M4 J35-38 Stage 2 WelTAG Report

South Wales Trunk Road Agent

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2. Introduction

Scope of Study

2.1 AECOM has been commissioned by SWTRA (The South Wales Trunk Road Agency) on behalf of the Welsh Government, to develop and appraise potential options for improving road-based congestion along the M4 transport corridor between Junction 35 (Pencoed/Bridgend) and Junction 38 (Margam). This report builds upon a Stage One study undertaken by Arcadis (published in 2019) covering the larger study section of Junctions 35 (Pencoed/Bridgend) to 49 (Pont Abraham).

2.2 This study represents part of wider objectives targeted by the Minister for Economy, Science & Natural Resources to develop projects tackling road-based congestion at high-priority locations on the South West Trunk Road and motorway network. Such projects will form the basis of the Congestion Pinch Points Programme. Subject to Ministerial approval, availability of resources and satisfying the necessary statutory processes, these projects will be progressed to the implementation stage.

2.3 The M4 corridor between Junctions 35 to 49 is identified by the Welsh Government in the National Transport Finance Plan (2017 update) as a corridor experiencing both congestion and air quality issues. It is their priority to develop sustainable options addressing such present and future issues along the corridor.

2.4 This study recognises that transportation, economic activity and housing growth are inextricably linked, requiring effective cooperation to deliver enhanced prosperity to a region. Regional growth potential with impacts upon the study area has therefore been identified and the study appraised in accordance with the Welsh Government's latest WelTAG guidance (December 2017).

2.5 The scope for this study was broadened by the Welsh Government in September 2018 to prioritise the role of strategic public transport options in addressing issues of M4 congestion. The following were thus considered at stage 1 within initial optioneering:

- Heavy rail options for the corridor for both local and strategic routes;
- Metro proposals alongside advice on benefits and possible prioritisation of Transport for Wales Rail Services elements and the Swansea Metro studies;
- Road based public transport initiatives and opportunities.

2.6 The appraisal and further investigation of shortlisted options has been undertaken in accordance with the Welsh Government's Welsh Transport Appraisal Guidance (WelTAG, 2017) including advice in relation to the Future Generations of Wales (2015) Act Well-being Goals. This report represents Stage 2 of the WelTAG process, known as the Outline Business Case Report. It follows on from a Stage 1 Strategic Outline Case (SOBC) published by Arcadis in July 2019, further investigating and refining the options shortlisted by that prior report.

2.7 At Stage One, the Strategic Outline Case identified key issues of congestion along the M4 corridor, before developing potential interventions to address them. This range of options developed sought to provide a holistic approach to tackling congestion problems on the social, economic, environmental, and cultural well-being of south west Wales.

2.8 Alongside Junction improvements to Junctions 36, 48 and 49, the SOBC recommended three main 'packages' of improvements to sections of the M4 corridor: Junctions 36-38, Junctions 38-43, and Junctions 43-47. As a result, it was preferred that the three option packages be developed as separate projects. As such, this report focuses on the section of the M4 between Junctions 35 and 38.

Study Area

2.9 The specific study area examined in this report extends from Pencoed (Junction 35) in the east to Margam (Junction 38) in the west, covering 30 km (19 miles) of the M4 corridor. As shown within Figure 2-1, this study area crosses between two local authorities: Bridgend County Borough Council, and Neath Port Talbot County Borough Council.

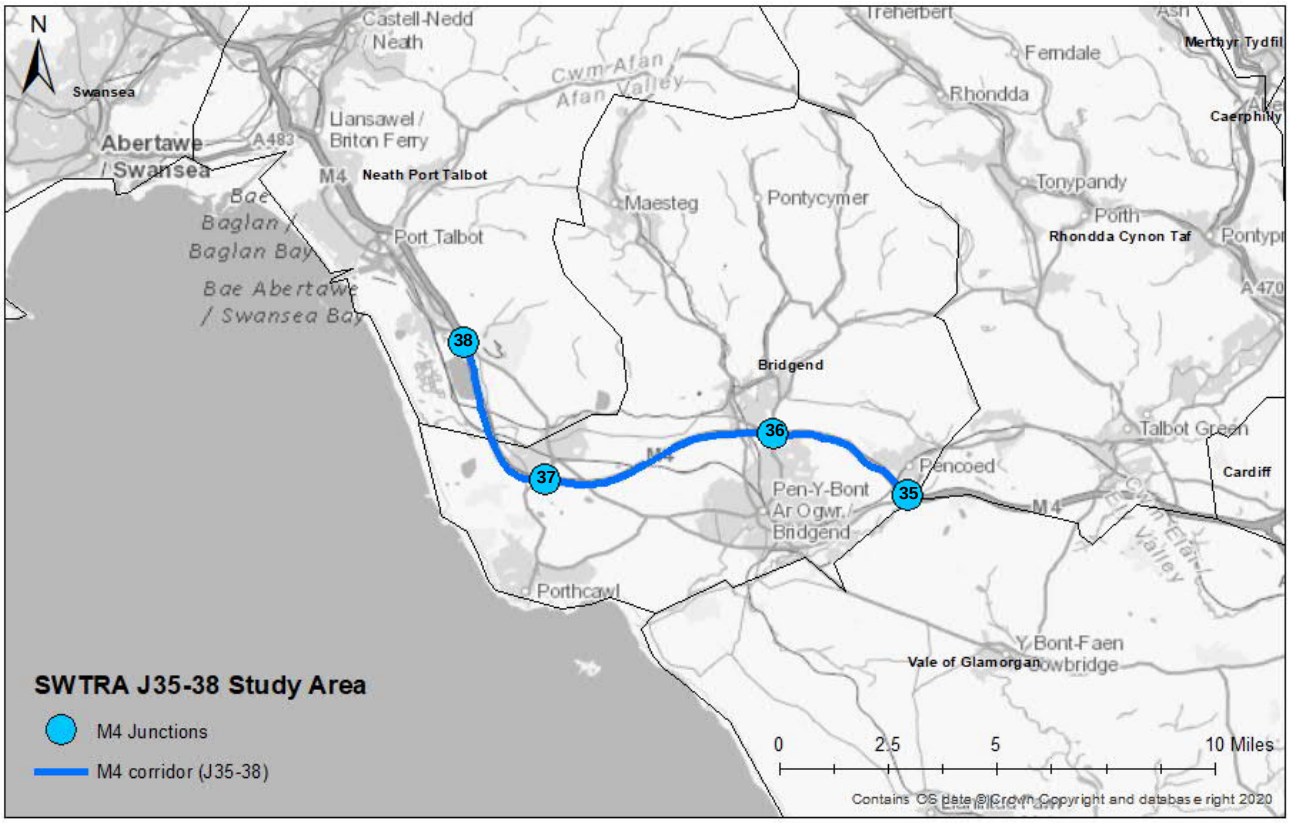


Figure 2-1. Study Area

Previous Studies

M4 J35 Pencoed to J49 Pont Abraham, WelTAG Stage One: Strategic Outline Case (Arcadis)

2.10 A WelTAG Stage One study, published in July 2019, was undertaken by Arcadis on behalf of SWTRA (for the Welsh Government). The study looked to identify existing issues in the use and management of the M4 corridor between Junctions 35 and 49, as well as potential opportunities for improvement in accordance with a series of defined objectives.

2.11 Alongside an accompanying Stage One: Impacts Assessment Report, the Stage One report outlined a series of potential solutions and interventions that could be put in place to help resolve the problems identified. This 'longlist' of options was taken forward within the Stage Two study set out within this report, with options assessed for their feasibility. The highest priority options were thereby subjected to appraisal, as discussed later in this report.

2.12 The findings of the Stage 1 WelTAG SOC for the M4 between Junction 35 and 49 are documented in the following reports:

- M4 J35 Pencoed to J49 Pont Abraham – WelTAG Stage 1: Strategic Outline Case Report (Arcadis, July 2019).
- M4 J35 Pencoed to J49 Pont Abraham – WelTAG Stage 1: Impacts Assessment Report (Arcadis, July 2019).

M4 Junction 36 WelTAG Stage 1 Final Report (Redstart)

2.13 A WelTAG Stage One study, published in October 2018, was undertaken by Redstart (Capita) on behalf of Bridgend County Borough Council. The study looked at existing issues at the M4 Junctions 36 as well as potential opportunities for improvement to the junction.

2.14 A series of options were identified and a short list of recommendations identified for further consideration at WelTAG Stage 2. These short listed options have been considered as part of the option sifting process undertaken at the start of Stage 2 of this study.

WelTAG Stage Two Requirements

2.15 The purpose of the WelTAG Outline Business Case (OBC) is to *'examine in greater detail the short list of options for tackling the problem under consideration'.* During Stage Two, the appraisal team was required to explore in more detail the mechanisms by which the proposed shortlist of options will lead to the desired outcomes, allowing refinements to the option designs and identification of key dependencies and constraints.

2.16 The OBC stage provides the background evidence required for the selection of a preferred option to take forward to WelTAG Stage 3. The OBC report therefore lays out how each of the proposed options will meet key local, regional and/or national objectives, anticipated impacts, and the effects of the varied context of the scheme on the success of each. Robustness of each option has been assessed via sensitivity testing and scenario analysis, with risks and dependencies highlighted.

2.17 This OBC report reviews and updates relevant changes that may have occurred in the study area, including both the transport system and wider context, since the completion of Stage One.

2.18 The WelTAG Stage Two report follows the structure of the Five Case Model used by the Welsh Government:

i. Strategic Case: The Case for change, fit with policies and well-being objectives
ii. Transport Case: Does the proposal offer good public value for money and maximise contribution to the well-being goals?
iii. Financial Case: Is the proposed spend affordable?
iv. Commercial Case: How can the scheme be procured, is it viable?
v. Management Case: Is the scheme achievable? Can it be delivered?

2.19 The Transport Case outlines the key social and cultural, environmental and economic impacts of each solution relevant to the end-of-stage review process. The Stage 2 WelTAG Impacts Assessment Report (IAR) provides supporting evidence and details of relevant appraisal methodologies utilised in the examination of impacts.

2.20 The outcomes of Stage Two: Outline Business Case report are:

- Decide whether there are any transport options that can address the issues identified;
- Select a preferred option from Stage One shortlist to be taken forward to the Full Business Case stage;
- Identify any legislative requirements relevant to, and needing to be met during, Stage Three.
- Document the decisions of the Stage Two Review Group, and the basis for these decisions.

2.21 The brief for this study also identifies the following additional objectives at Stage 2:

- To examine in greater detail the short list of options presented in the Stage One study;
- To consider multi-modal transport solutions that address the deliverable outcomes within the WelTAG 2017 7 Well-being Goals;
- Progressing through the 5 ways of working as per the Well-being of Future Generations (Wales) Act 2015 with key partners to assist funding and governance;
- To consider for inclusion future infrastructure proposals and technology-based improvements.

2.22 This Stage Two report follows the principle of proportionate appraisal, presenting a qualitative appraisal, providing stakeholders and decision-makers with technical information and awareness of the issues and potential options, as outlined in the accompanying Stage Two Impacts Assessment Report.

In accordance with the WelTAG guidance the significance and scale of the impacts within the assessment has been appraised using a seven-point scale, as illustrated in Table 1.

Table 1. WelTAG Seven-Point Assessment Scale

Large Beneficial	Moderate Beneficial	Slight Beneficial	Neutral	Slight Adverse	Moderate Adverse	Large Adverse
+++	++	+	0	-	--	---

Source: WelTAG 2017

Future Generations of Wales Act Approach

This section provides an overview of how the approach and proposals set out in this report evidence the Five Ways of Working and support the Well-being goals set out in the Future Generations of Wales Act 2015. As set out in detail in the Impact Assessment Report, the latest WelTAG guidance has been developed in such a way to ensure that public funds are invested to maximise contribution to the well-being of Wales. The onus is specifically focused upon the delivery of sustainable development, of which will in turn contribute to the achievement of the well-being goals.

Five Ways of Working

This section identifies how the Five Ways of Working have been applied to the consideration of potential solutions. The WelTAG guidance states it is required 'to ensure the needs of future generations are considered and understand how well they help public bodies to meet

the well-being objectives and maximise their contribution to each of the seven goals'. Consideration should be given to long-term challenges, trends, opportunities, as well as integration, collaboration, involvement and preventing problems from occurring or getting worse.

1 Long Term

The Stage Two Impact Assessment Report (IAR) which accompanies this report provides the evidence of both current and future problems, trends and opportunities to inform consideration of the long-term perspective and the development of options.

Improvements are needed to address the congestion and road safety issues associated with the M4 corridor and key connections and the subsequent impacts on the economy, access to education, jobs and services, health and the environment (notably air quality and noise impacts).

Current traffic congestion and connectivity issues will be exacerbated in the future with traffic growth. The options taken forward as part of this study offer long term solutions to address the existing issues.

2 Prevention

The options under consideration offer the opportunity to prevent as far as possible the future problems and trends from occurring, through enhancing alternative travel modes (public transport and active travel) and undertaking junction and link improvements. Moreover, the Commercial, Financial and Management Cases in this Strategic Outline Case report seek to identify costs and deliverability risks to aid decision making and prevent long term liabilities for public money by considering all of the issues at the outset.

3 Integration

The options under consideration involve the integration of active travel and bus modes together with the highway network. The WelTAG study has been undertaken in an integrated manner to consider and take account of other schemes and proposals through discussion with stakeholders as well as integration with adjacent studies.

4 Collaboration

In undertaking the WelTAG Stage Two study there has been collaboration between departments within Welsh Government, between stakeholders and between AECOM and other consultants working on projects influencing the study area issues and solutions.

5 Involvement

Stakeholder workshops have been undertaken, meetings with key stakeholders were held and other stakeholders were invited to provide written representation to inform the study. A good level of response was received through the engagement process. The Review Group brings together key stakeholders to oversee the studies. Stage 3 of WelTAG would involve full public consultation.

Well-being Goals

The objectives have been developed through consideration of the Well-being goals and this is presented in the Strategic Case Section. The Strategic Case also considers how each of the options meets the Well-being goals. Together this seeks to ensure that achieving the Well-being goals are at the centre of the setting of objectives for the study and the emerging interventions.

Stage Two Report Structure

2.23 In accordance with the WelTAG guidance, the structure of this report is as follows:

- Chapter 3: Strategic Case;
- Chapter 4: Transport Case;
- Chapter 5: Financial Case;
- Chapter 6: Commercial Case
- Chapter 7: Management Case; and
- Chapter 8: Next Steps.

3. Strategic Case

Introduction

3.1 The Strategic Case provides an evidence-based description of the current situation, addresses the need for change, describes the potential funding situation if no action is taken and offers reasons why an intervention is necessary. This incorporates analysis of the factors causing the issue and the development of possible solutions, establishing objectives with accompanying narrative to explain the benefits of each solution.

Evidence Base:

3.2 As outlined in the guidance the WelTAG process is an iterative one and the Strategic Case at Stage 2 primary seeks to update and verify the evidence presented at Stage 1. The initial development of the Stage 1 Strategic Case was an evidence-based process which is documented in the Stage One Impact Assessment Report.

3.3 Key sources of information reviewed at Stage One included:

- Studies and strategy documents – e.g. prior WelTAG studies relevant to the study area; draft report on the Case for Rail Investment in Wales.
- Transport Data – South East Wales Transport Model; mobile phone data; traffic counts; accident data; speed data; existing transport provision and appraisal of existing highways.
- Development proposals – Local Development Plan proposals for sites of significant strategic impact.
- Environmental Constraints – air quality, noise, heritage, landscape, water.
- Social, Economic and Cultural – e.g. data on demographics, facilities, the economy and tourism.

3.4 At Stage Two this evidence has been updated where relevant and focused in on evidence relating to the locations where shortlisted schemes have been identified, focusing on:

- Updated studies and strategy documents – e.g. the new Wales Transport Strategy 2021.
- Refreshed Transport data – e.g. accident analysis
- Development proposals – Consideration of the specifics of known development sites adjacent to or likely to impact travel behaviour
- Refreshed evidence of Environmental Constraints in the vicinity of scheme locations

3.5 The Stage Two Impact Assessment Report outlines the evidence used to inform decisions at Stage Two.

Consultation:

3.6 This section provides an overview of details provided by stakeholders that have informed this study.

3.7 For Stage Two, a range of stakeholders have been contacted, requesting their involvement in the stage two option development process as part of a stage Two review group.

Stakeholder Engagement at Stage One:

3.8 At Stage One, Arcadis held a number of meetings with the relevant local authorities including Bridgend County Borough Council and Neath Port Talbot County Borough Council. The purpose of this engagement was to discuss known areas of issues along the M4, as well as potential improvements that could be made via the scheme.

3.9 Key areas highlighted within the stakeholder sessions included:

- Junction 35: Concerns overreaching overcapacity in the future, with proposed future development increasing demand.
- Junction 36: Currently overcapacity, as discussed in a WelTAG Stage One study (Bridgend County Borough Council, 2018).
- Acknowledgement that junctions can serve as barriers to the movement of pedestrians and cyclists moving between communities either side of the motorway (increasing severance).
- An increased importance awarded to Electric Vehicle (EV) charging infrastructure availability, especially along the M4 corridor.
- The importance of long-distance bus travel along the M4 corridor, in order to support enhanced sustainable travel. For example, improvements to the journey time and route reliability of the TrawsCymru bus links connecting Aberystwyth – Carmarthen – Swansea – Cardiff.

3.10 Meetings were also held with several key organisational stakeholders, including the South West Trunk Road Agency (SWTRA), Transport for Wales, and Network Rail.

3.11 Key issues raised include:

- Junction 36: Westbound and Eastbound off-slip queuing.
- Signage and Communication: The option of upgrading the VMS (Variable Message Sign) throughout the network from MS2 boards with 2 lines of 12 characters per line (therefore only able to display Welsh or English), to MS4 boards with 4 lines of 12 characters.
- Network Rail have secured funding to develop an initial strategic plan for rail enhancement in South Wales. Whilst the scope of the study is to be confirm, it could include passenger demand forecasting, network capacity considerations and timetabling.

Stakeholder Engagement at Stage Two:

3.12 At Stage Two, AECOM has held a series of targeted stakeholder engagement sessions, as summarised in Table 2.

Table 2. Stakeholder Engagement

Date	Type of Engagement	Stakeholders Consulted	Outcomes
November 2020	Review Group Meeting	Bridgend County Borough Council; Neath Port Talbot County Borough Council; SWTRA; Swansea Council; Welsh Government	Initial kick-off meeting to establish terms of reference.
January 2021	Letter sent to stakeholders	Amazon; Bridgend County Borough Council; British Council; Business in the Community; CADW; Castell Howell; CGI; Community Transport Association; DVLA; Dyfed Steels; Fire & Rescue Service; Ford; G4S (operator of Parc Prison); Intertissue; Irish Ferries; John Raymond Transport; McArthur Glen; National Library; National Museum of Wales; Neath Port Talbot County Borough Council; Ortho-Clinical Diagnostics; Owens Transport; Police; RNA Plant; Rockwool	Responses received from a number of stakeholders who were then invited to the subsequent stakeholder engagement event held in March 2021.

Date	Type of Engagement	Stakeholders Consulted	Outcomes
		Rockpanel B V; Sarn Park Services; Sony UK Technology Centre; Sports Wales; Swansea Bay University Health Board; Swansea Council; Swansea University; SWTRA; Tata Steel; Transport for Wales; Traws Cymru; Wales Ambulance Service; Welsh Government (various officers); Welsh Language Commissioner	
February 2021	Review Group Meeting	Bridgend County Borough Council; Neath Port Talbot County Borough Council; SWTRA; Swansea Council; Welsh Government	Reviewed the scheme proposals prior to presenting to the wider stakeholders.
March 2021	Virtual meeting and presentation	McArthur Glen; Museum Wales; Police; Sarn Park Services; South Wales Trunk Road Agent (SWTRA); Swansea Bay University Health Board; Transport for Wales (TfW); Welsh Ambulance Service; Welsh Government	Presentation to the wider stakeholders which generated lots of detailed feedback.
April 2021	Virtual meeting and presentation	Transport for Wales (TfW)	Reviewed the scheme proposals and how they would integrate with wider TfW initiatives.
May 2021	Virtual meeting and presentation	Sustrans	All proposals reviewed and several refinements to the active travel provision were identified.

3.13 Copies of the presentation material shared at the sessions is provided in the Stage Two Impact Assessment Report along with minutes from the Stakeholder Engagement meeting held in March 2021.

3.14 The general themes from the feedback received are summarised as follows:

- Further consideration should be given to active travel provision to ensure opportunities are identified for all users. It should be noted that the proposals have since been subject to a WCHAR Assessment and further active travel measures have been included.
- Better provision should be made for bus services, especially on those routes that cross the M4 at the junctions. Junction 36 was identified as a primary opportunity to improve bus provision across the junction.
- Provision for Heavy Goods Vehicles should be considered when reviewing traffic signals at junctions.
- The police commented that Average Speed Enforcement is the only viable option in terms of speed enforcement.
- TfW noted a number of wider initiatives, in particular station upgrades, the introduction of new railway stations and new park and ride sites. Whilst none of the proposals directly impact the options being considered, because they are generally situated away from the M4 corridor, the proposals would have an impact on behaviours and could alter some traffic flows. These potential changes will need to be taken into consideration in the scheme design.
- There were discussions around the funding of schemes, particularly for the Junction 36 upgrades. All options for funding will need to be explored, which could include joint funding between Welsh Government and the Local Authorities. Opportunities for developer contributions should also be explored.

- A number of specific comments were made with respect to Junction 36 by local businesses (in particular McArthur Glen and Sarn Park), the Local Authority, TfW and Sustrans. These observations will need to be considered fully during the preliminary design.
- Bridgend County Borough Council requested that Junctions 35 and 37 be reviewed as although they were not taken froward from Stage One into this Stage Two study, there could be potential concerns as a result of future traffic growth. It was noted that other stakeholders did not share the same concerns.

The Case for Change

3.15 The combined appraisal of the existing issues and potential future opportunities for the study area are the predominant drivers of proposals for any transport intervention. Identification of such issues and opportunities has been completed via the analysis of local data, reference to policy, and feedback from stakeholder consultation. The Stage Two Impact Assessment Report provides the detailed evidence supporting the case for change, with key findings summarised below.

Summary of Issues

3.16 Potential future opportunities for the study area are the predominant drivers of proposals for any transport intervention. Identification of such issues and opportunities has been completed via the analysis of local data, reference to policy, and feedback from stakeholder consultation. The IAR sets out the context and evidence behind the issues and opportunities laid out below.

3.17 The Stage 1 study identified a series of problems, based upon the evidence presented in the Stage 1 IAR. At Stage 2 this evidence has been reviewed to determine which issues relate to the J35-38 section. Table 3 outlines the issues considered to be relevant to this section:

Table 3. Identified Problems

Reference	Issue
P02	Junction 36 experiences queuing and delays
P04	The study area includes some of the most deprived areas of Wales (particularly Neath Port Talbot); Neath Port Talbot residents have lower incomes than Wales as a whole.
P05	Residents in parts of the study area are less active and more likely to be obese than the Wales average (Bridgend and Neath Port Talbot).
P08	Road safety issues.
P010	Planned future development will increase demand along the M4 corridor.
P011	Long journey times or poor availability of public transport services and lack of connections to public transport interchanges.
P012	Lack of integration with public transport and limited opportunities for park and ride and joining bus and rail services from the M4.
P013	Limited provision for Active Travel.

Study Area Opportunities

3.18 Various opportunities presented by the study area were identified at Stage 1. Accounting for these assists in ensuring objectives and the preferred option are realistic, maximising benefits and taking into account the context of the study area. Table 4 summarises these opportunities of relevance to J35-38.

Table 4. Identified Opportunities

Reference	Opportunity
O1	Improve efficiency and capacity of links and junctions and connecting routes.
O2	Improve road safety.
O4	Enhance transport interchanges.
O5	Enhance public transport.
O6	Encourage usage of low emissions vehicles.
O7	Support and facilitate developments.
O8	Enhance the active travel network

The Impact of Not Changing

3.19 If no investment is made to improve the transport situation existing congestion issues will continue into the future. This is likely to be exacerbated by the impacts of planned development. Economic growth is likely to be constrained as a result of this, with a knock-on impact on incomes and opportunities for local people. Road safety issues are likely to impact the health and wellbeing of the local population in the long term.

Objectives

Policy Context/ Strategic Fit

3.20 The below are the key national and local objectives and goals which the study needs to align with. The Stage Two IAR demonstrates how the objectives of the study fit and will contribute positively towards these policies. Key documents include:

- Active Travel (Wales) Act (2013):

  Places a legal duty on local authorities to continuously improve infrastructure and routes for pedestrians and cyclists. All new road schemes must consider the needs of active travel users.

- Well-being of Future Generations (Wales) Act 2015:

  An act seeking to improve the social, economic, environmental and cultural well-being of Wales. Ensures that public bodies deliver an interconnected approach towards aims of making Wales more prosperous, healthy, resilient and community-led.

- Environment (Wales) Act 2016:

  Represents the legislation required to plan and manage Wales' natural resources in a more proactive, sustainable and interconnected way. Positions Wales as a low carbon, green economy, ready to adapt to the impacts of Climate Change.

- Wales Transport Strategy 2021 (Llwybr Newydd: A New Wales Transport Strategy):

  Sets out a 20-year vision for an accessible, sustainable transport system across Wales. Five key priorities: Reducing greenhouse gas emissions, growing public transport use, creating safe and well-managed transport infrastructure, making sustainable transport more attractive and affordable, and support sustainable transport innovation.

- Partnership for Growth: Welsh Government Strategy for Tourism 2013-2020 (2013):

Sets a 10% growth target in tourism earnings across Wales, aiming to grow the sector in a sustainable manner. The Strategy is based upon five key pillars: Brand promotion, product development, people development, profitable performance, and place building.

- Natural Resources Policy (2015):

  Focuses on the sustainable management of Wales' natural resources, with three priorities: Delivering nature-based solutions, increasing renewable energy and resource efficiency, taking a place-based approach.

- Taking Wales Forward 2016 -2021 (2017):

  Sets out four strategies for Welsh Government to deliver before 2021: creating better jobs and secure housing for all; a commitment to improving health and well-being; improving the accessibility and quality of education; striving to create a united and connected society.

- Prosperity for All – The National Strategy (2017):

  Targets the deliverance of quality health and care services, promoting good health and well-being, and constructing healthier communities and environments. Plans include: delivery of an integrated public transport network, delivery of the South Wales Metro, and construction of purpose-built housing developments near to easily accessible public transport.

- Prosperity for All: Economic Action Plan (2017):

  Aims to develop an inclusive economy centred around widespread opportunity and the promotion of well-being. Commits to a regionally focussed model of economic development, and includes a 5-year programme of transport capital funding through Transport for Wales.

- The Clean Air Plan for Wales (2020):

  Aims to improve air quality whilst reducing the impacts of air pollution on the environment, human health, and the economy. The plan sets out a 10-year pathway for achieving cleaner air across Wales, describing how Welsh Government will work collaboratively across sectors and with the public to create new evidence-based policy, legislation, regulations and investment to reduce air pollution in line with the highest international air quality standards.

- Planning Policy Wales: Edition 10 (2018):

  Sets out Welsh Government objectives, strategies and policies related to land-use, as part of the Planning Framework for Wales. This includes four key themes: Placemaking, Active and Social Places, Productive and Enterprising Places, and Distinctive and Natural Places.

- Emerging National Development Framework:

  Represents a new 20-year spatial plan for Wales setting out the direction for future investment into infrastructure and development.

Local Development Plans (Bridgend, Neath Port Talbot):

Set out a range of area-based objectives, aiming to improve the infrastructure, health, and environment of the local authority area.

- Local Transport Plans (Bridgend, South West Wales 2015-2020):

  Aim to improve transport and access within and beyond each region to facilitate economic regeneration, reduce deprivation and support use of more sustainable and healthier modes of transport.

Scheme Objectives

3.21 Objectives for interventions along the M4 corridor study area were identified by the Stage 1 study and derived from general and transport-specific objectives set by the Welsh Government. These were developed in accordance with issues and opportunities identified via stakeholder workshops.

The Scheme objectives relevant to the J35-38 section are displayed in Table 5.

Table 5. Scheme Objectives

Objective	Description	What will success look like?	How will success be measured?
1	Improve highway efficiency and resilience of the motorway, interchanges and connecting road network.	• Reduced delay at junctions • Reduced impact of major incidents on traffic delay	• Speed data • Average time taken to reopen M4 following incidents
2	Improve road safety and journey time reliability.	• Reduced rate of accidents	• Accident rate for vehicle kilometres by section • Speed data
3	Improve multi-modal travel options that reduce motorway dependence.	• Increased journeys undertaken by sustainable modes • Reduced traffic volume than forecast on M4	• Number of journeys to work via sustainable modes • Travel surveys of key employers • Rail patronage • Bus passenger surveys • Cycle/pedestrian counts on strategic routes
4	Improve access to employment, and for business and tourism to support sustainable economic growth and development to bring enhanced prosperity.	• Improved access to main employment and tourist facilities	• Number of employment or tourist developments with improved strategic infrastructure
5	Improve access to local services, education, health and cultural facilities to support social inclusion, health and well-being.	• Enhanced access to education, health and cultural facilities	• Number of education and cultural facilities with improved strategic infrastructure
6	Improve health and the local and global environment, including reducing air and noise pollution.	• Minimised impact of motorway and diversionary route traffic on air quality • Minimised traffic noise impacts • Improved levels of physical activity and reduced obesity	• Length of motorway within noise action priority areas • Exceedance of air quality guidance • Percentage of local authority residents physically active and / or obese
7	Improve communication and information to users and management of the motorway.	• Fully bilingual signage • Installation of variable signage or equivalent for diversionary routes • Increased user satisfaction with strategic network	• User satisfaction • Delays caused by incidents

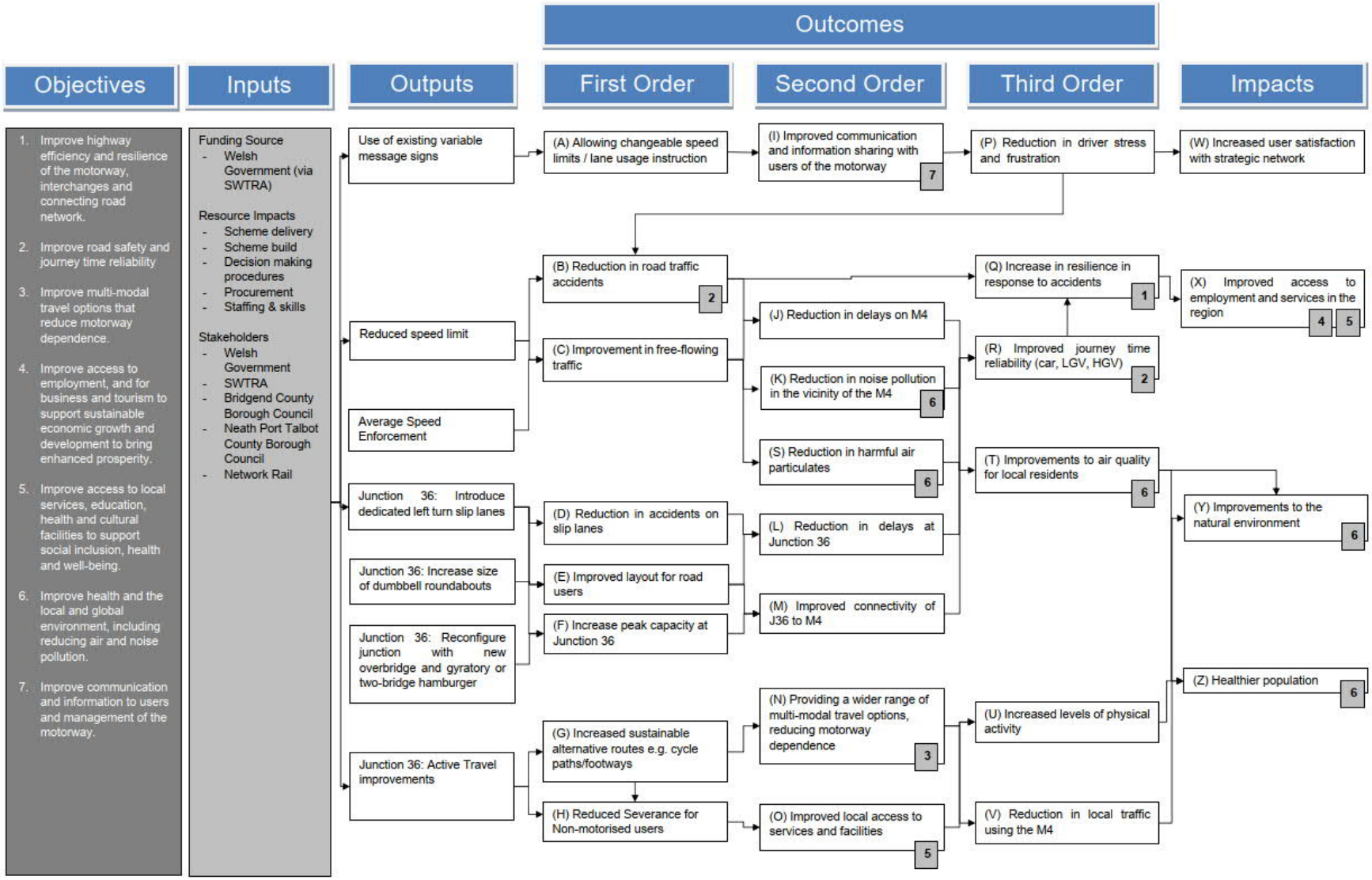
Verification of Objectives

3.22 The Stage One Strategic Outline Business case presented evidence to confirm that these objectives align strongly with:

- Resolving the identified problems of the study area
- The Well-being of Future Generations (Wales) Act well-being goals
- The Wales Transport Strategy (WTS) outcomes;
- The Welsh Government's Strategic Priorities; and
- The Economic Action Plan Priorities.

Logic Map

A logic map has been produced to illustrate how through delivery of the identified short-listed options a series of short-term outcomes would logically occur which would result in beneficial long-term impacts for road users and local communities. The logic map also demonstrates how the identified objectives map into these logical steps and the ways by which these objectives will be achieved.


Outcomes
Objectives
Inputs
Outputs
First Order
Second Order
Third Order
Impacts
1. Improve highway efficiency and resilience of the motorway, interchanges and connecting road network.
2. Improve road safety and journey time reliability
3. Improve multi-modal travel options that reduce motorway dependence.
4. Improve access to employment, and for business and tourism to support sustainable economic growth and development to bring enhanced prosperity.
5. Improve access to local services, education, health and cultural facilities to support social inclusion, health and well-being.
6. Improve health and the local and global environment, including reducing air and noise pollution.
7. Improve communication and information to users and management of the motorway.
Funding Source
- Welsh Government (via SWTRA)
Resource Impacts
- Scheme delivery
- Scheme build
- Decision making procedures
- Procurement
- Staffing & skills
Stakeholders
- Welsh Government
- SWTRA
- Bridgend County Borough Council
- Neath Port Talbot County Borough Council
- Network Rail
Use of existing variable message signs
Reduced speed limit
Average Speed Enforcement
Junction 36: Introduce dedicated left turn slip lanes
Junction 36: Increase size of dumbbell roundabouts
Junction 36: Reconfigure junction with new overbridge and gyratory or two-bridge hamburger
Junction 36: Active Travel improvements
(A) Allowing changeable speed limits / lane usage instruction
(B) Reduction in road traffic accidents 2
(C) Improvement in free-flowing traffic
(D) Reduction in accidents on slip lanes
(E) Improved layout for road users
(F) Increase peak capacity at Junction 36
(G) Increased sustainable alternative routes e.g. cycle paths/footways
(H) Reduced Severance for Non-motorised users
(I) Improved communication and information sharing with users of the motorway 7
(J) Reduction in delays on M4
(K) Reduction in noise pollution in the vicinity of the M4 6
(L) Reduction in delays at Junction 36
(M) Improved connectivity of J36 to M4
(N) Providing a wider range of multi-modal travel options, reducing motorway dependence 3
(O) Improved local access to services and facilities 5
(P) Reduction in driver stress and frustration
(Q) Increase in resilience in response to accidents 1
(R) Improved journey time reliability (car, LGV, HGV) 2
(S) Reduction in harmful air particulates 6
(T) Improvements to air quality for local residents 6
(U) Increased levels of physical activity
(V) Reduction in local traffic using the M4
(W) Increased user satisfaction with strategic network
(X) Improved access to employment and services in the region 4 5
(Y) Improvements to the natural environment 6
(Z) Healthier population 6

Options

3.23 This section provides a summary of the process undertaken at Stage One to identify and sift a long list of options and the subsequent work undertaken at Stage Two to identify an appropriate short list for design development, costing and appraisal within the Stage Two Transport Case.

Stage One Options Summary

3.24 At Stage One, potential interventions to address issues of congestion along the M4 corridor were developed, in tandem with stakeholder review groups, with a final longlist of options outlined. The options selected sought to provide a holistic approach to solving congestion issues and wider subsequent impacts on the social, economic, environmental, and cultural well-being of the surrounding area. It should be noted that the Stage One project examined a wider study area (Junctions 35-49) than is the focus of this report, thus only options relevant to the J35-38 section have been highlighted.

3.25 A range of sources were used to inform the identification of options to meet the strategy principles:

- Policies and Plans (e.g. LDPs, LTPs);
- Programmes (e.g. NTFP, South Wales Metro);
- Strategies and Studies (e.g. Welsh Route Study, Case for Rail Investment in Wales, J36 WelTAG Stage One);
- Stakeholder workshop (September 2018);
- Stakeholder consultation meetings (e.g. Local Authorities, Trunk Road Agency, Network Rail, Transport for Wales).

3.26 The initial long-list of options was developed into 'intervention packages' to enable appraisal. The three packages are illustrated in Figure 3-1.

Figure 2.3 Intervention Packages

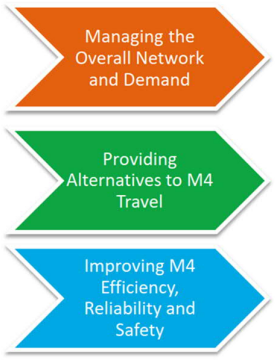


Figure 3-1. Stage One Intervention Packages

3.27 The Stage One study recommended that the options outlined could be taken forward in tandem or be prioritised based on the Stage One appraisal.

Study Area Wide Network Management

3.28 This intervention package takes the form of strategies for managing the trunk road network, aimed at increasing resilience, reducing noise impacts, lowering vehicle emissions, and travel planning of developments and land use in the study area.

3.29 Short-term interventions included development of:

- Network Management Plans to improve everyday operation and network resilience;
- Noise Priority Areas Action Plan;
- Low Emission Vehicle Fuelling Strategy;
- Travel Planning Strategy;
- ITS solutions: including VMS gantry signage.

3.30 Appraisal suggested that these measures would be expected to have a beneficial impact on the highway efficiency and resilience, road safety, access to employment and services and the environment, but neutral impact on multi-modal travel options.

Junction 36-38 Improvements Package

3.31 Existing issues with traffic speeds and accidents between Junctions 36 and 38 were highlighted. An improvement package was created aiming to improve the efficiency, reliability and safety of the M4 study area.

3.32 The package suggested the undertaking of a detailed corridor study, focused on accidents and traffic speeds, in order to identify measures to address high vehicle speeds.

3.33 Appraisal suggested that the measures would have major beneficial impacts on improving road safety and journey time reliability, with moderate benefits for air and noise quality objectives, and improved communication and management of the motorway.

3.34 Potential for adverse impacts on average journey times outside of peak periods as a result of speed restrictions was highlighted.

Junction Improvements for Junction 36

3.35 Various options were suggested in order to improve the efficiency of Junction 36. These included the construction of dedicated slip/relief lanes (short-term measure); a larger roundabout; a signalised two-bridge hamburger design; improvements to Heol Spencer, and active travel measures.

3.36 Appraisal suggested that the measures could have a moderate benefit for highway efficiency and resilience, as well as access to employment and services. Junction improvements are acknowledged to require a joint approach between the Trunk Road Agency and local authorities however, who may have different priorities.

Stage Two: Optioneering

3.37 At Stage Two, the longlisted option concepts selected at Stage One were taken forward for further consideration and refinement.

3.38 The first stage of this process consisted of optioneering, with potential interventions assessed for their level of impact. This involved consideration of each of the packages of interventions identified at Stage One, as listed above, to establish the measures that could be implemented to address the problems identified.

3.39 A 5-point scale of priority was established, rating each option from High (1) to Low (5), based on the levels of benefit foreseen from each. Table 7 outlines the priority rankings awarded to each intervention, with rationale given for each rating. Any options determined to have priority ratings of 1 or 2 were taken forward for consideration in Stage Two of the Optioneering process.

M4 Junction 35 to 36 Traffic Speeds and Road Safety

3.40 The original Stage One appraisal identified concerns with traffic speeds and accidents along this section of the M4. Further analysis of collision statistics, as presented in the Stage Two IAR and summarised below in Table 6, however indicates that accident numbers are below the rate expected for this type of road. Accordingly, road safety does not appear to be the primary concern for this section of the M4.

Table 6. Collision Data – M4 Junction 35 to 38

Location	Slight	Serious	Fatal	Total
Junction 35	2	-	-	2
Link from Junction 35 to 36	19	2	1	22
Junction 36	1	-	-	1
Link from Junction 36 to 37	11	-	-	11
Junction 37	2	1	-	3
Link from Junction 37 to 38	15	1	1	17
Junction 38	4	1	1	6
Total	**54**	**5**	**3**	**62**

3.41 With regards speeding, consultation with the Police has confirmed that high vehicle speeds is an ongoing issue through this section, as evidenced by the regular siting of the Go-Safe mobile speed camera positioned on an overbridge within the vicinity of Junction 35. The Police also advised that if enforcement was to be considered then the most effective means would be through the use of Average Speed Enforcement, rather than fixed-point cameras.

3.42 Furthermore, consideration has been given to reducing the speed limit to 50mph, as has been done on a number of sections of the M4. Together these combined measures could potentially resolve the ongoing issue of high traffic speeds, whilst also further improving road safety.

3.43 It should be noted that whereas the Stage One appraisal examined Junction 36 to 38 as a specific study area, this has been extended to include Junction 35 to incorporate the whole of the corridor study area.

M4 Junction 36 Improvements

3.44 Junction 36 suffers from a range of problems and has been subject to a series of previous studies undertaken by Capita on behalf of Bridgend County Borough Council. The following reports have been consulted:

- M4 Junction 36 Improvements Existing Layout Assessment, Capita, October 2014
- M4 Junction 36 Improvements Stage 4 Report: Analysis of the Efficiency, Capacity and Congestion Issues of the Existing Junction, Capita, August 2015
- M4 Junction 36 Improvements Stage 5 Report: Infrastructure Feasibility Study, Capita, December 2016
- Junction 36 of the M4 VISSIM Modelling, Redstart (Capita), October 2017
- Junction 36 WelTAG Stage 1 Final Report, Redstart (Capita), October 2018

3.45 These studies identified 17 options covering a range of potential measures which were sifted down to five options that were recommended for further appraisal at Stage Two. These were:

- F01 Dedicated slip / relief lanes – A possible short term measure that may provide some capacity benefit in some locations if only for a limited time period.
- F09 Larger roundabout – This option may allow the future capacity required, along with inclusion of Active Travel and passenger transport measures. However, it would require use of development or common land. It may not be possible to split north-south or east-west traffic as part of the design. Likely to be an expensive measure.
- F14 Signalised two-bridge hamburger – This option is confined within the existing development boundary of the junction and works for the next 10 years of growth. It provides Active Travel improvements and through increased capacity will improve journey times for all users (including passenger transport- although the option does not include dedicated measures for passenger transport). This option could be implemented as a first phase to option F09 if designed and constructed in the relevant manner.
- F11 Improvements to Heol Spencer - although this option would need to be considered in conjunction with undertaking either F01, F09 or F14 as a package. Alone this measure would not have the required benefits. It would be important to understand the traffic impacts of improvements to Heol Spencer and the surrounding areas and therefore requires further investigation.
- F17 Do Minimum – Taken forward for baseline assessment against other recommended options.

3.46 In addition, Capita recommends three further sub options that should be considered in combination with the above, namely F12 Active Travel Measures; F02 Improved Travel Plans and Smart Technology; and F04 Passenger Transport Improvements.

3.47 Of the five main options identified, and setting aside Option F17, which represents the do minimum scenario, it should be noted that Option F11, Improvements to Heol Spencer, is not a standalone option and would need to be considered in combination with the other shortlisted options. Hence there are three primary options coming out of the Capita study, namely:

- F01 Dedicated slip / relief lanes;
- F09 Larger roundabout; or
- F14 Signalised two-bridge hamburger.

3.48 Each of these options is illustrated in Figures 3-2, 3-3 and 3-4.

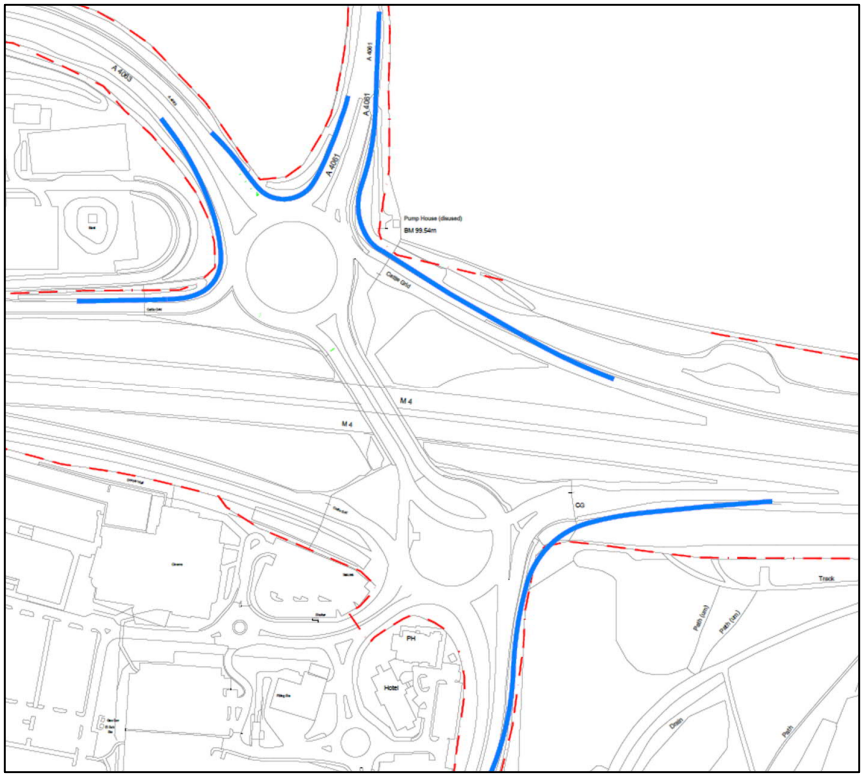


Figure 3-2. Capita Option F01 Dedicated Slip / Relief Lanes

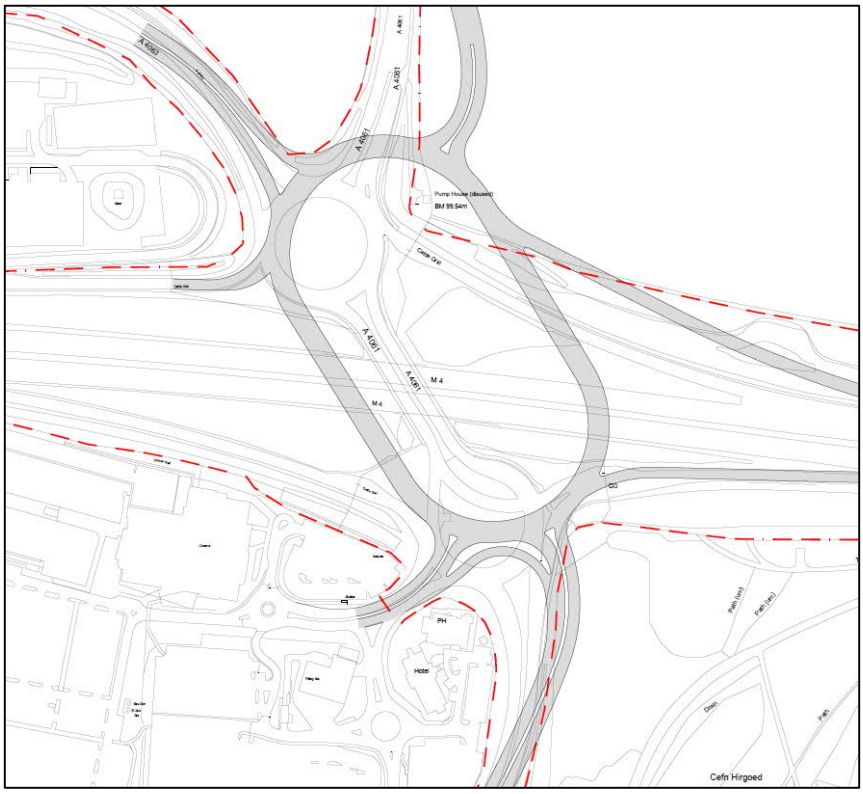


Figure 3-3. Capita Option F09 Larger Roundabout

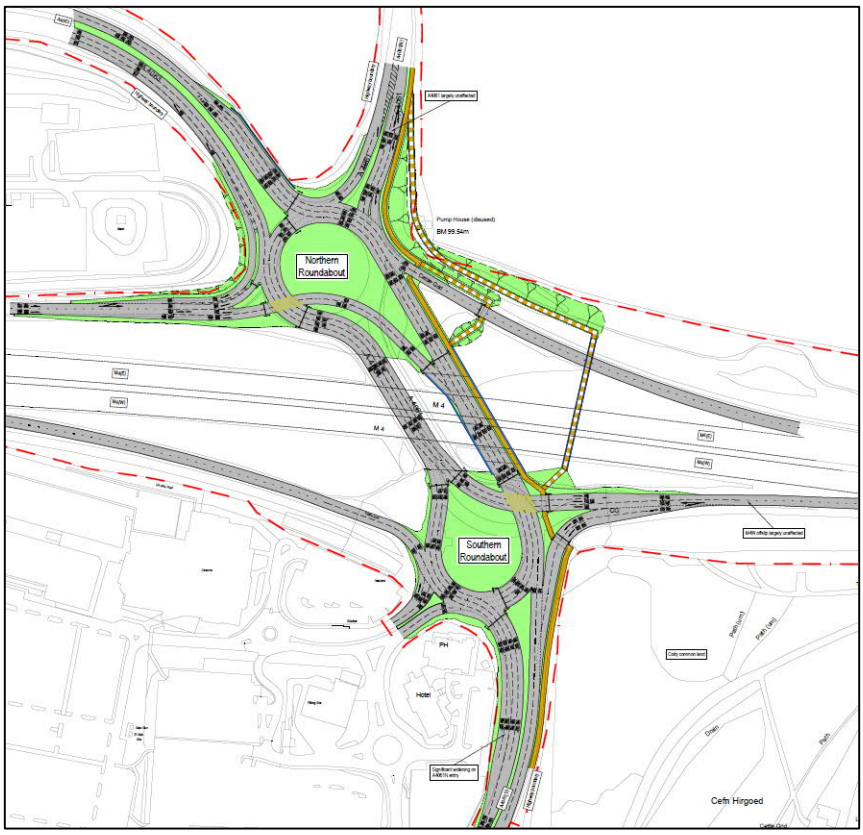


Figure 3-4. Capita Option F14 Signalised Two-bridge Hamburger

3.49 For option F01, the dedicated slip lanes, it is noted in the Capita Stage One appraisal that this should only be considered as a short term measure and it would provide some capacity benefit but only for a limited time period. The option only scores moderately well in the appraisal and a number of concerns are raised, in particular the likely impact on the adjacent common land which presents a risk to the deliverability of this option.

3.50 Option F09 would also require the acquisition of common land, as well as land from the adjacent retail park, which again represents a risk to the deliverability of this option. Of all of the options shortlisted by Capita, F09 does appear to be the best performing from a traffic perspective and could have the ability to provide long term future capacity. The works would involve the construction of two new bridges, and hence this option is the most expensive and it also scores poorly from an environmental perspective.

3.51 Option F14 seeks to make better use of the existing infrastructure where possible but with an additional bridge over the M4 to provide further capacity for future growth. The main advantage of this option is that it is confined within the existing highway boundary and does not appear to require land acquisition. There are some risks however, for example whether the existing split deck bridge can be reconfigured to accommodate the four northbound lanes across its width. Furthermore, the layout is relatively complex, with both roundabouts having a 'hamburger' style cut-through which may be counterintuitive for road users and difficult to interpret and may also require departures from standards. As for Option F09, this option scores poorly from an environmental perspective and it should be noted that from a traffic perspective, it is likely to only provide adequate capacity for the next 10 years of growth.

3.52 Capita notes that if option F14 was to be taken forward, then if it were designed appropriately and constructed with future expansion in mind, it could potentially be

upgraded to the F09 layout if and when capacity is reached. Given this, and given the potential risks associated with F09, as well as the significant costs, option F14 has been considered as the preferred option for the purpose of this Stage Two study. It is recognised that a wider study may be required to appraise the longer-term options however.

3.53 It should be noted that in appraising Option F14, no further development or refinement of the layout has been undertaken.

Table 7. Priority Rankings for Stage One Options, plus J35 and J37

Stage 1 Recommendation	Location	Option to be Considered	Priority (1 High - 5 Low)	To be considered in optioneering/design	Rationale
Measures to address high vehicle speeds and road safety	J35-38	Fixed traffic signs	5	No	Unlikely to have any tangible benefit and not clear what prescribed signs would be appropriate
	J35-38	Use of existing variable message signs	2	Yes	Recommendation that this could be undertaken as a trial, but no need for appraisal given the scale
	J35-38	New variable message signs	3	No	Additional VMS is unlikely to have significant impacts of a scale requiring appraisal
	J35-38	Reduced speed limit	1	Yes	Reduced speed limits without enforcement is not considered viable, therefore this will be considered alongside enforcement.
	J35-38	Average speed enforcement	2	Yes	Speed enforcement is likely to reduce incidents of speeding and improve road safety.
Junction improvements at J36 – to address congestion and delay. This may involve various options such as dedicated slip/relief lanes (short-term measures); larger roundabout; signalised two-bridge hamburger as well as improvements to Heol Spencer and active travel measures.	J36	Review slip road arrangements to confirm DMRB compliant (i.e. type) and reconfigure if needed	4	No	The existing merge and diverge arrangements are generally acceptable and further refinement is unlikely to reduce congestion or delays.
	J36	Review signal timings	3	No	There is considered to be limited opportunity for enhanced signal timings.
	J36	Introduce dedicated left turn slip lanes	2	Yes	The previous studies undertaken by Capita will be reviewed to understand the viability of each potential

	J36	Increase size of dumbbell roundabouts	2	Yes	option. Junction modelling will be used to confirm the benefits which could be achieved and the preferred option only will be appraised.
	J36	Reconfigure junction with new overbridge and gyratory or two-bridge hamburger	1	Yes	
	J36	Active Travel improvements	2	Yes	Active travel will be considered as part of the wider package of junction improvements and the proposals will be subject to a WCHAR Assessment.
	J36	Bus provision	2	Yes	Bus provision will be considered alongside proposed junction improvements but will not form a specific appraisal option.
	J36	Review Heol Spencer	3	No	Heol Spencer maintenance timeframes will be considered in the programming of improvements for this section, but this doesn't need to be considered in the appraisal
Improvements at junction 35 and J37 to address future development in the area	J35 & J37	Junction capacity improvement	5	No	The LDP indicated some development earmarked for locations close to these junctions, but no significant developments were identified to be reasonably foreseeable. Stakeholders confirmed that no existing congestion problems exist at these locations. Improvements at locations were therefore not considered to align with the Pinch Points programme goals.

Stage Two: Selection of Options for Appraisal

3.54 After identification of high priority options, the second stage of the selection process included the development of scheme designs and aimed to identify which interventions should ultimately be taken forward for appraisal – the key objective of WelTAG Stage Two.

3.55 The comparative benefits and feasibility of each option was explored, and a final list of options for appraisal was devised, as outlined in detail below.

Junction 36 Improvement Works

Scheme Description

3.56 The preferred option for Junction 36 is outlined within Figure 3-5. The proposed works would comprise:

- The A4061 northbound would be widened for approximately 150m south the southern roundabout to provide two additional lanes.
- The A4063 southbound would be widened to provide an additional lane for approximately 100m where it joins the northern roundabout. An additional lane for the A4063 northbound would also be provided for approximately 150m to the services junction. The additional A4063 northbound lane would link to a dedicated left-hand turn lane from the M4 eastbound off slip.
- The M4 eastbound off slip would be widened for approximately 120m to provide two additional lanes and would be realigned to provide a dedicated left hand turn lane to the A4063, a signalised lane entering the northern roundabout, and two signalised lanes routing traffic south over the M4 to the southern roundabout.
- A second bridge would be constructed crossing the M4 approximately 30m east of the existing bridge. To achieve this, two new bridge abutments would be constructed north and south of the M4 and a new bridge deck installed.
- Northbound traffic would be routed over the existing bridge and southbound traffic routed over the new bridge. This would be facilitated by providing dedicated lanes from M4 eastbound off slip and re-aligning the existing dedicated lanes from the M4 westbound off slip. Traffic signals would be added where traffic crosses the roundabouts and where it enters and exits the bridges.
- The footpath currently routed over the existing bridge would be diverted over the eastern side of the new bridge and linked to the existing footpath along the A4061 north of the junction via a pedestrian crossing over the M4 eastbound on slip and off slip. Given an at-grade pedestrian crossing across the on-slip is not an ideal solution, an alternative option comprising a separate footbridge is shown on the drawing which would cross the eastbound on-slip and the M4 mainline before re-joining the NMU facilities on the southern side of the M4.

How it tackles the problem

3.57 The proposed works are designed to improve traffic flows and reduce congestion for buses and general traffic through the provision of additional highway capacity and additional signalisation to balance flows through the junction. The provision of a new footpath would also help to address existing severance issues for pedestrians at this location and improve access to facilities at either side of the M4. The scheme would help to cater for planned development in the vicinity of J36 and support accessibility for deprived communities in Bridgend.

Contribution towards Objectives

The below table outlines how the proposed scheme would contribute towards the identified scheme objectives (which are designed to align with local and national wellbeing objectives).

Objective	Description	Objective Met?	Description
1	Improve highway efficiency and resilience of the motorway, interchanges and connecting road network.	++	*Proposals for construction of additional lanes and reconfiguration of the junction design would reduce journey times and relieve congestion on the junction, increasing resilience.*
2	Improve road safety and journey time reliability.	+	*Junction proposals should reduce accident risk and increase visibility at the junction. Reduced congestion would improve reliability of journey times.*
3	Improve multi-modal travel options that reduce motorway dependence	0	*Proposal includes the construction of a new pedestrian footbridge across the M4 carriageway, however, there is no additional provision for bus or rail options reducing motorway dependence.*
4	Improve access to employment, and for business and tourism to support sustainable economic growth and development to bring enhanced prosperity.	+	*The proposed measures at junction 36 should provide minor improvements to journey times with the reconfigured junction design. This should reduce congestion created by traffic towards the Bridgend Designer Outlet and increase the desirability of the area for business agglomeration.*
5	Improve access to local services, education, health and cultural facilities to support social inclusion, health and well-being.	+	*Minor improvements to journey times* and *construction of a new bridge for southbound traffic should reduce congestion for traffic re-joining the carriageway from Sarn Park services or coming off to access Princess Wales Hospital.*
6	Improve health and the local and global environment, including reducing air and noise pollution.	0	*Whilst noise pollution change would be imperceptible as a result of scheme implementation, reduced congestion may lead to minorly reduced greenhouse gas emissions.*
7	Improve communication and information to users and management of the motorway.	0	*The option will involve some minor updated signage facilities, but with no major changes to the way information is communicated to users.*

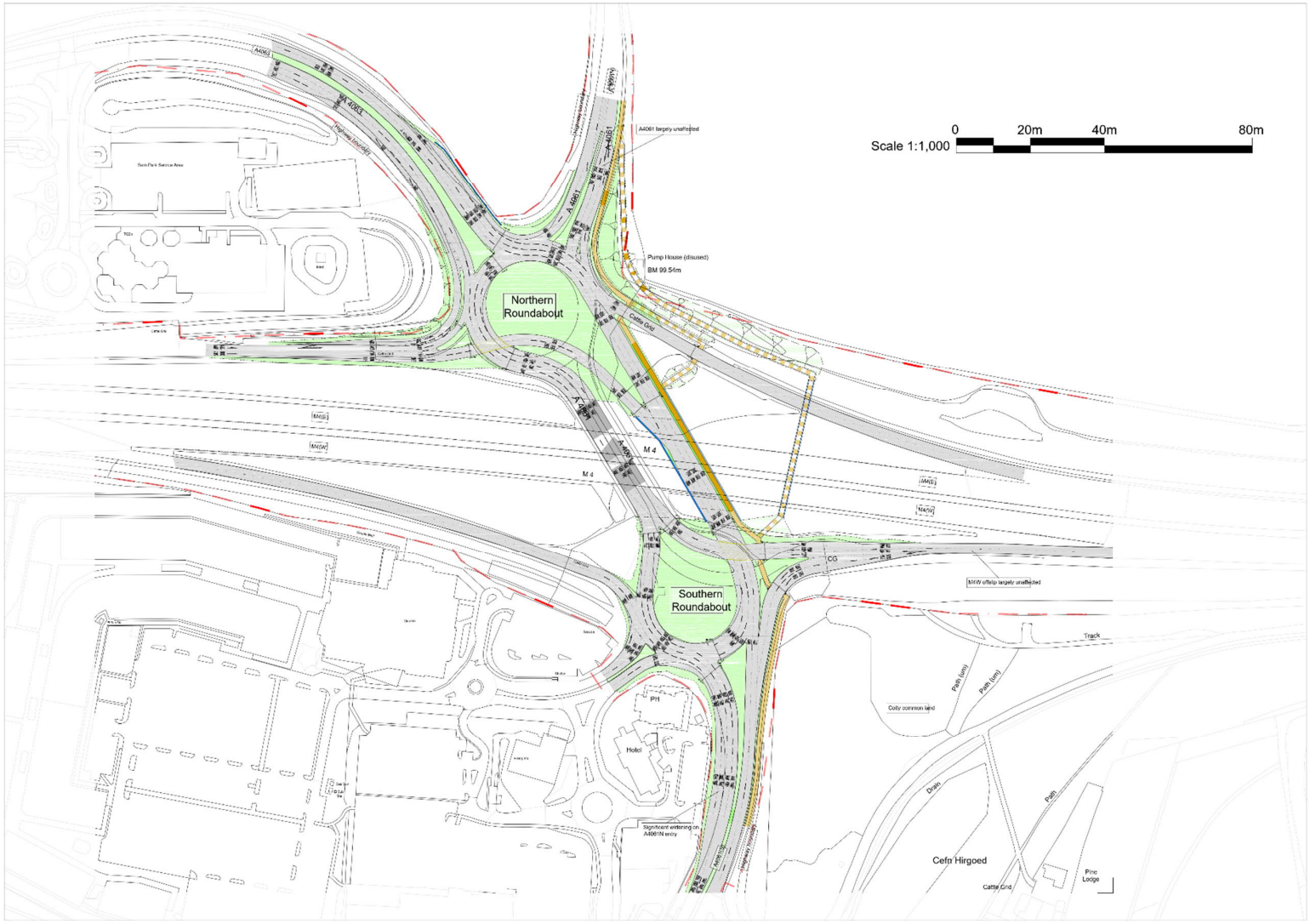


Figure 3-5 Junction 36 Improvement Plans

Average Speed Enforcement

Scheme Description

3.58 The Average Speed Enforcement (ASE) area would cover the area indicated in Figure 3-8 along the M4 between Junction 35 and Junction 38. The introduction of ASE would involve the following works:

- Traffic signs; and
- Cameras and supporting electrical infrastructure.

3.59 Two types of signs would be required within the ASE area: advance warning signs and speed limit terminal signs (see Figure 3-6). Two advance warning signs (2.6m wide x 3.9m high), one for each direction of traffic, would be installed within highways boundary ahead of the ASE. Eight smaller advance warning signs (1.3m wide x 2.0m high) would also be installed at each on-slip and off-slip within the ASE area, providing four per junction at Junction 36 and 37. A total of eight speed limit terminal signs (1.5m wide x 2.5m high), would also be installed within the verge and central reservation, to provide a pair of signs for each direction of traffic at each end of the ASE area. A further 16 speed limit terminal signs (1.5m wide x 2.5m high) would be provided at the top of each on-slip and off-slip within the ASE area, providing eight per affected junction. Finally, smaller speed limit repeater signs (0.6m wide x 0.9m high) would be installed 450m intervals for both directions of travel, alternating between the verge and central reservation.

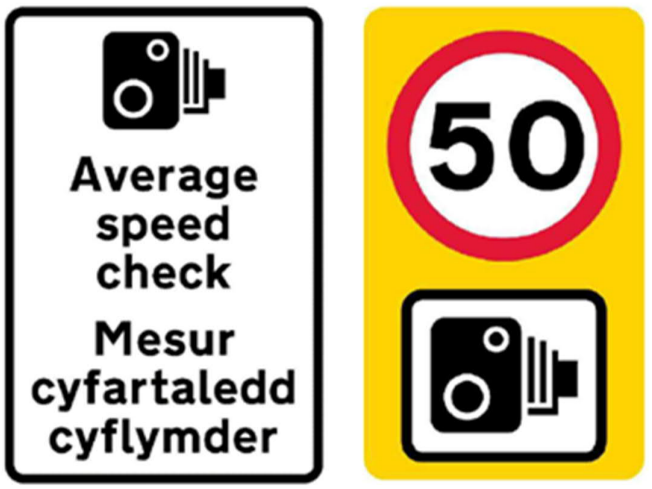


Figure 3-6. Traffic Signs

(Left: *Advance warning sign*)

(Right: *Speed limit sign – note 70mph is proposed)*

3.60 Automatic Number Plate Recognition (ANPR) cameras (typically 7.5m tall) and infrared lighting columns (typically 6.2m tall) would be required at several locations to implement the ASE area:

- At the terminal points of the ASE area on the main carriageway. Four sites would be required consisting of one pair for each direction of travel at each end of the ASE area.

- Entry and exit points to the ASE area from Junction 36 and 37. One site would be required at the top of each on-slip and off-slip, to give a total of eight.

3.61 One cabinet would be required to support each ANPR camera and infrared lighting column site (see Figure 3-7). The cabinets would be installed within an area of hardstanding within the verge and highways boundary. Power to supply the ANPR camera, infrared lighting column and cabinets would be provided via ducting laid in a trench from the nearest power supply. Connection to the nearest available fibre-optic would also be provided in the same way. The required trenches would typically be less than 50cm wide, with further disturbance either side from the required works and as a result of spoil heaps. This assessment has assumed that a trench would be dug to install the power and fibre-optic along the entire length of the verge with the ASE area to provide a 'worst case scenario', however this is unlikely to be required.

Figure 3-7. Typical ANPR camera (A), infrared lighting column (B) and cabinet (C) arrangement

.

How it tackles the problem

3.62 The proposed works are designed to improve traffic flows and reduce congestion through the creation of an average speed enforcement area. The introduction of average speed enforcement would help to regulate extreme speeds to balance out traffic flows along the route.

Contribution towards Objectives

The below table outlines how the proposed scheme would contribute towards the identified scheme objectives (which are designed to align with local and national wellbeing objectives).

Objective	Description	Objective Met?	Description
1	Improve highway efficiency and resilience of the motorway, interchanges and connecting road network.	+	*Whilst the implementation of average speed enforcement measures would be expected to increase average journey times, overall resilience should improve due to more consistency of vehicle speeds.*
2	Improve road safety and journey time reliability.	+	*Average speed enforcement would help to improve the consistency of flow experienced between J35-38, aiding improvements in journey time reliability. Lowered average speeds would also provide some minor reductions in accident risk.*
3	Improve multi-modal travel options that reduce motorway dependence	0	*The proposed option focus between Junctions 35-38 is on alterations to the carriageway layout and will therefore not impact on multi-modal travel options in the surrounding area.*
4	Improve access to employment, and for business and tourism to support sustainable economic growth and development to bring enhanced prosperity.	0	*Lengthened journey times would be balanced out with improved journey time reliability for employers, with less congestion experienced.*
5	Improve access to local services, education, health and cultural facilities to support social inclusion, health and well-being.	0	*Proposed measures would lengthen journey times to local services, however journey time reliability would be improved, nullifying many of the issues created by congestion.*
6	Improve health and the local and global environment, including reducing air and noise pollution.	++	*Road traffic noise levels along the M4 due to average speed enforcement are predicted to decrease by 2.4 to 2.9dB. This would be perceptible within 100m of the M4 carriageway. Significant greenhouse gas emissions reductions are predicted, resulting from lower fuel consumption. Local air quality would also improve.*
7	Improve communication and information to users and management of the motorway.	+	*Additional signage gantries would provide better opportunities to communicate with users.*

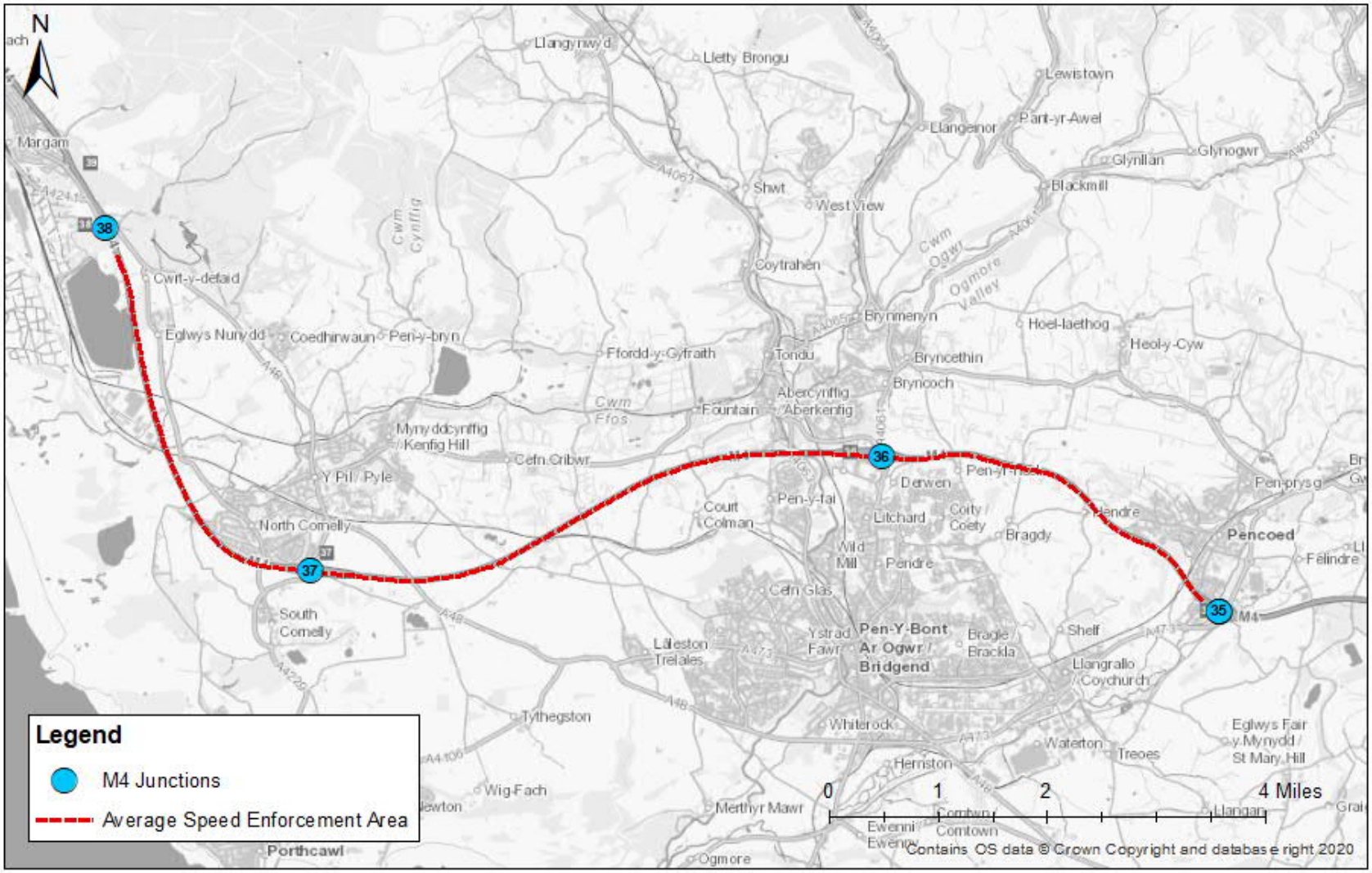


Figure 3-8 Average Speed Enforcement Area

4. Transport Case

Introduction

4.1 The Transport Case is designed to explain the expected impacts of the project, how any proposed option will contribute to identified objectives, and whether it will provide value for public money. Social, cultural, environmental and economic costs and benefits for each intervention are considered, with an evidence-based assessment of impacts made.

4.2 The transport case presents the approach and assessment of impacts of each option under the headings of social, cultural, environmental and economic impacts and an evidence-based assessment of the following:

- What the impacts will be;
- The scale of those impacts;
- Where will they occur; and
- Who/ what will experience them.

Approach to Impact Assessment:

4.3 The anticipated impact of the highway route options on traffic and the subsequent economic, social and environmental impacts has been quantified through use of a bespoke spreadsheet assessment tool (for average speed enforcement) and a VISSIM model (for Junction 36). Further details regarding the methodologies used to develop these tools can be found within the Stage Two IAR.

4.4 Economic impacts have been estimated through the development of a bespoke economic appraisal tool which follows cost-benefit analysis guidance found in TAG Unit A1.1 and TAG Unit A1.3.

4.5 At this stage environmental impacts have been assessed through a combination of qualitative assessments and measurement of receptors likely to be affected (for air quality and noise), but this is prior to environmental and technical surveys being undertaken, and a full Environmental Impact Assessment, which will be needed to progress an option in Stage Three.

4.6 For qualitatively assessed impacts the WelTAG seven-point assessment scale as set out in Table 1 has been adopted to indicate the scale of impact of each potential option, and has been determined in reference to the Stage One report and information presented in the Stage Two IAR. The impacts considered and means of assessment for each are presented below:

- **Social Impacts** – Social impacts have been assessed with reference to the guidance in WebTAG Unit A4.1. This represents qualitative assessment, with topics covered including: physical activity, security, severance, journey quality, option and non-use values, accessibility and personal affordability.
- **Cultural Impacts** – The Future Generations of Wales (2015) Act sets a well-being goal of ‘A Wales of vibrant culture and thriving Welsh language’ to be achieved through ‘a society that promotes and protects culture, heritage and the Welsh language, and which encourages people to participate in the arts, and sports and recreation’. Cultural assessment therefore takes the form of a qualitative commentary on impacts relating to cultural assets (e.g. arts, cultural and sports facilities, as well as heritage sites), the Welsh language and tourism.

- **Environmental Impacts** – Environmental impacts have been appraised with reference to the guidance in WebTAG Unit A3. Parameters examined include noise, air quality, greenhouse gases, landscape, townscape, historic environment, biodiversity and water environment. The Stage Two IAR sets out the environmental data used to inform the appraisal.
- **Economic Impacts** – This assesses the value for money offered by an option, calculated via a comparison of the quantifiable value of beneficial impacts, minus the value of adverse impacts, compared to the cost of delivering, maintaining and operating the option.

Options appraised

4.7 After identification of high priority options, a final list of two primary interventions has been finalised to take forward for appraisal.

Improvements at Junction 36:

- Signalised two bridge hamburger: Construction of a second road bridge to the east of the existing crossing, to carry southbound traffic across the M4 carriageway. Existing junction to be reconfigured with additional lanes and signalisation to improve resilience under peak flows.

Improvements between Junctions 35 and 38:

- Average Speed Enforcement: Putting average speed checks in place along the section in order to reduce incidents of speeding and improve road safety.

Impact Assessment

4.8 Table 8 presents a comparative summary of the results of appraisal for each option, when assessed against the range of Social, Cultural, Environmental and Economic impacts outlined within the WelTAG guidance. Further details by option are presented later in this section.

4.9 The WelTAG seven-point assessment scale, as laid out in Table 1, has been used to present the scale of impact.

Table 8. Impact Assessment Summary

Impact Criteria	Improvements at Junction 36:	Junctions 35 and 38: Average Speed Enforcement
Social		
Physical Activity	+	0
Journey Quality	+	+
Security	0	0
Access to Employment	+	+
Access to Services	+	+
Affordability	0	0
Severance	++	0
Option and Non-Use Values	0	+

Impact Criteria	Improvements at Junction 36:	Junctions 35 and 38: Average Speed Enforcement
Cultural		
Cultural Facilities	**0**	0
Welsh Language	**0**	0
Environmental		
Noise	**0**	+
Air Quality		
Greenhouse Gases	**+**	++
Landscape	**-**	0
Townscape	**0**	0
Historic Environment	**0**	0
Biodiversity		
Water Environment	**0**	0
Economic		
Journey Time Changes	**+++**	---
Transport Costs	**+**	++
Accidents	**+**	+
Wider Economic Impacts	**+**	-
Capital Costs	**-**	-
Revenue Costs	**0**	0

4.10 Table 9 outlines the performance of the identified options against the identified scheme objectives.

Table 9. Appraisal Against Scheme Objectives Summary

Objective	Description	Improvements at Junction 36:	J35-38: Average speed enforcement
1	Improve highway efficiency and resilience of the motorway, interchanges and connecting road network.	++	+
2	Improve road safety and journey time reliability.	+	+
3	Improve multi-modal travel options that reduce motorway dependence	0	0
4	Improve access to employment, and for business and tourism to support sustainable economic growth and development to bring enhanced prosperity.	+	0

5	Improve access to local services, education, health and cultural facilities to support social inclusion, health and well-being.	+	0
6	Improve health and the local and global environment, including reducing air and noise pollution.	0	++
7	Improve communication and information to users and management of the motorway.	0	+

Individual Option Appraisals

Improvements at Junction 36

Impact Criteria	WelTAG RAG Score	Criteria Appraisal
Social		
Physical Activity	+	*The proposed option design for Junction 36 maintains existing footbridges at each end of the junction but provides a new pedestrian footbridge crossing north-south across the carriageway (east of the junction). Construction will increase the range of options available for safe physical activity journeys, expanding the routes for NMUs north and south across the M4.*
Journey Quality	+	*The J36 option design proposes construction of additional lanes and a reconfigured junction design with a new bridge to carry traffic southbound across the M4. These upgrades aim to smooth traffic flows, especially at peak times on the junction. Some benefits to the experience of usage at the junction may therefore be provided by the scheme.*
Security	0	*The proposals for improvements at Junction 36 are not expected to create any significant changes to security for NMUs or road users.*
Access to Employment	+	*The proposed measures at junction 36 should provide minor improvements to journey times with the reconfigured junction design. Construction of new bridge for southbound traffic should reduce congestion for traffic coming off the M4 aiming to reach the Bridgend Designer Outlet to the south. The construction of a new pedestrian footbridge should also increase NMU access to employment sites.*
Access to Services	+	*The proposed measures at junction 36 should provide minor improvements to journey times with the reconfigured junction design. Construction of a new bridge for southbound traffic should reduce congestion for traffic rejoining the carriageway from Sarn Park services, or coming off to access Princess Wales Hospital. The construction of a new pedestrian footbridge should also increase NMU access to the north and south of the M4 carriageway.*
Affordability	0	*There are no changes to affordability expected for either NMUs or vehicle users as a result of the scheme proposals for Junction 36.*
Severance	++	*Substantial improvements to severance can be expected as a result of the scheme options at Junction 36, following construction of the new pedestrian footbridge from north-south across the M4 carriageway.*

Option and Non-Use Values	0	*Limited changes to option and non-use values as a result of the scheme plans at Junction 36, with no provision for alternative modes of transport at the junction.*
Cultural		
Cultural Facilities	0	*The junction improvements proposed will help to reduce congestion and increase traffic flows on and off of the main M4 carriageway. Proposals will not directly affect access to cultural facilities in the vicinity of Junction 36 however, so impact is limited.*
Welsh Language	0	*Whilst the option proposal will involve updated signage facilities including both Welsh and English language information, this does not represent a significant cultural shift from the Welsh language provision already in place. Impact is therefore neutral.*
Environmental		
Noise	0	*The adapting of the existing bridge for northbound traffic and construction a new bridge for southbound traffic are within the existing boundary. Since the proposed works would not result in traffic being routed closer to noise receptors, with a likely similar level of traffic using the roundabouts following completion of works, it is not considered this would result in any noticeable changes to existing road traffic noise levels in the locality.* *It is considered that changes in junction road traffic noise would not be perceptible and would also not be noticeable above existing levels of M4 mainline road traffic noise. No adverse impacts are expected to occur on nearby noise important areas or local receptors and therefore overall a Neutral (0) impact is anticipated*
Air Quality		
Greenhouse Gases	+	*Economic Modelling estimates that Junction 36 will produce minor emissions reductions as a result of construction of additional lanes and a reconfigured junction design reducing congestion. Monetary benefit from reduced CO2 emissions is calculated to be around £450,000 PVB (assuming benefits for the AM and PM peak periods and Saturday peak period only).*
Landscape	-	*Proposals at Junction 36 would not alter the overall landscape character, although the removal of some of the structure planting around the road corridors would slightly increase the prominence of the junction infrastructure within the local landscape. Mitigation planting would assist in limiting these effects.*
Townscape	0	*Proposals would be located at an existing junction which already defines the spatial pattern of the townscape. The additional widening, new bridge structures and associated vegetation removal would not alter the overall balance of townscape character which contains few distinctive features and lacks local distinctiveness.*
Historic Environment	0	*It is not anticipated that the proposed works at Junction 47 would impact directly on any designated or non-designated heritage assets within the 500m study area. Due to the level of modern development and intervening screening, it is not anticipated that there would be any substantial change in setting to surviving assets.* *There is assessed to be very low potential for archaeological assets to be affected and no effect to above ground heritage assets.*
Biodiversity		

Water Environment	0	*Improvement works located in DAM Zone A, therefore low potential for effects to the water environment. No likely impacts on surface water or groundwater quality or WFD status. Drainage strategy required to ensure management of surface water.*
Economic		
Journey Time Changes	+£75m	*Traffic Modelling indicates a reduction in Journey Times of over one minute per vehicle during peak hours, with the Do-Something scheme in place (using 2030 flows). This leads to a greater difference between Do Something and Do Minimum travel times in future.* *Economic Modelling estimates a PVB of around £75 million from Journey Time savings at Junction 36 (assuming benefits for the AM and PM peak periods and Saturday peak period only).*
Transport Costs	+£2m	*Scheme proposals at Junction 36 are likely to create minor reductions in both fuel costs and non-fuel operating costs, especially where a reconfigured junction design will reduce congestion. Economic Modelling estimates VOC (Vehicle Operating Costs) of around £2 million (assuming benefits for the AM and PM peak periods and Saturday peak period only).*
Accidents	+	*Existing accidents occurring in the vicinity of Junction 36 over the last 5 years represented minor incidents. These appear clustered around the roundabouts at either end of the junction however. A reconfigured design should reduce such accidents, with more lane separation and more free flowing traffic joining onto the junction carriageway.*
Wider Economic Impacts	+	*With the significant reduction in Journey Times as a result of the scheme option, there is potential for increased economic activity and agglomeration to the area, as more businesses may look to locate themselves close to the junction.*
Capital Costs	£43.9m	*Capital costs for the developments at junction 36 are projected to be £43.6m. This is reduced to £21.1m when discounted to 2010 prices.*
Revenue Costs	0	*The scheme option is not expected to produce any direct revenue costs.*

J35-38: Average speed enforcement

Impact Criteria	WelTAG RAG Score	Criteria Appraisal
Social		
Physical Activity	0	*The proposed option focus between Junctions 35-38 is on arrangements for road users and will therefore not impact on physical activities.*
Journey Quality	+	*Proposed increases in variable signage along the scheme route would provide greater access to information for road users, allowing for adaptive speed limits in real time. This would help to contribute towards an increased perception of safety for road users, serving to improve journey quality.*
Security	0	*The proposals for improvements between Junction 35 and 38 are not expected to create any significant changes to security for NMUs or road users.*
Access to Employment	+	*The proposed measures to address high vehicle speeds and road safety between Junctions 35 and 38 would serve to reduce extreme speeds along the study route, and therefore lengthen journey times to employment in real-time. However, this would likely be balanced out with lower levels of congestion and reduced accident rates, meaning that overall traffic flows would make journey times much more reliable.*
Access to Services	+	*The proposed measures to address high vehicle speeds and road safety between Junctions 35 and 38 would serve to reduce extreme speeds along the study route, and therefore lengthen journey times to services in real-time. However, this would likely be balanced out with lower levels of congestion and reduced accident rates, meaning that overall traffic flows would make journey times much more reliable.*
Affordability	0	*There are no changes to affordability expected for either NMUs or vehicle users as a result of the scheme proposals between Junctions 35 and 38.*
Severance	0	*The proposed option between Junctions 35 and 38 will not currently have any impact on existing severance in the area, as it is entirely road based.*
Option and Non-Use Values	+	*The proposed average speed enforcement would increase the resilience of the M4 network, with greater ability to regulate speeds increasing its ability to cope with high densities of traffic to prevent/minimise congestion.*
Cultural		
Cultural Facilities	0	*Proposed average speed enforcement measures would help to reduce congestion and increase the consistency of traffic flows along the main M4 carriageway. Proposals will not directly affect access to cultural facilities in the vicinity of M4 between J35-38 however, so impact is limited.*
Welsh Language	0	*Whilst the option proposal will involve updated signage facilities including both Welsh and English language information, this does not represent a significant cultural shift from the Welsh language provision already in place. Impact is therefore neutral.*
Environmental		

Noise	**+**	*Road traffic noise levels along the M4 due to average speed enforcement are predicted to decrease by 2.4 to 2.9dB. This is equivalent to a Slight beneficial (+) impact. It is considered that decreases in M4 road traffic noise in these areas would be perceptible along the extent of J35 to J38 for receptors within approximately 100m of the highway edge; at greater distances road traffic noise will attenuate such that any changes would not be noticeable above other more localised sound sources (e.g. other roads). No adverse impacts are expected to occur on nearby noise important areas or local receptors.*
Air Quality		
Greenhouse Gases	++	*Economic Modelling estimates that Junction 35-38 speed enforcement proposals will produce emissions reductions as a result of reduced average speeds in the with-scheme scenario. Monetary benefit from reduced CO2 emissions is calculated to be around £26 million PVB.*
Landscape	0	*The introduction of additional highway furniture would be in keeping with the existing structures present along the motorway corridor and would not be sufficient to increase visual clutter or be visually intrusive. The localised vegetation removal would not alter the overall pattern or function of the existing highway planting thereby maintaining the existing landscape character along the length of the M4 corridor affected.*
Townscape	0	*The Average Speed Enforcement scheme would be located entirely within the highway boundary which already defines the spatial pattern of the surrounding townscapes. The introduction of additional traffic signs, cameras and supporting electrical infrastructure along with localised removal of vegetation would not alter the overall balance of townscape character.*
Historic Environment	0	*It is not anticipated that the proposed works at Junction 47 would impact directly on any designated or non-designated heritage assets within the 500m study area. Due to the level of modern development and intervening screening, it is not anticipated that there would be any substantial change in setting to surviving assets.* *There is assessed to be very low potential for archaeological assets to be affected and no effect to above ground heritage assets.*
Biodiversity		
Water Environment	**0**	*Low potential for effects to the water environment. M4 motorway between Junctions 35 and 38 coincides with DAM Zone C2 at crossings with main river however motorway is generally elevated in these areas, and therefore it is not considered that there will be any impact in terms of flood risk. No likely impacts on surface water or groundwater quality or WFD status.*
Economic		
Journey Time Changes	-£767m	*The implementation of average speed enforcement measures is expected to create significant monetary disbenefits as a result of increased Journey Times. This is driven by the reduction of the section speed limit from 70mph to 50mph. Economic Modelling estimates a PVB of around -£670 million from Journey Time increases between Junctions 35-38.*
Transport Costs	+£71m	*Scheme proposals for average speed enforcement between J35-38 are likely to create benefits in both fuel costs and non-fuel operating costs, where reduced vehicle*

		speeds in turn reduce levels of fuel consumption. Economic Modelling estimates VOC (Vehicle Operating Cost) benefits of around £71 million.
Accidents	+£19m	*COBALT analysis indicated that accident rates remain the same for a motorway with speeds between 50-70mph, resulting in no significant change in accident rate benefits in line with TAG. Additional analysis using a 36% accident reduction measure sourced from a literature review, indicates potential benefits of around £19 million, with the introduction of speed enforcement.*
Wider Economic Impacts	-	*With the significant increase in Journey Times as a result of the scheme option, there is potential for reduced economic activity in the area, as more businesses may look to relocate themselves away from the area.*
Capital Costs	£1.3m	*Capital costs for the implementation of average speed enforcement between J35-38 are projected to be £1.3m.*
Revenue Costs	0	*The scheme option is not expected to produce any direct revenue costs.*

Economic Appraisal Process:

Improvements at Junction 36

4.11 Economic impact assessment of the proposals at Junction 36 have been undertaken using a VISSIM model requested from Capita's prior assessment of junction improvements. The full technical note detailing the process of economic appraisal can be found in Appendix A.

Data Sources:

4.12 Outputs from the VISSIM model were provided for this economic assessment. The model covers three scenarios for the base (2014) and forecast year (2030). These scenarios are:

- AM Peak Hour (08:00 to 09:00)
- PM Peak Hour (16:00 to 17:00)
- Saturday PM (12:00 to 13:00)

4.13 The data exported from the models has been fed into the economic modelling, including:

- Traffic Flows: turning movements (total vehicles) by entry to exit movement
- Travel time through junction (seconds) by entry to exit movement
- Distance between each arm

Data Analysis:

4.14 A spreadsheet-based approach was utilised using the outputs from the VISSIM model provided to produce a BCR for the scheme option.

4.15 Travel times and traffic flows through the junction have been used to compare the journey time differences between the Do Minimum (DM) and Do Something (DS) scenario. As the micro-simulation model only covers the three peak hours (AM, PM and Saturday), annualised flows have been aggregated from these proportionally. Whilst this method will over-estimate benefits during these periods, as benefits have not been calculated over the rest of the day, overall benefits will likely be underestimated.

4.16 The difference in journey time calculation between the DM and DS has been used as a basis for calculation of user benefits in the economic analysis.

Economic Analysis:

4.17 The economic assessment of each of three junctions follows cost-benefit analysis guidance found in TAG Unit A1.1 and TAG Unit A1.3. Having obtained the AADT flows for the base year 2019 from the DfT database, the flows were estimated over the 60-year appraisal period (with a scheme opening year of 2025 assumed).

4.18 The aim of the cost benefit analysis is to estimate the scheme induced consumer surplus changes, along with any monetisable changes to the environment and accident numbers. Therefore, the elements accounted for within the cost benefit analysis have undergone assessment to determine the change in surplus that results from the proposed scheme. The main factors accounted for within the cost benefit analysis are:

- Change in journey times (JT);
- Change in Vehicle Operating Costs (VOC);
- Change in Emissions (Carbon Dioxide (CO2)) and;

- Change in number of Accidents.

4.19 Economic analysis was undertaken to analyse the impact of the scheme. The various outputs arising from the factors accounted for in the economic analysis were then summed to provide a final Present Value of Benefits (PVB). Then, following calculation of Present Value of Costs (PVC) from construction cost estimates, a BCR has been calculated.

Economic Appraisal:

4.20 The outcomes of individual benefit analysis are summarised within Table 10, as well as in the option appraisal table above. It has been estimated there could be a PVB of around £80 million, with the majority of benefits attributed to journey time savings through the junction.

Table 10. J36: Present Value of Benefits

	Present Value of Benefits (in £,000s)
JT Savings	£75,323
VOC	£2,022
Emissions	£450
Total	**£77,795**

4.21 The scheme costs have been estimated and are shown in Table 11. The scheme costs have been discounted to 2010 prices. It has been assumed that all of the scheme costs are spent in 2025 and there are no additional costs of maintenance as a result of the scheme (in either do minimum or do something) assumed in this assessment. The costs include a 15% optimism bias and a risk budget but there is no VAT.

Table 11. J36: Scheme Costs

Scheme	Scheme Cost (2020 base year cost)	Scheme Cost (2010 prices, discounted to 2010)
J36	£43,645,145	£21,086,691

4.22 The final NPV (Net Present Value) and BCR (Benefit to Cost Ratios) are shown in Table 12. The NPV calculates the total benefits minus the scheme costs (PVB-PVC), and the BCR is the ratio between the benefits and cost (PVB/PVC). This shows that considering only peak benefits, it is estimated there could be a NPV of around £55 million leading to a BCR of 3.69.

Table 12. J36: NPV and BCRs

Present Value of Costs (PVC)	£21,087
Present Value of Benefits (PVB)	£77,795
Net Present Value (NPV)	**£56,709**
Benefit to Cost Ratio (BCR)	**3.69**

Sensitivity Testing:

4.23 Analysis has been undertaken of the scheme's levels of value for money if costs or benefits were to change. Table 13 indicates that with 50% higher scheme development cost the scheme would still achieve a BCR of >2. Similarly Table 14 indicates that if benefits reduced by 50% the scheme would achieve a BCR >1.5.

Table 13. J36: NPV and BCRs – 50% higher costs

Present Value of Costs (PVC)	£31,630
Present Value of Benefits (PVB)	£77,795
Net Present Value (NPV)	**£46,165**
Benefit to Cost Ratio (BCR)	**2.46**

Table 14. J36: NPV and BCRs – 50% lower benefits

Present Value of Costs (PVC)	£21,087
Present Value of Benefits (PVB)	£38,897.89
Net Present Value (NPV)	**£17,811**
Benefit to Cost Ratio (BCR)	**1.84**

Limitations of analysis and economic appraisal:

4.24 The economic analysis of this scheme has been undertaken with a methodology appropriate and proportionate for the early stage of scheme sifting, and scheme design. As such there are limitations on the completeness of the economic appraisal in terms of impacts considered and detail of assessment.

4.25 For this junction improvement scheme, these limitations include:

- Economic benefits have not been estimated for periods outside of the AM and PM weekday and Saturday peak times due to lack of data available. However, it is likely that these benefits, although not as significant, may add some economic value to the scheme.
- Economic benefits associated with addressing specific accident 'black spots' through scheme implementation have not been identified or quantified
- Economic benefits associated with addressing air quality in local areas of specific concerns, for example AQMAs, have not been identified or quantified.
- Economic benefits or disbenefits associated with air quality changes from changes in vehicle queue patterns have not been identified or quantified
- Economic benefits or disbenefits associated with vehicle operating cost of junction users have not been identified, modelled or quantified
- Economic disbenefits during construction have not been accounted for at this stage.

J35-38 – Average Speed Enforcement

4.26 For economic assessment of the Average Speed Enforcement proposals, a spreadsheet-based approach has been used as opposed to utilising the South East

Wales Transport Model (SEWTM). Professional judgement dictated that the implementation of a reduced speed limit from 70mph to 50mph on the motorway will not cause a noticeable redistribution in traffic as there are no other comparable alternative routes.

4.27 The spreadsheet has been developed through the utilisation of observed speed and flow data alongside Transport Analysis Guidance (TAG) guidance. In addition, the economic assessment has also been undertaken using relevant TAG guidance. The proposed opening year of the scheme is 2023. The full technical note detailing the process of economic appraisal can be found in Appendix B.

Data Sources:

4.28 To account for the effects of the Covid-19 pandemic, economic assessment for the option used data from October 2019. This data included:

- Observed Speed Data: This utilised the INRIX traffic analysis database that details vehicle speeds across the network taken primarily from mobile devices within vehicles, and downloaded in one-minute intervals across the whole of the month split by direction and section. This data was subjected to suitable cleaning methods before use.
- Count Data: DfT count data was downloaded from their count database which outlines a one-day 12-hour count as well as an estimated AADF for a specified link. Where DfT count data was not available, estimates were made based on existing data sources and count or model data provided by TfW from the South East Wales Transport Model (SEWTM).

Data Analysis:

4.29 To assess the impact of the proposed scheme, two scenarios have been created, a Do-Minimum (DM) and a Do-Something (DS) scenario. The DM scenario represented conditions with unconstrained speeds.

4.30 In the absence of a strategic model, assumptions have been made to estimate the impact of the scheme using the observed speeds on the speeds and journey times of vehicles travelling through the scheme. It has been assumed that the flows will remain the same with and without the scheme in place, but that the scheme would alter vehicle speeds (with all vehicles travelling at the limit of 50mph).

4.31 Using the speed data, the journey times for each minute were calculated for the DM and DS scenarios. From this, the total journey times per vehicle were calculated for each scenario to be fed into the economic assessment.

Economic Analysis:

4.32 The economic assessment of the M4 Junction 35 to 38 speed reduction scheme follows cost-benefit analysis guidance found in TAG Unit A1.1 and TAG Unit A1.3. Having obtained the AADF for the base year 2019 from the DfT database, the flows were estimated over the 60-year appraisal period (with an scheme opening year of 2023).

4.33 The aim of the cost benefit analysis is to estimate the scheme induced consumer surplus changes, along with any monetisable changes to the environment and accident numbers. Therefore, the elements accounted for within the cost benefit analysis have undergone assessment to determine the change in surplus that results from the proposed scheme. The main factors accounted for within the cost benefit analysis are:

- Change in journey times (JT);

- Change in Vehicle Operating Costs (VOC);
- Change in Emissions (Carbon Dioxide (CO2)) and;
- Change in number of Accidents.

4.34 Economic analysis was undertaken for each individual section, through junctions and by direction (eastbound and westbound). The various outputs from the economic analysis were then summed to provide a final Present Value of Benefits (PVB) for the whole scheme. Present Value of Costs (PVC) were then calculated from construction cost estimates, and a final BCR has been calculated

Economic Appraisal:

4.35 The outcomes of individual benefit analysis are summarised within Table 15, as well as in the option appraisal table above. It shows that despite the positive contributions of the vehicle operating costs and emissions to the total scheme present value of benefit, the disbenefit imposed by the increase in journey time with the scheme in place outweighs the benefits, leading to a total PVB of around -£650 million (with alternative accident benefit included).

Table 15. Average Speed Enforcement PVB

	Present Value of Benefits (WebTAG compliant) in £0,000s	Present Value of Benefits (Alternative) in £0,000s
JT Savings	-£767,236	-£767,236
VOC	£71,246	£71,246
Emissions	£26,380	£26,380
Accidents	-	£18,849
Total	**-£669,610**	**-£650,761**

4.36 The scheme cost estimate has been calculated as £1.3 million, which is £711,036 in 2010 prices. This includes an optimism bias of 15%, a risk budget and exclusive of VAT. For the purposes of this assessment, it is assumed that all the construction costs are spent in the opening year (2023) and there are no assumptions for additional maintenance costs for the Do Minimum or Do Something.

4.37 The final NPV (Net Present Value) and BCR (Benefit to Cost Ratios) are shown in Table 16. The NPV calculates the total benefits minus the scheme costs, and the BCR is the ratio between the benefits and cost.

4.38 This analysis shows that for the WebTAG-compliant economic calculations, it is estimated there could be a NPV of around -£670 million; and, even with the alternative accident rates, there is still a negative NPV of -£651 million. It is not appropriate to quote BCR when both costs are positive and scheme benefits are negative.

Table 16. Average Speed Enforcement NPV and BCR

	(WebTAG compliant) in £,000s	(Alternative) in £,000s
Present Value of Costs (PVC)	£711	
Present Value of Benefits (PVB)	-£669,610	-£650,761
Net Present Value (NPV)	-£670,321	-£651,472
Benefit to Cost Ratio (BCR)	N/A	N/A

Sensitivity Testing:

Given the very poor economic performance of this option it was not considered appropriate or necessary to undertake sensitivity testing.

Limitations of analysis and economic appraisal:

4.39 The economic analysis of this scheme has been undertaken with a methodology appropriate for the early stage of scheme sifting, and scheme design. As such there are limitations on the completeness of the economic appraisal (in terms of impacts considered) and detail of assessment.

4.40 For this average speed reduction scheme, these limitations include:

- economic benefits associated with addressing specific accident 'black spots' through scheme implementation have not been identified or quantified
- economic benefits associated with addressing air quality in local area of specific concerns, for example AQMAs, have not been identified or quantified.

Value for Money Statement

Improvements at Junction 36

4.41 The economic appraisal of this option indicates a BCR of 3.69, corresponding to a value for money category of High. The quantified economic benefits of the scheme derive principally from journey time savings, but beneficial impacts in terms of vehicle operating costs and emissions were also identified due to reduced delays at the junction. The scheme was also identified to have positive impacts in relation to physical activity, accessibility and severance resulting from improved crossing provisions for NMUs. A negative impact was identified in relation to the loss of some landscaping, which could potentially be mitigated. Sensitivity testing confirmed that this option would continue to represent value for money if costs increased or benefits reduced significantly. Overall it is considered that this option would represent **High** value for money.

J35-38 – Average Speed Enforcement

4.42 As demonstrated in the appraisal summary tables and economic appraisal results a significant economic disbenefit has been identified associated with the implementation of speed enforcement between J35-38 as a result of increasing journey times. Benefits are identified in terms of vehicle operating costs, greenhouse gas emissions and accidents, but these are not sufficient to counteract the journey time disbenefit. Slight beneficial impacts were also identified in relation to noise, journey quality and accessibility, but this option is considered to represent **Poor** value for money across the appraisal areas assessed.

Recommendation

4.43 Based upon the above value for money results and appraisal work outlined in this section, plus the appraisal against objectives presented in the Strategic Case our recommendation is that the Junction 36 improvements scheme is taken forward to WelTAG Stage 3, but that the J35-38 Average Speed Enforcement scheme is discounted at this point. The Commercial and Management Cases have therefore been written based upon this assumption.

5. Financial Case

Introduction

5.1 In the Welsh Government's latest WelTAG report (2017), the financial case is aimed at informing '*whether an option is affordable in the first place and the long-term financial viability of a scheme. It covers both capital and revenue requirements over the life-time of the project and the implications of these for the balance sheet, income and expenditure accounts for public sector organisations'.*

5.2 Funding gaps and potential sources of external funding to meet capital shortfalls should be identified.

Approach to Assessing Affordability

5.3 This WelTAG report represents the Stage Two: Outline Business Case, therefore details informing the financial case will build on the preliminary, qualitative scoping of the Stage One study.

Estimated Scheme Costs

5.4 Initial budget estimates have been developed for each of the proposed schemes based on the concept design drawings that have been prepared. The cost estimates have been based on a combination of benchmarking against other similar projects, along with bottom-up cost estimating using rates and estimated quantities to provide assurances that the cost estimates are reasonably robust. The rates that have been used are based on 2020 prices, with an inflation allowance of 2.1% per year up to the opening year. Appropriate risk and contingency allowances have also been made.

5.5 The scheme cost estimates are summarised in Table 17 below. A detailed breakdown is presented in Appendix C.

Table 17. Estimated Scheme Costs

Scheme Name	Construction Costs	Land Acquisition	Professional Fees	Risk and Contingency	VAT	Inflation Allowance	Total
M4 J35-38 Average Speed Enforcement	£950,000	£-	£61,750	£142,500	£230,850	£44,245	**£1,429,345**
M4 Junction 36	£31,420,000	£500,000	£2,042,300	£3,990,000	£7,590,460	£2,971,751	**£48,514,511**

5.6 A detailed whole life costing exercise has not been undertaken at this stage; however, the proposed schemes are not expected to introduce any significant additional maintenance burden over and above the existing situation.

Funding and Financial Arrangements

5.7 It is likely that there would be an expectation for capital costs to be covered by Welsh Government's Pinch Points Funding. However, there is no guarantee that sufficient funding would be available and therefore all potential options will need to be explored. This could include the following sources:

- Welsh Government as sole funder;
- Joint funding arrangements between Welsh Government, the Local Authorities;

- Developer contributions via Section 106 Agreements; and
- Regional city deals.

5.8 It is not envisaged that a Design Build Finance Operate (DBFO) arrangement would be appropriate for this scale of project.

5.9 Further work will be required through Key Stage 3 to confirm the availability of funding and the financial arrangements.

6. Commercial Case

Introduction

6.1 In the Welsh Government's latest WelTAG report (2017), the commercial case is aimed at measuring *'if a scheme will be commercially viable, whether it is going to be possible to procure the scheme and then to continue it into the future. It focuses in particular on the level and type of involvement of the public sector in each option'*. . The case considers the level and type of involvement from the private sector, as well as potential effects on the on-going viability of the option/ scheme.

6.2 Based upon the recommendations outlined in the Transport Case this Commercial Case assumes that the Junction 36 improvement scheme is the only scheme element to be taken forward to Stage 3.

Procurement Strategy

Full Business Case

6.3 A WelTAG Stage Three study would need to be commissioned to progress development of the full business case for the preferred option. This would be aimed at achieving the appropriate procurement and construction programme in Welsh Government's funding stream requirements. For concept highway schemes, conventional highway procurement approaches appear most feasible for construction elements, alongside detailed modelling of regional impacts of major highway interventions.

6.4 The study would need to undertake the relevant environmental and topographical surveys, together with a ground investigation assessment to support progression of the preferred scheme options at each junction/section of highway. The business case would also require further refinements with additional transport modelling to test the final scheme options and junction designs and update the finalised cost-benefit analysis.

6.5 At this stage it is anticipated that SWTRA would procure the WelTAG Stage Three study via existing framework arrangements on behalf of the Welsh Government, however the proposed procurement strategy is subject to confirmation.

Scheme Implementation

6.6 A consultant, contractor or a combination of both would be required to take the project forward through the statutory process, detailed design, construction and post-implementation. The different procurement options available for this stage are as outlined below:

- Early Contractor Involvement (ECI) – Under ECI, the Contractor is appointed under a two-stage Engineering and Construction Contract before the final scheme design has been fully developed and priced. This procurement method has its advantages where the construction of the project is complex.
- Design and Build (D&B) – Under a Design and Build Contract, the Employer employs a consultant under a Professional Services Contract who takes the project through the design and statutory process. A Contractor with Consultant is then procured to carry out the detailed design and construction of the works. This procurement method is more suited to the simpler projects where an ECI Contractor would not have much to bring the early stages of the design process.
- Employers Design (ED) – With an Employers Design Contract the Employer employs a consultant under a Professional Services Contract who takes the

project through the design, statutory process and into the detailed design process. Once the detailed design is complete a contractor is procured to complete the construction and maintenance works.

6.7 The process of implementation and post-implementation would also need to be captured through formal completion of WelTAG stages four and five respectively. The principle aims of Stage Four and Five is to subsequently record what happens so that lessons can be learnt. They may lead to alterations to the current scheme and will form valuable evidence for use in future WelTAG appraisals. The procurement strategy of these two stages would be subject to confirmation.

Contract Management

Procurement Process

6.8 The procurement process should comply with the corresponding UK Public Contract Regulations 2015 and the Welsh Government Key Stage Approval process.

6.9 Depending on the procurement route selected, and the value of the individual project, it may be necessary to advertise the opportunity on the UK Government's Find a Tender website, particularly for the larger Junction 36 project which exceed the value threshold for the SWTRA framework.

6.10 Consideration will need to be given to the procurement strategy, for example whether to go single stage, or two stage, or open tender or with pre-qualification and only a shortlist of Contractor's invited to tender. Appropriate timescales will need to be built into the delivery programme to ensure that all applicable procurement requirements can be adhered to.

Supplier Options

6.11 The Employer can stipulate where the consultant/ contractor should operate. In addition to this the Employer can insert additional clauses into the contract which stipulates that the employed contractor/ consultant should use make use of local resources/ materials/ suppliers where possible. A percentage of overall costs may also be inserted into the contract which ensures the employed contractor/ consultant complies with the relevant clauses and uses all local resources/ materials/ suppliers.

Payment Mechanisms

6.12 The chosen contract will stipulate what the payment mechanisms/ arrangements are for each stage. However, the employer (Welsh Government and/or SWTRA) may make amendments to these payment process to suit their requirements, with any amendments detailed in the relevant contract documents. If a Target Cost contract is utilised, a pain/ gain mechanism would need to be developed identifying the necessary share. This ensures any over-spend or under-spend is shared between the Employer and Consultant/ Contractor in accordance with these share ranges.

Income Produced and Charging Levels

6.13 Each of the options proposed within the scheme would require on-going revenue support, the extent of which is currently unknown for each proposal.

Risk Allocation and Transfer

6.14 The allocation of risk would need to be covered in a specific project risk register for each scheme, building upon the current risk register presented in Appendix D following risk workshops conducted throughout the project design stage and further in the

construction stage. Allocation of risk would also be specified in the chosen contracts, utilising contract conditions and any additional clauses required by the Employer.

Contract Length

6.15 Within the Contract Notice, the duration of the chosen contract is estimated by providing a given start and end date. In addition, the contract would be structured around key stages, relating to Welsh Government's Transport Division's linear Key Stage Approval process which is used to obtain approval for projects through all stages of design, construction and aftercare. Therefore, it is likely within each key stage within the project, week numbers will be identified which in turn show the overall duration. Depending on the procurement method chosen, the following Key Stages apply:

- Key Stage 3 (KS3) – Preliminary design and preparation of Environmental Statement and draft Orders;
- Key Stage 4 (KS4) – Public Inquiry (if required);
- Key Stage 5 (KS5) – Procure Contractor (this key stage is only used where an Employers Design or Design and Build Contract is utilised, and does not apply to ECI Contracts); and
- Key Stage 6 (KS6) – Detailed Design, Construction and Maintenance (ECI and D&B Stages only, for Employers Design KS6 relates to Construction and Maintenance as Detailed Design is completed during KS4).

Human Resource Issue

6.16 At this stage it is assumed that SWTRA has sufficient resources to take forward the client functions for these schemes. Additional support will be sought via existing framework arrangements as required.

7. Management Case

Introduction

7.1 In the latest WelTAG report (2017), the management case aims to show *'if an option is achievable. This case covers the delivery arrangements for the project and then its management during its life time. It covers the arrangements for the procurement, construction and on-going operation of the intervention, details of the monitoring arrangements and the undertaking of the evaluation plan. The management case should embed the five ways of working'.*

7.2 Based upon the recommendations outlined in the Transport Case this Management Case assumes that the Junction 36 improvement scheme is the only scheme element to be taken forward to Stage 3.

Dependencies with other projects and programmes

7.3 The preferred option outlined within this Stage Two: Outline Business Case, would fall predominantly within the remit of the Congestion Pinch Points Programme led by Network Management alongside the relevant Local Authorities. Delivery of this programme would be a collaborative process:

- The provision of the Alternatives to M4 Travel Interventions would sit within the remit of Welsh Government Policy and Planning, working alongside SWTRA to deliver the scheme with appropriate input from relevant local stakeholders where necessary. Other key partners would include Transport for Wales, Network Rail and alternative transport operators such as the bus companies;
- Partnerships would be required with the relevant local authorities directly impacted by the scheme, and hence Bridgend County Borough Council and Neath Port Talbot County Borough Council will need to be included as partners in the delivery process;
- There are a significant number of transport schemes and initiatives in development or delivery phases in the study corridor and it is important that liaison and collaboration is maintained with local authorities to ensure that the policy, programme, and operational aspects of schemes are aligned and co-ordinated.
- Public engagement will be needed to fully understand local public acceptability of the schemes proposed.

Programme/Project Plan

7.4 How the project is to be delivered is to be determined at the next stage, however there are three main options available for procuring the works:

- ECI Contract;
- Design and Build Contract; or
- Construct-only Contract.

7.5 Under an ECI arrangement the Contractor would be appointed at the end of Key Stage 2 and would be responsible for delivering the scheme through Key Stages 3, 4 and 6. Welsh Government has successfully used ECI contracts on a number of schemes including the A40 Penblewin to Slebech Park, A477 St Clears to Red Roses and A465 Heads of the Valley Dualling, Sections 2 and 3.

7.6 Under a Design and Build arrangement, the Contractor would be appointed at the end of Key Stage 4 and would be responsible for delivering the scheme through Key Stages 5 and 6.

7.7 Under a Construct-only arrangement, the Contractor would be appointed at the end of Key Stage 5 to carry out Key Stage 6 only. Under this arrangement the Client would appoint an Employer's Designer to carry out the detailed design.

7.8 Given the scale of the Junction 36 proposals, the scheme could lend itself to ECI delivery, especially because the construction methodology will have a significant bearing on the impact of the scheme and hence will influence the design. Alternatively, it could be delivered under a Design and Build arrangement but the scheme is likely to be too large for a construct-only arrangement which would reduce the Employer's ability to share risk with the Contractor. Furthermore, a scheme of this value would exceed the threshold that can be delivered via the SWTRA framework, which is traditionally a construct-only contract.

7.9 Whichever procurement method is chosen, the project will need to align with the Welsh Government Approvals Process. The KSA process provides a staged financial approval system to manage the process of projects from inception, through to construction and initial maintenance and complies with the principles of PRINCE2 project management: Milestones, and Approvals.

7.10 An initial delivery programme has been developed as presented in Appendix E, which sets out the likely timescales for each of the Key Stages. It should be noted that the timescales would be subject to change depending on which procurement option is selected.

7.11 The key milestone dates have been extracted from the programme and are presented in Table 18 below for reference.

Table 18. Programme Milestone Dates

		KS2	KS3	KS4	KS4	KS6
M4 Junction 36	Duration	8 months	18 months	12 months	7 months	18 months
	Start	28/09/2020	07/06/2021	19/12/2022	18/12/2023	29/07/2024
	Finish	04/06/2021	16/12/2022	15/12/2023	26/07/2024	06/02/2026

Delivery Methods

7.12 To be reviewed and updated.

Programme/Project Reporting

7.13 The project would be managed following the principles of the PRINCE2 project management process combined with a compatible web-based project management system. The key stages of the project will form the Stage Boundaries within PRINCE2 and will require Project Board approval.

7.14 The project could potentially be led by the Welsh Government (potentially through SWTRA) as the Employer. The Employer will also include other individuals and departments within the local authority identified by the Project Engineer and Project Director for the delivery of the project.

7.15 Interaction with the Employer, unless otherwise agreed, will be made through the Project Director or the Project Engineer as identified within the contract documents (once the procurement route has been determined).

7.16 Progress meetings should be held at monthly intervals with the Designer, Contractor, Employer's Agent and Employer. Quarterly Financial Review meetings should also be utilised to discuss financial matters and to ensure the project stays on track within budget and to agreed timescales.

Legal Requirements

7.17 The Highway scheme would be required to conform to all legal requirements and will be delivered under the Highways Act 1980. Land required for the Scheme will be acquired via the Acquisition of Land Act 1981 via a Compulsory Purchase Order.

7.18 Design and construction of the project should be undertaken with due consideration of the following key items:

- Construction (Design and Management) Regulations 2015;
- Equality Act 2010;
- Active Travel (Wales) Act 2013;
- The Wellbeing and Future Generations (Wales) Act 2015;
- Wales Act 2017 and Welsh Language Standards (Welsh Ministers, County and County Borough Councils, and National Park Authorities) Regulations 2015; and
- The project should also conform to all EU and UK Environmental Legislation.

Environmental and Health Impact Assessments

7.19 The Health Impact Assessment (HIA) supports the Welsh Assembly Government Public Health Strategic Framework for Wales. The process considers the wider effects of local and national policies or initiatives and how they, in turn, may affect people's health. The HIA also helps to identify whether the scheme could lead to differences in health and well being, where the differences are unfair, but avoidable.

7.20 No HIAs have been completed at this stage, however, will be completed at Stage 3 WelTAG upon appraisal of the final scheme.

Governance, organisational structure and roles

Organisational Structure

7.21 Depending on the type of procurement method used for further design and construction, the anticipated core parties involved in the delivery of the project would be:

The Client

- The Employer: representing the Welsh Government;
- The Employer's Agent: acting as the Welsh Government's representative, providing financial, project management and technical advice throughout the project.

Design and Build Contract

- Contractor: commissioned to undertake detailed design, construction and aftercare of the project;

- Contractor's Designers: commissioned by the Contractor to carry out the preliminary environmental and engineering design for the preferred route, as well as undertake all activities necessary for the publication of orders, and procure the Contractor.

ECI Contract (ECI)

- ECI Contractor: commissioned to develop the outline design, prepare the necessary statutory orders and EIA documentation, publish draft Orders, progress the project through the statutory process, including Public Inquiry if required and, if successful, then to undertake the detailed design, construction and aftercare of the project.
- ECI Contractor's Designers: employed by the ECI Contractor to carry out the preliminary environmental and engineering design for the preferred route, as well as undertake all activities necessary for the publication of orders, and to complete detailed design.

Employer's Designer (ED)

- Contractor: commissioned to undertake construction and aftercare of the project
- Designers: commissioned by the Employer to carry out the preliminary environmental and engineering design for the preferred route, as well as undertake all activities necessary for the publication of orders, Detailed Design and procure the Contractor

Assurance and approvals plan

Communication and stakeholder management

7.22 To ensure the management of stakeholders and communication on the project is managed correctly, a Communications Plan should be drafted which identifies how all communications between project team members and external parties will be managed. All parties adhering to the communications plan should ensure that the needs of the Employer are met, and the project is delivered successfully.

7.23 Continuing on from the stakeholder engagement activities undertaken during Stages One and Two (as described in Section 3 of this report), it is envisaged that the following stakeholders will be activity engaged through Stage Three:

- Emergency Services (Ambulance, Fire and Police);
- The general public (through public exhibitions and the like);
- Landowners (where land acquisition is required);
- Local Authorities (Bridgend County Borough Council, Neath Port Talbot County Borough Council and Swansea Council);
- Local Businesses (Amazon, DVLA, Ford, McArthur Glen, Sarn Park Services, Welcome Break, etc.);
- Local Developers (for example St. Modwen at Coed Darcy);
- Natural Resources Wales (NRW has not been actively engaged as of yet, but will need to be consulted during the preliminary design);
- Network Rail (for any proposals affecting existing rail infrastructure);
- Sustrans;
- SWTRA;
- Swansea Bay University Health Board;

- Transport for Wales (TfW); and
- Welsh Government.

7.24 The aim of the ongoing engagement will be to ensure all potential opportunities are captured in the preliminary design, to identify potential concerns and address these through the preliminary design and to keep stakeholders informed of the progress and likely timescales for the next steps.

Risk Management Strategy

7.25 Risk will be managed on the project in accordance with the procedures set out in the latest version of the Value for Money Manual – Risk Analysis and Management.

7.26 A risk workshop should be conducted early in the next stage of the project (WelTAG Stage Three). The current Risk Register, as presented in Appendix D, should be developed further and then reviewed and updated (where required) as a minimum every three months throughout the project's life.

7.27 The current top ten risks are presented in Table 19 below. Reference should be made to the risk register presented in Appendix D for further detailed analysis and further risks and opportunities that have been identified.

Table 19. Top 10 Risks

Risk Description	Impact	Proposed Mitigation	Residual Risk Ranking
Construction of the Junction 36 works would cause significant disruption, resulting in the benefits being negated by the disbenefits caused during construction.	Benefits may not be fully realised and the scheme may be called into question.	Ensure the construction impacts are fully quantified at Key Stage 3.	16
Utilities diversions may increase the cost estimates.	The scheme may longer be considered viable if the cost escalates.	Include appropriate risk allowances and contingencies in the cost estimates. Begin consultations with Statutory Undertakers as early as possible.	12
Cost estimates could escalate due to unknowns or inaccurate assumptions.	The scheme may longer be considered viable if the cost escalates.	Include appropriate risk allowances and contingencies in the cost estimates.	12
A shortage of construction labour, plant and materials due to other large scale infrastructure projects being delivered concurrently may affect deliverability.	A delay to scheme delivery due to lack of resources.	Ensure strategic planning taking into account wider industry. Include appropriate contingencies in cost estimates to allow for potential cost increases due to demand.	9
The scheme designs may need to be updated once	The cost estimate may escalate.	Include appropriate risk allowances and contingencies in the cost	9

Risk Description	Impact	Proposed Mitigation	Residual Risk Ranking
topographical survey information is available.		estimates. Obtain topographical survey information as early as possible.	
Additional retaining walls may be required to deal with level differences.	The cost estimate may escalate.	Include appropriate risk allowances and contingencies in the cost estimates.	9
Ecological survey seasons could be missed.	There could be programme delays.	Plan to undertake ecological surveys as early as possible and consider the ecology seasons when planning the project delivery.	9
Land acquisitions may delay delivery and introduce additional costs.	There may be cost increases and programme delays.	Include programme contingencies and risk allowance. Begin liaison with affected land owners as early as possible.	9

Benefits Realisation

7.28 The Benefits Realisation Plan allows benefits that are expected to be generated by the scheme implementation to be planned for, monitored, and achieved. It provides details of the key activities that will facilitate the success of the expected benefits arising from the scheme.

7.29 Desired outputs are those tangible effects that are funded and produced directly as a result of the scheme. Desired outcomes are the final impacts brought about by the scheme in the short, medium, and long term, and can be considered as the main benefits expected to be brought about by the implementation of the scheme

7.30 The Benefits Realisation Plan also outlines the benefit measurement methods and baseline data requirements associated with the scheme; and highlights responsibilities and resources required to monitor and supervise the Plan.

7.31 A high-level Benefits Realisation Plan (BRP) has been prepared for the scheme, see Appendix F, and will be updated during Stage 3 WelTAG.

Monitoring & Evaluation

7.32 The purpose of the Monitoring and Evaluation Plan (MEP) is to identify how the actual scheme delivery, including wider scheme impacts, construction and budget management, are to be evaluated. The Monitoring and Evaluation Plan will culminate with a Post Implementation evaluation at one and five years after scheme opening.

7.33 The scope of the MEP includes a detailed process evaluation of how the scheme will be delivered, considering any changes in schedules, costs and design elements. This would be undertaken during the scheme's implementation. This review will be completed approximately one year following scheme opening. A key output of the review will be the lessons learnt log, which will assist in planning and delivering future schemes.

7.34 Some of the Monitoring that would be required to be undertaken during the life of the project are outlined below:

- Environmental aftercare;
- Annual Environmental Performance and Monitoring Report (AEPMR);
- Health and Safety File; and
- Safety audits following completion of design and then construction works.

7.35 The evaluation will also consider the outcomes/impacts delivered by the scheme, planned for one and five years after the scheme has opened. This includes:

- Collection of pre-opening baseline data to assist with monitoring.
- One year after study – data collection and report to assess each key benefit against the baseline.
- Five Year After Study – Expands on the findings of the year one data collection and report to assess each key benefit against the baseline.

7.36 Unexpected (dis)benefits – identifying any additional impacts that were not planned for as part of the scheme.

7.37 The evaluation will also include the re-assessment of the scheme's value for money, considering changes in scheme costs and outturn benefits realised.

7.38 WelTAG 2017 includes the requirement for a detailed monitoring and evaluation plan to be drawn up in Stage Three. This plan would describe what evidence would be used in the project's evaluation report and how it will be collected. A high-level MEP is set out in Appendix G, which will be expanded on further during Stage 3 WelTAG.

8. Next Steps

Summary

8.1 This Stage 2 WelTAG assessment has considered a range of options to improve the transport network between Junction 35 and Junction 38 of the M4. A detailed appraisal of potential options has identified that the Junction 36 Improvement scheme represents High value for money and it is recommended that this option should be taken forward for further appraisal at Stage 3.

8.2 We recommend that the following steps are taken to progress the study:

- That the Review Group should approve the recommendations of this study so that the Stage 3 business case work can be commissioned, taking forward the preferred option for upgrading Junction 36.
- That an appropriate methodology for the Stage 3 assessment should be established.
- That a construction impacts assessment should be undertaken to quantify the likely significant adverse impacts that will be suffered during construction so that the implications for the overall cost benefit can be understood. This should include early engagement with contractors to understand the likely approach to construction.
- That the Junction 36 design should be refined and optimised to address the comments received during stakeholder engagement, particularly with respect to Active Travel measures and provision for buses.
- That an assessment should be carried out on the existing bridge to confirm if it can be reconfigured to accommodate the revised layout.
- That further consideration should be given to the longer term aspirations for Junction 36 so that opportunities can be identified to refine the design and enable a phased approach to implementing the preferred option F14 so that F09 can potentially be implemented in the future.
- That the need for land acquisition should be determined so that draft orders can be prepared if required.
- That a detailed cost estimate should be prepared for the scheme and that a quantified risk assessment should be undertaken.
- That early engagement should be undertaken with Statutory Undertakers to identify any significant constraints.
- That the procurement strategy should be finalised so that a preferred procurement route can be agreed.
- That seasonal ecology surveys should be undertaken to avoid programme delays.
- That the baseline data collection recommended in the Monitoring and Evaluation Plan is undertaken. This should include further NMU surveys to enable Active Travel benefits to be demonstrated post-construction.
- That a detailed communications plan should be prepared to ensure appropriate engagement with key stakeholders.
- That a Health Impact Assessment should be undertaken.

Appendix A Economic Appraisal Methodology - M4 Junction 36

Technical Note

Technical Note: SWTRA M4 J36 – Economic Assessment of Junction Improvement Scheme

Project name	Date	Project number	Prepared by
SWTRA M4 J35-J38	11/05/2021		Daniel Purkis
Approved by	**Checked by**	**Verified by**	
Lindsey Kinver	Daniel Aldridge	Daniel Aldridge	

1 Introduction

Background

1.1 AECOM have been commissioned to deliver a Stage 2 Outline Business Case (OBC) which is built upon the findings of the Stage 1 Welsh Transport Appraisal Guidance (WelTAG) Strategic Outline Case (SOC) developed for the M4 between Junction 35 and 38 by Arcadis on behalf of the Welsh Government.

1.2 As part of this study, improvements have been suggested for at junction along the M4 J36. These junctions have been assessed by Capita using VISSIM. The model and reports have been requested from Capita and this note covers the economic assessment using outputs from this model. The reports that detail the VISSIM modelling include:

- M4 Junction 36 Improvements Final Report (October 2014)
- Junction 36 Of the M4 VISSIM Modelling (October 2017)

2 Scheme Information

2.1 The CAPITA modelling includes reference to two schemes for J36, Option 2 and Option 3. It has been discussed with SWTRA that only Option 2 is being tested.

2.2 This scheme is shown in Figure 1. The scheme includes a hamburger style link through the junction and some widening of the approach arms as well as a signalised gyratory.

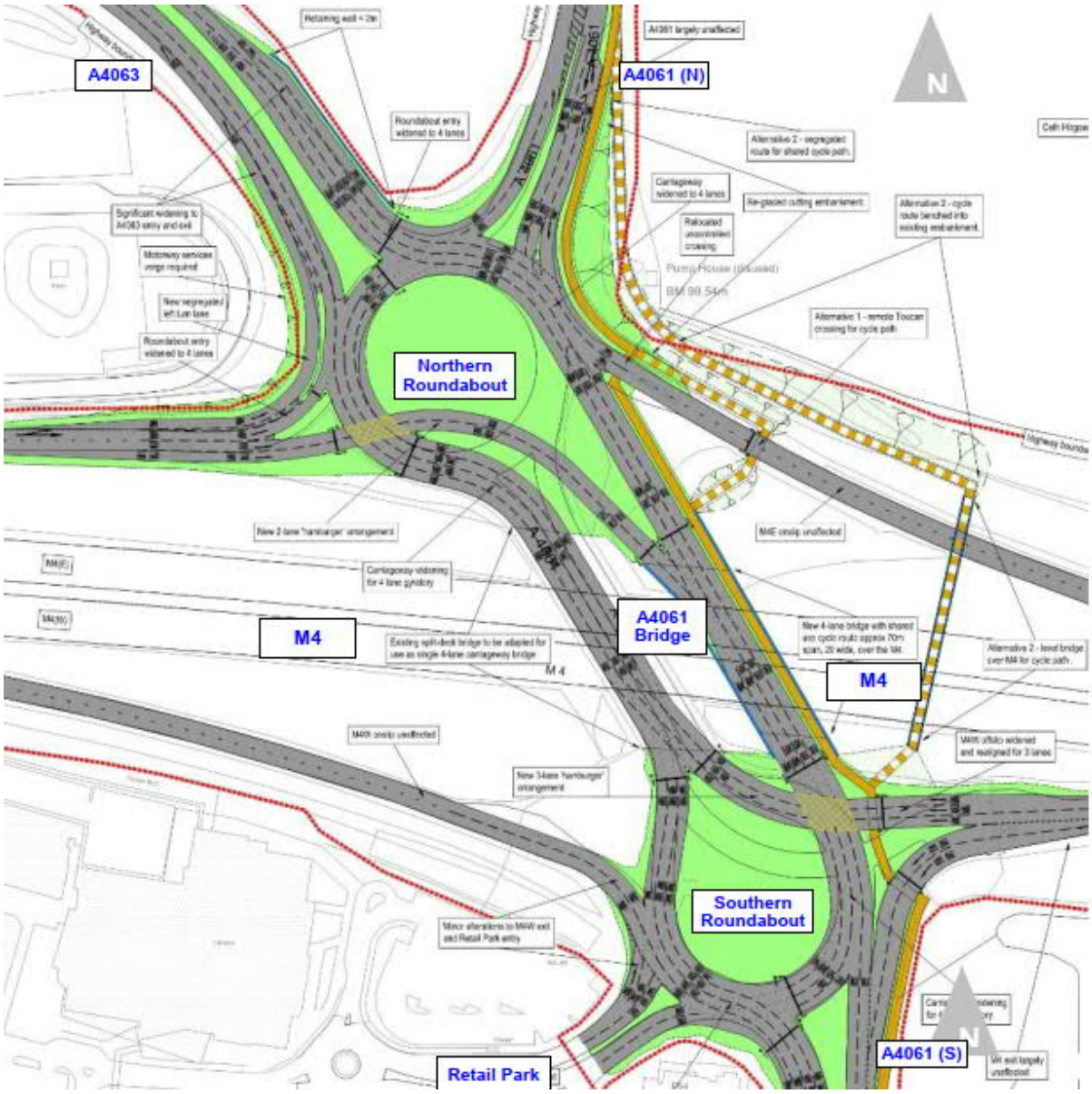


Figure 1: J36 Option 2

3 Junction Models

3.1 The outputs from the VISSIM model have been provided. From this, a spreadsheet-based approach has been used to produce a BCR for this scheme.

3.2 The VISSIM models covers three scenarios for the base (2014) and forecast year (2030). The scenarios are;

- AM Peak Hour (08:00 to 09:00)
- PM Peak Hour (16:00 to 17:00)
- Saturday PM (12:00 to 13:00)

3.3 The data has been exported from the models to feed into the economic modelling – this includes:

- Traffic Flows: turning movements (total vehicles) by entry to exit movement
- Travel time through junction (seconds) by entry to exit movement

- Distance between each arm

4 Data for Economic Analysis

4.1 Data has been provided from these models which have been built to assess the junction improvements. These travel times and traffic flows through the junction have been used to compare the journey time differences between the DM and DS scenarios for each junction. For each model, the flows, distance and journey time

4.2 For economic analysis, there is a need to calculate annualised flows. As the microsim model only covers the three peak hours (AM, PM and Saturday), it has been decided to only assess the benefits during these hours. Looking at the count data provided within the VISSIM model reports, the calculations are as follows:

- AM peak hour and PM peak hour will cover a three-hour period each, by multiplying the flows from the models by three. Then to annualise this figure, the results is multiplied by 253.
- The flows from the Saturday peak hour will be multiplied by 4 to give a Saturday period. Then multiplied by 52 to give data for a full year (52 Saturdays in a year)

4.3 Using this method will over-estimate the benefits during these periods, given that the flow in the rest of the calculated period are lower than the modelled hour. However, as we are not calculating benefits over the rest of the day (e.g. Sundays, between 10:00 and 16:00 on a weekday), we are likely to be underestimating the total benefits overall.

4.4 Table 1 below shows the total traffic flow and average difference in journey time per vehicle for Junction 36.

Table 1:J36 – Total Traffic Flow and Average Difference in Journey Time per vehicle between DM and DS

	Annual Average Daily Flow – (AM peak hour * 3 + PM peak hour * 3 - Monday to Friday)		Annual Average Daily Flow (Saturday peak hour * 4)		**Average Difference In Journey Time Per Vehicle** (DM-DS) in minutes			
					AM and PM Peak		Saturday	
Year	Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy
2030	37,514	904	22,728	548	1.31	1.19	0.21	0.25

4.5 The table shows that there is an average decrease in over one minute per vehicle in the peak hours with the Do Something scheme in place using 2030 flows. This leads to a greater difference between Do Something and Do Minimum travel times in future.

4.6 The difference in journey time calculation has been used as a basis for calculation of user benefits in the economic analysis.

5 Economic Analysis

Introduction

5.1 The economic assessment of each of three junctions follows cost-benefit analysis guidance found in TAG Unit A1.1 and TAG Unit A1.3. This outlines a 60-year economic assessment assuming the opening year is 2025.

5.2 The following section will go through each of the factors accounted for in the economic analysis of the scheme and the guidance that was used in order to facilitate the economic calculations.

5.3 The economic assessment has been undertaken using a cost-benefit analysis spreadsheet. This spreadsheet mirrors the calculations that are undertaken by TUBA, which is generally used when a scheme has been assessed using a strategic model. As only one modelled year is available, National Road Traffic Forecasts (NRTF) have been used to growth flows over the 60 year appraisal period and it has been assumed that there is a constant time saving over time.

5.4 Having obtained the AADT flows for the base year 2019 from the DfT database, the flows were estimated over the 60 year appraisal period (with an scheme opening year of 2025) which is in line with tag guidance in TAG Unit A1.1 and the HMT's Green Book.

5.5 The aim of the cost benefit analysis is to estimate the scheme induced consumer surplus changes, along with any monetisable changes to the environment and accident numbers. Therefore, the elements accounted for within the cost benefit analysis will undergo an assessment to determine the change in surplus that results from the proposed scheme. The main factors accounted for within the cost benefit analysis are;

- Change in journey times (JT)
- Change in Vehicle Operating Costs (VOC),
- Change in Emissions (Carbon Dioxide (CO_2) and;
- Change in number of Accidents.

5.6 Economic analysis was undertaken to analyse the impact of the scheme. The various outputs arising from the factors accounted for in the economic analysis were then summed to provide a final Present Value of Benefits (PVB). Then, following calculation of Present Value of Costs (PVC) from construction cost estimates, a BCR has been calculated.

Change in Journey Time

5.7 TAG Unit A1.3 states that the changes in travel time resulting from an intervention need to be converted into monetary values using the TAG Data Book Value of Travel Time Savings parameters.

5.8 For this scheme, it is expected that journey times will decrease with the scheme in place. Given this, the journey time benefits outputted by the overall scheme will be positive, indicating a journey time benefit and increase in traveller surplus.

Change in Vehicle Operating Costs (VOC),

5.9 The calculations for the VOC are based on the guidance given in TAG Unit A1.3. The magnitude of VOC is dependent on the amount of fuel costs and non-fuel costs, which are both heavily impacted by the speed at which a vehicle is travelling

5.10 Given this scheme changes junction layouts, where speeds are already limited, speeds are unlikely to make a large impact on VOC's. This scheme is adding signals to the gyratory which will negatively impact speeds, however the adding of capacity on some approaches and the addition of a lane through the centre of the junction may positively impact speeds and therefore vehicle operating costs. There is likely to be a small reduction in both fuel costs and non-fuel operating costs with the scheme in place which will be expected to lead to a small benefit.

Change in Emissions (Carbon Dioxide (CO_2)

5.11 TAG Unit A3 provides guidance on how road-based fuel consumption related carbon dioxide emissions for the Do-Minimum and Do-Something scenarios can be estimated. In addition, TAG Unit A1.3 provides guidance on how fuel consumption can be first calculated for both scenarios.

5.12 Upon calculating the fuel consumption figures, TAG Unit A3 specifies the method of using the TAG Databook to convert calculated consumption figures into kilograms of CO_2, which can then be converted in a monetary cost.

5.13 One of the main inputs into the fuel consumption equation outlined in TAG unit A1.3 is vehicle speed. The speed is a factor in the magnitude of the consumption, with higher speeds resulting in a higher fuel consumption.

5.14 As with VOCs, Given this is junction scheme, speeds are unlikely to dramatically change to make a large impact on VOC's. There is expected to be a small benefit with reduced congestion and faster speeds with the scheme in place.

Change in Accident Rates

5.15 As this is a junction scheme, the economic impact of the change in accident rates has not been calculated. It would be expected that if this was taken forward to Stage 3 that the benefits of accident rates would be looked at in more detail on a junction specific basis, with consideration of historic accident data.

6 Scheme Benefits

6.1 As already mentioned, the benefits are based on the AM and PM peak periods and four hours on a Saturday. As the VISSIM model is based on a peak hour, we are over-estimating the number of trips during the peak period (as in reality, flows are slightly lower in the hours within the period that are outside of the peak) but the economic assessment does not considered the benefits outside of these periods. In reality there may be some benefits outside of these modelled periods and should be considered if the scheme is to taken forward to the next stage.

Table 2 shows the breakdown of benefits for J36, assuming benefits for the AM and PM peak periods and Saturday peak period only. It has been estimated there could be a PVB of around £80 million, with the majority of benefits attributed to journey time savings through the junction.

Table 2: J36: Present Value of Benefits

	Present Value of Benefits (in £0,000s)
JT Savings	£75,323
VOC	£2,022
Emissions	£450
Total	£77,795

7 Scheme Costs

7.1 The scheme costs have been estimated and are shown in Table 3. The scheme costs have been provided in 2010 prices. It has been assumed that all of the scheme costs are spent in 2025 and there are no costs for maintenance (in either do minimum or do something) included in this assessment. The costs include a 15% optimism bias with an additional risk budget but there is no VAT.

Table 3: Scheme Costs (in 2010 prices)

Scheme	Scheme Cost (2020 Base Cost)	Scheme Cost (2020 prices) assumed to spent in 2025	Scheme Cost (2010 prices, discounted to 2010)
J36	£43,645,145	£36,564,000	£21,086,691

8 Final NPV and BCR

8.1 The final NPV (Net Present Value) and BCR (Benefit to Cost Ratios) are shown in Table 4. The NPV calculates the total benefits minus the scheme costs (PVB-PVC), and the BCR is the ratio between the benefits and cost (PVB/PVC).

Table 4: NPV and BCRs – J36

(in 0,000s)	
Present Value of Costs (PVC)	£21,087
Present Value of Benefits (PVB)	£77,795
Net Present Value (NPV)	£56,709
Benefit to Cost Ratio (BCR)	3.69

8.2 This shows that considering only peak benefits, it is estimated there could be a NPV of around £56 million leading to a BCR of 3.69.

9 Limitations of analysis and economic appraisal

9.1 The economic analysis of this scheme has been undertaken with a methodology appropriate for the early stage of scheme sifting, and scheme design. As such there are limitations on the completeness of the economic appraisal in terms of impacts considered and detail of assessment.

9.2 For this junction improvement scheme, these limitations include:

- Economic benefits have not been estimated for periods outside of the AM and PM weekday and Saturday peak times due to lack of data available. However, it is likely that these benefits, although not as significant, may add some economic value to the scheme.
- Economic benefits associated with addressing specific accident 'black spots' through scheme implementation have not been identified or quantified
- Economic benefits associated with addressing air quality in local areas of specific concerns, for example AQMAs, have not been identified or quantified.
- Economic benefits or disbenefits associated with air quality changes from changes in vehicle queue patterns have not been identified or quantified
- Economic benefits or disbenefits associated with vehicle operating cost of junction users have not been identified, modelled or quantified

Appendix B Economic Appraisal Methodology - M4 Junctions 35 to 38 Average Speed Enforcement

Technical Note

Technical Note: SWTRA M4 J35-J38 – Speed Reduction Scheme

Project name	Date	Project number	Prepared by
SWTRA M4 J35-J38	04/05/2021		Ejaz Din
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1 Introduction

Background

1.1 AECOM have been commissioned to deliver a Stage 2 Outline Business Case (OBC) which is built upon the findings of the Stage 1 Welsh Transport Appraisal Guidance (WelTAG) Strategic Outline Case (SOC) developed for the M4 between Junction 35 and 49 by Arcadis on behalf of the Welsh Government.

1.2 The M4 Junction 35 to 38 crawler lane scheme is part of a series of projects assessed as part of the Stage 2 OBC. These schemes are principally aimed at tackling road-based congestion along some of the most severely affected locations on the Welsh Government Trunk Road and Motorway Network.

Technical Note purpose and structure

1.3 This technical note covers the analysis of the speed reduction scheme between Junction 35 and 38, focusing on the transport modelling and economic assessment of the scheme. This will outline any benefits or disbenefits incurred by introducing a reduced speed limit alongside Average Speed Enforcement (ASE) measures which aims to address incidences of speeding and improve road safety.

1.4 Following this introductory section, the remainder of this Technical Note is structured as follows:

- Section 2 looks into the scope of the assessment carried out;
- Section 3 outlines the data sources;
- Section 4 presents an analysis of traffic data;
- Section 5 discusses the findings of the economic analysis undertaken; and
- Section 6 summarises the findings of the analysis

2 Scope of Assessment

2.1 For this assessment a spreadsheet-based approach has been used as opposed to utilising the South East Wales Transport Model (SEWTM). One of the main reasons for using a strategic model is to understand the wider redistribution of traffic with a scheme in place. However, professional judgement states that the implementation of a reduced speed limit from 70mph to 50mph on the motorway will not cause a noticeable redistribution in traffic as there are no other comparable alternative routes. For example, it is unlikely that a vehicle travelling from Cardiff to Swansea will route off the M4 through the scheme as there are no comparable routes due to all alternative routes having a speed limit slower than 50mph.

2.2 The spreadsheet has been developed through the utilisation of observed speed and flow data alongside Transport Analysis Guidance (TAG) guidance. In addition, the economic assessment has also been undertaken using relevant TAG guidance.

2.3 The proposed opening year of the scheme is 2023.

3 Data Sources

Introduction

3.1 It is important to ensure that when analysing the impact and economic potential of schemes that reliable and valid data is used. This will then ensure that the conclusions made are based on sound reasoning and numerical accuracy.

3.2 Furthermore, to ensure the validity of results, it is important to ensure that the transport related data reflects a neutral (ordinary) period of conditions on the network. Guidance given in the Department for Transport's (DfT) TAG Unit M1.2 states that any month between March to November (excluding August, the weeks before/after Easter, Thursday before bank holiday and school holidays) is defined as a neutral period.

3.3 TAG Unit M1.2 states that data collected from any traffic survey should ensure that the environment being surveyed is representative of the transport conditions (especially traffic flow). Due to the Coronavirus (COVID-19) causing a change in working patterns which has certainly had a drastic impact on traffic flows, it was necessary to make use of data before the COVID-19 period. Therefore the spreadsheet and economic analysis undertaken in the assessment of the M4 35 to 38 speed reduction scheme makes use of data from October 2019.

Observed Speed Data

3.4 The analysis of the M4 Junction 35 to 38 speed reduction scheme utilises the INRIX traffic analysis database that details vehicle speeds across the network taken primarily from mobile devices within vehicles. INRIX is private data services company that collects and collates anonymised data on a variety of transportation related variables which includes speeds.

3.5 The speed data available on the database is based on observed data, with some assumptions made where necessary on estimated speeds. The database includes a confidence level on the basis of the speed outlined for the time slice from 0 to 100, with 100 showing the speed is taken from fully observed data, and 0 being based on estimated data from the rest of the database.

3.6 Data from the database has been downloaded in one-minute intervals across the whole of the month split by direction and section (i.e. J35-J36 westbound, through J36 westbound etc)

3.7 The travel time data includes:

- Observed speed of vehicles per minute (average across all vehicle types)
- Historic average speed for that hour and day of the week
- The confidence value as explained above
- A road closure column which highlighted the periods within the month that certain segments of the motorway section were closed.

3.8 In order to analyse the data outputted by INRIX it first needed to undergo a data cleaning process. To ensure that the data is based on observed speeds rather than actual speeds, only those minutes in which the confidence value is greater than 90 were retained, the rest were removed from the dataset. This means that we are left with those time slices where the data is 90% or more based on observed data.

3.9 In addition, any periods where the motorway was closed during the month were removed from the dataset.

3.10 Table 1 details the data cleaning process and the number of minutes removed from the dataset. It should be noted that for some sections (i.e. J35-J36 Eastbound), INRIX data is split down into smaller sections so there may be multiple records for the same time slice.

Table 1: Data Cleaning Process

Eastbound		
	Number of data slices	Percentage of raw data
Raw data (pre cleaning)	1028100	
Data removed due to less than 90% based on observed data	112171	11%
Data removed due to closure on the motorway	1228	<1%
Data remaining post-cleaning	914701	89%
Westbound		
	Number of data slices	Percentage of raw data
Raw data (pre cleaning)	983400	
Data removed due to less than 90% based on observed data	85569	9%
Data removed due to closure on the motorway	960	<1%
Data remaining post-cleaning	896871	91%

Count Data

3.11 INRIX data does not provide vehicular data alongside the speed data therefore observed data has been taken from other sources. Where available, the preference was to use DfT count data. This has been downloaded from their count database which outlines a one-day 12-hour count as well as an estimated AADF for a specified link.

3.12 Where DfT count data was not available, estimates were made based on existing data sources and count or model data provided by TfW from the South East Wales Transport Model (SEWTM).

3.13 Table 2 outlines how the flows were calculated for each section of the motorway. The flow profiles across the analysis period are outlined in Appendix A. The AADFs along the corridor are shown in Table 3.

3.14 DfT data also provides one day counts covering the period from 7am to 7pm. For the purposes of this assessment, the count data required spliting by vehicle type by minute across the whole month. Therefore, DfT Statistics (Table TRA0305, 0306 and 0307) have been used to segment flow data into hours across the whole day. Hourly flows have then been divided by 60 to give flow by minute.

Table 2: Count Data used for J35-J38 mainline

	Count Data Used
J35 - J36	DfT Data from 2019
J36 – J37	ATC Count Data supplied from 2016 and factored to 2019
J37 – J38	DfT Data from 2019
Through J35	SEWTM flow provided for these sections as well as between J35-J36 and J36-J37 so factors calculated from these to apply to DfT Data for the mainline.
Through J36	
Through J37	No modelled data was available therefore assumed similar proportion as used for above.
Through J38	Due to the link being located on the edge of both the SWMWTM and SEWTM, it was decided to use an average of the two factors calculated for each of the 'through' junctions above.

Table 3: 2019 AADF along M4 J35-J38

Corridor Name	Eastbound	Westbound
Through J38	32,183	31,147
J38 to J37	29,279	30,316
Through J37	29,941	27,841
J37 to J36	38,289	38,268
Through J36	29,019	23,048
J36 to J35	37,111	36,707
Through J35	33,364	28,523

4 Traffic Data Analysis

4.1 To assess the impact of the proposed scheme, two scenarios have been created, a Do-Minimum (DM) and a Do-Something (DS) scenario. The DM has been created from the data sources in section 3 and outlines the conditions with speeds unconstrained.

4.2 In the absence of a strategic model, assumptions have been made to estimate the impact of the scheme using the observed speeds on the speeds and journey times of vehicles travelling through the scheme. It has been assumed that the flows will remain the same with and without the scheme in place, but that the scheme would alter vehicle speeds.

4.3 For the DS scenario, it has been assumed that all vehicles will travel at the limit of 50 mph. This is based on two rational notions the first being that drivers will want to get from their origin to destination as quickly as possible. The second notion is that the average speed enforcement will restrict drivers to driving up to the speed limit and not exceeding it as the scheme is so that it will fine those travelling above the 50mph limit.

4.4 Using the speed data, the journey times for each minute were calculated for the DM and DS scenarios. From this, the total journey times per vehicle were calculated for each scenario to be fed into the economic assessment.

5 Economic Analysis

Introduction

5.1 The economic assessment of the M4 Junction 35 to 38 speed reduction scheme follows cost-benefit analysis guidance found in TAG Unit A1.1 and TAG Unit A1.3. This outlines a 60-year economic assessment assuming the opening year is 2023.

5.2 The following section will describe each of the factors covered by the economic analysis of the scheme and the guidance that was used in order to facilitate the economic calculations.

5.3 Having obtained the AADF for the base year 2019 from the DfT database, the flows were estimated over the 60 year appraisal period (with an scheme opening year of 2023) which is in line with tag guidance in TAG Unit A1.1 and the HMT's Green Book.

5.4 The flows have been growthed into the future using the Road Traffic Forecasts 2018 as referenced in Table 4. NRTF forecasts for motorways in Wales have been used.

Table 4: Road Traffic Forecasts 2018, Scenario 1 – Reference, Welsh Motorways

Traffic - Billion Vehicle miles (bvm)*								
Vehicle Type	2015	2020	2025	2030	2035	2040	2045	2050
Car	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
LGV	0.3	0.4	0.4	0.4	0.4	0.4	0.5	0.5
HGV	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
PSV	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	2.3	2.5	2.6	2.7	2.9	3.0	3.1	3.2

5.5 The aim of the cost benefit analysis is to estimate the scheme induced consumer surplus changes, along with any changes to the environment and accident factors. Therefore, the factors covered in the cost benefit analysis will undergo an assessment to determine the change in surplus that results from the proposed scheme. The main factors accounted for within the cost benefit analysis are;

- Change in journey times (JT)
- Change in Vehicle Operating Costs (VOC),
- Change in Emissions (Carbon Dioxide (CO2) and;
- Change in Accident rates.

5.6 Economic analysis was undertaken for each individual section, through junctions and by direction (eastbound and westbound). The various outputs from the economic analysis were then summed to provide a final Present Value of Benefits (PVB) for the whole scheme. Present Value of Costs (PVC) were then calculated from construction cost estimates, and a final BCR has been calculated

Change in Journey Time

5.7 TAG Unit A1.3 states that the changes in travel time resulting from an intervention need to be converted into monetary values using the TAG Data Book Value of Travel Time Savings parameters.

5.8 As part of the proposed scheme, the speed limit will be reduced from 70mph to 50mph. The DM speeds are generally higher than the DS speeds therefore average journey times are expected reduce with the scheme in place. Given this, the journey time benefits outputted by the overall scheme will be negative, indicating a journey time disbenefit and reduction in traveller surplus.

Change in Vehicle Operating Costs (VOC),

5.9 The calculations for the VOC are based on the guidance given in TAG Unit A1.3. The magnitude of VOC is dependent on the amount of fuel costs and non-fuel costs, which are both heavily impacted by the speed at which a vehicle is travelling.

5.10 Since the DS scheme involves a reduction in the speed limit (towards the optimum speed to minimise car fuel consumption), the benefits of the VOC are expected to be positive. This is due to a lower vehicle speed that causes a decline in fuel consumption which reduces fuel costs and a reduction in speed reducing the amount of non-fuel costs experienced by individual vehicles.

5.11 Therefore, since both fuel costs and non-fuel operating costs are expected to decline the monetary impact on the scheme will be positive due to the increase in traveller surplus.

Change in Emissions (Carbon Dioxide (CO_2)

5.12 TAG Unit A3 provides guidance on how road-based fuel consumption related carbon dioxide emissions for the DM and DS scenarios can be estimated. In addition, TAG Unit A1.3 provides guidance on how fuel consumption can be first calculated for both scenarios.

5.13 Upon calculating the fuel consumption figures, TAG Unit A3 specifies the method of using the TAG Databook to convert calculated consumption figures into kilograms of CO_2, which can then be converted in a monetary cost.

5.14 One of the main inputs into the fuel consumption equation outlined in TAG unit A1.3 is vehicle speed. The speed is a factor in the magnitude of the consumption, with higher speeds resulting in a higher fuel consumption.

5.15 Consequently, since the average DM speeds are higher than the DS speeds, the scheme induces a fuel consumption saving leading to better fuel efficiency in the DS. Therefore, the kilograms of CO2 emitted by vehicles in the DS will be lower indicating a positive benefit of the scheme.

Change in Accident Rates

5.16 As outlined in TAG Unit A1.1 and the Cost and Benefit to Accidents – Light Touch (COBALT) User Manual, schemes should also be assessed in terms of their impact on accident rates. The difference between the number of accidents and number of casualties with and without the scheme can then be monetised, which are based on severity of accident.

5.17 The monetary values of the accident rates are outlined in the TAG Databook and the COBALT spreadsheet. COBALT assesses the safety aspects of road schemes using detailed inputs of either (a) separate road links and road junctions that would be impacted by the scheme; or (b) combined links and junctions. The assessment is based on a comparison of accidents by severity and associated costs across an identified network in 'Without-Scheme' and 'With-Scheme' forecasts, using details of link and junction characteristics, relevant accident rates and costs and forecast traffic volumes by link and junction.

5.18 The COBALT spreadsheet shows that for a motorway with a speed limit between 50 and 70mph, that the accident rates are the same. This means that in line with TAG, the accident rates for the with and without-scheme are the same therefore there is no benefit to the scheme in terms of accidents.

5.19 However, a literature review has been undertaken on accident rates observed in relation to this type of average speed reduction scheme. A report for the RAC Foundation by Owen, Ursachi and Allsop[1] *The Effectiveness of Average Speed Cameras in Great Britain, 2016.* This report states that on average, with the introduction of speed cameras the number of fatal and serious collisions decreases by 36%. The schemes that have been sampled as part of this study do not include a reduction in speed as part of the average speed camera implementation scheme as they have removed any influencing factors from their study to understand the impact of the cameras in isolation. However, with a slower speed, it can be judged that accidents are less likely to occur without the impact of the speed cameras in place.

5.20 Given the evidence base provided by this report, these accident reduction rates have been applied to calculate indicative accident impact of the scheme. However, it should be reiterated that this is not formally WebTAG-compliant.

Results

5.21 The M4 Junction 35 to 38 speed reduction scheme is expected to provide a present value of benefits (PVB) of -£678 million, indicating that the project is of high economic disbenefit.

5.22 The breakdown per motorway section is shown in Table 5. This table includes the WebTAG compliant PVB as well as the alternative calculation based on the RAC Foundation report on accident rates. It should be noted that the significant user time disbenefit from reducing speeds significantly outweighs VOC, emissions and accident savings whichever methodology is used to estimate accident benefits.

Table 5: Present Value of Benefits for Bridgend Speed Reduction Scheme

Corridor Name	Total Present Value of Benefits (WebTAG compliant) in £0,000s	Total Present Value of Benefits (Alternative Accident Rates) in £0,000s
Through J38	-£36,346	-£35,014
J38 to J37	-£150,024	-£145,698
Through J37	-£32,822	-£31,847
J37 to J36	-£246,026	-£239,481
Through J36	-£23,691	-£22,984
J36 to J35	-£161,789	-£157,193
Through J35	-£25,082	-£24,374
Corridor Total	-£669,610	-£650,761

[1] *The Effectiveness of Average Speed Cameras in Great Britain, 2016 - https://www.racfoundation.org/assets/rac_foundation/content/downloadables/Average_speed_camera_effectiveness_Owen_Ursachi_Allsop_September_2016.pdf*

5.23 Table 6 shows the breakdown of benefits by factor. It shows that despite the positive contributions of the vehicle operating costs and emissions to the total scheme present value of benefit, the disbenefit imposed by the increase in journey time with the scheme in place outweighs the benefits. The scheme covers a 13 mile section of motorway, which has a high volume of traffic. Reducing these vehicles from 70mph to 50mph is a reduction in journey time through the section of around 4 minutes which is leading to a large disbenefit in journey time.

Table 6: Present Value of Benefits: Breakdown

	Present Value of Benefits (WebTAG compliant) in £0,000s	Present Value of Benefits (Alternative) in £0,000s
JT Savings	-£767,236	-£767,236
VOC	£71,246	£71,246
Emissions	£26,380	£26,380
Accidents	-	£18,849
Total	-£669,610	-£650,761

5.24 The table also outlines the benefits with the alternative accident rate assessment. The estimated benefits of accidents increase slightly, however, the scheme continues to be of high economic disbenefit however there is a marginal improvement in the total present value of benefits of nearly £19 million, resulting in a new total of around -£650 million.

6 Scheme Costs

6.1 The scheme cost estimate has been calculated as £1,327,388 (2020 base cost). This includes an optimism bias of 15% and a risk budget, and exclusive of VAT. For the purposes of this assessment, it is assumed that all the construction costs are spent in the opening year (2023) and there are no assumptions for maintenance costs for the Do Minimum or Do Something. Assuming the costs have been discounted to 2010 prices, the final PVC is £711,036.

7 Final NPV and BCR

7.1 The final NPV (Net Present Value) and BCR (Benefit to Cost Ratios) are shown in Table 7~~Table 7~~. The NPV calculates the total benefits minus the scheme costs, and the BCR is the ratio between the benefits and cost.

Table 7: NPV and BCR for the scheme

	(WebTAG compliant) in £,000s	(Alternative) in £,000s
Present Value of Costs (PVC)	£711	
Present Value of Benefits (PVB)	-£669,610	-£650,761
Net Present Value (NPV)	-£670,321	-£651,472
Benefit to Cost Ratio (BCR)	N/A	N/A

7.2 This analysis shows that for the WebTAG-compliant economic calculations, it is estimated there could be a NPV of around -£670 million; and, even with the alternative accident rates, there is still a negative NPV of -£651 million.

7.3 It is not appropriate to quote BCR when both costs are positive and scheme benefits are negative.

8 Limitations of analysis and economic appraisal

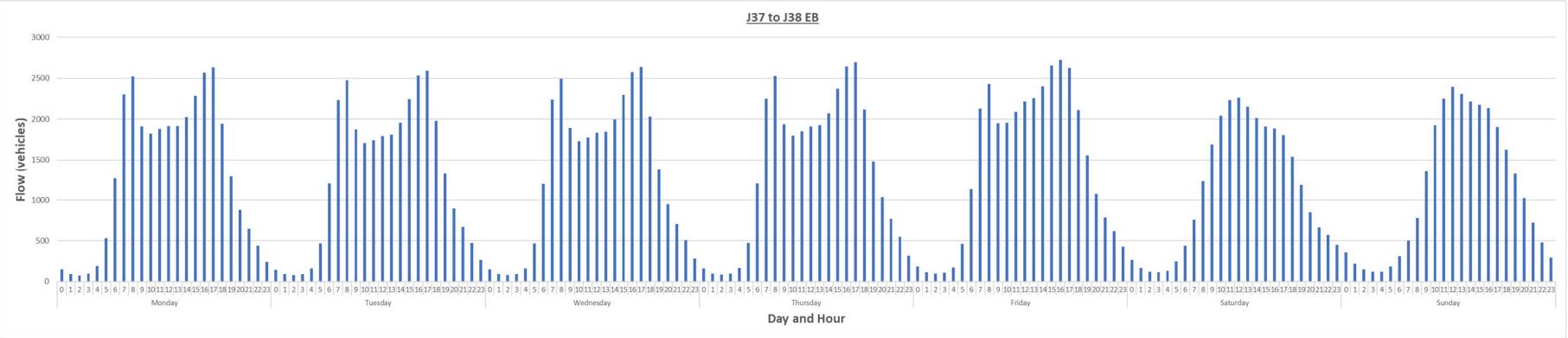
8.1 The economic analysis of this scheme has been undertaken with a methodology appropriate for the early stage of scheme sifting, and scheme design. As such there are limitations on the completeness of the economic appraisal (in terms of impacts considered) and detail of assessment.

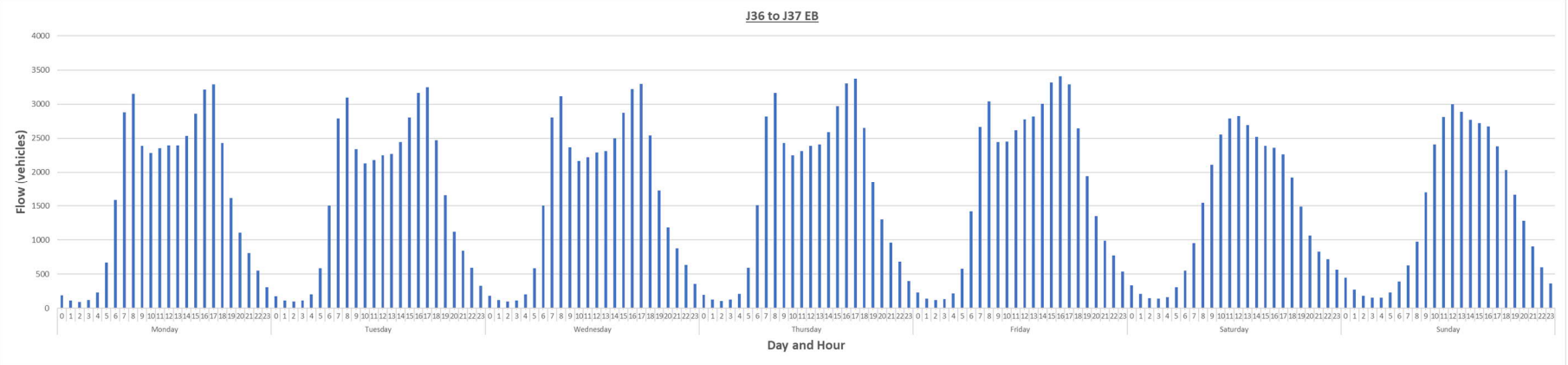
8.2 For this average speed reduction scheme, these limitations include:

- economic benefits associated with addressing specific accident 'black spots' through scheme implementation have not been identified or quantified
- economic benefits associated with addressing air quality in local area of specific concerns, for example AQMAs, have not been identified or quantified.

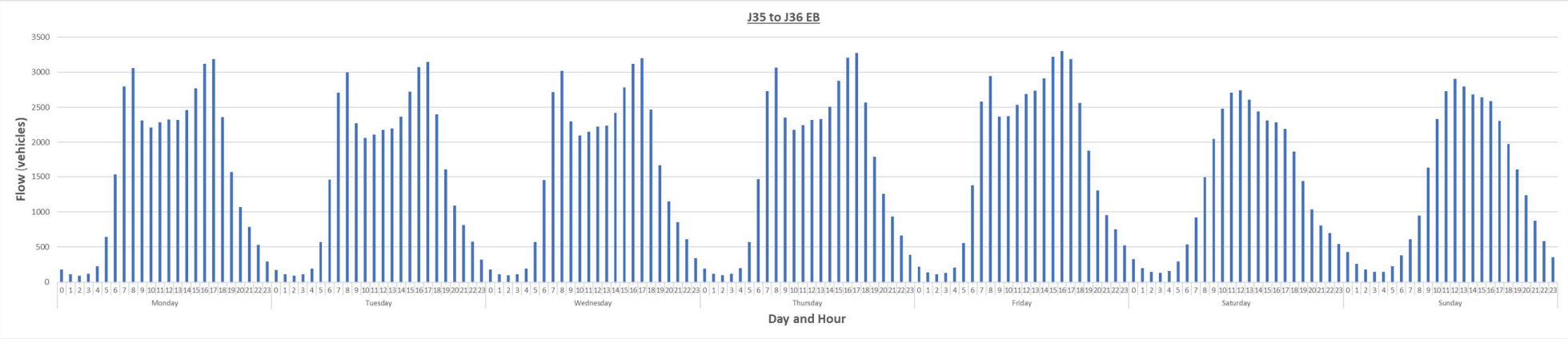
Technical Note

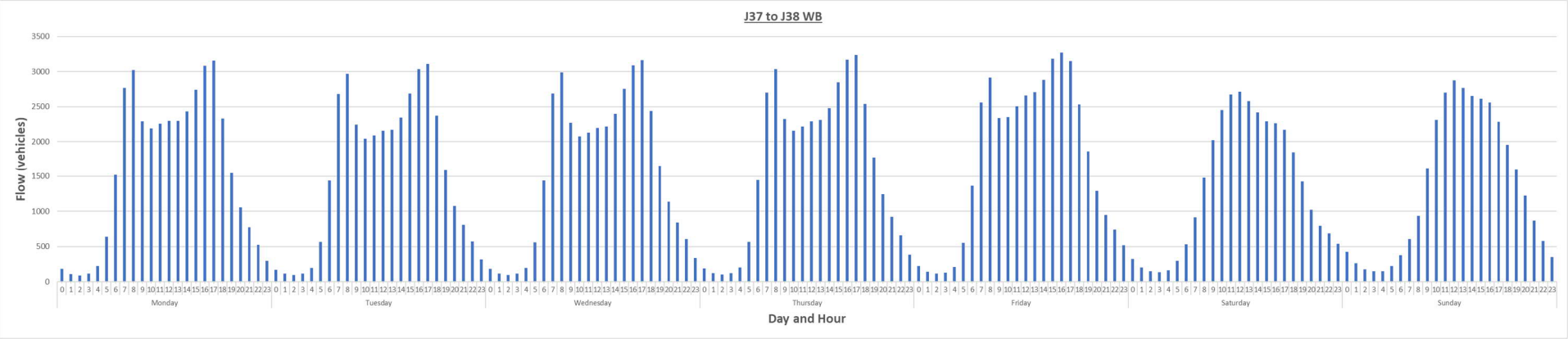
Appendix A Vehicle Flow Patterns by Weekday and Hour





Technical Note





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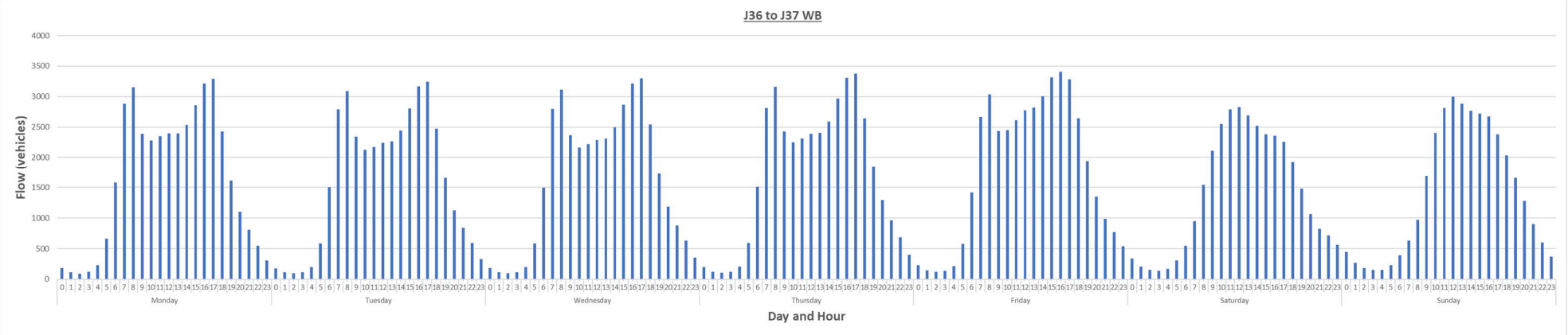
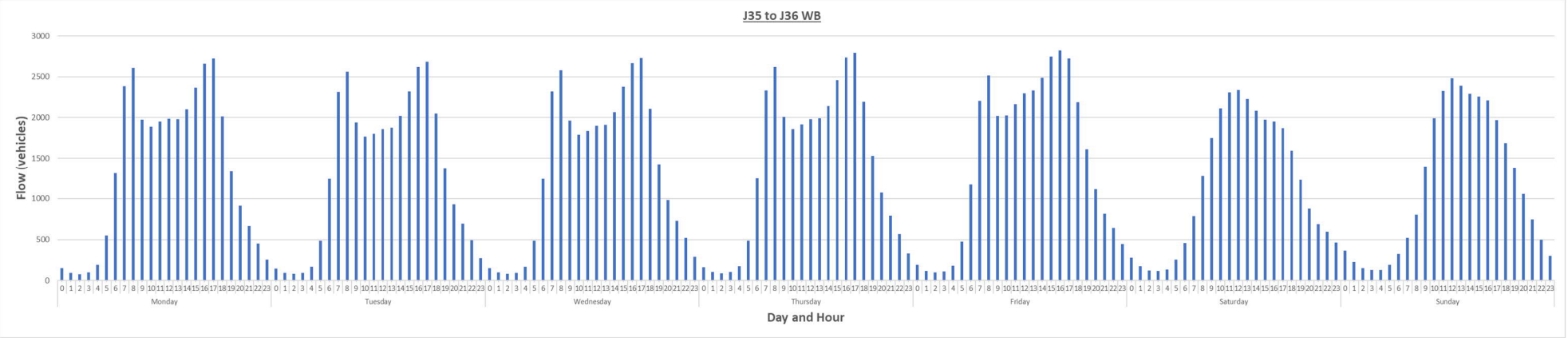




Appendix C Cost Estimates

COST ESTIMATES

M4 J35-38 Congestion Pinch Points Programme

CONSTRUCTION COST ESTIMATE

Scheme Name	Preliminaries	Site Clearance	Fencing	Road Restraints	Drainage	Earthworks	Pavements	Kerbs, Footways, Paved Areas	Traffic Signs and Road Markings	Road Lighting and Electrical	Traffic Signals	ITS	Structures	Landscaping	Utilities	Construction Cost Estimate (2020 Prices)	Land Acquisition	Professional Fees	Base Cost (2020 Prices)
M4 J35-38 Average Speed Enforcement	£ 171,000	£ 9,500	£ 9,500	£ 47,500	£ -	£ -	£ -	£ 19,000	£ 114,000	£ 95,000	£ -	£ 332,500	£ 95,000	£ 9,500	£ 47,500	**£ 950,000**	£ -	£ 61,750	**£ 1,011,750**
M4 Junction 36	£ 5,027,200	£ 314,200	£ 314,200	£ 314,200	£ 1,885,200	£ 1,885,200	£ 3,770,400	£ 2,199,400	£ 628,400	£ 1,256,800	£ 3,142,000	£ 1,571,000	£ 7,855,000	£ 314,200	£ 942,600	**£ 31,420,000**	£ 500,000	£ 2,042,300	**£ 33,962,300**

FINANCIAL CASE

Scheme Name	Base Cost (2020 Prices)	Risk and Contingencies	Sub-Total	VAT	Sub-Total (inc. VAT)	Opening Year	Inflation Allowance @ 2.1%	Total (inc. Inflation)
M4 J35-38 Average Speed Enforcement	£ 1,011,750	£ 142,500	£ 1,154,250	£ 230,850	£ 1,385,100	2023	£ 44,245	**£ 1,429,345**
M4 Junction 36	£ 33,962,300	£ 3,990,000	£ 37,952,300	£ 7,590,460	£ 45,542,760	2026	£ 2,971,751	**£ 48,514,511**

ECONOMIC CASE

Scheme Name	Base Cost (2020 Prices)	Risk and Contingencies	Sub-Total	Optimism Bias @ 15%	Total
M4 J35-38 Average Speed Enforcement	£ 1,011,750	£ 142,500	£ 1,154,250	£ 173,138	**£ 1,327,388**
M4 Junction 36	£ 33,962,300	£ 3,990,000	£ 37,952,300	£ 5,692,845	**£ 43,645,145**

Appendix D Risk Register

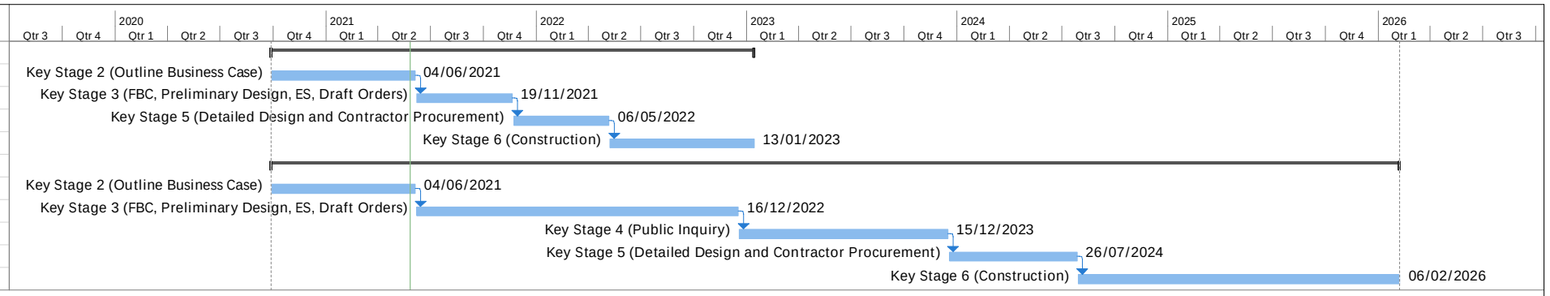
PROJECT RISK REGISTER

M4 J35-38 Congestion Pinch Points Programme

RISK IDENTIFICATION							RISK ASSESSMENT								RISK MANAGEMENT	RESIDUAL RISK							
Risk No (Identifier)	Risk Source / Reference	Risk Description "There is a Risk that ……. will happen"	Risk or Opportunity	Risk Type	Owner	Impact Description "The impact of the Risk is ….."	Probability Score	Cost Impact Score	Time Impact Score	Quality Impact Score	Cost Risk Ranking	Time Risk Ranking	Quality Risk Ranking	Overall Risk Ranking	Proposed Response Measure	Probability Score	Cost Impact Score	Time Impact Score	Quality Impact Score	Cost Risk Ranking	Time Risk Ranking	Quality Risk Ranking	Overall Risk Ranking
-	-	**Costs and Financing**	-		-	-									-								
0020	KS2	Utilities diversions may increase the cost estimates.	Risk	Project	WG	The scheme may longer be considered viable if the cost escalates.	4	5	4	3	**20**	16	12	**20**	Include appropriate risk allowances and contingencies in the cost estimates. Begin consultations with Statutory Undertakers as early as possible.	3	4	3	2	12	9	6	12
0014	KS2	Cost estimates could escalate due to unknowns or inaccurate assumptions.	Risk	Project	WG	The scheme may longer be considered viable if the cost escalates.	4	5	3	4	**20**	12	16	**20**	Include appropriate risk allowances and contingencies in the cost estimates.	3	4	2	3	12	6	9	12
0016	KS2	There may be a lack of funding available to implement the works, or a lack of funding may delay scheme delivery.	Risk	Strategic	WG	A delay to scheme delivery, or the scheme is cancelled due to lack of funding.	4	2	3	3	8	12	12	12	Explore all opportunities for funding, including developer contributions and joint funding with other public bodies.	3	2	2	2	6	6	6	6
-	-	**Stakeholders**	-		-	-									-								
0015	KS2	There may be a lack of public support for the proposals.	Risk	Project	WG	Public opposition could jeopardise the scheme delivery.	3	3	3	3	9	9	9	9	Undertake stakeholder mapping, prepare a communications plan and ensure close liaison with key stakeholders throughout.	2	2	2	2	4	4	4	4
-	-	**Design Risks**	-		-	-									-								
0023	KS2	The scheme designs may need to be updated once topographical survey information is available.	Risk	Project	WG	The cost estimate may escalate.	4	4	3	4	16	12	16	16	Include appropriate risk allowances and contingencies in the cost estimates. Obtain topographical survey information as early as possible.	3	3	2	3	9	6	9	9
0021	KS2	Additional retaining walls may be required to deal with level differences.	Risk	Project	WG	The cost estimate may escalate.	4	4	3	3	16	12	12	16	Include appropriate risk allowances and contingencies in the cost estimates.	3	3	2	2	9	6	6	9
0017	KS2	There may be a need to Departures from Standards which could delay delivery and/or increase costs as mitigation measures are required.	Risk	Project	WG	The cost estimate may escalate.	4	3	3	3	12	12	12	12	Include appropriate risk allowances and contingencies in the cost estimates. Ensure early liaison with the Technical Approval Authority.	3	2	2	2	6	6	6	6
0019	KS2	Dependencies on other projects (such as the River Tawe Bridge replacement and the J45-46 Multi Asset Renewal) may affect delivery.	Risk	Project	WG	There may be programme delays and/or additional costs associated with ensuring the various schemes integrate.	3	3	3	3	9	9	9	9	Remain in close contact with the other project teams and ensure the overall programmes align and opportunities for efficiencies are fully explored.	2	2	2	2	4	4	4	4
-	-	**Construction Risks**	-		-	-									-								
0203	KS2	A shortage of construction labour, plant and materials due to other large scale infrastructure projects being delivered concurrently may affect deliverability.	Risk	Strategic	WG	A delay to scheme delivery due to lack of resources.	4	4	4	3	16	16	12	16	Ensure strategic planning taking into account wider industry. Include appropriate contingencies in cost estimates to allow for potential cost increases due to demand.	3	3	3	2	9	9	6	9
-	-	**Benefits Realisation**	-		-	-									-								
0012	KS2	The findings of Key Stage 2 could be questioned due to unreliable or out of date traffic data.	Risk	Strategic	WG	There may be a need to collect new data and re-consider the proposals.	3	3	3	3	9	9	9	9	Apply best practice in determining the impact of lockdown on traffic data and undertake new traffic surveys when considered appropriate.	2	2	2	2	4	4	4	4
0013	KS2	Behaviours may change as a result of the Covid-19 pandemic meaning that the expected benefits are not fully realised.	Risk	Strategic	WG	Benefits may not be fully realised and the scheme may be called into question.	3	2	2	3	6	6	9	9	Consider whether the Covid-19 pandemic presents opportunities for changing behaviours and ensure the scheme objectives align with these opportunities.	2	2	2	2	4	4	4	4
0196	KS2	Removing congestion pinch points may discourage modal shift away from the car.	Risk	Strategic	WG	Benefits may not be fully realised and the scheme may be called into question.	3	2	2	3	6	6	9	9	Consider how the overall scheme objectives align with the updated Wales Transport Strategy and ensure all opportunities for encouraging modal shift are explored.	2	2	2	2	4	4	4	4
-	-	**Environment and Ecology**	-		-	-									-								
0011	KS2	Ecological survey seasons could be missed.	Risk	Project	WG	There could be programme delays.	4	3	4	3	12	16	12	16	Plan to undertake ecological surveys as early as possible and consider the ecology seasons when planning the project delivery.	3	2	3	2	6	9	6	9
0024	KS2	The overall environmental impact may be considered unacceptable.	Risk	Project	WG	The scheme may longer be considered viable unless the negative impacts can be mitigated.	3	3	3	3	9	9	9	9	Undertake early assessment of the environmental impacts and identify potential alternative solutions or suitable mitigation measures.	2	2	2	2	4	4	4	4
0024	KS2	There could be further environmental impacts over and above those already identified.	Risk	Project	WG	The scheme may longer be considered viable unless the negative impacts can be mitigated.	3	3	3	3	9	9	9	9	Undertake environmental surveys as early as possible to understand the likely impacts.	2	2	2	2	4	4	4	4
-	-	**Active Travel**	-		-	-									-								
0026	KS2	Failure to provide adequate facilities for Active Travel may result in limited modal shift.	Risk	Project	WG	The scheme may fail to realise all objectives.	3	2	2	3	6	6	9	9	Undertake a thorough WCHAR Assessment and explore all opportunities for providing appropriate Active Travel facilities.	2	2	2	2	4	4	4	4
-	-	**Public Transport Integration**	-		-	-									-								
0025	KS2	The schemes may not fully integrate with wider initiatives, such as TfW schemes.	Risk	Project	WG	The scheme may fail to realise all objectives.	3	2	3	3	6	9	9	9	Liaise closely with TfW to understand the wider initiatives and ensure integration of the various schemes.	2	2	2	2	4	4	4	4
0028	KS2	The South Wales Metro and/or Swansea Bay Metro may change how the M4 corridor is used resulting in different priorities.	Risk	Strategic	WG	The scheme may fail to realise all objectives.	3	2	3	3	6	9	9	9	Liaise closely with TfW to understand the wider initiatives and ensure integration of the various schemes.	2	2	2	2	4	4	4	4
0027	KS2	A lack of provision for buses may limit the opportunities for encouraging modal shift.	Risk	Project	WG	The scheme may fail to realise all objectives.	3	2	2	3	6	6	9	9	Explore all opportunities for delivering improved bus provision.	2	2	2	2	4	4	4	4
-	-	**Land Acquisition**	-		-	-									-								
0018	KS2	Land acquisitions may delay delivery and introduce additional costs.	Risk	Project	WG	The may be cost increases and programme delays.	4	3	4	3	12	16	12	16	Include programme contingencies and risk allowance. Begin liaison with affected land owners as early as possible.	3	2	3	2	6	9	6	9
0209	KS2	Land acquisitions may require a Public Local Inquiry which would delay implementation and introduce additional costs.	Risk	Project	WG	The may be cost increases and programme delays.	4	3	4	3	12	16	12	16	Include programme contingencies and risk allowance. Begin liaison with affected land owners as early as possible.	3	2	3	2	6	9	6	9
-	-	**Junction 35 to 38 Average Speed Enforcement**	-		-	-									-								
0210	KS2	The introduction of Average Speed Enforcement without a reduction in the speed limit may result in missed opportunities to improve air quality and noise impact.	Risk	Project	WG	The scheme may fail to realise all objectives.	2	2	3	3	4	6	6	6	Appraise all opportunities and consider the wider benefits associated with a reduction in speed limit.	2	2	2	2	4	4	4	4
-	-	**Junction 36 Improvements**	-		-	-									-								
0009	KS2	Construction of the Junction 36 works would cause significant disruption, resulting in the benefits being negated by the disbenefits caused during construction.	Risk	Project	WG	Benefits may not be fully realised and the scheme may be called into question.	5	5	4	4	**25**	**20**	**20**	**25**	Ensure the construction impacts are fully quantified at Key Stage 3.	4	4	3	3	16	12	12	16

Appendix E Programme

ID	Task Mode	Task Name	Duration	Start	Finish
1		**M4 J35-38 Average Speed Enforcement**	**600 days**	**Mon 28/09/20**	**Fri 13/01/23**
2		Key Stage 2 (Outline Business Case)	180 days	Mon 28/09/20	Fri 04/06/21
3		Key Stage 3 (FBC, Preliminary Design, ES, Draft Orders)	120 days	Mon 07/06/21	Fri 19/11/21
4		Key Stage 5 (Detailed Design and Contractor Procurement)	120 days	Mon 22/11/21	Fri 06/05/22
5		Key Stage 6 (Construction)	180 days	Mon 09/05/22	Fri 13/01/23
6		**M4 Junction 36**	**1400 days**	**Mon 28/09/20**	**Fri 06/02/26**
7		Key Stage 2 (Outline Business Case)	180 days	Mon 28/09/20	Fri 04/06/21
8		Key Stage 3 (FBC, Preliminary Design, ES, Draft Orders)	400 days	Mon 07/06/21	Fri 16/12/22
9		Key Stage 4 (Public Inquiry)	260 days	Mon 19/12/22	Fri 15/12/23
10		Key Stage 5 (Detailed Design and Contractor Procurement)	160 days	Mon 18/12/23	Fri 26/07/24
11		Key Stage 6 (Construction)	400 days	Mon 29/07/24	Fri 06/02/26



Project: M4 WelTAG Delivery P
Date: Thu 27/05/21

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Manual Progress
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline	
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Progress	

Appendix F Benefits Realisation Plan

Appendix G Monitoring and Evaluation Plan