on roadside electronic message signs. Significant road works and incidents are also posted on the Traffic Wales and Roadworks.org websites. Ongoing traffic updates are provided through commercial and public radio broadcasters by a third party, including use of NMWTRA-sourced information. A basic service is provided outside of 0700-1900 which includes the automated tweets/web updates and responding to basic call queries.

2.1.6 PUBLIC TRANSPORT

RAIL

Analysis shows that there is increased rail patronage to the east compared to services further west. Nationally, passenger rail usage for 2015-2016 increased by 5.1%[2] compared to a -1.3%[3] decrease for the North Wales Coastline Stations.

When comparing rail and road journeys for short trips, the train is generally competitive with the car from a journey time perspective. However, when journey distances increase the difference in journey times also increases, favouring the car journey. In cases where train journey times may be comparative to car driver journey times, the frequency of train services may be poor and therefore be less appealing to commuters. Parking provision is fairly low at smaller stations e.g. Abergele/Pensarn station has approximately 10 parking spaces and Llanfairfechan has approximately 15 spaces.

BUS

Bus services along the vicinity of the A55 corridor are operated privately. The current level of service generally operates over short to medium distances, connecting key towns such as Llandudno, Bangor and Colwyn bay to neighbouring towns and villages. In general, the bus journey times are higher than car drive times along the A55. Service frequencies are limited, especially in peak periods. It is also noted that, in the event of an incident on the A55, the alternative routes used by buses will be heavily congested.

2.1.7 TRAVEL PATTERNS

The Census Datashine tool has been used to provide a high level indication of commuting patterns by mode and by day along the A55 corridor from the 2011 Census. The modes analysed in Table 2-6 are Car, Bus, and Rail.

Table 2-6: Travel Patterns

	COMMUTE	NO. OF TRIPS
Car	Valley – Holyhead	451 trips
	Bethesda – Bangor	371 trips
	Deiniolen, Bethel, Llangaffo and Menai Bridge - Bangor	200-300 trips
	Llandudno - Llandudno	440 trips
	Llandudno Junction - Llandudno	453 trips
	J19 (Glan Conwy) of the A55 - Llandudno	352 trips
	Broughton and Bretton - Chester	411 trips
Bus	Bethesda – Bangor	94 trips
	Glanadda – Bangor	74 trips
	Blacon - Chester city centre	500 trips
	Broughton/Bretton - Chester city centre	210 trips
Rail	Holyhead – Bangor	16 trips
	Valley – Bangor	4 trips
	Colwyn Bay - Bangor	6 trips
	Llandudno – Llandudno Junction	22 trips
	Flint – Chester	21 trips
	Prestatyn - Chester	6 trips

[2] Source Location: http://orr.gov.uk/__data/assets/pdf_file/0003/23952/regional-rail-usage-profiles-2015-16.pdf
[3] Source Location: http://gov.wales/statistics-and-research/rail-station-usage/?lang=en

2.1.8 TRAFFIC FLOWS

A summary of the traffic flows along the A55 and A494 has been illustrated on Link Flow Diagrams provided in Appendix A. It illustrates that the AADT steadily increases about 6-fold from west to east, between A55 J1 (Kingsland) and the A494 on the Welsh/English borders. The A55 two-way AADT ranges from the lowest between A55 J2 (Ty Mawr) and J3 (Pen Caledog) (11,117 AADT) to the highest between A55 J33 (Northop) and J34 (Ewloe) (53,071 AADT). The AADT range along the A494 ranges from 47,473 at Deeside Park Interchange to 70,002 just south of Ewloe Interchange.

The level of HGV flows on this route is around 6-7% of the total AADT flow. This is not particularly high for this type of road. For example the A19 in the north East of England is a similar design standard of road and has 12% of AADT as HGV. However the A55 HGV traffic comes in 'waves' dependent upon loading and off-loading of freight at the port of Holyhead, the impact of this is that at certain times network resilience issues can be exacerbated.

Figure 2-1 demonstrates that levels of traffic have grown along the A55 between 2012 and 2016. The purpose of this graph is to demonstrate traffic growth, and so the DBFO flow dataset has been used due to its reliability above other sources. These numbers include the average AADT across 48 count locations between the Britannia Bridge and Holyhead. The AADT in these locations are lower than those further east along the A55.

Figure 2-1: Growth in A55 Traffic Flows (J1 (Kingsland) to J11 (Llandygai))

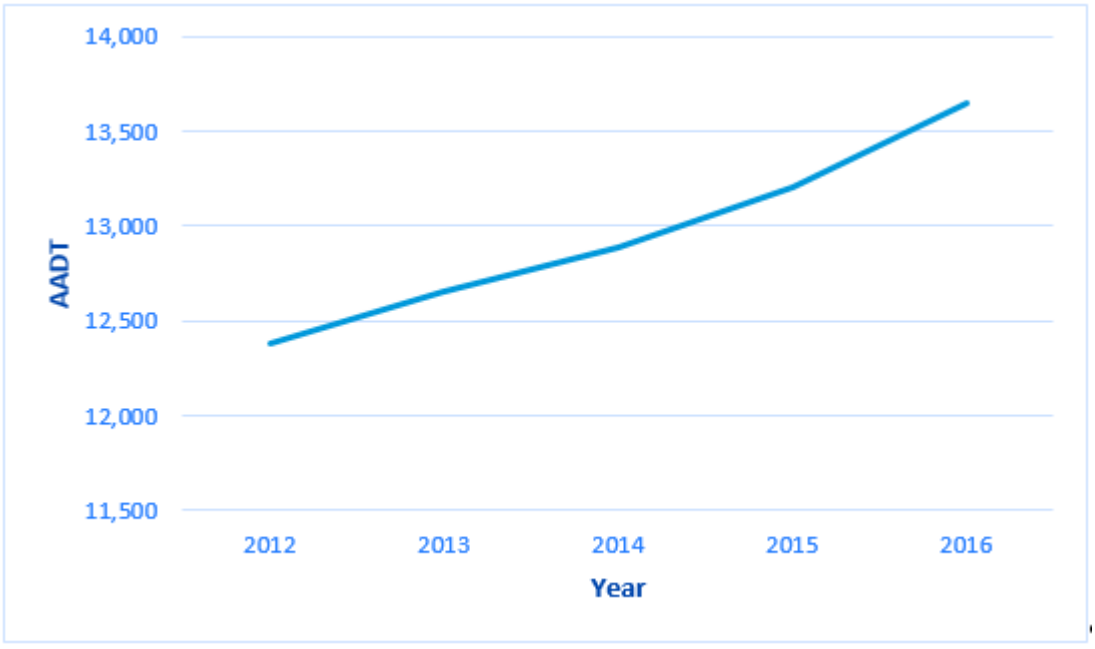


Table 2-7 also demonstrates the seasonality of the A55/A494 network. Throughout the route, January or February had the lowest flows in both directions, with the highest flows occurring in August.

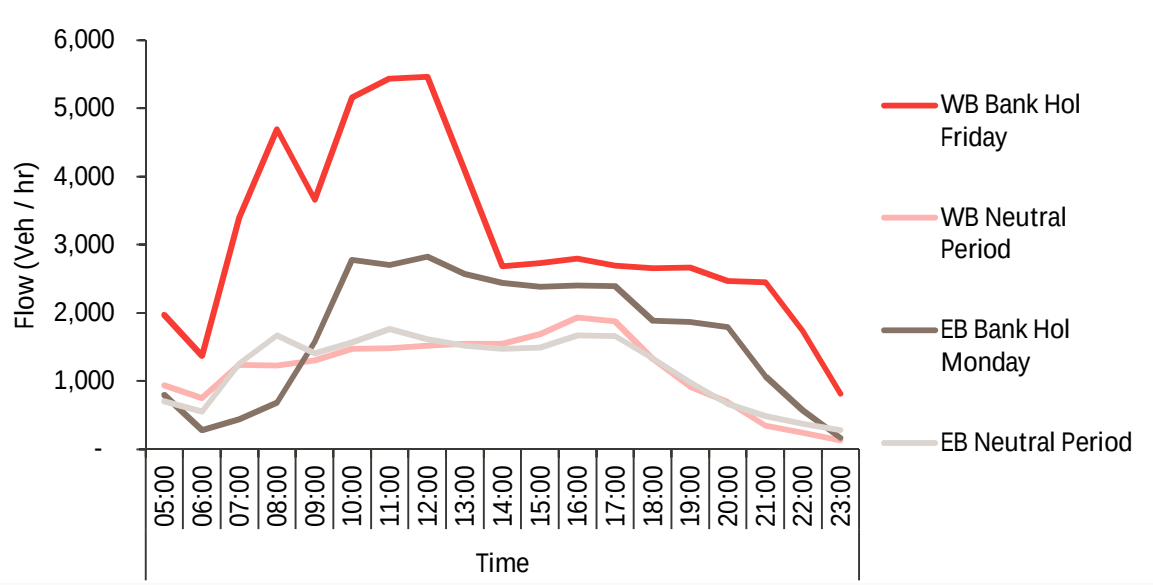
Table 2-7: A55 Seasonality

	Penmaen-bach Gwynedd EB	Penmaen-bach Gwynedd WB	Bodel-wyddan EB	Bodel-wyddan WB	Pont Dafydd, E. of St Asaph EB	Pont Dafydd, E. of St Asaph WB	Northop BP (West) Clwyd EB	Northop BP (West) Clwyd WB	Hawarden Bypass Clwyd EB	Hawarden Bypass Clwyd WB
Jan	12,374*	11,693*	16,005	15,657	17,024	16,190	22,277	21,861	12,220	11,503
Feb	6,539*	4,742*	17,248	17,444	18,534	18,255	24,163	24,337	12,921	12,521
Mar	16,488*	5,801*	18,919	19,308	20,887	20,918	26,608	27,156	13,578	13,422
Apr	17,676	12,515	20,235	20,572	22,238	22,098	28,273	28,710	14,359	14,062
May	18,284	18,174	21,048	21,858	23,314	23,480	29,247	29,729	14,865	14,653
Jun	19,075	18,268	21,210	20,812	24,168	23,308	30,222	29,876	14,992	14,472
Jul	19,256	19,588	22,100	23,233	24,436	24,620	30,332	31,030	14,785	14,868
Aug	21,561	21,331	25,327	25,188	27,977	27,367	33,376	33,280	15,654	15,574
Sep	18,862	18,339	21,823	21,466	23,685	22,749	29,597	29,241	14,796	14,410
Oct	18,158	18,017	20,594	20,780	22,771	22,382	28,762	28,953	14,697	14,393
Nov	16,295	15,964	18,337	18,471	19,777	19,223	25,642	25,614	13,741	13,233
Dec	14,661	14,781	17,765	17,827	18,113	18,231	23,703	24,364	12,622	12,317

Note: *Planned roadworks closed the Penmaenbach tunnels during the first quarter of 2016.

Demand tends to be the greatest during bank holidays. For example, in the late May bank holiday 2017, the total daily westbound demand exceeded 2.5 times that of a neutral day in early April, with a total of 58,926 vehicles on the A55 J27 (St Asaph). Figure 2-2 compares the demand profile throughout a neutral day in April against that of the late May bank holiday.

Figure 2-2 Bank Holiday Flow Profile



The A55 route tends to operate within capacity, however, during occurrences of heightened situations (i.e. road traffic collisions (RTCs) or seasonal flow variances), road users can be subject to severe delays (sometimes regardless of the incident magnitude/severity). This fragility is an indication that the A55 is approaching or at capacity. A number of the main pinch points associated with capacity are; J8 (Ael y Bowl) – J9 (Treborth) across Britannia Bridge, J21 (Colwyn Bay) – J24 (Abergele), and J34 (Ewloe) to A494 Drome Corner.

2.1.9 JOURNEY TIME RELIABILITY

Journey Time reliability on the A55/A494 varies depending on the time of day/year and location. Typical locations where regular journey time increases are experienced include the Menai Strait, St Asaph, J31 (Caerwys) to J36a (Broughton) and the A494 (Deeside Corridor). As an example, customers on the A494 westbound on a typical Friday experience a 100% increase in travel time at PM Peak and do not experience free flow conditions from 13:00 to 20:00. [4]

2.1.10 OPERATIONS

The current WG Traffic Officer service responds to over 10,000 A55/A494 incidents per annum (27 incidents/day) with an average response time of less than 8mins against a target response time of 20mins. The month with the highest incident rate is August with 70% greater than the lowest month, December. Collisions and breakdowns cause the most disruption in terms of longer duration incidents.

Due to intervention by Traffic Officers over 92% of incidents were dealt with without impacting upon journey times. An economic evaluation of the service in 2012, taking account of the cost of delay to traffic, indicated a return in investment ratio of 1 to 5.65.

Incident response times for the A55/A494 are shown below and an indicative comparison with Highways England (HE) for context.

Table 2-8: Incident Response Times

METRIC	A55/A494[5]	HE COMPARISON[6]
Incident Response Times (Dispatch/Discovery to Arrival)	8 Mins	14 Mins
Average Incident Response & Recovery Times[6]	19 Mins	25 Mins

2.1.11 INCIDENT DATA

Incident data between October 2012 and July 2017 has been provided from the WG IRIS (Integrated Roads Information System) database. This has been analysed to identify the general impact of these incidents on the road network as well as highlighting incident hot spots. The analysis has highlighted the main incident hot spots as J23 (Llanddulas), J23A (Pensarn), J28 (Waen) to J35 (Dobshill) and Deeside Park Interchange.

The most significant incident type is breakdowns, accounting for 54% of incidents. Obstruction is the second most common incident type, 14% of incidents. In relation to driver behaviour there were approximately 1.5% out of fuel incidents and 0.7% related to mobile phone use. The majority of incidents are recorded as having no recorded impact on traffic capacity. The incident data shows that the carriageway remains open for 97% of all recorded incidents. The majority of the incidents that result in carriageway closure were collisions. Furthermore, the vast majority of incidents that resulted in some carriageway disruption in 2016 only lasted 15 minutes or less. This indicates that the response rate to incidents along the highway is generally good, and that incidents are resolved promptly.

[4] INRIX Roadway Analytics Dataset May to July 2017.
[5] Figures from August 2017 Welsh Government CRM Dataset.
[6] From Parliamentary Question regarding M1 - 11th May 2015

2.1.12 PERSONAL INJURY COLLISIONS

During 2011-2015 there have been a total of 329 road traffic collisions and 892 casualties[7], with a general upward trend in collisions from west to east. There are a number of key road traffic collision hot spots on the A55/A494 corridor, these include; Britannia Bridge, J16A (Dwygyfylchi) to J20 (Rhos on Sea), Rhuallt Hill, J33A (Connahs Quay) to J33B (Northop Hall). The road traffic collision hotspots are illustrated in Figure 2-3.

Of the total of 329 road traffic collisions in the dataset, 270 (82%) were slight, 50 (15%) were serious and 9 (3%) fatal in severity. The records also illustrate that of the road traffic collisions outlined above, three collisions involved pedestrian, resulting in one fatal, one serious and one slight casualty. The records also show that five collisions involved casualties to cyclists, one fatal, 4 serious, and one slight. In comparison with other similar roads it does not have excessively high road traffic collision rates per million vehicle miles with the A55 showing 0.06 road traffic collisions per million vehicle miles compared with the A19 in North East England (a road with similar design standards and features) having a road traffic collision rate of 0.12 road traffic collisions per million vehicle miles. The independent EuroRAP road safety rating also shows the A55/A494 as low-medium risk based on frequency and type of incidents when compared with other routes in the UK[8].

Figure 2-3: Road Traffic Collision Hotspots

Imagery based on Open Street Maps Data

Based on the information provided for this study, the estimated costs of road traffic collisions and casualties on the A55/A494 have been calculated at approximately £9 million a year to the local economy from 2011-2015.

[7] Figures from DfT STATS 19 Data
[8] 2010-2012 EuroRAP Risk Rating shows the A55 as low –medium risk in terms of safety (http://www.eurorap.org/partner-countries/great-britain/)

2.1.13 WEATHER CONDITIONS

Weather data recorded by MET Weather Stations demonstrate that the number of adverse weather conditions recorded (incidents where temperatures reached zero/ showers/ storms/ and high winds), is highest during the winter months and peaks in December.

Over the last 5 years, the A55 has experienced a number of serious flooding events from two different catchments that have resulted in the carriageway being submerged and the road being closed. The following locations were closed due to flooding; between J12 (Tal-y-Bont) and J11 (Llandygai), and between J11 (Llandygai) and J15 (Llanfairfechan). However, mitigation works have been recently completed to reduce further instances of flooding.

2.1.14 ENVIRONMENT

This section of the report identifies and determines the potential environmental constraints and opportunities within the vicinity of the A55 and A494 using aerial imagery and ordnance survey mapping.

BIODIVERSITY

Throughout the route along the A55 from Holyhead to Broughton, there are several statutory designated sites comprising SAC/SSSI/SPA/RAMSAR within 2km of the A55. Many of these designations are located adjacent to the A55, and several of which the A55/A494 travels through the boundary of these protected areas. Many of these sites have been designated for their unique, rare and important habitat features which support a number of protected species such as otters, reptiles, bats and birds.

There are also a number of non- statutory designated sites which are within proximity to the A55/A494 comprising Local Nature Reserves and Natural Nature Reserves. The A55/A494 does not fall within the boundary of any of these designations, but some are within proximity (closest 35m). Similarly, these sites have been designated by the Local Authority due to their vast and unique habitat systems which help support a number of protected species.

These protected areas represent ancient woodlands, mountain ranges, rivers, coastal habitats, estuarine habitats and areas of geological importance.

LANDSCAPE

The A55 passes through two Areas of Outstanding Natural Beauty (AONB) and Snowdonia National Park.

The route also passes through rural and urban landscapes which comprise a mixture of coastal routes with views out towards Colwyn Bay and also mountainous and rolling countryside views further in the distance towards the north. Further towards the south east the landscape changes slightly, the areas of land become flatter and the views from the road become reduced as the roadside vegetation becomes denser.

The A494 comprises a mainly urban landscape as the road passes through a built up area which has several industrial retail parks situated either side of the A494. However, much of the A55/A494 dual carriageways are lined with high hedges and mature trees, as a result, the view of the surrounding landscape from the road is limited.

NOISE

There are 21 designated Noise Action Planning Priority Areas (NAPPA Sites) situated along the A55 and A494 between Holyhead and Broughton.

There are also a number of residential dwellings throughout many of the towns and villages through which the A55/A494 passes, which are situated adjacent to the carriageway or are within a few metres of the A55/A494 carriageway (within 20m in some places). There are also a number of commercial properties adjacent to the A55 such as guesthouses, hotels, restaurants and caravan/camping parks.

WATER ENVIRONMENT

There are four significant watercourses which the A55 crosses between Holyhead and Broughton comprising the Menai Strait, The River Elwy, River Clwyd and the River Dee. The A55 also travels under the River Conwy via an immersed tube tunnel. There are also a number of smaller named rivers along the route which pass below the A55. Within proximity to the A55/A494 there are a network of small drainage ditches and unnamed watercourses which flow in all directions throughout the extent of the A55/A494 some of which are tributaries that contribute to the larger named rivers, estuaries and bays.

AIR QUALITY

There are no designated air quality monitoring areas (AQMAs) along the A55/A494, though air quality monitoring and ventilation systems are in place in the tunnels for safety reasons. Therefore, it is considered that air quality in these areas is relatively good.

The number of cars using the A55 and A494 is likely to increase over time, therefore Greenhouse Gas emissions from the A55 and A494 are also likely to increase but could be offset with changes to the efficiency of the vehicle fleet.

HISTORIC ENVIRONMENT

The towns and villages of North Wales have a high historic value, with many historic assets. Many of the towns and villages comprise dozens of listed buildings many of which are predominately clustered around the centres of the towns and villages. There are several other cultural heritage designations comprising; Bangor town is designated for its Historic Interest, and between the A55 from Holyhead to Broughton there are several Conservation Areas and designated Historic Parks and Gardens, several of which are adjacent to the A55.

TOWNSCAPE

The A55 passes through several towns and predominately small villages. Some of the towns comprise small residential villages with small residential dwellings and several small businesses such as cafes some of which have significant historic landscape such as Bangor up to Colwyn Bay. These areas attract high tourism footfall and also comprise of many campsites and caravan parks.

There are several larger and more urbanised towns along the route interspersed with smaller villages and individual farmsteads. These towns comprise built up areas of large and dense residential dwellings which are adjacent to the A55, and contain hotels, restaurants, hospitals and schools, with out of town shopping centres and industrial parks located on the outskirts.

The A494 passes through a more urbanised area with residential and commercial properties fronting the side of the road.

2.1.15 CONSULTATION

A stakeholder workshop was undertaken on the 19 July 2017 at Tŷ Menai, Bangor to which representative from key stakeholders of the following organisations were invited:

- Welsh Government
- NMWTRA
- Gwynedd Council
- Flintshire County Council
- Conwy County Borough Council
- North Wales Police

The aim of the workshop was to discuss and identify the following:

- The main customers
- Key problems and issues
- Identify an initial set of solutions that would address these problems

The findings of the workshop formed a key part of issue identification, development of objectives and initial option development. Throughout the study there have been further, more focussed workshops with key Welsh Government and NMWTRA stakeholders to feed into study development.

2.1.16 IDENTIFICATION OF ISSUES

Following the review of baseline information and consultation with stakeholders, the identified issues that require addressing are summarised in Table 2-9.

Table 2-9: Key issues along A55 / A494 corridor

KEY PROBLEMS	FURTHER DETAIL
Topographical Constraints	The A55 has many topographical constraints: such as where the route shadows the North Wales coastline; climbs the flanks of the Halkyn Mountain range; follows the North Wales coast railway line; crosses the River Conwy Estuary, River Dee and two major headlands: Penmaenbach and Pen y Clip, and across the single carriageway Britannia Bridge over the Menai Strait.
History of short term improvements	A number of the existing problems along the A55 and A494 have been solved with short term solutions. These are relatively low cost options which can be quickly implemented and often have immediate tangible benefits. However, these improvements do not necessarily offer long term solutions to problems and can result in reactive rather than proactive network management.
Network does not comply with current standards	A number of junctions and sections of the A55 do not comply with current standards and this may affect the overall safety and capacity of the network.
Annual Traffic Growth	Analysis of WG count sites along the A55 corridor indicates year on year traffic growth. The consequence of this is that many of the problems identified herein are likely to worsen over time if no action is taken.

KEY PROBLEMS	FURTHER DETAIL
Seasonality of traffic flows	Data from WG count sites has been analysed to determine the seasonality of flow on the A55 corridor. This data indicates that there is a notable increase in traffic through the summer months, which peaks in August. On some sections of the network the flow in August can be double that which is observed in January for the same section. This means that capacity improvements may not necessarily provide year round benefits and this may decrease the Value for Money for a number of schemes.
Vehicle Types	There are a number of problems with respect to slow moving vehicles on the network. Whilst the overall proportion of HGV traffic on the A55 corridor is not unusual, the HGV proportions are peaky due to the scheduling of the ferries at the Port of Holyhead.
Conflicting Stakeholder Priorities	There are occasional conflicting stakeholder priorities during incidents, including; primacy dependent upon incident type. This can result in wider aspects of the incidents not being communicated sufficiently and can impact upon clearance times.
Incident management is more problematic in some locations	The characteristics of the network are not consistent along its length. As such, incidents may be more difficult to manage on some sections of the network relative to others. Therefore, it is possible that the infrastructure to manage incidents may not necessarily be uniform across the extents of the network.
Decision making process and procedures for ECPs	Restricted potential for use of the emergency crossing points (ECP's) under certain incident scenarios.
Limited programmes for planned works	The programmes for planned works are usually defined by the embargo periods and allocations set by Welsh Government.
Constrained and untimely annual funding	Inefficiencies of the maintenance and asset management programme as a result of a lack of a long term funding programme.
Constrained resources	Lack of readily available resource during unplanned incidents and prolonged winter maintenance periods resulting in immediacy problems for example reallocation of resource from programmed works to an incident.
Communications	There is a limited and uncoordinated communications strategy for the dissemination of information relating to the network. Whether this be via social media (lead by a social media communications manager within WG or NMWTRA) or by radio, newspapers, internet etc. Work has already started on improved communications.
Lack of investment	Historically, limited funding and the profile of investment has restricted the planning and scope of improvements along the A55/ A494 corridor.
Limited working hours for maintenance	Embargo periods and the preference of night time working to minimise impact to the traveling public, restricts the working hours to complete planned maintenance.
Vehicle recovery contract	The existing vehicle recovery contract is managed by the North Wales Police and thus the necessary call out via a 3rd party which can cause delay to recovery times, e.g. dispatch of inappropriate recovery vehicles.

KEY PROBLEMS	FURTHER DETAIL
Lack of performance analysis	A significant amount of operational data is collected by WG and NMWTRA but this is currently not meaningfully analysed in a systematic way. This data provides a valuable evidence base to the requirements for asset management and improvements across the network and a baseline of network performance.
Constrained by standard operating procedures	Standard operating procedures fit in with historical hierarchy, reactive rather than proactive. This may therefore not be the most efficient process.
Lack of viable diversion routes	There is a lack of suitable diversion routes due to the topography of North Wales and limited parallel routes.
Poor mobile phone coverage	Mobile phone coverage across the network drops out in places and this may impact upon response times of emergency vehicle recovery.
Limited hard shoulders	Significant parts of the A55/ A494 lack hard shoulder provision. Safety fencing also restricts access to verges for use as a runoff. The consequence of this is that broken down vehicles (amongst other incidents), have a greater impact on delay and potentially increase the severity of incidents.
Lack of competitive sustainable travel options	Census Journey to Work data indicates a strong reliance on private car for commuting trips. This is believed to be a consequence of the fact that bus and rail do not provide competitive (comparable) journey times and therefore do not represent an attractive alternative to private car trips.
VMS limited in places	VMS coverage across the network is inconsistent. This means that incident management is more challenging on some parts of the network than others. It is important to consider that the A55/ A494 corridor has a number of varying characteristics along its length and therefore VMS coverage should not necessarily be uniform.
CCTV blind spots	CCTV coverage across the network is incomplete. CCTV coverage can speed up response times to broken down vehicles, other incidents and improve tactical decision making on the network. It should be noted that incidents are more problematic on some sections of the network compared to others.
Limited infrastructure for low carbon emission vehicles	The UK government has announced that no new Petrol and Diesel cars will be sold from 2040. The A55/ A494 corridor currently has limited provision for electric vehicle charging or other alternative forms of fuel.
Unsuitable pedestrian crossing	There are a number of unsuitable pedestrian crossings along the A55/A494 corridor. This includes a number of at grade crossings and grade separated crossings which are not accessible to those with mobility impairment. Similarly, some of the grade separated pedestrian crossings which currently exist are unattractive due to not being traffic free, or have poor lighting which results in a perception of poor personal security.
Eastern end of the A55 and A494 are nearing or at link capacity	An analysis of congestion reference flows indicates that the A55 between J32 (Springfield) to J36A (Broughton) is nearing or over capacity in 2016, and by a horizon year of 2046 the A494 is also likely to be nearing or over capacity.

KEY PROBLEMS	FURTHER DETAIL
Capacity pinch points on network	There are a number of key pinch points on the A55/A494 corridor. Including: A55 J8 (Carreg Bran) – J9 (Treborth) across Britannia Bridge, J21 (Colwyn Bay) – J24 (Abergele), and the A55 J34 (Ewloe) to A494 Drome Corner.
Incident hotspots	There are a number of key incident hot spots on the A55/A494 corridor, this includes; J23/23A (Llanddulas/Pensarn), J28 (Waen) to J35 (Dobshill) and Deeside Park Interchange.
Road traffic collision hotspots	There are a number of key road traffic collision hot spots on the A55/A494 corridor, these include; Britannia Bridge, J16A (Dwygyfylchi) to J20 (Rhos on Sea), Rhuallt Hill, J33A (Connahs Quay) to J33B (Northop Hall).
Flooding	There are a number of locations along the A55 corridor that have been closed as a result of the carriageway being submerged due to flooding. These include; J11 (Llandygai) to J13 (Abergwyngregyn).
Noise Action Planning Priority Areas (NAPPA)	There are 21 designated Noise Action Planning Priority Areas (NAPPA Sites) situated along the A55 and A494 between Holyhead and Broughton.
Areas of Outstanding Natural Beauty (AONB)	The A55 passes through two Areas of Outstanding Natural Beauty (AONB) and Snowdonia National Park. This provides further constraint along the corridor.

A number of problems have been identified along the A55 / A494 corridor, due to the size of the study are and the complexity of the transport system along this corridor. Whilst 33 unique problems have been identified, there is a degree of overlap between many of these and as such these can be grouped into the following key themes.

- → Communication
- → Network Asset Management
- → Network Capacity and Demand
- → Network Incident Management
- → Diversion Routes
- → Environment
- → Sustainable Travel
- → Future Proofing

2.2 OBJECTIVES FOR THE INTERVENTION

The objectives for the intervention have been derived from key issues, constraints, and transport specific objectives as set by the Welsh Government. By developing options that will address these objectives will ensure that this study contributes to the strategic priorities of the Welsh Government, including that of the Well-being of Future Generations (Wales) Act.

The final objectives for the intervention are outlined in Table 2-10.

Table 2-10: Proposed Objectives

ID	OBJECTIVE	PROPOSED METRICS
	Communication	
1	Improve real time and advanced communication with travelling public, the media and elected members regarding network performance and levels of disruption	- Reduction in level of complaints from the travelling public directly to WG and NMWTRA - Reduce negative correspondence from elected representatives - Visibility of proposed mitigation in the media
	Network and Asset Management	

ID	Objective	Proposed Metrics
2	Improve asset management planning to minimise disruption on the network	- Reduce number of occurrences of delays due to planned, routine and reactive maintenance compared to baseline data
3	Design for reduced whole life maintenance interventions of assets	- Reducing the proportion of onsite intervention for asset management
	Network Demand & Capacity	
4	**Progressive improvement in Journey Time** 1) Across the A55 and A494 (long term) 2) Through pinch points (short/medium term)	- Decrease journey time during the peak period in comparison to the mean across the A55/A494 Corridor from Holyhead to Welsh/English Borders - Decrease journey time during the peak period in comparison to the mean through specific pinch points on the A55 and A494 from Holyhead to Welsh/English Borders
5	**Progressive improvement in Journey Time Reliability** 1) Across the A55 and A494 (long term) 2) Through pinch points (short/medium term)	- Improve journey time reliability by reducing the ratio of the 95%ile journey time to the free-flow journey time across the A55 / A494 Corridor from Holyhead to Welsh/English Borders - Improve journey time reliability by reducing the ratio of the 95%ile journey time to the free-flow journey time through specific pinch points on the A55 and A494 from Holyhead to Welsh/English Borders
	Network Incident Management	
6	Reduce the number of fatal & serious road traffic collisions across the A55/A494 Corridor from Holyhead to Welsh/English Borders	- Reduce the number of fatal and serious road traffic collisions across the A55/A494 Corridor from Holyhead to Welsh/English Borders in line with current policy
7	Reduce the level of incidents across the A55/A494 Corridor from Holyhead to Welsh/English Borders	- Reduce the number of incidents across the A55/A494 Corridor from Holyhead to Welsh/English Borders
8	Reduce Incident duration and associated delays	- Increase the number of incidents resolved within a 20min threshold response time compared to base year average 2012-2017 - Increase the number of incidents resolved compared to the base year average 2012-2017
	Diversion Routes	
9	Improve suitability and directness of strategic and tactical diversion routes.	- Reduction of journey time on diversion routes during an incident when these are required.
10	Reduce the number of times strategic and tactical diversion routes are required as a result of incidents and planned works	- Reduction in number of times diversion routes are required
	Environment	
11	No significant adverse impacts on environmental sensitive receptors during construction and operation	- No significant adverse impact in relation to environmental receptors
	Sustainable Travel	
12	Improve provision for sustainable travel	- Reduction in the amount of at grade NMU crossings - Increase the amount of Equality Act compliant crossings - Increase in modal shift away from private vehicle
	Future Proofing	
13	Plan for a transport network that is future ready e.g. decarbonisation and future technology,	- Suitable analysis of future technology, connected vehicle infrastructure and innovation - Forward plan developed for the network

Table 2-11 illustrates how the objectives relate to the key issues which have been identified. As can be seen, the objectives cover all of the key issues.

Table 2-11: Comparison of Objectives against Key Issues

KEY ISSUES	OBJECTIVES												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	Improved Communication	Maintenance Planning	Design for Maintenance	Improved Journey Times	Improved Journey Time Reliability	Road traffic collision Reduction	Incident Reduction	Reduce Incident Duration	Improve Diversion Routes	Reduced reliance on diversions	Impacts on Environment	Improved Sustainable Travel	Future Proofing
Topographical Constraints									■	■			
History of short term improvements		■	■										■
Network does not comply with current standards					■	■	■			■			■
Annual Traffic Growth				■	■								■
Seasonality of traffic flows	■			■	■								
Vehicle Types					■	■	■						
Conflicting Stakeholder Priorities	■							■	■	■			
Incident management problematic in some locations	■				■			■	■	■			
Operating Procedures for ECPs					■			■					
Limited programmes for planned works		■	■										■
Constrained and untimely annual funding	■	■	■										■
Constrained resources		■						■		■			
Communications	■				■			■				■	
Lack of investment		■	■										■
Limited working hours for maintenance		■	■							■			
Vehicle recovery contract					■			■					
Lack of performance analysis	■	■	■										■
Constrained by standard operating procedures	■	■	■					■		■			
Lack of viable diversion routes									■	■			■
Poor mobile phone coverage	■				■			■					
Limited hard shoulders			■			■	■	■		■			
Lack of competitive sustainable travel options					■						■	■	
VMS limited in places	■				■	■	■	■	■				
CCTV blind spots					■	■	■	■		■			
Limited infrastructure for low carbon emission vehicles							■				■		■
Unsuitable pedestrian crossing						■					■	■	
Eastern end of the A55 and A494 at link capacity				■	■								■
Capacity pinch points on network				■	■								■
Incident hotspots					■		■			■			
Road traffic collision hotspots					■	■				■			
Flooding			■		■		■			■			
Noise Action Planning Priority Areas (NAPPA)											■		
Areas of Outstanding Natural Beauty (AONB)											■		

2.3 LONG LIST OF OPTIONS

Following the identification of objectives and through consultation with stakeholders, potential interventions were identified that address the problems and objectives. These are detailed in the following section and have been grouped by the themes identified above.

Those opportunities highlighted grey within the table were either discarded or have been combined into a larger option at this stage of the appraisal. The rationale for this is explained in the following section.

2.3.1 COMMUNICATION

Communication Manager *(S28)*
Employ dedicated Communications Manager - to manage media, social media, etc. and a live Social Media/radio/news media feed assistant.
Radio A55 *
Provide real time information for the road user, For example “Radio A55” ** Proposed to be covered under the role of a communication manager*
Live Social Media Feed*
Implement live social media (as per train companies) to provide real time responses so improving communications ** Proposed to be covered under the role of a communication manager*
VMS Templates and Campaign Messages *(S6c)*
Update trunk road VMS message templates & develop a suite of campaign messages.
Traffic Information*
Journey Times and delay information on VMS and information points at ports, airports and service areas. Legend/Pictograms/Graphical Route displays. ** Proposed to be covered under the role of a real time floating vehicle data incident detection system.*
Real-time Floating Vehicle Data - Travel Times API *(S5)*
Currently there is no automated setting of VMS (compared with the majority of VMS settings in England being automated or semi-automated) on the A55 and as a result the type of information that can be given to the road users to make journey planning decisions is limited. This option proposes to enhance the use of the existing (as well as the proposed new VMS) to display travel times that vary with changing conditions to key destinations. This information would be driven by real-time floating vehicle data such that the information provided would update based on current/expected conditions.
Road Timetable - Real-time Floating Vehicle Data *(S83)*
Promote web based analytical tool to advise customers on future typical travel times and real time traffic conditions
Driver Behavioural Change Campaign *(S86)*
Development of a behavioural change campaign via VMS, social and local media to improve the quality of driving to reduce the amount of incidents along the A55 and A494. The behavioural campaign may include areas such as driver frustration/aggression, tackling late lane manoeuvres, speed compliance, vehicle maintenance and mobile phone misuse.

2.3.2 DIVERSION ROUTES

Diversion Route Operation Procedures *(S73)*

This option proposes to review and develop the current operational procedures to implement diversion routes. This would include Map/ Route Cards, Operational Information, Diversion Signs Information, details of documents and records to be kept.

Strategic Diversion Routes Symbol Signage *(S74)*

Strategic Diversion Route (SDR) No. 18 has diversion signage 'symbols' on existing signs. This option considers diversion 'symbol' signing for SDR No. 14, 17, 19 & 20. The Strategic Diversion Routes would be signed by either using the standard Chapter 8 symbols stickered onto existing signage or new signs.

Tactical Diversion Routes Symbol Signage *(S75)*

Consider signing TDR's with symbols on existing signs or new signs. This will need to be agreed with the Local Councils. The Tactical Diversion Routes would be signed by either using the standard Chapter 8 symbols stickered onto existing signage or new signs.

Diversion Route Operation Procedures – Traffic Management Plans *(S76)*

Finalise and confirm traffic management plans that can be implemented to release trapped traffic and divert traffic off the A55 and A494 to allow users to take an alternative route, to find somewhere suitable to await incident clearance or return to their point of origin in the event of an incident that is over 90mins. These traffic management plans would become part of the Contingency Plan/Diversion route operational procedures. The plans have already been prepared by NMWTRA but would need to be reviewed, agreed and implemented as part of the Contingency Plan/Diversion Route Operational procedures.

Provide wireless electronic driver information signs on Strategic Diversion Routes *(S77)*

Provide wireless electronic driver information signs on Strategic Diversion Routes entry point on to the A55. The wireless electronic driver information signs would be located on the A55 / A494 entry points from Strategic Diversion Routes No. 14, 17, 18, 19 & 20. A total of twelve signs would be required.

Provide wireless CCTV on Strategic Diversion Routes *(S78)*

Provide wireless CCTV at known problem sites along the Strategic Diversion Route. The wireless CCTV could be provided at known problem sites on Strategic Diversion Routes No. 14, 17, 18, 19 & 20. A total of eight CCTV's would be required.

A470 Llanrwst Bypass *(S79a)*
Strategic Diversion Route 18 & Strategic Diversion Route 19

The route of the bypass has been assumed the same as the previous 'old' Llanrwst Bypass Route. The improvement would be a single 7.3m wide carriageway with 1m wide hardstrips. The improvement would commence approximately 2km south of Llanrwst near to Bryn Derwen and would bypass to the east of the town before re-joining the A470 approximately 3km to the north of Llanrwst near Bryn Rhudd. The total length of the bypass is approximately 5.75km. The bypass would cross over existing Local Highway Authority A, B and unclassified roads, which would require the construction of new at grade roundabouts and junctions. The road would also cross over 5no streams.

A470 - Road Widening to the South of Waterloo Bridge, near Betws y Coed *(S79b)*
Strategic Diversion Route 17

The A470 between Dolwyddelan and Pont yr Afanc has previously been improved by Welsh Government, however there is a section on the A470 between Pont yr Afanc and the A5 Junction, a length of approximately 980m, which remains narrow and can become congested under high traffic volumes. This section is within the Snowdonia National Park.

Due to the steep embankment and the River Conwy being to the west of the A470, any road widening would have to be to the east of the existing road and into an existing slope, where tree clearance and retaining walls would be required to accommodate the additional width.

A494 – Road widening and change A494/Corwen Road junction priority (south of Ruthin)
Strategic Diversion Route 19 *(S79c)*

There is a 600m section on the A494 to the south of Ruthin that is narrow and does not have a road centre line. This can become congested under high traffic volumes. To the south of this narrow section there is an existing road junction. The A494/Corwen Road junction gives priority to vehicles on the unclassified Corwen Road and can therefore cause queuing along the A494 as traffic give way to the minor road. It is proposed to widen the carriageway to 7.3m width with 1m hard strips along the narrow section. Some tree clearance and minor earthworks would be required. It is proposed to realign the minor Corwen Road so that traffic gives way to the A494. The existing junction will then be remodelled and re-profiled to benefit through traffic on the A494.

A494/A5104 junction remodelling to give priority to the A494 *(S79d)*
Strategic Diversion Route 19

There is a junction along the A494 (T) to the north of Corwen which gives priority to the A5104 County Road. In the event of using the A494 as a diversion, this could cause queuing delays at this junction for westbound traffic. It is proposed to realign the A5104 to give way to the A494 and to re-profile the A494 so it takes priority over the minor road. This option will require the purchasing of additional land.

A5/A470 Urban Areas – Additional on-street parking restrictions *(S79e)*
Strategic Diversion Route 17 and Strategic Diversion Route 18

Whilst there are off street car parks in urban areas (e.g. Bethesda, Betws y Coed), parking along the A5/A470 is still permitted along certain sections of the Trunk Road. This can cause severe congestion under high traffic volumes.

Increase VMS signage (fixed or mobile) along the A55 & A494 between each junction *(S80)*

Increase Variable Message Signs (VMS) signage (fixed or mobile) along the A55 & A494 between each junction. The proposed VMS would be positioned in advance of each junction along the A55 & A494 to inform drivers of junction closures and diversions ahead.

Improved Maintenance Planning *(S81)*

Liaise / coordinate with Local Authorities to reduce street works on County Roads which are used as diversions during busy periods. This option would entail continued liaison between NMWTRA and Local Highway Authority (LHAs) representatives to minimise or stop any roadworks during busy periods, e.g. during the summer holiday embargoes. The Welsh Government has already recognised this problem and it published its National Approach for Road and Street Works in June 2016, and continues to work with local authorities and utilities companies to promote best practice.

New Penmaenbach Tunnel *(S87)*

In normal operation, the eastbound headland route does not comply with current standards and operates at 30mph. If there is an incident in the westbound bore a contraflow on the headland tunnel could not be operated daytime as the route does not comply with current standards (HGV's and buses would not be able to pass each other on parts of the headland. SDR would need to be used. Maintenance closures successfully operate a batched contraflow operation at night time.

Development of an eastbound tunnel at Penmaenbach would provide an alternative to the headland route. The tunnel would follow a similar alignment to the 1980s preliminary design. This would include two cross-passages linking into the existing westbound tunnel to provide enhanced evacuation facilities in the event of an incident in either bore.

New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – Upgrade Roman Road *(S88a)*

Development of a new diversion route between J12 (Tal y Bont) and J14 (Madryn) to avoid the long diversion route (36 mile) via the A5. This option would upgrade the existing Roman Road to single carriageway standard from J12 (Tal y Bont) to J13 (Abergwyngregyn). A new parallel route of single carriageway standard would also be constructed from J13 (Abergwyngregyn) to J14 (Madryn) following the alignment of Gwyllt Road. This option would involve the removal of existing hedgerows and land take along the existing route.

New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – New Parallel Route *(S88b)*

Development of a new diversion route between J12 (Tal y Bont) and J14 (Madryn) to avoid the long diversion route (36 mile) via the A5. This option would be a new single carriageway and would run parallel to the existing A55 to J13 (Abergwyngregyn). The new parallel route would then continue to the east of J13 (Abergwyngregyn) to J14 (Madryn) following the alignment of Gwyllt Road.

Penmaenbach Eastbound Marine Embankment – 120kph Design Speed *(S90)*

The narrow, twisty eastbound carriageway around Penmaenbach poses the single greatest risk to the resilience of the A55 highway network. Should a major incident occur in the existing westbound tunnel forcing its prolonged closure, the traffic management measures needed for dealing with such an event would lead to major delay to local and international traffic due to the lack of suitable alternative routes. This option proposes a new eastbound carriageway marine embankment with a 120kph (70mph) design speed at the Penmaenbach Headland.

2.3.3 SUSTAINABLE TRAVEL

Improved Rail Provision *(S64a)*

Improved rail provision through the delivery of the North Wales and North East Wales Metro which aims to create a sustainable, reliable, efficient and quality integrated transport network across the region. For example this could include more frequent train services across the North Wales rail network, with emphasis on providing more services into the workplace destinations such as Bangor, Llandudno, Colwyn Bay and Rhyl.

Improved Bus Provision *(S64b)*

Improved bus provision through the delivery of the North Wales and North East Wales Metro which aims to create a sustainable, reliable, efficient and quality integrated transport network across the region. For example this could include improving the frequency and attractiveness of bus services along A55 corridor via more direct bus service to key destinations such as Holyhead, Bangor, Llandudno, Colwyn Bay, Mold and Chester.

Improve NMU crossings - Penmaenmawr Beach Subway *(S67a)*

Improvements to the attractiveness of the underpass connecting Station Road East to Penmaenmawr Beach including improved lighting, and removal of graffiti through the subway tunnels beneath the A55 and the adjacent railway.

Improve NMU crossings - Glan Conwy Interchange *(S67b)*

Improvements to attractiveness of existing shared use paths to include: Wider shared use paths, Tactile paviours, Review of positioning of signing to improve visibility of pedestrians, Potential for a more direct path through roundabout with some grade separation.

Improve NMU Footbridges *(S67c)*

Review footbridges for Equality Act compliance e.g. Rainbow bridge.

Close at-grade Pedestrian Crossings *(S71a)*

This option would involve closing pedestrian crossings that do not affect any Public Rights of Way, and where there is a suitable alternative route. This would affect 5 crossing points along the A55.

Close at-grade Pedestrian Crossings and Reroute Movements *(S71b)*

This option involves closing pedestrian crossings and (where necessary) removing/rerouting public rights of way and providing signs to the alternative route. This would affect 8 crossing points along the A55.

Close at-grade Pedestrian Crossings and Reroute Movements, Plus Associated Works *(S71c)*

This option involves closing pedestrian crossings and (where necessary) removing/rerouting public rights of way and providing signs to the alternative route, as well as improvements to the alternative routes. This would affect 3 crossing points along the A55, with improvements to 2 road over bridges required.

Close at-grade Pedestrian Crossings and Provide Alternative Provision *(S71d)*

Four crossing points are located where there is no alternative route nearby. This option close the pedestrian crossing point and remove/reroute public rights of way (where necessary), and construct a new footbridge for NMU movements. This would affect 4 crossing points, 2 of which are close to one another and would therefore only require an additional 3 footbridges.

2.3.4 FUTURE PROOFING

Smart Road Technology – EV Charging Points *(S9a)*

Deployment of EV charging points to power electric vehicles and future proof the network against empty battery breakdowns - also supports green technologies and reduces emissions along the corridor. This option proposes locating EV charging points at existing service stations along the route or in refuge areas if there is a long gap (greater than 20 miles) between EV charging locations.

Smart Road Technology – Solar Road *(S9b)*

Installation of a solar road via the introduction of photovoltaic panels to generate electricity for road infrastructure.

Smart Road Technology – Wireless Power Transfer *(S9c)*

Installation of a wireless, inductive charging facility for electric and hybrid vehicles as they drive along the route. This option is anticipated to require additional infrastructure adjacent to the carriageway to facilitate the distribution of power, however the lane itself will be accommodated within the existing highway boundary.

2.3.5 NETWORK INCIDENT MANAGEMENT

Smart Phone App (Roadside Incident Data Collection) ***(S1)***

Develop a simple off the shelf Dynamics 365 Smart Phone App or similar linked to the existing Dynamics CRM solution using the recently purchased Traffic Officer Smart Phones. This would be used by Traffic Officers and Maintainers to report Incidents, Asset damage and resulting Emergency Roadworks data in a structured form including images of damage to assets.

CCTV Incident Detection Software (standalone) ***(S3)***

Utilise existing published statically refreshed CCTV image by the Traffic Wales service and apply the SaturnEclipse software or similar as a service stopped vehicle detection machine learning algorithms to support quicker identification and verification of the location of stopped vehicles using existing CCTV assets.

Real-time Floating Vehicle Data - INRIX Traffic EU Website ***(S4)***

Purchase Real-time Floating Vehicle Data at 1 minute update frequency to detect and monitor the impact of incidents. This would be purchased from a data aggregator such as INRIX, Here, TomTom or Trafficmaster.

Variable Message Signs - Strategic Infill ***(S6a)***

Development of a plan and rollout of additional/relocation of existing fixed VMS at key Incident hotspots/information points providing journey time and delay information.

Mobile Variable Message Signs ***(S6b)***

Development of a plan and rollout of additional mobile VMS signs at key Incident hotspots/information points providing journey time and delay information.

CCTV ***(S7a)***

Development of a plan and rollout of additional/relocation of existing fixed CCTV Rollout locations to coincide with Incident hotspots and provide good spread of coverage across the route.

Wireless CCTV ***(S7b)***

Development of a plan and rollout of wireless CCTV. Rollout locations to coincide with Incident hotspots and provide good spread of coverage across the route.

Sidefire Radar (Queue Protection) ***(S8)***

Development of a plan and rollout of real-time Sidefire radar devices for traffic monitoring, queue detection and measuring vehicle flows by category to determine impact of incident on road users.

Connected Vehicle Corridor ***(S10)***

Rollout connected vehicle corridor infrastructure to support in vehicle information dissemination and collection using Vehicle to Infrastructure.

Integrating Bluetooth Technology *

Integrate existing Bluetooth real-time journey time monitoring into Traffic Management Centre for network monitoring

**Discarded as difficult to identify existing Bluetooth locations and cost benefit compared to Floating Vehicle Data will be significantly less*

Integrating Control Room Systems & Data *(S12)*

Development of an integrated control room system for discovering & logging incidents, recording planned events and roadworks, traffic monitoring, response plan generation and suggested dissemination messages on all information dissemination channels.

Common Location Referencing *(S13)*

Utilise a common network location referencing system to support operational identification of incidents/roadworks.

Single Traffic Officer crewing*

Single Crewing to flex the existing resources and get more Traffic Officer vehicles on the road

**Discarded as single crewing would reduce functionality as certain roles would not be undertaken by a single crew e.g. vehicle recovery.*

Performance Targets - Business Analytics Platform *(S15)*

Development of a Performance Monitoring Platform with appropriate targets set out in WG TRMM on response times and clearance times for the Control Room and on road maintenance operations such as planning and delivering work. The platform will be used to provide regular and ad hoc reporting, linking to WG IRIS, as well as supporting business case development and continuous improvement. It will also support measurement of Service Levels across the road network and allow comparisons between similar routes elsewhere.

Incident Recovery *(S16a)*

Consider single Police and NMWTRA recovery framework contract to reduce lines of communication providing more clarity on which incidents NMWTRA take the lead on. Options for improvement could include dedicated or improved supply chain arrangement to deal with incident recovery.

Free Vehicle Recovery *(S16b)*

Free vehicle recovery at incident hotspots / network wide to improve incident resolution time.

Automated VMS setting *

Automated VMS setting and System to System interfaces for provision of information by social media and detection of incidents

Proposed to be covered under Real-time Floating Vehicle Data Travel Times on VMS

Single Incident Response Team *

One team approach joining the traffic officers with the control staff and having shared training modules

**Proposed to be covered under Integrated Control Room*

Integrated Control Room *(S31)*

Propose to make the TMC Control Room the centre of all communications bringing in all organisations that would be involved in incidents (TOs, TW, Police, operational management, maintenance etc.). This would also include the development of an incorporated roadworks calendar.

Extend Traffic Officer Operation *(S36)*

Upgrade to 12 hour operation - review after a period and look to implement 24 hour operation to assist with night time works if can bring efficiencies etc.

Additional Traffic Officer Teams *(S37)*

Additional teams will provide improved incident identification and can provide support away from incidents (at diversions etc.)

Dedicated Traffic Officer Laybys *(S38)*

Construct dedicated lay by areas at strategic risk points (e.g. Rhuallt Hill)

Traffic Officer Dynamic Risk Assessment *(S40)*

Introduction of on-road lead Traffic Officer to manage incidents and better facilitate dynamic risk assessments on site rather than escalate.

Increased Emergency Crossing Provision Operation *(S46)*

Implement pre-agreed response plans and quicker verification of incident type and carriageway closures could aid decisions on when to use the existing Emergency Crossing Provision (ECP) to enhance resilience.

Britannia Bridge - High wind mitigation *(S47)*

Install permanent traffic signals at the Britannia Bridge to introduce batching operation (as there is a risk that vehicles may struggle to stay in lane as strong gusts push against them) and a bridge closure (as A55 tunnels). VMS to be used to inform drivers.

Provision of Hard shoulder (incident hotspots) *(S56d)*

Provision of new hard shoulder in the following locations:

- A55 J17 (Conwy Morfa) to J19 (Glan Conwy Interchange, excluding Conwy Tunnel)
- A55 J28 (Waen) to J36A (Broughton)
- A494 Ewloe Interchange to Queensferry river bridge

Provision of Hard shoulder (network wide) *(S56e)*

Provision of hard shoulder along full route of A55 (excluding Four Mile Bridge and Britannia Bridges, Tunnels, and where insufficient space exists due to proximity of the railway or adjacent properties).

Additional laybys *(S57)*

Provision of additional lay-bys and emergency refuge areas

Average Speed Enforcement at Rhuallt Hill (West bound) – Trial *(S85)*

Introduction of average speed enforcement on Rhuallt Hill westbound to reduce the number of excess speed related collisions in this location

Gantries on Britannia Bridge for Speed and Traffic Control *(S91)*

Introduction of gantries with VMS on the Britannia bridge to manage speeds and traffic flow during congested periods or high wind events.

Wind Deflectors for Britannia Bridge *(S92)*

Introduction of wind deflectors on the Britannia Bridge to protect vehicles during high wind events. This option with regard to cost and programme has assumed no major structural strengthening required to accommodate the deflectors.

2.3.6 NETWORK AND ASSET MANAGEMENT

Smart Phone App (Asset Management) *(S2)*

Use of Vionice RoadAI Smart Phone Asset Management system or similar by Maintainers and Traffic Officer Vehicles to record regular accurate asset condition information so issues can be easily identified without needing site visits. The data collection would occur whilst Traffic Officers were undertaking regular driving patrols using existing Smart Phones IT assets.

Innovative Maintenance Processes *(S19)*

Continual review of Welsh Government Trunk Road Maintenance Manual (WGTRMM) to include improvements in technology and bringing in industry based best practice (looking worldwide not just UK).

Preventative Maintenance *(S20)*

Preventative maintenance v reactive maintenance – proactively replace ageing asset before failure so providing planned works rather than emergency works (e.g. bridge bearings).

Offline Access Points *(S21)*

Provide off line network access points for inspection and maintenance - identify and undertake an initial assessment of ways that maintenance access could be gained to highway assets, without the need to affect lane closures and hence disrupt the network and to identify key existing challenges or anticipated challenges that will result from the change of operational regime. This also includes direct IP devices that have remote access functionality installed on them and that are configured to use remote access.

High tech Asset Monitoring *(S22)*

Use of tech e.g. drones / sensors – introduce high technical equipment which will be able to monitor asset without the need for traffic management.

Route based Maintenance *(S23)*

Review previous route based maintenance rather than by asset type – changes to strategies and planned works.

Winter Maintenance *(S24)*

Winter Maintenance Plan / Strategic winter maintenance resources - look at bringing in dedicated resources at known risk spots (e.g. purchase of high specification gritter dedicated for the Rhuallt Hill route).

Remote Access*

Remote Access - continue programme of providing remote maintenance access services to compliant roadside devices (direct IP devices that have remote access functionality installed on them and that are configured to use remote access).

*Already in place

Long term asset specification *(S26)*

Replacement with long term specification (e.g. 40 year life bitumen); Slightly more expensive upfront capital costs outweighed by lower maintenance costs and less disruption.

Concrete central reserve barriers at road traffic collision hotspots *(S59a)*

Concrete central reserve barriers at accident hot spot locations:

- A494 between Aston Rd Junction and Queensferry Interchange
- A55 in the vicinity of J32A (Halkyn)
- Rhuallt Hill between J29 (Pant ar Dulath) and the B5429
- A55 in the vicinity of J23 (Llanddulas)
- A55 East of Penmaenbach Tunnels West of Conwy Tunnel
- A55 J8 (Ael y Bowl) -J8A (Carreg Bran)

Concrete central reserve barriers along whole route of A55 *(S59b)*

Excl. Britannia Bridge, tunnels and sections with concrete barriers

Propose precast concrete central reserve barriers along full route of A55 (excluding tunnels and sections with existing concrete barriers).

Concrete central reserve barriers along A55 excluding Anglesey *(S59c)*

Excl. Britannia Bridge, tunnels and sections with concrete barriers

Propose precast concrete central reserve barriers along A55 excluding Anglesey (excluding Britannia Bridge, tunnels and sections with concrete barriers)

Cross border collaboration *(S63)*

Refresh cross border arrangements with Highways England to re-align and enhance the relationships in this area especially with cross border patrolling and VMS setting requests.

Integrated Communications*

Currently there are a number of systems for communications - look to integrate systems so minimising need for multiple faces

* *Proposed to be covered under an Integrated Control Room*

Incorporated roadworks calendar*

Coordination of maintenance and incorporated roadworks calendar - Bring roadworks into integrated centralised system available to all parts of the organisation especially TO's, Incident Manager etc. and linking to LA's, HE etc. The Welsh Government has already recognised this problem and it published its National Approach for Road and Street Works in June 2016, and continues to work with local authorities and utilities companies to promote best practice.

* Proposed to be covered under *Integrated Control Room*

Staff Responsibility *(S39)*

Empower staff sitting in Control Room to higher level of decision making before raising to Silver status (remote) - additional training, competencies required.

Implement new technology*

Review existing systems and implement new technology (e.g. Floating Vehicle Data - real-time heat map and is speed information from GPS probes in vehicles hence doesn't rely on roadside infrastructure, which is benefit in areas with faulty / sparse / decommissioned equipment. Can also be used for real-time travel time on VMS information and to feed into Incident Detection systems.)

*Proposed to be covered under *Integrated Real-time Floating Vehicle Data, and Control Room Systems and Data*

Service Monitoring *(S43)*

Data analysis - additional staff required so that robust analysis can be carried out of all data to support improvements to the maintenance regimes and strategies to reflect metrics in WGTRMM

Programme of Funding *(S44)*

Early release of funding allows long term planning and therefore reducing impact on network (e.g. surfacing all year rather than in later months).

Rhuallt Hill*

Rhuallt Hill - breakdowns / winter maintenance issues

*Proposed to be covered under *Winter Maintenance*

Update to DBFO Contract *(S89)*

Update to the DBFO contract to implement night time working for cyclic and major maintenance as per WGTRMM.

2.3.7 NETWORK DEMAND AND CAPACITY

Centralised UTMC *

Centralise UTMC so all signals etc. managed and operated as a single entity through the Control Room.

* *Proposed to be covered under an integrated control room*

Operational regime*

Operational regimes to improve traffic flow through applying network restrictions e.g. Mandatory speeds/average speeds, and potential change to route status including limiting HGV overtaking.

* *Proposed to be covered under Expressways*

Maximum or minimum speeds *

Implementation of maximum or minimum speeds in key locations along the corridor.

* *Proposed to be covered under Expressways*

Ramp Metering *(S55)*

Introduction of ramp metering on key congestion hotspots to regulate the traffic onto the mainline carriageway along the corridor.

Third Lane and Hard Shoulder A55 J35 (Dobshill) – J36a (Broughton) *(S56a)*

Provision of third lane & hard shoulder between A55 J35 (Dobshill) -J36A (Broughton) in both directions to ease congestion.

Third Lane Expressway (congestion hotspots) *(S56b)*

Provision of a third lane expressway to be provided on the following stretches of carriageway

- → A55 J21 (Colwyn Bay) - J24 (Abergele)
- → A55 J28 (Waen) -J36A (Broughton)
- → A494 – From A55 J34 (Ewloe) to A494 (Queensferry river bridge)

Third Lane Expressway (network wide) *(S56c)*

Provision of third lane expressway along full route of A55 (excluding Four Mile Bridge and Britannia Bridges, Tunnels, and where insufficient space exists due to proximity of the railway or adjacent properties).

Two Lane Expressway (congestion hotspots) ***(S56f)***

Convert existing carriageway to expressway in the following locations:

- A55 J15 (Llanfairfechan) to J24 (Abergele) - excluding/co-ordinating with the tunnels
- A55 J32 (Springfield) to J36A (Broughton)
- A494 – From A55 J34 (Ewloe) to A494 (Queensferry river bridge)

Existing areas of hard shoulder to be converted to third lane expressway

Two Lane Expressway (network wide) ***(S56g)***

Convert existing carriageway to expressway along full route of A55 (excluding Four Mile Bridge and Britannia Bridges, Tunnels, and where insufficient space exists due to proximity of the railway or adjacent properties). Existing hard shoulder areas to be converted to third lane expressway.

Expressways (Eastern/Deeside hotspots) ***(S56h)***

Upgrading of the section in both directions to align with the All Lane Running smart motorways concept to include the following sections:

- A55 J32 (Springfield) to J36A (Broughton)
- A494 – From A55 J34 (Ewloe) to A494 (Queensferry river bridge)

Existing areas of hard shoulder to be converted to third lane expressway. Option includes:

- Concrete Central Barrier
- Provision of lay-bys / emergency refuge areas
- Above ground traffic detection
- Variable message signs between each junction
- Lane signals with variable mandatory speed limits (VMSL)
- CCTV, where gaps presently exist

Enforced Peak Hour Reduced Speed ***(S56i)***

Reduction of speeds for peak traffic flow periods with average speed enforcement. In this scenario average speed cameras would implemented with one set per junction to junction link, unless the link is under approximately 1 km, in which case a common sense judgement would be made, as to the next appropriate location.

Software is needed to adapt the average speed enforcement to the appropriate speed limit being set at the reduced times, i.e. for 50 mph for between 07:00 to 09:00 and 16:00 to 19:00; and then for 70 mph at all other times.

Improve non-standard junctions ***(S58)***

Standardise / improve non-standard sections at the following locations:

- A55 J16A (Dwygyfylchi) - Improve WB Off/On slips
- A55 J19 (Glan Conwy Interchange) – Improve A55/A470 circulatory
- A55 J28 (Waen) - Improve slips
- A55 J29 (Pant ar Dulath) - Improve EB Off/On slips
- A55 J30 (Travellers Inn) – Improve W/B off/on slips
- A55 J32A (Halkyn) – Improve junction
- A55 between J32B (Pentre Halkyn) & J33 (Northop) – Improve WB off-slip
- A55 J33A (Connahs Quay) – Improve WB junction
- A55 J36A (Broughton) - Consider 190m auxiliary lane for EB merge

Integrated Network Management ***(S62)***

Integrated network management by aligning the operation of Trunk Road with the local council roads to improve the customer experience and prevent queuing on either routes. The Welsh Government has already recognised this problem and it published its National Approach for Road and Street Works in June 2016, and continues to work with local authorities and utilities companies to promote best practice.

Performance Analysis *(S65)*

In-depth performance analysis of current network such as origin destination surveys & whole-route traffic modelling to forecast future issues.

Britannia Bridge Tidal Flow *

Provision of third lane to implement tidal flow system over the Britannia Bridge

* *Discarded as previous studies had illustrated that this option was not feasible due to safety*

Reduce number of junctions *(S69)*

Reduce the number of junctions and other entry/exit points, such as closing private route of access. An analysis of the network has identified the following junctions for potential full or partial closure:

- A55 J7A (Cefn Du) – Close
- A55 J8A (Carreg Bran) - Close
- A55 J24A (Abergele) – Close WB off slip
- A55 between J25 (Bodelwyddan) & J26 (St Asaph business park) – close WB off slip
- A55 J27A (St Asaph) - Close WB slip roads
- A55 between J29 (Pant ar Dulath) and J30 (Travellers Inn), Close WB slip roads
- A55 J30 (Travellers Inn) – Close EB slip roads
- A55 J32A (Halkyn) – Close WB slip roads
- A55 between J32B (Pentre Halkyn) & J33 (Northop) – Close EB slip roads
- A55 J33A (Connahs Quay) - Close EB Off/On, Close WB on slip

Vehicle Restrictions *

Implement restrictions on slow vehicles (e.g. agricultural vehicles)

* *Proposed under Operational Regime*

Limit HGV overtaking on uphill gradients *(S72)*

HGV overtaking ban on uphill gradients

Increased Speed Limits *(S82)*

Consider removal of existing 50mph speed limit around Colwyn Bay

Vehicle Restrictions *(S84)*

Prohibit the use of the A55 to certain vehicle types such as tractors to reduce the impact of slow moving vehicles.

3 TRANSPORT CASE

3.1 METHODOLOGY

The approach to the Stage 1 level of appraisal is intended to screen and test the options against the objectives and the three WelTAG areas to ensure that proposals address the problems identified. The three WelTAG areas are:

- Economy
- Environment
- Society

The Stage 1 appraisal aims to:

"…understand the issue of concern, explore its context and to present a wide list of possible solutions, with sufficient clarity and depth for the review group to be able to decide whether there are any possible solutions within the transport sector that are worth pursuing and to select a short list of options for more detailed consideration".

3.2 APPRAISAL CRITERIA

The appraisal has been summarised using Appraisal Summary Tables (AST), for comparison of their performances against the appraisal criteria. The best performing options can then be identified and recommended for further development or implementation.

ASTs extract the core economic, environmental and social impacts from each transport proposal, under the respective appraisal criteria. As well as assessing how well a proposal performs against the objectives and WelTAG areas presented in Table 3-1.

Table 3-1: WelTAG Appraisal Criteria

Economic Impacts	Environmental Impacts	Social and Cultural Impacts
Journey time changes	Noise	Accidents
Journey time reliability	Air Quality	Journey Quality
Land	Landscape and Townscape	Severance
Local Economy	Historic Environment	Security
Value for Money	Biodiversity	
	Water Environment	

3.3 OPTION APPRAISAL

Each of the option appraisals are summarised below by theme. A summary of the option appraisal has been included at the end of this section.

3.3.1 COMMUNICATION

Communication Manager (S28)

This option has a neutral impact on all appraisal areas with the exception of security, where a slight benefit is anticipated as a result of improved conveyance of information to road users.

VMS Templates and Campaign Messages (S6c)

This option has a neutral impact across all of the appraisal areas.

Real-time Floating Vehicle Data - Travel Times API (S5)

This option has a neutral impact on all appraisal areas, with the exception of a slight benefit to journey quality occurring as a result of improved provision of information to road users.

Road Timetable - Real-time Floating Vehicle Data (S83)

This option has slight beneficial economic impacts due to increased journey time reliability and a reduction in the loss of productive time, slight beneficial social & cultural impacts due to an increase in journey quality (reduced driver stress), and a neutral environmental impact. Due to the low costs the scheme has a very good BCR value.

Driver Behavioural Change Campaign (S86)

This option is anticipated to have neutral impact across all of the appraisal areas.

3.3.2 DIVERSION ROUTES

Diversion Route Operation Procedures (S73)

This option has neutral benefits for all economic, environmental, and social & cultural impacts.

Strategic Diversion Routes Symbol Signage (S74)

This options has neutral benefits for all economic and environmental impacts, but slightly beneficial social & cultural impacts due to an expected improvement in journey quality (reduced driver stress)

Tactical Diversion Routes Symbol Signage (S75)

This options has neutral benefits for all economic and environmental impacts, but slightly beneficial social & cultural impacts due to an expected improvement in journey quality (reduced driver stress)

Diversion Route Operation Procedures – Traffic Management Plans (S76)

This option has neutral benefits for all economic, environmental, and social & cultural impacts.

Provide wireless electronic driver information signs on Strategic Diversion Routes (S77)

This option has neutral benefits for all economic and social & cultural impacts. There are negative impacts to landscape and biodiversity.

Provide wireless CCTV on Strategic Diversion Routes (S78)

This option has neutral benefits for all economic and social & cultural impacts. There are negative impacts to landscape, biodiversity, and the historic environment.

A470 Llanrwst Bypass (S79a)
Strategic Diversion Route 18 & Strategic Diversion Route 19

This option has a large adverse benefit upon the economy due to the large amount of land acquisition required. A slight to moderate adverse benefit on all environmental impacts locally to the scheme is expected due to the location and scale of construction required. There is a neutral social and cultural impact on the A55 but there would be local benefits to severance, accidents, air quality and noise.

A470 - Road Widening to the South of Waterloo Bridge, near Betws y Coed (S79b)
Strategic Diversion Route 17

This option has a slight adverse impact on the economy due to the additional land requisition required, moderate adverse impacts upon the environment due to impacts on landscape (within Snowdonia National Park) and biodiversity (within Fairy Glenn Wood SSSI), and a neutral social & cultural impact.

A494 – Road widening and change A494/Corwen Road junction priority (south of Ruthin)
Strategic Diversion Route 19 (S79c)

This option has a neutral impact on the Social and Cultural and Environment appraisal areas. There is a slight adverse impact on the economy due to additional land requisition required. There is a slight adverse impact to the landscape and biodiversity.

A494/A5104 junction remodelling to give priority to the A494 (S79d)
Strategic Diversion Route 19

This option has a neutral impact across all of the appraisal areas except environment. There is a slight adverse impact to the landscape and biodiversity.

A5/A470 Urban Areas – Additional on-street parking restrictions (S79e)
Strategic Diversion Route 17 and Strategic Diversion Route 18

This option has a neutral impact across all of the appraisal areas.

Increase VMS signage (fixed or mobile) along the A55 & A494 between each junction (S80)

This option has a neutral impact across all of the appraisal areas except environment. There is a slight adverse impact to the landscape and biodiversity.

Improved Maintenance Planning (S81)

This option has a neutral impact both upon the environment and the economy, but slightly beneficial social & cultural impacts due to an expected reduction in accidents and increase in journey quality (reduced driver stress).

New Penmaenbach Tunnel (S87)

This scheme is expected to provide slight benefits in terms of journey time, journey quality, and the local economy. It is also anticipated to benefit journey time reliability by providing additional network resilience. This option is expected to have a number of adverse impacts in environmental terms. The construction phase is anticipated to have a significant noise impact due to the close proximity of caravan sites and residential dwellings in the area. Tunneling is expected to generate dust, causing a slight adverse impact on air quality. The impact on landscape and townscape is anticipated to be moderate adverse during the construction phase.

This option has considerable risk due to its complex deliverability.

New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – Upgrade Roman Road (S88a)

This option has a moderate adverse land impact due to the additional land required for the new route. Adverse Noise and Air Quality impacts are anticipated to occur during the construction phase, with adverse impacts to occur to the water environment, surrounding biodiversity, and the historic environment.

New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – New Parallel Route (S88b)

This option has a moderate adverse land impact due to the additional land required for the new route. Adverse Noise and Air Quality impacts are anticipated to occur during the construction phase, with significant adverse impacts also predicted to occur on the water environment, surrounding biodiversity, and the historic environment due to the permanent land take required.

Penmaenbach Eastbound Marine Embankment – 120kph Design Speed (S90)

This scheme has slight benefits in terms of journey time, journey quality, and the local economy. It is also anticipated to benefit journey time reliability by providing additional network resilience. The scheme has a moderate adverse impact in terms of land, as it will necessitate acquisition of coastline located within a European Special area of Conservation and a Site of Special Scientific Interest. This option is expected to have a number of adverse impacts in environmental terms. The construction phase is anticipated to have a significant noise impact due to the close proximity of caravan sites and residential dwellings. The impact on the landscape is anticipated to be moderate adverse during the construction phase as the scheme is within the Snowdonia National Park Boundary. The scheme has a large adverse impact on biodiversity as it is located adjacent to the Menai Strait SAC. A moderate adverse impact on the water environment is also expected.

3.3.3 SUSTAINABLE TRAVEL

Improved Rail Provision (S64a)

This option has a slight beneficial impact on the economy as a result of its potential to improve connectivity for households which do not own a vehicle, however additional land will be required for the expansion of existing car park facilities. A slight social and cultural benefit is expected as the quality of journeys is improved. This option has been identified to have a negative impact land.

Improved Bus Provision (S64b)

This option has a slight beneficial impact on the economy as a result of its potential to improve connectivity for households which do not own a vehicle. A slight social and cultural benefit is expected as the quality of journeys is improved. However, a slight adverse impact on the townscape and biodiversity is anticipated as a result of any structural improvements.

Improve NMU crossings - Penmaenmawr Beach Subway (S67a)

This option has a slight social and cultural impact as pedestrian journeys via the underpass become more attractive. This option is not expected to elicit any notable benefits in economic terms, and environmental benefits are expected to be minimal overall.

Key risk is that there would be increased community severance during upgrade/construction of new crossing.

Improve NMU crossings - Glan Conwy Interchange (S67b)

This option has a slight social and cultural impact, as pedestrian journeys within the vicinity of Glan Conwy Junction are made to be safer, more convenient, and therefore more appealing. This option is not expected to have any notable economic or lasting environmental impacts.

Key risk is that there would be increased community severance during upgrade/construction of new crossing.

Improve NMU Footbridges (S67c)

This option has a slight social and cultural impact as a result of the provision of disabled access, however the replacement of the bridge has the potential for a slight adverse impact on landscape and biodiversity if vegetation clearance is necessitated. This option is not anticipated to produce any notable economic impacts.

Key risk is that there would be increased community severance during upgrade/construction of new crossing.

Close at-grade Pedestrian Crossings (S71a)

This option has a neutral impact across all of the appraisal areas.

Key risk is that there would negative publicity if alternatives not proposed.

Close at-grade Pedestrian Crossings and Reroute Movements (S71b)

This option has a neutral impact across all of the appraisal areas, with the exception of severance, where the closure and rerouting of crossings is anticipated to length some pedestrian journeys.

Close at-grade Pedestrian Crossings and Reroute Movements, Plus Associated Works (S71c)

This option has a neutral impact across all of the appraisal areas, with the exception of social and cultural, where the proposed improvements to alternative routes are anticipated to encourage further usage, and improve the sense of security among pedestrians as a result of improved signage and footways, resulting in slight benefits to severance, journey quality and accidents.

Key risk is that there would be increased community severance during upgrade/construction of new crossing.

Close at-grade Pedestrian Crossings and Provide Alternative Provision (S71d)

This option has a neutral economic impact. A slight adverse environmental impact is anticipated on the landscape and biodiversity. A moderate beneficial social and cultural impact is expected as the proposed alternative routes are anticipated to encourage further usage, and improve the sense of security among pedestrians as a result of improvements to signage and lighting. A moderate benefit to severance is expected as this option replaces four inadequate at-grade crossings.

Key risk is that there would be increased community severance during upgrade/construction of new crossing.

3.3.4 FUTURE PROOFING

Smart Road Technology - EV Charging Points (S9a)

This option has a slight benefit to journey time reliability, the local economy and journey quality as a result of a reduction in breakdown-related incidents, and improved future proofing for electric vehicles. The environmental impact is expected to be neutral.

No open standardised charging provider therefore as standards develop charging points may need updating.

Smart Road Technology – Solar Road (S9b)

This option has a large benefit to the local economy through the provision of renewable energy which could be used to provide power for streetlights, highway assets, homes and local businesses. This would have the potential to open up future employment and development within the region, and promote North Wales as a pioneer of state of the art smart road technology. The environmental impact is expected to be neutral.

Key risk is that this is untested technology in the UK road environment.

Smart Road Technology – Wireless Power Transfer (S9c)

This scheme is expected to have large benefit to the local economy through reduced travel costs, allowing vehicles to travel further, and aligning the A55 with modern standards. This option also has a slight benefit to journey time reliability and journey quality as a result of a reduction in breakdown-related incidents. This option has a slight beneficial impact in terms of air quality as it is anticipated that more road users may be encouraged to switch to electric cars. However, a slight adverse impact is expected on both landscape/townscape, and biodiversity as a result of the land required for ancillary infrastructure.

Key risk is that this is untested technology in the UK road environment.

3.3.5 NETWORK INCIDENT MANAGEMENT

Smart Phone App (Roadside Incident Data Collection) (S1)

This option has a neutral impact across all of the appraisal areas with the exception of journey time reliability, where a slight benefit will occur as a result of improved dissemination of information.

CCTV Incident Detection Software (standalone) (S3)

This option has a slight beneficial impact on the economy and a slight social and cultural benefit as journey time reliability and journey quality are expected to improve as a result of a reduction in incident related disruption. This option will not have any environmental impact.

Key risk is that the software flags a number of false positives which reduces the confidence in the benefits of the system

Real-time Floating Vehicle Data - INRIX Traffic EU Website (S4)

This option has a slight benefit to the economy as journey time reliability is expected to improve due to quicker clearance of incidents. This option will not have any environmental or social and cultural impact.

Variable Message Signs – Strategic Infill (S6a)

This option has a neutral impact on all appraisal areas, with the exception of a slight benefit to journey quality occurring as a result of improved provision of information to road users. There will be a slight adverse impact on the landscape due to the temporary use of plant machinery.

Moblie Variable Message Signs (S6b)

This option has a neutral impact on all appraisal areas, with the exception of a slight benefit to journey quality occurring as a result of improved provision of information to road users.

Key risk is that the reduced sign size could limit information quality and reach (dual language).

CCTV (S7a)

This option has a slight benefit to journey time reliability, the local economy, and security as a result of improved incident detection and response times. There will be a slight adverse impact on the landscape due to the temporary use of plant machinery.

Wireless CCTV (S7b)

This option has a slight benefit to journey time reliability, the local economy, and security as a result of improved incident detection and response times. There will be a slight adverse impact on the landscape due to the temporary use of plant machinery.

Sidefire Radar (Queue Protection) (S8)

This option has a slight benefit to journey time reliability, the local economy and journey quality as a result of quicker incident detection and response times. The environmental impact is expected to be neutral.

Connected Vehicle Corridor (S10)

This option has a neutral impact across all of the appraisal areas with the exception of journey time reliability and the local economy, where a slight benefit is expected as a result of improved incident detection, which will minimise unproductive time.

Integrating Control Room Systems & Data (S12)

This option has a neutral impact across all of the appraisal areas with the exception of a slight benefit to journey time reliability and the local economy as a result of a reduction in the margin for error during incident management.

Common Location Referencing (S13)

This option has a neutral impact across all of the appraisal areas, with the exception of a slight benefit to journey quality as a result of a reduction in errors which exacerbate delay during incident response.

Performance Targets - Business Analytics Platform (S15)

This option has slight journey time reliability benefits as a result of improved incident response times, and therefore has a slight economic benefit.

Incident Recovery (S16a)

This option has a slight beneficial economic impact as a result of journey time reliability benefits through improved incident response times. Quicker clearance of incidents is expected to result in improved perception of journey quality.

Free Vehicle Recovery (S16b)

This option has a slight beneficial economic impact as a result of journey time reliability benefits through improved incident response times. Quicker clearance of incidents is expected to result in improved perception of journey quality.

Integrated Control Room (S31)

This option has a neutral impact on all appraisal areas with the exception of the economy, where improved coordination could result in improved response times, thus resulting in a slight benefit to journey time reliability and the local economy.

Extend Traffic Officer Operation (S36)

This option has a neutral impact on all appraisal areas with the exception of security, as the upgrade to 24 hour TO operation is expected to make travellers feel more secure. Other benefits will be marginal as it is focused on operations during off-peak travel where there are fewer road users.

Additional Traffic Officer Teams (S37)

This option has a slight beneficial impact upon journey time reliability and the local economy as a result of improved response times. Additionally, this scheme is expected to make travellers feel more secure and will have a slight beneficial impact on journey quality. No environmental impact is expected.

Dedicated Traffic Officer Laybys (S38)

This option has a slight beneficial impact on journey time reliability and the local economy as a result of improved response times. Additionally, this scheme is expected to make travellers feel more secure and will have a slight beneficial impact on journey quality. It is anticipated that there would be a slight negative impact on noise during construction as some of the additional laybys are located within or near NAPPAs. There is also potential for impact on Biodiversity in the case that vegetation removal is required.

Traffic Officer Dynamic Risk Assessment (S40)

This option has a neutral impact across all areas for the exception of benefits to journey time reliability as a result of quicker decision making during incidents. Significant Value for Money expected due to the low implementation cost.

Increased Emergency Crossing Provision Operation (S46)

This option has a neutral impact across all areas for the exception of benefits to journey time reliability, the number of accidents and journey quality as a result of quicker incident clearance times.

Britannia Bridge - High wind mitigation (S47)

This option has a neutral impact across all areas for the exception of a disbenefit to the historic landscape as the option directly affects a Grade II listed structure. A poor BCR is expected due to expected delays caused to private cars during extreme weather conditions. Some negative implications are expected in relation to the landscape and the historic environment as a result of additional proposed signage and signalisation.

Provision of Hard shoulder (incident hotspots) (S56d)

This option has slight benefits to both the economy and social & cultural areas as a result of minimising delays during incidents. The extension of the carriageway is expected to have an adverse impact upon severance. There are also some negative impacts on the landscape, historic environment, and biodiversity.

Provision of Hard shoulder (network wide) (S56e)

This option has a large benefit to journey time reliability, journey quality and accidents as a result of minimising delays during incidents. The extension of the carriageway is expected to have an adverse impact upon severance. There are also some negative impacts on the landscape, historic environment, and biodiversity.

Additional laybys (S57)

This option has a neutral impact across all of the appraisal areas with the exception of the landscape, historic environment, and biodiversity which have a slight adverse as a result of increased emissions closer to residential properties.

Average Speed Enforcement at Rhuallt Hill (West bound) – Trial (S85)

This scheme is anticipated to reduce the number of incidents caused by speeding, and therefore improve journey time reliability. Landscape and Townscape has a slight adverse impact as a result of the installation of gantry signage along the section of route affected.

Gantries on Britannia Bridge for Speed and Traffic Control (S91)

This option has slight beneficial impacts in terms of journey time reliability and the local economy as a result of improved network resilience. A slight beneficial impact on journey quality is also expected as a result of a reduction in driver stress. This option has moderate adverse impacts in environmental terms both on Landscape and the Historical Environment, as the bridge is adjacent to an AONB, and is a Grade II listed structure.

Wind Deflectors for Britannia Bridge (S92)

This option has slight beneficial impacts in terms of journey time reliability as a result of improved network resilience. Moderate adverse impacts on landscape and the historic environment are expected as the bridge is a grade II listed structure and is adjacent to an AONB. The Social & Cultural impact is expected to be neutral.

3.3.6 NETWORK AND ASSET MANAGEMENT

Smart Phone App (Asset Management) (S2)

This option has a slight benefit to the economy and a slight social and cultural benefit, as journey time reliability and journey quality are expected to improve as a result of a reduction in unplanned and emergency maintenance. A neutral environmental impact is expected.

Key risk to this option is that not all maintenance issues are identified so therefore some site visits are still required.

Innovative Maintenance Processes (S19)

This option has a neutral impact across all of the appraisal areas with the exception of accidents, which are expected to reduce as a result of quicker identification of risks through continual improvements in technology, detection systems, and communication.

Preventative Maintenance (S20)

This option has a neutral environmental impact but a moderate beneficial impact on the economic and social and cultural aspects. Journey time reliability and journey quality will experience moderate benefits as a result of proactively maintaining the A55 and A494, as it becomes possible to plan convenient timings for maintenance rather than requiring emergency works. A slight benefit for the local economy and a slight reduction in accidents is expected.

Offline Access Points (S21)

This option has a neutral environmental impact, but slight beneficial impacts on the economic and social and cultural aspects. By reducing the need to implement traffic management, it is anticipated that this scheme would result in a slight benefit for journey time reliability, the local economy, accidents, and journey quality.

Deliverability is the key risk as there is limited space for offline access points.

High tech Asset Monitoring (S22)

This option has a slight beneficial impact on journey time reliability, the local economy, accidents, and journey quality as a result of the reduced need to implement traffic management. This option has a neutral impact on the environment.

Key risk that this approach does not allow for the full set of inspection tests to be undertaken resulting in some site visits still being required.

Route based Maintenance (S23)

This option has a slight benefit for journey time reliability, the local economy, accidents, and journey quality, as a result of the reduced need to implement traffic management. This option has a neutral impact on the environment.

Winter Maintenance (S24)

This option has a slight benefit for journey time reliability, accidents, and journey quality, as a result of the potential to minimise disruption during winter weather events. This option has a neutral impact on the environment.

Long term asset specification (S26)

This option has a neutral impact on the environment, but has slight benefits for journey time reliability, the local economy, accidents, and journey quality, as a result of the reduced frequency and duration of maintenance. Due to the low scheme cost, this option is anticipated to be good value for money.

Concrete central reserve barriers at road traffic collision hotspots (S59a)

This option has a slight beneficial impact on the economy as a result of the minimisation in disruption arising from accidents. A slight adverse impact upon air quality is anticipated during the construction phase. This scheme is likely to result in a slight adverse impact to the landscape.
Key risk is that existing civil and technology assets in the central reserve may need to be moved/re-designed.

Concrete central reserve barriers along whole route of A55 (S59b)
Excl. Britannia Bridge, tunnels and sections with concrete barriers

This option has a slight beneficial impact on the economy as a result of the minimisation in disruption arising from accidents. A slight adverse impact upon the landscape is anticipated during the construction phase.

Key risk is that existing civil and technology assets in the central reserve may need to be moved/re-designed.

Concrete central reserve barriers along A55 excluding Anglesey (S59c)
Excl. Britannia Bridge, tunnels and sections with concrete barriers

This option has a slight beneficial impact on the economy as a result of the minimisation in disruption arising from accidents. A slight adverse impact upon the landscape is anticipated during the construction phase.

Key risk is that existing civil and technology assets in the central reserve may need to be moved/re-designed.

Cross border collaboration (S63)

This option has a neutral impact across all of the appraisal areas.

Staff Responsibility (S39)

This option has a neutral impact across all areas for the exception of benefits to journey time reliability as a result of quicker decision making during incidents. Significant BCR expected due to the low implementation cost.

Service Monitoring (S43)

This option has a neutral impact across all of the appraisal areas.

Programme of Funding (S44)

This option has a neutral impact across all areas for the exception of benefits to journey time reliability, the local economy and journey quality as a result of less delays expected on the network due to maintenance.

Update to DBFO Contract (S89)

This scheme is anticipated to result in slight benefits to journey time reliability, the local economy, and journey quality. The option has a neutral environmental impact.

3.3.7 NETWORK DEMAND AND CAPACITY

Ramp Metering (S55)

This option has a neutral impact across the environment and social & cultural areas. Slight benefits within the economy as a result of reducing congestion and improving journey times and reliability. High BCR expected as a result of targeting key congestion hotspots with limited cost.

This option will require buy-in from partnering authorities as can impact local road network.

Third Lane and Hard Shoulder A55 J35 (Dobshill) - J36A (Broughton) (S56a)

This scheme is beneficial to both the economy and social & cultural areas. Moderate benefits expected to the local economy by improving connectivity within North Wales. A slight adverse impact is expected on air quality, and a moderate adverse impact is anticipated on noise, landscape, and biodiversity. A good BCR is expected due to improvements in journey times.

Third Lane Expressway (congestion hotspots) (S56b)

A slight adverse impact is expected on air quality, and a moderate adverse impact is anticipated on noise, landscape, and biodiversity. There are also some negative impacts to the historic environment. Moderate benefits to the economy due to improvements in journey times and journey time reliability and the resultant impact upon the local economy.

Third Lane Expressway (network wide) (S56c)

A slight adverse impact is expected on air quality, and a moderate adverse impact is anticipated on noise, landscape, and biodiversity. There are also some negative impacts to the historic environment. Moderate benefits to the economy due to improvements in journey times with a large benefit to journey time reliability and the resultant impact upon the local economy. Low BCR expected due to the significant implementation cost of this option.

Two Lane Expressway (congestion hotspots) (S56f)

This option has a moderate benefit upon the local economy as a result in improved capacity. The extension of the carriageway is expected to have a significant adverse impact upon severance. High BCR due to targeting congestion hotspots with relatively low scheme costs. There are also some negative impacts on the landscape, historic environment, and biodiversity.

Two Lane Expressway (network wide) (S56g)

This option has a large beneficial impact upon the local economy as a result in improved capacity. The extension of the carriageway is expected to have a significant adverse impact upon severance. High BCR due to targeting congestion hotspots with relatively low scheme costs. A slight adverse impact is expected on air quality and the historic environment; and a moderate adverse impact is anticipated on noise, landscape, and biodiversity.

Expressways (Eastern/Deeside hotspots) (S56h)

This option has a moderate beneficial impact upon social and cultural due to the reduced level of delay and resultant accidents. Slight beneficial impact upon the economy as a result in reduced congestion. This option however has a slight adverse impact on the environment due to the impact upon the local setting and biodiversity.

Enforced Peak Hour Reduced Speed (S56i)

This option has a slight beneficial impact upon the economy and social & cultural due to the reduced level of delay and resultant accidents. This option however has a slight adverse impact on the environment due to the impact upon the local setting and biodiversity.

Improve non-standard junctions (S58)

This option has is beneficial to both the economy and social & cultural areas. Slight benefits to the economy as a result of removing slower vehicles who leave or enter the carriageway. Moderate benefits to accidents due to the removal of additional vehicle conflict. There is anticipated to be a slight adverse impact to the landscape, historic environment, and biodiversity.

Integrated Network Management (S62)

This option has a neutral impact across all appraisal areas with the exception of the economy, where a slight benefit to journey time reliability and the local economy is anticipated as a result of a reduction in delay.

Performance Analysis (S65)

This option has a neutral impact across all of the appraisal areas.

Reduce number of junctions (S69)

This option has an impact upon the economy, as the closure of minor junctions and other access points is expected to improve journey times, journey time reliability and the local economy through the minimisation of disruption to free flowing traffic. A slight social and cultural impact is anticipated, as the removal of junctions is expected to result in a reduction of road accidents, improving both road user safety and journey quality. A slight benefit is anticipated to the environment in terms of the landscape and biodiversity.

This option may not be publically acceptable.

Limit HGV overtaking on uphill gradients (S72)

This option has neutral benefits for all economic and environmental impacts, but slightly beneficial social & cultural impacts due to an expected reduction in accidents and increase in journey quality (reduced driver stress),although there will be an impact to HGV traffic.

Key risk is that stakeholders are vocal in their disapproval of the scheme.

Increased Speed Limits (S82)

This option has both slightly beneficial and adverse impacts on the economy due to a reduction in journey times (slight beneficial) but an increased risk of accidents (slight adverse). The option would have a moderate adverse benefit to social & cultural impacts due to the increased risk of accidents, and a neutral environmental impact. There is a slight adverse environmental impact in terms of noise and air quality. Due to the low cost the scheme has a good BCR value.

Vehicle Restrictions (S84)

By rerouting restricted vehicles onto less desirable routes, it is anticipated that there will be a slight adverse impact on the local economy. The scheme has a slight adverse impact on noise and air quality for the same reason.

Key risk is that this option would be difficult to enforce.

3.4 SUMMARY

A summary of the option appraisal has been included overleaf.

Area	ID	Scheme Option Description	Scheme Implementation Time	Scheme Life	Economy						Environmental						Social and Cultural				VfM	Objectives												
					Journey time changes	Journey time reliability changes	Cost Estimate	Capital/Revenue	Land	Local economy	Noise	Air Quality	Landscape and Townscape	Historic Environment	Biodiversity	Water Environment	Accidents	Severance	Journey Quality	Security	Benefit to Cost Ratio	Objective 1	Objective 2	Objective 3	Objective 4	Objective 5	Objective 6	Objective 7	Objective 8	Objective 9	Objective 10	Objective 11	Objective 12	Objective 13
Communi-cation	S28	Communication Manager	QUICK	60 Years	0	0	£4,475,000	REV	0	0	0	0	0	0	0	0	0	0	1	1	-	Y				Y								
	S6c	VMS Templates and Campaign Messages	QUICK	15 Years	0	0	£48,500	CAP	0	0	0	0	0	0	0	0	0	0	0	0	0-1	Y				Y	Y							
	S5	Real-time Floating Vehicle Data - Travel Times API	QUICK	15 Years	0	0	£400,000	REV	0	0	0	0	0	0	0	0	0	0	1	0	0-1	Y												
	S83	Road Timetable - Real-time Floating Vehicle Data	QUICK	15 Years	0	1	£350,000	REV	0	1	0	0	0	0	0	0	0	0	1	0	10-50	Y				Y								
	S86	Driver Behavioural Change Campaign	LONG	60 Years	0	0	Low	CAP	0	0	0	0	0	0	0	0	0	0	0	0	0-1	Y					Y	Y						
Diversion Routes	S73	Diversion Route Operation Procedures	QUICK	60 Years	0	0	£40,000	CAP	0	0	0	0	0	0	0	0	0	0	0	0	-	Y								Y	Y			
	S74	Strategic Diversion Routes Symbol Signage	QUICK	60 Years	0	0	£55,000	CAP	0	0	0	0	0	0	0	0	0	0	1	0	0-1	Y								Y				
	S75	Tactical Diversion Routes Symbol Signage	QUICK	60 Years	0	0	£190,000	CAP	0	0	0	0	0	0	0	0	0	0	1	0	0-1	Y								Y				
	S76	Diversion Route Operation Procedures – Traffic Management Plans	QUICK	60 Years	0	0	£10,000	CAP	0	0	0	0	0	0	0	0	0	0	0	0	-	Y							Y		Y			
	S77	Provide wireless electronic driver information signs on Strategic Diversion Routes	QUICK	15 Years	0	0	£513,600	CAP	0	0	0	0	-1	0	-1	0	0	0	0	0	0-1	Y								Y				Y
	S78	Provide wireless CCTV on Strategic Diversion Routes	SHORT	15 Years	0	0	£117,700	CAP	0	0	0	0	-1	-1	-1	0	0	0	0	0	0-1	Y								Y				Y
	S79a	A470 Llanrwst Bypass Strategic Diversion Route 18 & Strategic Diversion Route 19	LONG	60 Years	0	0	Medium	CAP	-3	0	-1	-1	-2	-2	-2	-2	0	0	0	0	0-1									Y				
	S79b	A470 - Road Widening to the South of Waterloo Bridge, near Betws y Coed Strategic Diversion Route 17	LONG	60 Years	0	0	Low	CAP	-1	0	0	0	-2	0	-2	0	0	0	0	0	0-1									Y				
	S79c	A494 – Road widening and change A494/Corwen Road junction priority (south of Ruthin) Strategic Diversion Route 19	LONG	60 Years	0	0	Low	CAP	-1	0	0	0	-1	0	-1	0	0	0	0	0	0-1									Y				
	S79d	A494/A5104 junction remodelling to give priority to the A494 Strategic Diversion Route 19	LONG	60 Years	0	0	Low	CAP	0	0	0	0	-1	0	-1	0	0	0	0	0	0-1									Y				
	S79e	A5/A470 Urban Areas – Additional on-street parking restrictions Strategic Diversion Route 17 and Strategic Diversion Route 18	SHORT	60 Years	0	0	£10,000	CAP	0	0	0	0	0	0	0	0	0	0	0	0	0-1									Y				
	S80	Increase VMS signage (fixed or mobile) along the A55 & A494 between each junction	SHORT	15 Years	0	0	£19,260,000	CAP	0	0	0	0	-1	0	-1	0	0	0	0	0	0-1	Y								Y				Y
	S81	Improved Maintenance Planning	QUICK	15 Years	0	0	-	-	0	0	0	0	0	0	0	0	0	0	1	0	-		Y							Y				
	S87	New Penmaenbach Tunnel	LONG	60 Years	1	1	High	CAP	0	1	-2	-1	-2	-1	-2	-1	0	1	1	0	0-1				Y	Y				Y	Y			
	S88a	New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – Upgrade Roman Road	LONG	60 Years	0	0	Low	CAP	-2	0	-2	-1	-2	-1	-2	-1	0	0	0	0	0-1					Y				Y	Y			
	S88b	New Diversion Route A55 J12 (Tal y Bont) - J14 (Madryn) – New Parallel Route	LONG	60 Years	0	0	Low	CAP	-2	0	-2	-1	-2	-1	-3	-1	0	0	0	0	0-1					Y				Y	Y			
	S90	Penmaenbach Eastbound Marine Embankment – 120kph Design Speed	LONG	60 Years	1	1	High	CAP	-2	1	-2	0	-2	-1	-3	-2	0	-1	1	0	0-1				Y	Y				Y	Y			
Sustainable Travel	S64a	Improved Rail Provision	LONG	60 Years	0	0	Low	REV	-1	1	0	0	-1	0	0	0	0	0	1	0	1-2	Y			Y	Y	Y	Y				Y		
	S64b	Improved Bus Provision	LONG	60 Years	0	0	Low	REV	0	1	0	0	-1	0	-1	0	0	0	1	0	1-2	Y			Y	Y	Y	Y				Y		
	S67a	Improve NMU crossings - Penmaenmawr Beach Subway	SHORT	60 Years	0	0	£53,000	CAP	0	0	0	0	1	0	0	0	0	1	0	1	0-1	Y			Y						Y	Y		
	S67b	Improve NMU crossings - Glan Conwy Interchange	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	0	0	0	0	1	1	0	1	0-1										Y	Y		
	S67c	Improve NMU Footbridges	LONG	60 Years	0	0	Low	CAP	0	0	0	0	-1	0	-1	0	0	1	0	0	0-1										Y	Y		
	S71a	Close at-grade Pedestrian Crossings	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	0	0	0	0	0	0	0	0	0-1	Y					Y	Y			Y	Y		
	S71b	Close at-grade Pedestrian Crossings and Reroute Movements	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	0	0	0	0	0	-1	0	0	0-1	Y					Y	Y			Y	Y		
	S71c	Close at-grade Pedestrian Crossings and Reroute Movements, Plus Associated Works	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	0	0	0	0	0	1	1	1	0-1	Y					Y	Y			Y	Y		
	S71d	Close at-grade Pedestrian Crossings and Provide Alternative Provision	LONG	60 Years	0	0	Low	CAP	0	0	0	0	-1	0	-1	0	0	2	1	1	0-1	Y					Y	Y			Y	Y		
Future Proofing	S9a	Smart Road Technology – EV Charging Points	SHORT	15 Years	0	1	£520,000	CAP	0	1	0	0	0	0	0	0	0	0	1	0	0-1							Y			Y			Y
	S9b	Smart Road Technology – Solar Road	LONG	15 Years	0	0	High	CAP	0	3	0	0	0	0	0	0	0	0	0	0	1-2										Y			Y
	S9c	Smart Road Technology – Wireless Power Transfer	LONG	30 Years	0	1	High	CAP	-1	3	0	1	-1	0	-1	0	0	0	1	0	1-2							Y			Y			Y
Incident Management	S1	Smart Phone App (Roadside Incident Data Collection)	QUICK	5 Years	0	1	£195,000	REV	0	0	0	0	0	0	0	0	0	0	0	0	0-1					Y			Y					
	S3	CCTV Incident Detection Software (standalone)	QUICK	5 Years	0	1	£210,000	CAP	0	1	0	0	0	0	0	0	0	0	1	0	1-2					Y			Y					
	S4	Real-time Floating Vehicle Data - INRIX Traffic EU Website	QUICK	10 Years	0	1	£350,000	REV	0	1	0	0	0	0	0	0	0	0	0	0	1-2					Y			Y					
	S6a	Variable Message Signs - Strategic Infill	MEDIUM	15 Years	0	0	Low	CAP	0	0	0	0	-1	0	-1	0	0	0	1	0	0-1	Y								Y				Y
	S6b	Mobile Variable Message Signs	QUICK	15 Years	0	0	£205,000	CAP	0	0	0	0	0	0	0	0	0	0	1	0	0-1	Y								Y				
	S7a	CCTV	MEDIUM	15 Years	0	1	Low	CAP	0	1	0	0	-1	0	-1	0	0	0	1	1	1-2								Y					Y
	S7b	Wireless CCTV	QUICK	15 Years	0	1	£500,000	CAP	0	1	0	0	-1	0	-1	0	0	0	1	1	1-2								Y					
	S8	Sidefire Radar (Queue Protection)	SHORT	15 Years	0	1	£1,800,000	CAP	0	1	0	0	0	0	0	0	0	0	1	0	0-1						Y	Y	Y		Y			Y
	S10	Connected Vehicle Corridor	LONG	15 Years	0	1	Medium	CAP	0	1	0	0	0	0	0	0	0	0	0	0	0-1					Y	Y	Y						Y
	S12	Integrating Control Room Systems & Data	MEDIUM	15 Years	0	1	Low	REV	0	1	0	0	0	0	0	0	0	0	0	0	-		Y			Y			Y					Y
	S13	Common Location Referencing	QUICK	60 Years	0	0	£50,000	CAP	0	0	0	0	0	0	0	0	0	0	0	0	-								Y					
	S15	Performance Targets - Business Analytics Platform	QUICK	15 Years	0	1	£2,250,000	REV	0	1	0	0	0	0	0	0	0	0	0	0	-	Y	Y	Y					Y		Y			
	S16a	Incident Recovery	MEDIUM	15 Years	0	1	Low	REV	0	1	0	0	0	0	0	0	0	0	1	0	-	Y							Y					
	S16b	Free Vehicle Recovery	QUICK	15 Years	0	1	£500,000	REV	0	1	0	0	0	0	0	0	0	0	1	0	-	Y							Y					
	S31	Integrated Control Room	MEDIUM	60 Years	0	1	Low	CAP	0	1	0	0	0	0	0	0	0	0	0	0	1-2	Y	Y						Y		Y			
	S36	Extend Traffic Officer Operation	QUICK	60 Years	0	0	£6,550,000	REV	0	0	0	0	0	0	0	0	0	0	0	1	0-1	Y							Y		Y			
	S37	Additional Traffic Officer Teams	QUICK	60 Years	0	1	£6,050,000	REV	0	1	0	0	0	0	0	0	0	0	1	1	0-1	Y							Y		Y			
	S38	Dedicated Traffic Officer Laybys	SHORT	60 Years	0	1	£30,000	REV	0	1	-1	0	0	0	-1	0	0	0	1	1	0-1	Y							Y		Y			
	S40	Extend Traffic Officer Dynamic Risk Assessment	SHORT	60 Years	0	1	£90,000	REV	0	1	0	0	0	0	0	0	0	0	0	0	4-10	Y							Y		Y			
	S46	Increased Emergency Crossing Provision Operation	SHORT	60 Years	0	1	£50,000	CAP	0	0	0	0	0	0	0	0	1	0	1	0	-	Y					Y	Y	Y		Y			
	S47	Britannia Bridge - High wind mitigation	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	-1	-1	0	0	0	0	0	0	0-1	Y				Y	Y	Y	Y		Y			
	S56d	Provision of Hard shoulder (incident hotspots)	LONG	60 Years	0	2	High	CAP	0	1	0	0	-1	-1	-1	0	1	-1	1	1	1-2			Y		Y			Y					
	S56e	Provision of Hard shoulder (network wide)	LONG	60 Years	0	3	High	CAP	0	1	0	0	-1	-1	-1	0	2	-1	2	2	1-2			Y		Y			Y					
	S57	Additional laybys	MEDIUM	60 Years	0	0	Low	CAP	0	0	0	0	-1	-1	-1	0	0	0	0	0	0-1	Y				Y	Y		Y					
	S85	Average Speed Enforcement at Rhuallt Hill (Westbound) - Trial	QUICK	15 Years	0	1	£200,000	CAP	0	1	0	0	-1	0	0	0	1	0	0	0	1-2					Y	Y	Y						
	S91	Gantries on Britannia Bridge for Speed and Traffic Control	MEDIUM	60 Years	0	1	Low	CAP	0	1	0	0	-2	-2	0	0	0	0	1	0	1-2	Y				Y								
	S92	Wind Deflectors for Britannia Bridge	MEDIUM	60 Years	0	1	Low	CAP	0	0	0	0	-2	-2	0	0	0	0	0	0	0-1					Y					Y			
Asset Management	S2	Smart Phone App (Asset Management)	QUICK	5 Years	0	1	£100,000	REV	0	0	0	0	0	0	0	0	0	0	1	0	0-1		Y	Y		Y								Y
	S19	Innovative Maintenance Processes	QUICK	60 Years	0	0	£3,050,000	REV	0	0	0	0	0	0	0	0	1	0	0	0	0-1	Y	Y	Y		Y					Y			Y
	S20	Preventative Maintenance	MEDIUM	60 Years	0	2	-	-	0	1	0	0	0	0	0	0	1	0	2	0	-	Y	Y	Y		Y					Y			Y
	S21	Offline Access Points	MEDIUM	60 Years	0	1	Low	CAP	0	1	0	0	-1	-1	-1	0	1	0	1	0	1-2	Y	Y	Y		Y								
	S22	High tech Asset Monitoring	SHORT	60 Years	0	1	£250,000	CAP	0	1	0	0	0	0	0	0	1	0	1	0	1-2	Y	Y	Y		Y								Y
	S23	Route based Maintenance	MEDIUM	60 Years	0	1	-	-	0	1	0	0	0	0	0	0	1	0	1	0	-	Y	Y	Y		Y					Y			
	S24	Winter Maintenance	SHORT	60 Years	0	1	£3,150,000	REV	0	0	0	0	0	0	0	0	1	0	1	0	0-1	Y					Y	Y						
	S26	Long term asset specification	MEDIUM	60 Years	0	1	-	-	0	1	0	0	0	0	0	0	1	0	1	0	2-4	Y	Y	Y		Y					Y			Y
	S59a	Concrete central reserve barriers at road traffic collision hotspots	MEDIUM	60 Years	0	1	Medium	CAP	0	1	0	0	-1	0	0	0	1	-1	1	0	0-1	Y	Y	Y							Y			
	S59b	Concrete central reserve barriers along whole route of A55 Excl. Britannia Bridge, tunnels and sections with concrete barriers	LONG	60 Years	0	1	High	CAP	0	1	0	0	-1	0	0	0	1	-1	1	0	0-1	Y	Y	Y							Y			
	S59c	Concrete central reserve barriers along A55 excluding Anglesey Excl. Britannia Bridge, tunnels and sections with concrete barriers	LONG	60 Years	0	1	High	CAP	0	1	0	0	-1	0	0	0	1	-1	1	0	0-1	Y	Y	Y							Y			
	S63	Cross border collaboration	MEDIUM	60 Years	0	0	-	-	0	0	0	0	0	0	0	0	0	0	0	0	-	Y	Y			Y								Y
	S39	Staff Responsibility	SHORT	60 Years	0	1	£30,000	REV	0	1	0	0	0	0	0	0	0	0	0	0	4-10								Y					
	S43	Service Monitoring	SHORT	60 Years	0	0	£4,675,000	REV	0	0	0	0	0	0	0	0	0	0	0	0	-	Y	Y											Y
	S44	Programme of Funding	SHORT	60 Years	0	1	-	-	0	1	0	0	0	0	0	0	0	0	1	0	-	Y	Y			Y					Y			

4 DELIVERY CASE

4.1 OVERVIEW

The Delivery Case 'covers the delivery arrangements for the project and proposed management during its life time'. The WelTAG guidance states that in the Stage One report the Delivery Case needs to 'set out which organisation and groups within that organisation will sit on the Review Group that meets at the end of each WelTAG stage'.

4.2 PROJECT PLANNING – GOVERNANCE, ORGANISATIONAL STRUCTURE

4.2.1 KEY PROJECT PARTIES & ROLES

WELSH GOVERNMENT (WG)

Ultimate client commissioning the study and part of the Project Board overseeing delivery.

NORTH & MID WALES TRUNK ROAD AGENT (NMWTRA)

WG's Trunk Road Agent, managing the study on behalf of WG and procuring WSP via their consultancy framework.

WSP

Project Consultant, delivering the study - supported by Framework partner Gwynedd Consultancy

4.2.2 REVIEW GROUP

A Project Board has been set up to guide the WelTAG process and have met regularly to discuss the project. This group will take on the role of the Review Group and its members are as follows:

- → Welsh Government
- → North and Mid Wales Trunk Road Agent.

4.3 COMMUNICATIONS & STAKEHOLDER MANAGEMENT PLAN

Key stakeholders for the current stage of the study are:

WELSH GOVERNMENT AND NMWTRA

The study team will consult with Welsh Government and NMWTRA staff who currently manage and operate the network to capture views on current processes, issues and potential solutions. Consultation will be carried out informally throughout the study as well as through workshop exercises.

OTHER THIRD PARTY STAKEHOLDERS

Third party stakeholders, such as emergency services may be consulted to support development of the study. Third party consultation will be via NMWTRA.

THE PUBLIC / TRAVELLING PUBLIC

Public consultation will not be carried out during this stage of the study, however it will form part of a later stage.

5 FINANCIAL CASE

5.1 OVERVIEW

The financial case ‘presents information on whether an option is affordable in the first place and long term financial viability. It covers both capital and annual revenue requirements over the life cycle of the project and the implications of these for the balance sheet, income and expenditure accounts of public sector organisations.’

5.2 ASSESSMENT

The WelTAG report represents a Stage One: Strategic Outline Case and the details to inform the financial case are of a preliminary nature at this stage. The lifetime costs and the anticipated scheme life of the options are illustrated in the Appraisal Summary.

At this stage, detailed data on the revenue and capital implications are not available due to the complexity and scope of the options contained herein. However, it is expected that the options will include both a revenue and capital funding stream.

6 COMMERCIAL CASE

6.1 OVERVIEW

The Commercial case covers ‘whether it is going to prove possible to procure the scheme and then to continue with it in the future’.

6.2 ASSESSMENT

It is not considered possible at this stage to determine the commercial case of each option, given the preliminary information available.

7 SUMMARY AND NEXT STEPS

7.1 OVERVIEW

Please note that this study looks at many options. Any of these options, if taken forward will need the involvement and agreement from other stakeholders, for example and not limited to, police, emergency services, local authorities, land owners, third parties, interested groups and the public. All options will require close working with these groups, before any schemes or projects are confirmed and will need to follow all the statutory processes.

This WelTAG report has presented the development, appraisal and evaluation of transport related projects to improve resilience on the A55/A494 and has been undertaken with the involvement of key stakeholders. The appraisal of options has been undertaken in accordance with the Welsh Government's latest draft version of WelTAG [December 2016].

In total 33 unique problems have been identified across the study area and these have been grouped into a number of key themes.

- Communication
- Network Asset Management
- Network Capacity and Demand
- Network Incident Management
- Diversion Routes
- Environment
- Sustainable Travel
- Future Proofing

Based on these themes, a set of objectives were defined for the study to ensure that the options which have been developed positively contribute to resolving the problems identified.

A long list of options were developed and a number of these were sifted out at an early stage as they were either unviable or merged with similar options. 91 options were appraised against the WelTAG areas. The appraisal has shown differing impacts across all the appraisal criteria. As the WelTAG study area includes the A55 / A494 corridor, many of the options provide localised benefits, though these benefits are considered to be neutral in the context of the corridor.

7.2 RECOMMENDATIONS

The options have been broken down into differing implementation time periods. Based on the following durations:

- Quick wins: 0-6 months
- Short: 6-18 months
- Medium: 18-30 months
- Long: greater than 30 months

7.2.1 QUICK WINS

The quick wins as summarised in the appraisal have been considered viable with benefits to resilience and the travelling public. These options are focused on the following key areas:

- Journey time reliability
- Improved resilience
- Better informed customers
- Journey time improvements (limited for Quick Win solutions)
- Overall customer benefit

The following table provides a summary of the identified quick wins, their costs, benefits and how they perform when measured against the above criteria.

Table 7-1: Summary of Quick Wins

What	Why	Cost	Risk Level	Journey Time Reliability	Resilience	Journey Time	Comms	Customer Benefits
Wireless CCTV (Low cost option – not fully compliant)	Additional CCTV coverage through current significant gaps on the network to improve overall response capability	£200,000 Capital	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Incident Detection Software - Trial (Network-wide)	Quicker discovery and verification of incidents on the network.	£80,000 Capital	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Traffic Officer coverage extended hours	To provide improved incident identification and recovery at critical times e.g. major events; Bank holidays	£60,000 Revenue	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Additional Traffic Officer Unit	Provide improved incident identification and recovery (e.g. through shorter patrol routes) whilst also extending cover to the whole of the A55 across Anglesey	£120,000 Revenue	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Roads Time Table	Promote web based analytical tool to advise customers on future typical travel times and real time traffic conditions	£50,000 Revenue	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Free Vehicle Recovery - Trial	To improve incident resolution time by providing a service at critical locations and times e.g. Rhuallt Hill Bank Holiday Weekend	£50,000 Revenue	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

What	Why	Cost	Risk Level	Journey Time Reliability	Resilience	Journey Time	Comms	Customer Benefits
Additional mobile VMS	To better communicate with travelling public re journey times, congestion, delays, incidents and positive messages	£350,000 Capital	• Compliance with technical and language standards	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Communications Manager	To coordinate/manage all communications to customers to provide a proactive communication service pan Wales.	£75,000 Revenue	• Scale of task for one individual – large network Scope	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Performance Analysis	Enhance performance analysis to measure the effectiveness of interventions against the baseline and inform decisions and support continuous improvement	£20,000 Revenue	• Low Risk	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓
Average Speed Enforcement at Rhuallt Hill (West bound) - Trial	To reduce the number of excess speed-related collisions.	£200,000 Capital	• Police support required for enforcement	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

7.2.2 SHORT/MEDIUM & LONG

The proposed short, medium and long term options are summarised below under the seven themes. All of these options have been considered viable with benefits to resilience and the travelling public and are therefore recommended to be taken forward for further consideration during WelTAG Stage 2.

Asset Management		
Short	Smart Phone App (Asset Management) High tech Asset Monitoring Staff Responsibility Programme of Funding	Innovative Maintenance Processes Winter Maintenance Service Monitoring Update to DBFO Contract
Medium	Preventative Maintenance Route Based Maintenance Cross Border Collaboration	Offline Access Points Long Term Asset Specification Concrete central reserve barriers at road traffic collision hotspots
Long	Concrete central reserve barriers along whole route of A55 Excl. Britannia Bridge, tunnels and sections with concrete barriers	Concrete central reserve barriers along A55 excluding Anglesey Excl. Britannia Bridge, tunnels and sections with concrete barriers
Sustainable Travel		
Short	Improve NMU Crossings - Penmaenbach Beach Subway	
Medium	Improve NMU Crossings – Glan Conwy Interchange Close at-grade Pedestrian Crossings and Reroute Movements	Close at-grade pedestrian crossings Close at-grade Pedestrian Crossings and Reroute Movements, Plus Associated Works
Long	Close at-grade Pedestrian Crossings and Provide Alternative Provision Improved Bus Provision	Improved Rail Provision Improve NMU crossings - Rainbow Bridge
Capacity and Demand		
Short	Performance Analysis	Limit HGV overtaking on Rhuallt Hill
Medium	Increased Speed Limits Expressways (Eastern/Deeside Hotspots) Vehicle Restrictions	Improve non-standard junctions Ramp Metering
Long	Third Lane and Hard shoulder A55 J35 (Dobshill) -J36A (Broughton) Third Lane Expressway Expressway 2 Lane - Whole Corridor Reduced number of junctions	Third Lane Expressway (congestion hotspots) Expressway 2 Lane – Congestion hotspots Integrated Network Management
Communication		
Short	Real-time Floating Vehicle Data Travel Times on VMS	Driver Behavioural Change Campaign

Diversion Routes		
Short	Diversion Route Operation Procedures Diversion Route Operation Procedures – Traffic Management Plans Improved Maintenance Planning Provide wireless electronic driver information signs on Strategic Diversion Routes Increase VMS signage (fixed or mobile) along the A55 & A494 between each junction	Strategic Diversion Routes Symbol Signage Provide wireless CCTV on Strategic Diversion Routes Tactical Diversion Routes Symbol Signage A5/A470 Urban Areas – Additional on-street parking restrictions Strategic Diversion Route 17 & 18
Long	A470 - Road Widening to the South of Waterloo Bridge, near Betws y Coed Strategic Diversion Route 17 A494/A5104 junction remodelling to give priority to the A494 Strategic Diversion Route 19 New Diversion Route A55 J12 (Tal y Bont) -J14 (Madryn) - New Parallel Route Penmaenbachh Eastbound Marine Embankment – 120kph Design Speed	A494 – Road widening and change A494/Corwen Road junction priority (south of Ruthin) Strategic Diversion Route 19 New Diversion Route A55 J12 (Tal y Bont) -J14 (Madryn) - Upgrade Roman Road New Penmaenbach Tunnel
Future Proofing		
Short	Smart Road Technology (EV Charging points)	
Long	Connected Vehicle Corridor Solar Road	Wireless Power Transfer
Incident Management		
Short	Smart Phone App (Roadside Incident Data Collection) Sidefire Radar (Queue Protection) Increased Emergency Crossing Provision Operation	Real-time Floating Vehicle Data Incident Detection System Common Location Referencing Traffic Officer Dynamic Risk Assessment
Medium	Variable Message Signs (Fixed) Integrating Control Room Systems & Data Free Vehicle Recovery Dedicated Traffic Officer Laybys Additional laybys	CCTV Incident Recovery Integrated Control Room (Co-location) Gantries on Britannia Bridge for Speed & Traffic Control
Long	Connected Vehicle Corridor Provision of Hard shoulder (network wide)	Provision of Hard shoulder (Incident Hotspots) Wind Deflectors for Britannia Bridge

7.3 NEXT STEPS

This study has taken option development and appraisal through WelTAG Stage 1. In some instances this has developed options in further detail than is required at this stage due to the complex nature and geographic extent of the study. The next stage will be to complete a WelTAG Stage 2, and the following sections outline some the key areas to be considered at the outset of this stage.

7.3.1 JOURNEY TIME DATA REVIEW

Due to programme constraints and availability of the Trafficmaster data set, it has not been possible to fully analyse this data during the current stage of the study. Alternative data such as INRIX, has been utilised to illustrate some baseline information regarding journey times and reliability along the corridor. Trafficmaster data will however provide a more robust evidence base to carry out the quantified appraisal of options regarding journey time and journey time reliability during the next stage of the study. It will also be required to quantify the journey time and journey time reliability objectives at the outset of WelTAG Stage 2.

7.3.2 QUICK WINS

Through this study 10 options have been identified as a suite of Quick Wins, which provide immediate benefits to the travelling public, are compatible with each other and are deliverable within a 6 month timeframe. It is therefore proposed that these options are prioritised for development immediately to enable implementation within 6 months.

7.3.3 SHORT/MEDIUM AND LONG TERM OPTIONS

It is acknowledged that a number of the short/medium and long term options have synergies. For example, Expressway options incorporate several other options such as VMS and concrete barriers. Therefore is it is recommended that these options are reviewed at the beginning of the next stage to identify potential option packaging to provide further cumulative benefits. This should be undertaken via a stakeholder workshop to ensure that there is stakeholder buy in to future option packages.

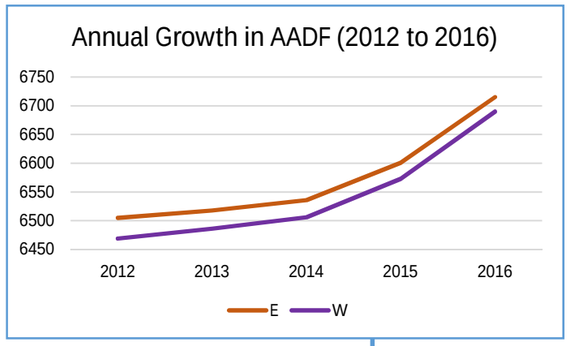
Appendix A

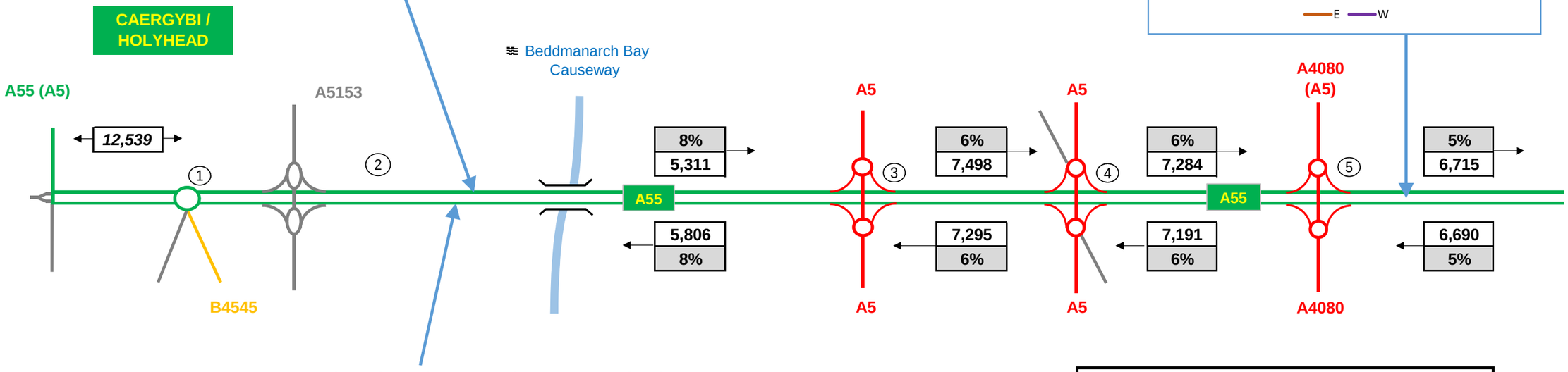
APPENDIX A-1

TRAFFIC FLOW DIAGRAM

Eastbound Hourly Average (DBFO - TME Site 9)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	322	355	294	368	457	532	388	386	406	491	385	332
August	309	314	309	397	598	723	477	441	443	532	507	401
October	311	363	290	354	463	540	396	387	415	493	410	310





Westbound Hourly Average (DBFO - TME Site 9)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	247	364	336	422	465	539	454	420	497	535	484	368
August	294	325	353	514	582	708	599	500	551	620	549	454
October	251	373	330	413	459	556	453	418	500	550	478	372

KEY

XXX	AADT (All Vehicles)
X%	AADT (HGV %)
← →	Direction of flow

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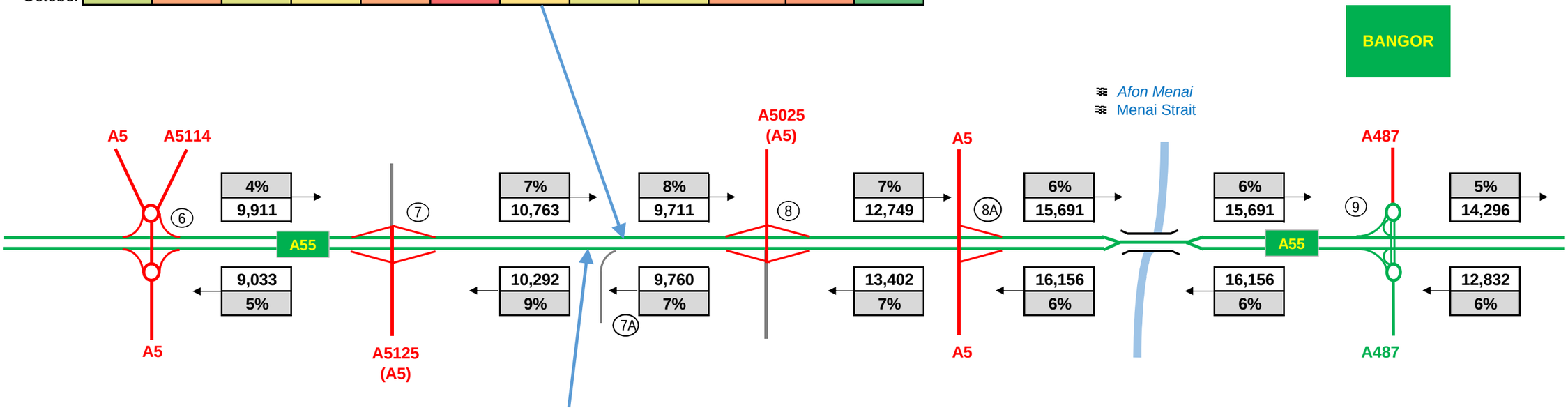
Eastbound Hourly Average (DBFO - TME Site 4)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	721	890	760	767	858	978	789	740	746	896	834	543
August	697	868	808	912	1,092	1,194	934	831	829	965	1,036	705
October	703	873	731	762	871	959	792	736	747	881	889	556



Westbound Hourly Average (DBFO - TME Site 4)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	601	771	621	699	763	828	769	827	962	1,065	1,029	685
August	643	747	728	872	921	1,003	939	951	1,060	1,176	1,124	853
October	613	781	620	700	753	826	763	843	975	1,078	1,007	705

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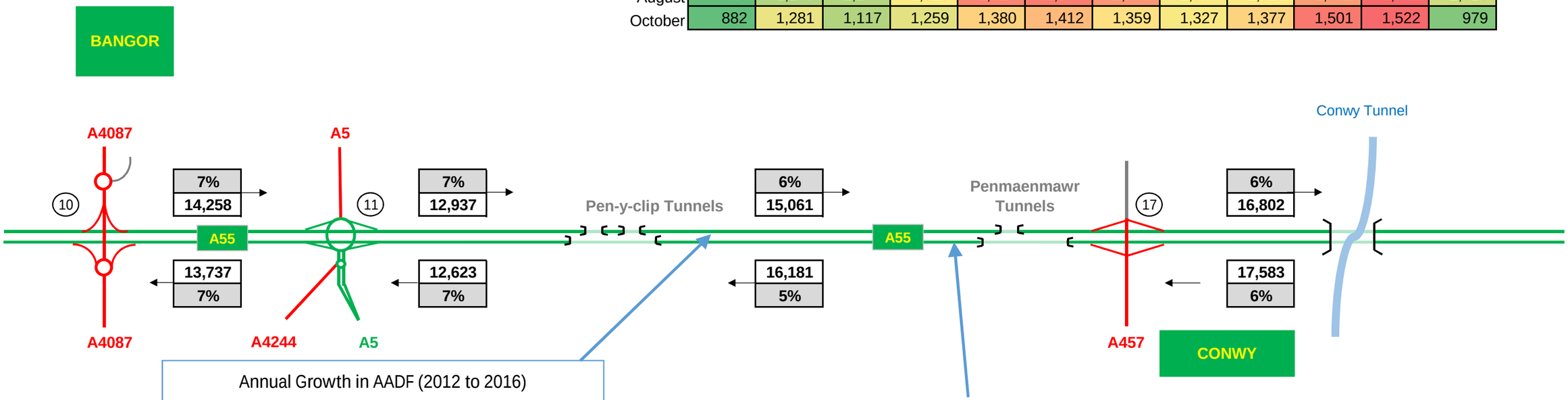
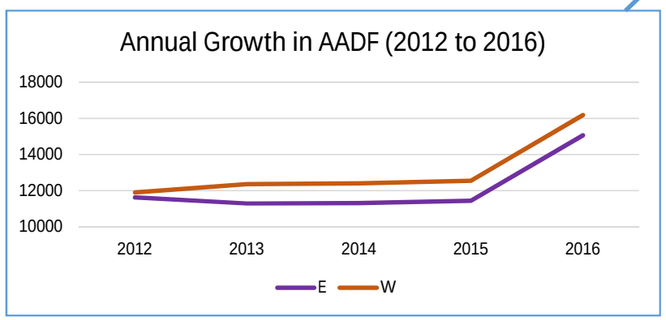
Eastbound Hourly Average (Traffic Wales Site 00000016)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	876	1,292	1,115	1,224	1,341	1,396	1,293	1,239	1,296	1,424	1,425	908
August	849	1,197	1,200	1,520	1,719	1,733	1,684	1,509	1,524	1,671	1,772	1,318
October	882	1,281	1,117	1,259	1,380	1,412	1,359	1,327	1,377	1,501	1,522	979





Westbound Hourly Average (Traffic Wales Site 00000016)

	07:00	08:00	09:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00
April	492	757	656	756	882	911	887	931	1,039	1,148	1,207	774
August	867	1,201	1,259	1,526	1,664	1,634	1,547	1,514	1,598	1,626	1,631	1,231
October	805	1,212	1,085	1,177	1,276	1,280	1,204	1,204	1,342	1,481	1,497	1,008

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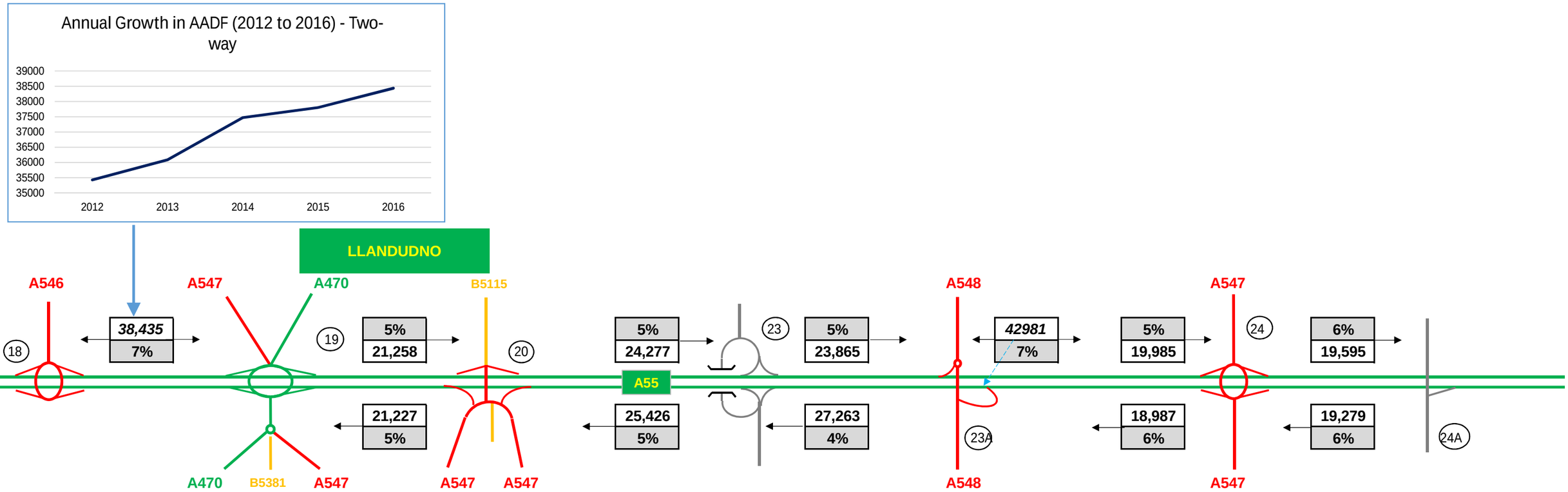

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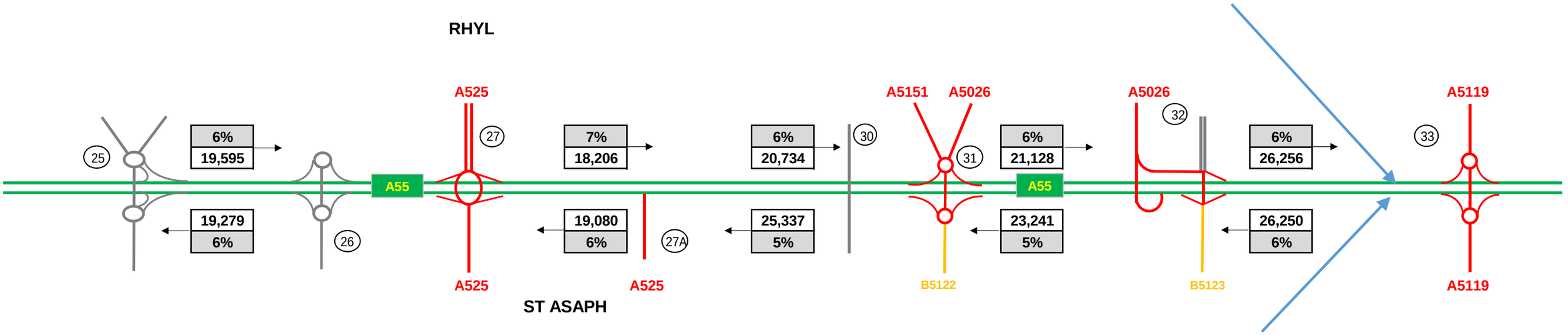
Eastbound Seasonality (Traffic Wales - Site 00000076)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
22,277	24,163	26,608	28,273	29,247	30,222	30,332	33,376	29,597	28,762	25,642	23,703



Westbound Seasonality (Traffic Wales - Site 00000076)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
21,861	24,337	27,156	28,710	29,729	29,876	31,030	33,280	29,241	28,953	25,614	24,364

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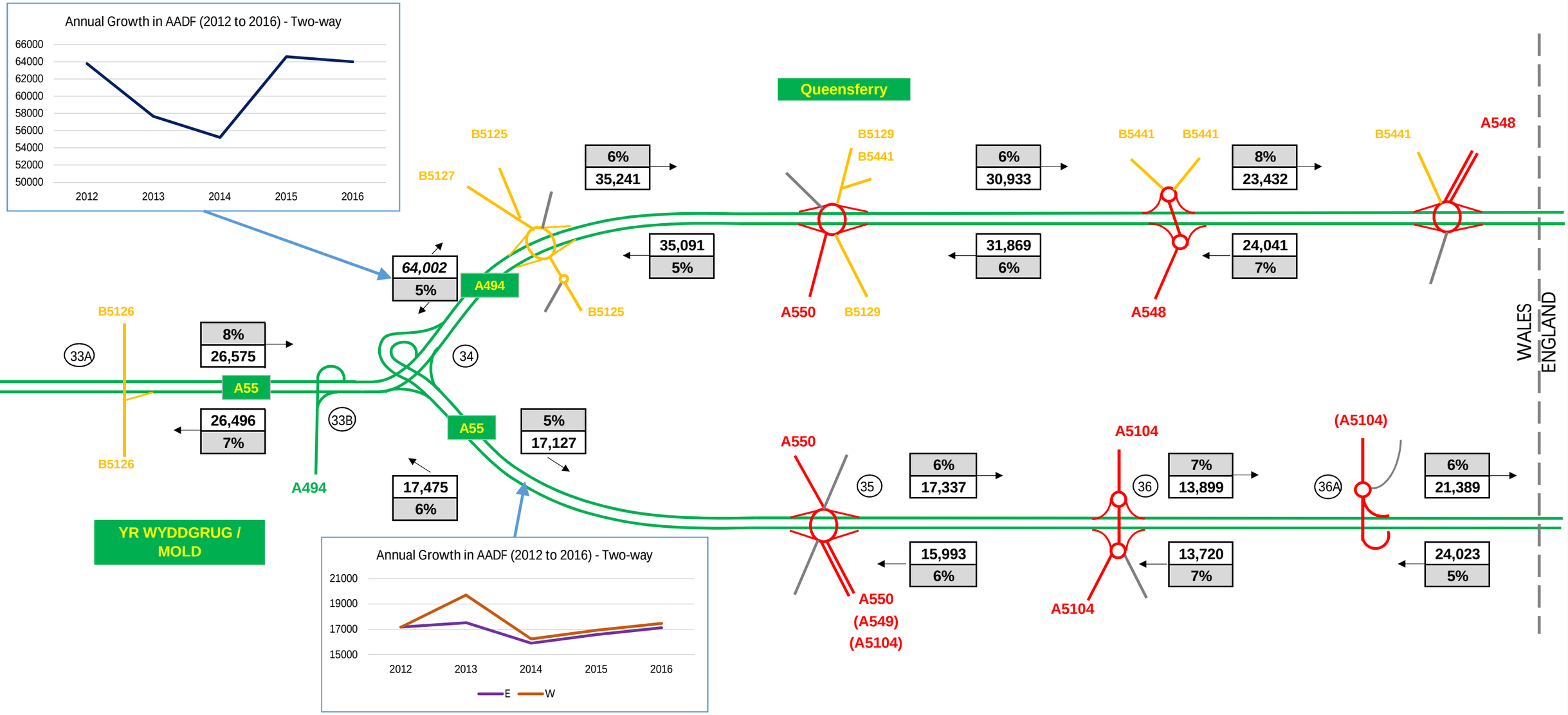

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