Welsh Government

M4 NEWPORT J25 TO J26 - WELTAG STAGE THREE REPORT

Consideration of Measures on the Welsh Government Motorway and Trunk Road Network for Nitrogen Dioxide Reduction

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SEPTEMBER 2018

PUBLIC

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1 INTRODUCTION

1.1 CONTEXT

The European Union Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations of certain air pollutants in outdoor air, termed 'limit values'. The Directive requires that Member States report annually on air quality within zones designated under the Directive and, where the concentration of pollutants in air exceeds limit values, to develop air quality plans that set out measures in order to attain the limit values. The only limit values that the UK currently fails to meet are those set in respect of nitrogen dioxide (NO_2).

In July 2017, the UK Government published its Air Quality Plan (the 2017 Plan) for tackling roadside NO_2 concentrations[1]. The 2017 Plan set out details of the authorities responsible for delivering air quality improvements including devolved administrations and Local Authorities.

Wales is divided into 4 zones under the Directive:

- Two urban agglomeration zones (Cardiff and Swansea)
- Two non-agglomeration zones (North Wales and South Wales)

WSP have been commissioned by Welsh Government (WG) to undertake a WelTAG Stage One (Strategic Outline Case), Two (Outline Business Case), and Three (Full Business Case) appraisals of potential Network Management measures for reducing NO_2 levels arising from traffic emissions at five separate locations on the Welsh Strategic Road Network (SRN). The five locations (and their respective zones) are:

- A494 Deeside (North Wales)
- A483 Wrexham (North Wales)
- A470 Upper Boat to Pontypridd (South Wales)
- M4 J41 – J42, Port Talbot (South Wales and Swansea)
- M4 J25 – J26, Newport (South Wales)

Given the differences between the five identified locations, and for parity with the WelTAG Stage One and Two reports[2], five separate WelTAG reports have been produced. It is acknowledged that what might represent a practical measure in one location, might not be viable or deliverable in another. Therefore, the reports have been produced independently in parallel to ensure that the individual requirements of any one location do not dictate the measures considered at the others.

All the reports are supported by a WelTAG Stage Two and a Stage Three Impact Assessment Report (IAR), and Effectiveness Review, which are reported in separate documents.

1.2 APPROACH

The Stage One and Two WelTAG reports were undertaken in accordance with the 2017 Consultation Draft WelTAG guidance published in autumn 2016. In December 2017, WG published the final revised WelTAG 2017 which will be applied to activities associated with Stage Three[3]. The revised guidance makes specific reference to the Well Being for Future Generations (Wales) Act 2015 within the appraisal, whilst removing specific reference to individual elements that make up the WelTAG Impact Areas. The final WelTAG 2017 guidance has been used for this study.

[1] UK plan for tackling roadside nitrogen dioxide concentrations; Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/633269/air-quality-plan-overview.pdf

[2] Tackling roadside nitrogen dioxide concentrations in Wales; Available at: https://beta.gov.wales/tackling-roadside-nitrogen-dioxide-concentrations-wales

[3] WelTAG 2017 (December 2017), WG; Available at: https://beta.gov.wales/sites/default/files/publications/2017-12/welsh-transport-appraisal-guidance.pdf

A summary of the changes to WelTAG from the draft to final release of the 2017 WelTAG guidance is contained within Appendix A.

The objective of this study is to identify potential network management measures which will assist in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements in five locations on the Welsh SRN listed above.

Therefore, the transport case focuses on air quality and reflects the key considerations in relation to the EU Air Quality Directive and bringing forward compliance with limit values.

The WelTAG guidance states that the purpose of the Stage Three (Full Business Case) is to:

'make a full and detailed assessment of the preferred option to inform a decision as to whether or not to proceed to implementation'.

As such, this Stage Three (Full Business Case) report:

- Determines whether a transport option exists that can address the issues identified, contributes positively to the well-being goals and objectives, and can be delivered within technical and financial constraints, although is mainly driven by if a measure can achieve compliance in the shortest possible time;
- Presents the preferred option(s), referred to as 'likely measure(s)', to be taken forward to procurement and implementation;
- Identifies each dimension of the Five Cases with a level of detail proportionate to scale and/or significance of the impacts and the associated risks; and
- Outlines issues affecting the deliverability of options, the realisation of the anticipated benefits and the mitigation of adverse impacts.

1.3 REPORT STRUCTURE

The structure of this Stage Three report is as follows:

Chapter 2: Strategic case
This chapter presents a summary of the baseline of the existing situation presented in WelTAG Stage One and Two. It outlines the objective and the EU Air Quality Directive and includes an evidence-based description of the current problem. It identifies the process undertaken and the measures that are included within Stage Three.

Chapter 3: Transport case
This chapter provides a summary of the appraisal against the objective through consideration of the key and secondary criteria and appraisal against the aspects of well-being. Supporting technical information is provided within the WelTAG Stage Three Impact Assessment Report (IAR).

Chapter 4: Financial case
This chapter identifies whether the costs for each of the shortlist of measures appraised at Stage Three are affordable, and the potential funding mechanisms for delivery.

Chapter 5: Commercial case
This chapter includes a description as to whether the measures are commercially viable, and provides an analysis as to whether measures could be packaged together for a phased delivery.

Chapter 6: Management case
This chapter identifies the delivery arrangements of the likely measures and then its management during its life time.

The conclusion of this Stage Three report identifies the likely measures that will be implemented to bring forward reductions in NO_2 in the shortest possible time and to do so in a way that reduces exposure as quickly as possible to ensure compliance with the Ambient Air Quality Directive, as per the objective of the study.

2 STRATEGIC CASE – STUDY OVERVIEW

2.1 OVERVIEW

The strategic case 'tells us if we need change and why. It presents an evidence based description of the current situation, describes the likely future situation if no action is taken, and presents the reasons why an intervention is required'.

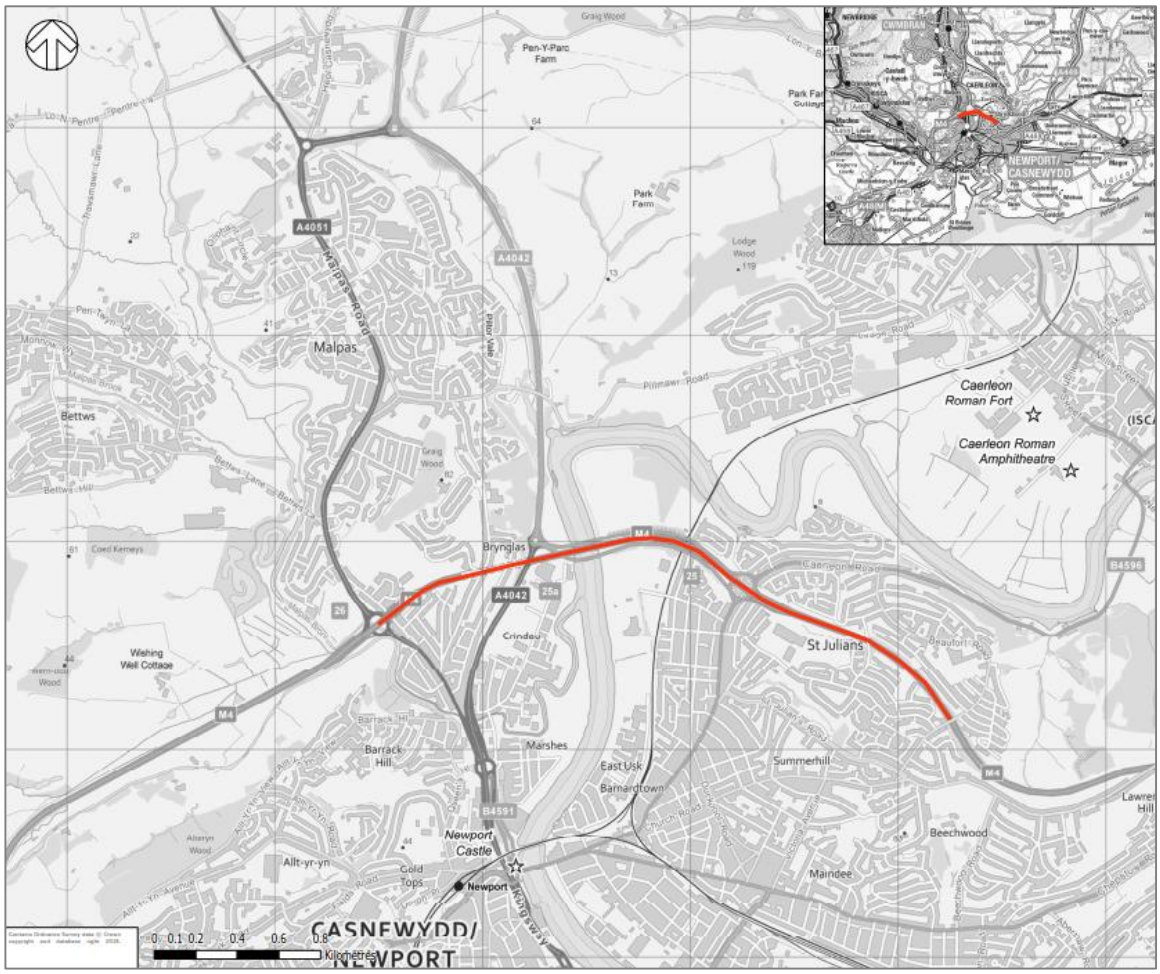
WelTAG Stages One and Two of this study were finalised in January/February 2018 and include a complete Strategic Case. This Stage Three report therefore provides additional and updated information where relevant, and is intended to be read in conjunction with the previous reports.

2.2 STUDY CORRIDOR

The M4 study corridor is located in Newport, which is the third largest city in Wales. The city forms part if the Cardiff-Newport metropolitan area, and is located on the River Usk close to its confluence with the Severn Estuary, approximately 19km northeast of Cardiff.

The study corridor considered in this report covers the principal corridor on the M4 motorway between the east of J25 (Caerleon Road) and J26 (Malpas Road). This is shown in Figure 1.

Figure 1: The Study Corridor



The M4 study corridor assumed for the purposes of this WelTAG study is centred on, but not limited to, the road links within Defra's Pollution Climate Mapping (PCM) model that have shown an exceedance in limit values. This acknowledges that the measures and their subsequent impacts may be realised beyond the identified area with NO_2 exceedances.

The study corridor is approximately 1.4km in length and has an east to west alignment. The length of the M4 study corridor between J25 and J26 is a 2 lane all-purpose motorway with the exception of a stretch on the eastbound carriageway reaching from J25A (Grove Park) to J25, which is a 3 lane all-purpose motorway. Westbound between J25 and J25A, there are also 3 lanes; however, Lane 1 forms the off-slip for J25A. The study corridor also features the Brynglas Tunnels, which carry the M4 motorway under Brynglas Hill, between J25A and J26.

2.3 OBJECTIVE OF THIS STUDY

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the report should be proportionate to the impacts under consideration.

Following on from the WelTAG Stage One and Two reports, **the objective of this Stage Three study is to carry out further investigation and identify potential network management measures which will assist in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements in five locations on the Welsh Strategic Road Network.**

2.4 THE PROCESS

2.4.1 WELTAG STAGE ONE AND TWO

The WelTAG Stage One appraised a long list of 57 measures against the key criteria of the objective based on their ability to bring forward the date of compliance with EU Limit Values (Effectiveness, Timescales, and Deliverability). This resulted in a short list of 13 measures for the M4 study corridor that were taken forward to Stage Two.

The WelTAG Stage Two appraisal examined in greater detail the short list of 13 measures for tackling the problem under consideration. The measures were reappraised against the key criteria and appraised against the secondary criteria for the objective, as well as the WelTAG aspects of well-being.

The appraisal of air quality impacts was undertaken semi-quantitatively using detailed emissions and dispersion modelling underpinned by assumed changes in traffic flow characteristics and volume for each measure.

Typically, at the end of WelTAG Stage Two, a preferred measure is identified to be taken forward to Stage Three. However, because the EU Ambient Air Quality Directive states measures should be implemented to bring forward compliance *in the shortest possible time*, the 8 measures that were considered to reduce NO_2 in part were identified as preferred measures and taken forward to Stage Three.

2.4.2 WELTAG STAGE THREE

The following 8 measures have been appraised at Stage Three:

- **S7: Enforce/Reduce Speed Limit**: introduction of a new speed limit on the M4 and enforced through average speed cameras.
- **S16: Junction Closures**: implement a closure of the westbound off-slip at Junction 25A and/or closure of the westbound off-slip at Junction 26 and/or closure of the eastbound on-slip at Junction 26 of the M4.
- **S19: Variable Diversions**: implement advisory variable diversion routes for local traffic, for instance the Southern Distributor Road (SDR), through signage to reduce cars from the M4 in the AM and PM peak hours.
- **S28: Behaviour Change**: implement a package of several measures aimed at changing travel behaviour, encouraging mode shift away from private car use.
- **S46: Clean Air Zones / Low Emission Zones**: promotion of clean air zones/ low emission zones for the study corridor along the M4. Welsh Government held a consultation for 'A Clean Air Zone Framework for Wales' which provides guidance to local authorities for addressing local air quality issues. The consultation was held between 25th April and 19th June 2018. The introduction of clean air zones have been appraised however they would need to be introduced by local authorities.

- **S51: Intelligent Traffic Management**: linking real-time emissions / air quality data with traffic management, and / or remote monitoring through use of Intelligent Transport Systems and other innovative technological systems.
- **S65: Air Quality Areas**: use publicity campaigns and branding of areas to raise awareness of poor air quality within the area.
- **S66: Air Quality Communications**: implement a package of measures to generally raise awareness of air quality.

2.5 SHORT TERM MEASURES

Following Stage Two, it was recognised that reduced speed limits could provide immediate benefits with respect to the reduction of NO_2. The M4 around Newport operates a Variable Speed Limit (VSL) under the Road Traffic Act between the west of Junction 23A (Magor) to the east of Junction 29 (Castleton). Using this regulation, the speed limit through the exceedance corridor has been set to a maximum of 50mph throughout the day.

2.6 STAKEHOLDER CONSULTATION

A stakeholder workshop was undertaken on 17 July 2018 at the South Wales Traffic Management Centre. Key stakeholders from the following organisations were invited:

- Welsh Government
- NMWTRA
- SWTRA
- Neath Port Talbot County Borough Council
- Rhondda Cynon Taf County Borough Council
- Newport City Council
- Flintshire County Council
- Wrexham County Borough Council
- Cardiff Council
- Caerphilly County Borough Council
- Freight Transport Association (FTA)
- Welsh Government Police Liaison Officer

The workshop included an overview of the WelTAG Stage One and Two appraisals, and discussion of the acceptability and risks to implementation of the preferred measures that were identified at Stage Two.

It should be noted that for those stakeholders that were unable to attend the workshop meeting, notes from the meeting were sent out for any additional comments and/or feedback.

2.7 PACKAGING OF MEASURES

The 8 preferred measures have been subdivided into 'hard measures' with tangible benefits and 'soft measures' with marginal indirect benefits. The soft measures are those that passively reduce NO_2 levels by increasing peoples' awareness to the problem and encouraging a behaviour change, which positively impacts upon the problem. The soft measures could provide benefits at all five locations on the network, and potentially across the Welsh SRN.

2.7.1 000 - COMPLEMENTARY PACKAGE – 'SOFT MEASURES'

A workshop on the 17 July 2018 with WG and Stakeholders discussed the measures and identified the 'soft measures' that should be included as a complementary package of measures and implemented universally across all sites. These include:

- S28: Behaviour Change
- S51: Intelligent Traffic Management
- S62: Signage
- S65: Air Quality Areas
- S66: Air Quality Communications

It is expected that the above soft measures will be achieved initially with a significant communications campaign using social media, radio and signs on the network to highlight the air quality issues. This campaign will be reiterated throughout the year at key periods when the air quality is measured to be at a high level from the roadside monitors.

To complement the reduced speed limits, additional signs both permanent and Variable Matrix Signs (VMS) will be placed at the start of the reduced speed limit areas to relay the reasons for the speed limit reductions. A campaign has already been released to drive responsibly using the VMS at all of the sites.

There will also be regular updates and announcements provided on the air quality monitoring results at key stages over the coming years which should help reaffirm the messages and understanding of the issues.

It is anticipated that the complementary package of soft measures could have the following benefits:

- **Reduced demand**: By communicating the problem, and actively encouraging mode shift, a reduction in emission could be realised through reduced dependency on private car, or the passive rerouting of trips away from the exceedance locations.
- **Reduced emissions though more efficient driving**: A reduction in emission could be realised through changed driver behaviour. Vehicle speeds and rates of acceleration have a significant impact on emissions and this could be passively managed through education rather than physical measures.
- **Increased Public Acceptability for 'Hard Measures'**: It is likely that many of the 'hard measures' could face resistance due to potential impacts on journey times and accessibility. The complementary measures would likely mitigate this by highlighting the necessity of the measures.
- **Make best use of existing infrastructure**: Many of the 'soft measures' can make best use of existing infrastructure, therefore providing a cost-effective solution.
- **Minimised adverse impacts**: Whilst the direct benefits of the 'soft measures' are generally less than the 'hard measures', the 'soft measures' have been identified as having little to no adverse impacts against the other WelTAG areas.

The complementary measures will engage and involve the public to prevent the worsening of the problem, and provide short-term solutions that do not have long-term impacts on the people and communities of Wales. Due to the minimal adverse impacts, it is considered that the complementary measures integrate well with the Future Generations Act and other key polices.

2.7.2 MEASURES TO BE APPRAISED – 'HARD MEASURES'

The WelTAG Stage Two appraisal identified 'large beneficial' benefits to air quality from a reduction in the speed limit. In light of this, and the fact that a reduced speed limit has already been implemented on the corridor, each of the 'hard measures' that have been appraised at Stage Three have been packaged with a reduced speed limit. For the M4 at Stage Three, the 'hard measures' that have been appraised are presented in Table 1.

Table 1: Measures to be Appraised – Measure Description

Ref	Measure Description
001	Enforce / Reduce Speed Limit (50mph)
002	Junction Closures (Option A - Junction 25A Westbound off-slip), plus 50mph Speed Limit
003	Junction Closures (Option B - Junction 26 Westbound off-slip), plus 50mph Speed Limit
004	Junction Closures (Option C - Junction 26 Eastbound on-slip), plus 50mph Speed Limit
005	Junction Closures (Option D - Junction 26 Westbound off-slip and Eastbound on-slip), plus 50mph Speed Limit
006	Variable Diversions (e.g. Southern Distributor Road), plus 50mph Speed Limit
007	Clean Air Zone, plus 50mph Speed Limit

The short list of 'hard measures' have been appraised against the key criteria and secondary criteria for the objective. The measures have also been appraised against the four aspects of well-being in Wales: economic, social, environmental, and cultural. Whilst the individual measures have already been appraised against these criteria at Stage One and Two, they have been revaluated as a package with the reduced speed limit at Stage Three.

3 STRATEGIC CASE – BASELINE

3.1 AIR QUALITY BASELINE

The air quality baseline for the M4 has been derived from a combination of national modelling (the Pollution Climate Mapping – PCM – model) and monitoring undertaken by the local authority, Newport City Council (NCC) and Welsh Government.

National Modelling

The PCM model was developed by Ricardo AEA on behalf of Defra/DfT for the purpose of the assessment of compliance with the limit values set out in the European Union Ambient Air Quality Directive. As such, this assessment uses the outputs of the PCM model to define baseline and future baseline NO_2 concentrations for the purpose of assessing the efficacy of measures designed to bring forward the date of compliance with limit values.

The PCM model projections presented in support of the 2017 Plan indicate that annual mean NO_2 concentrations on the section of the M4 under consideration will reach compliance with air quality limit values between 2018 and 2021 (i.e. projected concentrations at or below 40µg/m^3).

The dates in Table 2 provide an indication of the timescales within which the measures must be deliverable to bring forward compliance.

The percentage reduction in emissions from road transport required to achieve compliance has been estimated using the maximum PCM concentration in any given year, the corresponding background NO_2 concentration and Defra's NOx to NO_2 calculator (v6.1) to calculate the roadside contribution to NOx concentrations and the level of emissions required to give a roadside concentration of 40µg/m^3.

Table 2: Baseline PCM Predicted NO_2 Concentrations at Newport, without NO_2 reduction network measures (projections from 2017 Plan, July 2017)

Measure	**2015**	**2017**	**2018**	**2019**	**2020**	**2021**
M4 (ID 70057, East of Brynglas)	**43.1**	**40.8**	38.9	37.2	35.3	33.1
M4 (ID 40500, West of Brynglas)	**51.3**	**48.5**	**46.1**	**44.0**	**41.7**	39.0
Approx. % Reduction in NOx Emissions from Road Transport Required for Compliance	51%	26%	20%	14%	6%	

Local Authority Monitoring

The PCM modelled concentrations in Table 2 are consistent with the concentrations monitored by NCC in the vicinity of the M4 (Table 3). That is to say, in places, the monitored concentrations exceed the EU limit value by a considerable margin, although monitored concentrations are typically lower than the PCM concentrations to the west of the River Usk and higher than the PCM concentrations to the east of the Usk.

NCC have declared multiple Air Quality Management Areas (AQMA) under their statutory duties for Local Air Quality Management. The Shaftesury/Crindau AQMA straddles the M4 at J26, and there is a further AQMA on Malpas Road approximately 500m south of J26. There are no AQMA on the M4 corridor to the east of the Brynglas tunnels.

Table 3: Monitored Annual Mean NO_2 concentrations alongside the M4 (µg/m^3)

NCC Location ID	Location	Distance to M4	Bias-adjusted Annual Mean		
			2014	2015	2016
NCC6B	153 Malpas Road	4m	39.8	**41.1**	38.0
NCC17A	179 Malpas Road	20m	32.4	31.3	27.7
NCC19B	177 Malpas Road	40m	38.3	36.1	-
NCC16A	40 Denbigh Road	9m	38.7	36.0	33.8
NCC25B	41 Denbigh Road	9m	29.7	26.6	-
NCC21D	M4 Old Barn	11m	**58.3**	**61.8**	**56.6**
NCC23E	M4 Old Barn	11m	**57.6**	**58.2**	**55.5**
NCC 37 - 39	St Julians School	55m	20.9	20.5	22.9

Welsh Government Indicative Monitoring

Welsh Government has commissioned air quality monitoring along the M4 study corridor. The monitoring is currently undertaken using diffusion tubes, at 7 roadside locations and 1 background location. At each site, the monitoring consists of triplicate diffusion tubes, exposed for ~2week durations. Data for 6 months (12 exposure periods) is currently available. The roadside monitoring is undertaken at distances between 4 and 5m from the side of the M4, at a height of approximately 2m above the carriageway.

Under the Ambient Air Quality Directive, the reference method for monitoring ambient NO_2 is based on chemiluminescence (EN 14211:2005). Diffusion tube monitoring has greater uncertainty and cannot be considered equivalent to reference method monitoring. It provides indicative measurements only. Moreover, the diffusion tube data do not, at the time of writing, meet the data quality objectives for indicative measurements under Annex I of the Directive[4] and should not be used to assess compliance with limit values. The data are, however, useful in the provision of greater spatial information than is practicable with reference method monitoring or national modelling.

Prior to comparison with the annual mean limit value and modelled PCM concentrations, the monitored concentrations require:

- 'bias correction' to account for tubes and laboratory practices to result in either under or over reading relative to reference methods
- 'annualisation' to account for the total survey length being less than 12 months, and
- 'distance correction' to a standard 4m from the roadside[5].

Further to the uncertainty inherent in diffusion tube monitoring and analysis, these corrections introduce additional uncertainty into the monitoring data. Notwithstanding this, Table 4 provides a summary of the available data.

The indicative monitoring survey shows that roadside concentrations are higher to the west of the Brynglas Tunnels (Link 40500) than to the east (Link 70057), which is consistent with the PCM modelling. However, the monitored concentrations are higher than the PCM concentrations.

[4] Due to the survey duration not covering a whole year, whether continuously or intermittently
[5] The PCM model provides concentrations at a nominal distance of 4m from the side of the road

Table 4: Indicative diffusion tube monitoring (µg/m^3)

PCM Link	Number of Monitoring Locations(a)	Annualised and Bias Adjusted Concentration (b) (2017)	Average Indicative Concentration on PCM Link Distance Corrected to 4m (c)(2017)
70057	3	50.7 – 67.0	*51.4*
40500	1	79.4	*67.8*

NOTE: Data are indicative only and should not be used to assess compliance with limit values
(a) Locations considered were compliant with requirements of EU Directive Annex III on micro and macroscale siting of monitoring points
(b) Bias adjusted using national factors provided by Defra (0.88); Annualised to 2017 using data from Cardiff, Cwmbran and Bristol
(c) Distance corrected using Defra's calculator

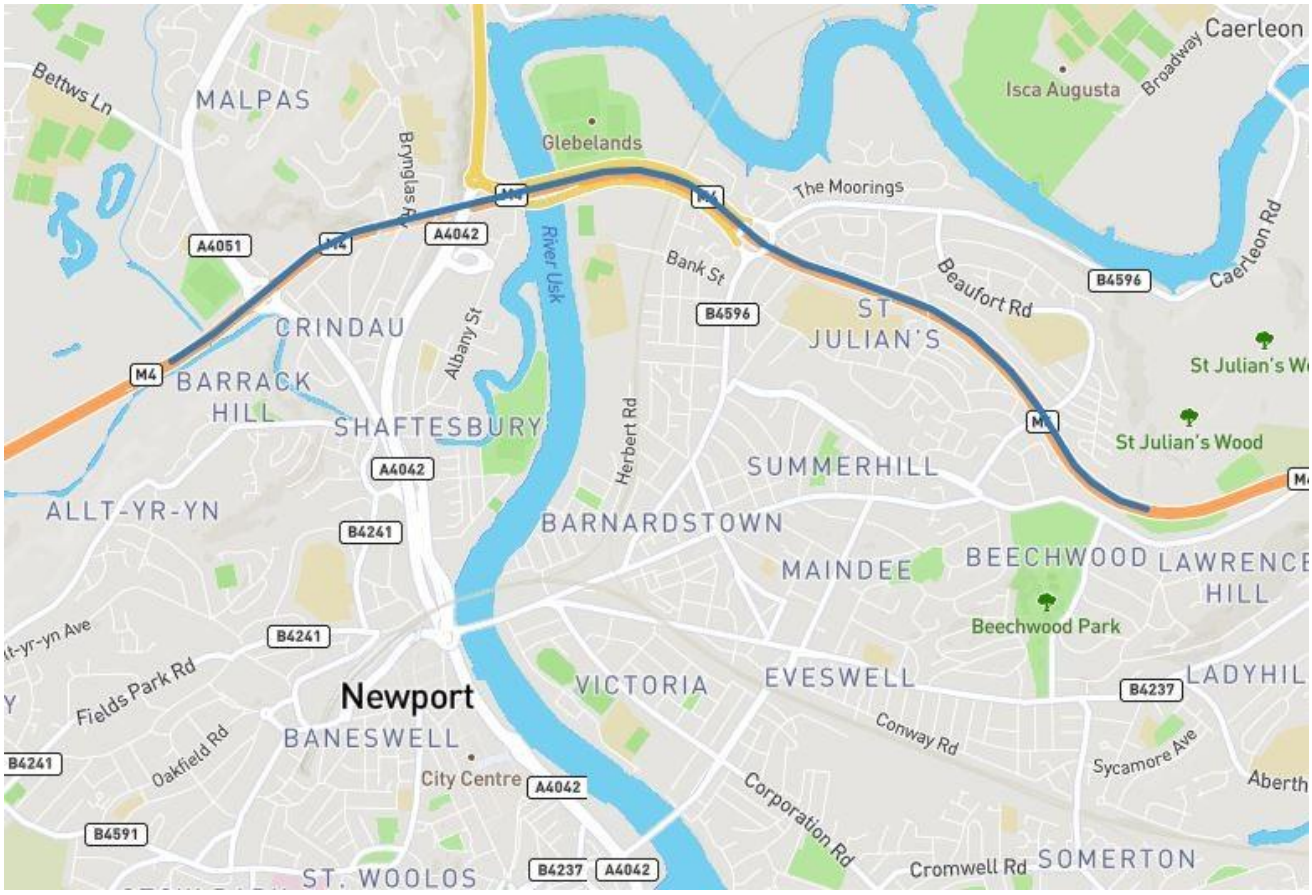
3.2 TRAFFIC BASELINE

An overview of the existing traffic flows and speeds along the M4 corridor is provided in the WelTAG Stage Two report, and includes data extracted from the Department for Transport (DfT) as well as Trafficmaster.

INRIX Analytics

As part of the Stage Three WelTAG appraisal, INRIX data has also been considered. INRIX gathers real-time, predictive and historical data from more than 300 million sources, including commercial fleets, GPS, mobile devices and cameras. This data has been used to establish speed and travel time throughout the day in both directions on the corridor shown in Figure 2, which is as closely aligned to the M4 study corridor as possible.

Figure 2: INRIX M4 Corridor



Speed data has been extracted for the M4 eastbound and westbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday). This data shows the average speeds are between 50 and 60mph throughout the day for vehicles travelling eastbound on the M4 study corridor, except for the AM period between 06:15 and 08:00 where speeds reduce to below 50mph.The lowest average speed of approximately 45mph occurs between 07:15 and 07:30.

The data shows that speeds drastically reduce for vehicles travelling westbound during the AM and PM peak periods from approximately 06:30 to 09:00, and 14:15 to 18:30, with the lowest average speed of 26mph occurring at 16:45. Free-flow speeds in the inter-peak and off-peak periods are approximately 50mph.

Travel times have also been extracted from INRIX for the M4 corridor for the same period. Travel time on the eastbound carriageway increases during the AM peak period, from an approximate free-flow time of 2 minutes 45 seconds to an average of 3 minutes 18 seconds at 07:15. Delay in this direction on the corridor can therefore be inferred as an average of approximately 30 seconds during the AM peak. The 95th percentile, however, shows that travel times can reach 4 minutes 37 seconds, therefore delays could be in the region of 2 minutes.

For the M4 westbound corridor, INRIX shows that free-flow travel time is approximately 3 minutes, which increases to an average of 4 minutes 30 seconds in the AM peak and 5 minutes 50 seconds in the PM peak. Delay in this direction on the corridor can therefore be inferred as approximately 1 minute 30 seconds during the AM peak, which could increase to 4 minutes when considering the 95th percentile travel times. In the PM peak, average delay is approximately 3 minutes, which could increase to around 4 minutes 30 seconds.

The INRIX data for this corridor is presented graphically in Appendix B.

3.3 OTHER BASELINE DATA

In addition to the air quality and traffic baselines detailed in this report, the following areas have been covered by the WelTAG Stage One and Two reports.

- Infrastructure and local facilities
- Other related work
- Public Transport
- Economy
- Demographics
- Other sensitive environmental areas

4 TRANSPORT CASE

4.1 OVERVIEW

The transport case 'tells you what the expected impacts of the project are, how the project will contribute to the well-being goals and whether a project will provide value for public money. This is the equivalent of the 'Economic Case' (Option Appraisal) in HM Treasury's Green Book. This is calculated by thinking about social, cultural, environmental and economic costs and benefits of each option'.

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the WelTAG report should be proportionate to the impacts under consideration. Therefore, the transport case focuses on air quality and reflects the key considerations in relation to the EU Air Quality Directive and bringing forward compliance with limit values.

4.2 METHODOLOGY

4.2.1 APPROACH

The approach to the Stage Three level of appraisal is intended to examine in greater detail the physical 'hard measures', which have tangible benefits for tackling the problem under consideration. The 'soft measures' included within the complementary package have not been modelled as the direct benefits are expected to be intangible. The general approach to the modelling of measures is outlined in Table 5.

Table 5: Modelling Approach to Measures

Ref	Measure	Traffic Modelling	Air Quality Modelling
000	Complementary Package	Not Modelled	Not Modelled
001	Enforce / Reduce Speed Limit (50mph)	Modelled (AM, IP, and PM peak hours)	Modelled (AM, IP, PM, OP periods)
002	Junction Closures (Option A - Junction 25A Westbound off-slip), plus 50mph Speed Limit	Modelled (AM, IP, and PM peak hours)	Modelled (AM, IP, PM, OP periods)
003	Junction Closures (Option B - Junction 26 Westbound off-slip), plus 50mph Speed Limit	Modelled (AM, IP, and PM peak hours)	Modelled (AM, IP, PM, OP periods)
004	Junction Closures (Option C - Junction 26 Eastbound on-slip), plus 50mph Speed Limit	Modelled (AM, IP, and PM peak hours)	Modelled (AM, IP, PM, OP periods)
005	Junction Closures (Option D - Junction 26 Westbound off-slip and Eastbound on-slip), plus 50mph Speed Limit	Modelled (AM, IP, and PM peak hours)	Modelled (AM, IP, PM, OP periods)
006	Variable Diversions (e.g. Southern Distributor Road), plus 50mph Speed Limit	Modelled (AM and PM peak hours)	Modelled (AM, IP, PM, OP periods)
007	Clean Air Zone, plus 50mph Speed Limit	Not Modelled	Modelled (AM, IP, PM, OP periods)

Clean Air Zones (CAZ) are defined under the Clean Air Zone Framework for Wales as:

"A geographical target area where a range of co-ordinated actions are applied with the purpose of ensuring, in the soonest time possible, a significant reduction in public and environmental exposure to harmful airborne pollutants for all sources".

With the target area being a stretch of the strategic network, many of the measures suggested in the Framework have limited applicability (vehicle idling policies, provision of public transport infrastructure, use of wood burning stoves etc.) whilst others have been assessed during the WelTAG process as individual measures or packages (traffic management, adjusting speed limits, improved facilities for car sharing, information campaigns etc.).

However, the preferred model for a CAZ in Wales is to restrict access to only the least polluting vehicles, via either a total ban or via a charging scheme to allow limited access to certain vehicles. The CAZ measure has, therefore, been modelled using the same traffic data as provided for Measure 001 – Enforce/Reduce Speed Limit but assuming the elimination of all vehicles older than Euro 5/VI from the fleet. This is a somewhat more conservative CAZ than the Welsh Government preferred model (Euro VI/6 for HDVs and diesel LDVs, Euro 4 for petrol LDVs) but takes account of the economic disadvantage of certain areas and the potential for limited access by Euro 5 vehicles.

The following sections set out how each of the 'hard measures' have been appraised during Stage Three of the study. The appraisals undertaken adhere to the WelTAG 2017 guidance, and consider the seven national well-being goals. The appraisal outcomes have been summarised within Appraisal Summary Tables (AST), which are included at the rear of the chapter.

4.2.2 ENVIRONMENTAL APPRAISAL

TRAFFIC MODELLING

The emissions and dispersion modelling undertaken at Stage Two was based on the assumed impacts of measures on traffic speeds and volumes. At Stage Three a fully quantifiable approach to appraising the benefits of measures has been undertaken, and this required the 'hard measures' to be modelled with micro-simulation traffic modelling. It was not necessary to undertake traffic modelling for all measures as some measures (e.g. Air Quality Barriers) are not fundamentally expected to result in a change in traffic flows.

A static VISSIM micro-simulation model was developed for the morning and evening peak hours, as well as an average interpeak period, on the M4 study corridor near Newport, , utilising demand data from the South East Wales Transport and Land Use Model prepared by Mott MacDonald for the Welsh Government. The study was calibrated and validated utilising existing data sources. Results were output and averaged over several random seeds to ensure the 'daily variability' in traffic flow was accurately modelled.

High resolution data was output form the model (across 115 data collection points) and included volume, classification and speed data. Robust long-term traffic count sites from Traffic Wales were used to factor the morning and evening peak hour flow data to AM, PM, and OP periods. As the data from the inter-peak period is an average hour between 09:30 and 15:30, the data for the hour was factored by 6 to determine the whole period, which along with the other periods covered 24 hours in total.

Whilst the model was developed for the M4 corridor of the exceedance only, general consideration has been given to the wider impacts of displacing traffic in the instance of closing junctions or operating variable diversions.

The full detail on the traffic modelling, including the base model calibration and validation statistics are included within the WelTAG Stage Three Impact Assessment Report.

AIR QUALITY

Emissions Calculation and Dispersion Modelling

The air quality impacts of the measures have been quantified through emissions modelling, using Defra/DfT's emissions factor toolkit (EFT) and detailed dispersion modelling, using the ADMS-Roads model. Vehicle emissions were calculated using the latest EFT (v8) and traffic data from micro-simulation traffic modelling for a year representative of 2017 - 2018 (see below).

To maximise the transfer of information from the micro-simulation modelling to the dispersion modelling, the statistical distribution of speeds (as the 5^{th}, 15^{th}….85^{th} and 95^{th} percentiles) on modelled routes was used to calculate emissions rather than the simple fleet average speed. Since traffic modelling was undertaken for peak and interpeak hours only, flows and speeds outside of these hours (off-peak) were calculated using a standard factoring approach and assuming free flow speeds derived from INRIX data, unless limited by the measure.

The dispersion modelling was verified against data from the ongoing Welsh Government's diffusion tube survey (with data annualised to 2017).

The modelled area was limited to the M4 study corridor (Figure 1) with the impacts of measures on emissions and roadside NO_2 concentrations calculated for the PCM links only.

Impacts were modelled at a distance of 4m from the roadside. This is the nominal distance at which concentrations area assessed within the UK's national PCM modelling. Multiple assessment locations ('receptors') were modelled along each PCM link, and the impact of the measure was assessed as the average impact at all receptors along the link.

The impact of the measures on the compliance of routes with the EU limit value was assessed following the methodology set out in the Design Manual for Roads and Bridges Interim Advice Note 175/13 and based on the results of the national PCM modelling. That is, the modelled impact of a measure is added to the PCM concentration to derive an Equivalent 'with Measure' PCM concentration.

Equivalent 'With Measure' PCM Concentration = PCM Concentration + Modelled Impact of Measure

(where the modelled impact is generally a decrease in concentration and the Equivalent PCM concentration is lower than the original PCM concentration)

It is necessary to add the locally modelled impact to the output of the national PCM model because the PCM model is not fully available to 3rd parties to directly model the impact of measures on compliance dates.

Future Years

No forecast traffic models have been developed, as the assessments consider the implementation of measures and the impact relative to the 2017/2018 base year. The air quality impacts in future years have been modelled by running the EFT with 2017/2018 traffic data but year-specific vehicle emissions from 2017 to 2022. It can be reasonably assumed that there will be some, albeit limited, traffic growth in the years to 2022. Taking into account the decrease in vehicle emissions over time (as older more polluting vehicles are replaced by newer vehicles), neglecting the effects of traffic growth in future years may lead to a slight underestimation of the benefits of a measure. However, in the context of the overall study methodology, the neglect of a few percentage points in traffic growth will not place a constraint on the compliance assessment.

In deeming when a particular measure could be deployed in the field, taking into account, *inter alia*, the required investigations and, consultation periods, commissioning and construction times, and existing statutory powers of the trunk road agents, the timescales in Table 6 were assumed.

Table 6: Assumed implementation timescales

Measure	Earliest Implementation Timescale
Speed Limits	Immediate (In Place)
Variable Diversions*	End of 2019
Junction Closures*	End of 2019
Implementation of Clean Air Zone	End of 2022

* Measures can be implemented with temporary infrastructure ahead of permanent installations

Offline Screening of Impacts

In addition to the detailed modelling of the M4 J25 to J26 corridor, and acknowledging that some measures may have an impact on adjacent routes, screening of potential impacts was undertaken to determine the likelihood of significant 'offline' impacts.

This involved the use of property counts along potentially affected offline routes i.e. routes from the M4 towards the centre of Newport and 'Headroom' Calculations. For the latter, the monitoring undertaken by NCC was used to infer a relationship between the monitored roadside NO_2 and vehicle flow. This relationship was then used to quantify the impact of a change in vehicle flow with a measure and to assess whether this impact would be likely to cause or exacerbate existing exceedances of air quality standards.

OTHER SENSITIVE ENVIRONMENTAL AREAS

A qualitative appraisal has been undertaken to assess the impacts on:

- Noise
- Landscape
- Historic Environment
- Biodiversity

- Water Environment
- Townscape

4.2.3 SOCIAL AND CULTURAL APPRAISAL

A qualitative appraisal has been undertaken to assess the impacts on:

- Journey Quality - taking into consideration the following aspects:
  - Traveller care: aspects such as cleanliness, level of facilities, information, and the general transport environment
  - Travellers' views: the view and pleasantness of the external surroundings in the duration of the journeys
  - Traveller stress: frustration, fear of accidents, and route uncertainty
- Accidents
- Access to Employment and Services

4.2.4 ECONOMIC APPRAISAL

JOURNEY TIME AND JOURNEY TIME RELIABILITY CHANGES

Journey time and journey time reliability changes have been combined within this assessment and have been considered in the appraisals accordingly.

Where possible, the VISSIM model has been used to determine a quantitative appraisal of the changes to journey times along the study corridor in the morning and evening peak hours. This has been supplemented by a qualitative appraisal to assess changes in journey times across the whole network throughout the day by all affected modes both for users and non-users of the measure. The appraisal also considers changes in the variation in journey times between times of day and between journeys made at the same time each day i.e. morning and evening peak periods.

CAPITAL AND REVENUE COSTS

The measures have been costed both in terms of capital (investment costs) and revenue (operating costs). Typical components of capital cost include construction costs, land and property costs, preparation and administration costs, and traffic management during construction. Typical components of revenue costs include routine and non-traffic related maintenance costs.

LAND

A qualitative appraisal has been undertaken to assess the land take required by each measure.

4.2.5 VALUE FOR MONEY ASSESSMENT

The Value for Money assessment has been determined based on capital and revenue costs and broad benefits that have been weighted as far as possible in favour of the objective. Whilst all benefits have been considered, the final value for money score has taken into the impact on air quality as the primary consideration. As such, the Value for Money (VfM) will be presented a £/µg reduction in NO_2 at 4m from the PCM link.

4.3 APPRAISAL AGAINST OBJECTIVES

The Stage One procedure involved undertaking the appraisal of the long list of measures, with each measure assessed against the WelTAG criteria, and then considered within the context of the study objective; namely, the extent to which each measure would be successful in bringing forward reductions in NO_2 in the shortest possible time to ensure compliance with the Ambient Air Quality Directive requirements.

The Stage Two appraisal essentially comprised a re-undertaking of this process. This was necessary, as it elicited different results in cases where additional evidence had been produced or sourced, allowing appraisals to be undertaken in greater detail and with a greater degree of certainty, with the potential for differing appraisal outcomes in comparison to Stage One.

KEY CRITERIA

The following **key criteria** for the appraisal were established in Stage One, updated in Stage Two, and finalised in Stage Three:

Effectiveness – Is the measure likely to deliver reductions in roadside concentrations proportionate to the scale of the exceedance above the 40µg/m^3 legal limit

This has been updated following more detailed assessment work at Stage Three.

Timescales – Can the measure be implemented within timescales that are meaningful (short enough) to have an impact on bringing forward the projected compliance date

This has been updated following more detailed assessment work at Stage Three.

Deliverability – Can the measure be delivered in the location involved with the powers available to the Welsh Government as Highway or Traffic Authority

This has been updated following more detailed assessment work at Stage Three.

SECONDARY CRITERIA

In addition to the Air Quality Directive, the study contributes to the strategic priorities of the Welsh Government, including that of the Well-being of Future Generations (Wales) Act 2015. As such, the following were considered as **secondary criteria** in the appraisal process at Stage Two:

Will the measure deliver an overall reduction in NO_2 emissions to air

This is a qualitative appraisal based on the likelihood of overall reduction to NO_2 resulting from the measure. This will enable the differentiation of measures which simply redistribute the impacts rather than seeking to reduce overall NO_2 emissions to air.

Will the measure result in unintended consequences or other environmental impacts

This is a qualitative appraisal that considers whether there will be any other adverse environment impacts resulting from the measures. This will summarise the findings of the appraisal against the environmental aspects of well-being.

Will the measure contribute to well-being

This is a qualitative appraisal which considers the seven goals of the Well-being of Future Generations (Wales) Act 2015, with the following criteria:

- Will the measure impact equally across multiple vehicle classes and journey types
- Will the measure have a positive impact on wider public health and inequalities

4.3.1 OTHER ISSUES

Further potential issues with each measure have been explored and considered accordingly in the instance that they have not been covered under any of the other appraisal areas. These include:

Overall Acceptability

A qualitative appraisal has been undertaken in order to assess the receptivity of the public, local authorities and key stakeholders, both groups and individuals to the measure. The appraisal has been undertaken on a measure by measure basis.

Technical, Operational and Financial Feasibility

Where appropriate a qualitative appraisal has been undertaken to assess measures on the following criteria:

- Technical: The extent to which the measure is technically feasible within the specified budget and timeframe
- Operational: The extent to which the measure is operationally feasible within the specified budget and timeframe
- Financial: The extent to which the measure is financially feasible

Deliverability and Risk

At this stage, it is difficult to identify issues regarding deliverability and risk given the high-level nature of the measure's development. Where possible, this has been identified as qualitative statements though should be reassessed at WelTAG Stage Three when the measures are developed further.

4.4 STAGE THREE APPRAISAL

For Stage Three of the study, the appraisal outcomes have been summarised as follows:

- Air Quality Impacts
  - Vehicle Emissions and Commentary on Measure (Table 7)
  - Equivalent PCM Concentrations and Compliance Dates (Table 8)
- Overall Impacts
  - Appraisal Summary Tables (ASTs)
  - Summary of Appraisals (Table 9)

The process has identified those measures that have

a) the potential to bring forward compliance dates and/or reduce exposure to NO_2 in non-compliant areas as quickly as possible on PCM links within the study corridor.

but also identified those measures for which there is

b) reasonable scientific doubt as to the efficacy of the measure in reducing exposure to NO_2 in non-compliant areas, or
c) reasonable scientific doubt that the measure would not result in unacceptable dis-benefits, for example significant deterioration of air quality in offline areas, whether compliant or non-compliant with limit values.

The modelling of the impacts of the measures undertaken for the appraisal follows best practice guidance and uses the latest available information on vehicle emissions and local monitoring. Where the modelling has been able to robustly demonstrate a measure's effectiveness in reducing NO_2 concentrations, the measure has been classed as **likely** to bring forward compliance or, depending on the PCM concentration, to reduce exposure to NO_2 alongside the PCM link as quickly as possible. This judgement is based on the measure's impact on NO_2 concentrations on the PCM link. If, in addition, the measure has been demonstrated to be timely in relation to the compliance timescales and, beyond reasonable scientific doubt, to have no unacceptable adverse impacts, the measure is classed as a **likely measure**.

Measures are classed as **unlikely measures** if there is reasonable scientific doubt as to their efficacy in reducing NO_2 concentrations (classed as **unlikely** to reduce NO_2 concentrations) and/or if the measure gives rise to unacceptable dis-benefits. A measure can also be classed as an **unlikely measure** if it is included within, or cannot be implemented at the same time as, another more or equally effective package of measures. In the latter case, the other appraisal areas may be used to identify the optimum measure, including consideration of whether the measure results in an overall beneficial impact on air quality.

Total pollutant concentrations at the roadside, whether taken from the PCM model or from reference method monitoring, are of prime importance in determining when a particular road link becomes compliant with limit values. They are, however, less important in determining whether a measure will bring forward compliance in the shortest possible time or reduce exposure to NO_2 as quickly as possible. That is to say if, for example, the imposition of a measure is assessed as being likely to bring forward compliance in the shortest possible time, that would apply whether or not total pollutant concentrations are, say 50µg/m^3 or 45µg/m^3 in a particular year, although the projected compliance date in the two cases would be different.

In recognising uncertainty within the appraisal methodology, measures that have been identified as being likely to reduce NO_2 concentrations but which fail on the Key Criterion of 'Timeliness' have been classed as **precautionary retained measures**. These are measures which are **likely** to be effective under the objective of the study, but only if compliance on a link is significantly delayed beyond the current PCM projection timescales.

Key Air Quality Impacts

Table 7 and Table 8 present the impacts of the measures on annual vehicle emissions and annual mean NO_2 concentrations respectively on PCM Links 70057 and 40500.

The imposition and enforcement of a 50mph limit is ***likely*** to remove the risk of exceedance of the limit value in the PCM modelling on Link 70057. It is also ***likely*** to reduce concentrations on Link 40500, by up to 0.9µg/m^3, but without bringing forward compliance in relation to the current PCM projections. The reduction in

concentrations is driven by reduced impacts from cars and light duty vehicles outside of hours of congestion (inter-peak and off-peak periods). The measure has no effect during peak hours.

The junction closure and variable diversion measures have beneficial impacts on the M4, over and above the impacts of speed limit reduction alone, due to the redistribution of traffic onto local roads. There are consequential adverse impacts offline but, taking into account the likely alternative routes for traffic and NCC's air quality monitoring, these impacts are unlikely to result in a net increase in population exposure or net increase in properties at risk of exceedance of air quality standards.

The closure of the westbound off-slip at J25A (east of the Brynglas tunnels) potentially offsets some of the benefits of speed limit imposition on Link 40500 (or at least provides no greater benefit than speed limit imposition alone) and is, therefore, discounted as a potential measure on the grounds of efficacy. Closure of J26 westbound off-slip is less effective than closing both slips at J26 and is also discounted on grounds of efficacy.

The most effective measures at reducing concentrations are 005 - the combined closure of the westbound off-slip and eastbound on-slip at J26, and 006 - the use of variable diversions (together with speed limit imposition in both cases). These measures are, to a degree, mutually exclusive since both act to reduce the use of the M4 by Newport-bound/based traffic but are ***likely*** to be equally effective in terms of reducing concentrations without unacceptable adverse air quality impacts offline. The identification of the likely measure being taken forward for implementation was, in this case, based on the appraisal of the WelTAG aspects of well-being (Table 9).

The imposition of a Clean Air Zone has ***potential beneficial impacts*** but is unlikely to be implementable within a timeframe that could affect compliance with limit values. However, taking into account the ongoing monitoring programme, initial indications from which suggest that the M4 around Newport might not achieve compliance within the projected PCM timeframe, the measure is retained pending the results of fixed monitoring, using reference methods.

Table 7: Impact of measures on annual vehicle emissions on PCM Link 70057 and 40500

ID	Measure	Emissions Reduction*		Commentary on Impact (First Year of Implementation)
		Link 70057	Link 40500	
001	Enforce / Reduce Speed Limit (50mph)	3.0%	2.4%	Benefits in interpeak and off-peak only; Increase in HDV emissions (2017)
002	Junction Closures (Option A - Junction 25A WB off-slip), plus 50mph Speed Limit	7.2%	2.2%	Potentially offsets some benefits of speed limits to the west of the Brynglas tunnels (2019)
003	Junction Closures (Option B - Junction 26 WB off-slip), plus 50mph Speed Limit	3.8%	4.0%	Benefits on the mainline; Offline increase in emissions but no significant increase in exposure
004	Junction Closures (Option C - Junction 26 EB on-slip), plus 50mph Speed Limit	3.8%	4.5%	Benefits for 70057 greatest with J25A closure (both east of tunnels); Benefits for 40500 greatest with J26 closure (both west of tunnels) (2019)
005	Junction Closures (Option D - Junction 26 WB off-slip and EB on-slip), plus 50mph Speed Limit	4.0%	5.9%	
006	Variable Diversions (e.g. SDR), plus 50mph Speed Limit	3.1%	3.6%	Benefits due to reduced flows to the west of Brynglas tunnels; lower benefits to the east of tunnels (2019)
007	Clean Air Zone, plus 50mph Speed Limit	3.9%	3.4%	Euro 4 and older vehicles excluded in 2022, but with limited benefits (2022). Excluding Euro 5 vehicles would increase benefits
*Emissions Reductions provided for first year of implementation				

Table 8: Impact of measures on roadside annual mean concentrations (Equivalent PCM Concentration, µg/m³)

Measure	Impact*	2017	2018	2019	2020	2021	2022
				PCM Link 70057			
Baseline		**40.8**	38.9	37.2	35.3	33.1	31.1
001 Speed Limit (SL)	-0.9	39.9	38.0	36.3	34.4	32.2	30.2
002 SL + J-Close J25A WB off-slip	-1.4			35.8	34.0	31.8	29.9
003 SL + J-Close J26 WB off-slip	-0.9			36.3	34.4	32.2	30.2
004 SL + J-Close J26 EB on-slip	-1.0			36.2	34.4	32.2	30.2
005 SL + J-Close J26 WB off-slip and EB on-slip	-0.9			36.3	34.4	32.3	30.2
006 SL + Variable Diversions	-1.1			36.1	34.2	32.1	30.1
007 SL + Clean Air Zone	-0.9						30.2
				PCM Link 40500			
Baseline		**48.5**	**46.1**	**44.0**	**41.7**	39.0	36.5
001 Speed Limit (SL)	-0.9	**47.6**	**45.2**	**43.1**	**40.7**	38.1	35.6
002 SL + J-Close J25A WB off-slip	-1.0			**43.1**	**40.8**	38.1	35.6
003 SL + J-Close J26 WB off-slip	-1.2			**42.9**	**40.6**	37.9	35.5
004 SL + J-Close J26 EB on-slip	-1.4			**42.6**	**40.3**	37.7	35.2
005 SL + J-Close J26 WB off-slip and EB on-slip	-1.7			**42.4**	**40.1**	37.5	35.1
006 SL + Variable Diversions	-1.6			**42.4**	**40.1**	37.5	35.1
007 SL + Clean Air Zone	-0.9						35.5

** in first year of implementation*

Note: (Red) Non-compliant, (Green) compliance achieved, (Grey) before implementation timeframe

4.4.1 APPRAISAL SUMMARY TABLES

The appraisal outcomes have been summarised within Appraisal Summary Tables (AST). The ASTs provide a breakdown of the impact of each measure on each of the appraisal areas. The scoring has been undertaken using the WelTAG 7-point scale where applicable. This is qualitative for all metrics except air quality impacts, for which the following quantitative criteria apply:

Magnitude of Change

- >10% of limit value — Large Beneficial or Adverse
- ≥5% - 9% of limit value — Medium Beneficial or Adverse
- ≥1% - 4% of limit value — Small Beneficial or Adverse
- <1% of limit value — Negligible

Date Produced - 06/09/2018

Appraisal Summary Table **Measure No.** 001

	Name of measure:	**Enforce/Reduce Speed Limit**
	Location:	**M4 Newport**
	Description of measure:	**The M4 around Newport operates a Variable Speed Limit under the Road Traffic Act between west of Junction 23A (Magor) to east of Junction 29 (Castleton). Using this regulation, the speed limits around Newport have been implemented at a maximum of 50mph throughout the day. The intention is that lower speed limits will reduce vehicle emissions and improve air quality, aiding compliance with NO2 limits set out in legislation. If successful in reducing NO2 levels, arrangements will be made to make the speed limits permanent.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 0.9µg/m3**
	Timescales:	**50mph speed limit implemented 2018**
	Deliverability:	**This measure has been delivered by WG Network Management Division**

	Impacts	Summary of key impacts	Assessment
Environmental	Air Quality	The measure reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed (i.e. speeds greater than the optimal speed for minimising emissions from light duty vehicles ~60 - 80 kph). The speed limit will be enforced with average speed cameras and include off-peak/inter-peak periods. It has little impact in areas of congestion (e.g. westbound PM peak). Emissions reduced by up to 3%; Roadside concentrations reduced by up to 0.9µg/m3, which is 2% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. The reduction in speed limits is likely to result in a reduction in noise levels between the source and the receptors.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the associated benefits to air quality. The addition of the complementary 'soft' measures should increase public acceptability for the measure.	Slight Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents.	Slight Beneficial
	Access to Employment and Services	A reduction to the speed limit is unlikely to have an impact on access to services, employment, or healthcare.	Neutral
Economy	Journey Time Changes	Reducing speed limits on the strategic route increases total travel time for users, with modelling showing increases of approximately 120 vehicle hours in total across both AM and PM peak hours. There will be further increases in travel time across the rest of the day, including 130 vehicle hours in the interpeak period, and likely to be more so in the off-peak period, although this has not been modelled.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	It is estimated that implementing the reduced speed limit on the M4 study corridor would cost in the region of £200,000. This would include the cost of providing additional spot speed enforcement cameras, with the limit set via the VSL system.	£200,000
VfM	Value For Money	Reducing the speed limit to 50mph will reduce the roadside concentrations by up to 0.9µg/m3, at a cost of £200,000. This measure will therefore be a cost of approximately £220,000/µg.	£220,000/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	There will be an overall reduction in NO_2 emissions to air as a result of reducing the speed limit to 50mph on the M4 study corridor.	
	Will the measure result in unintended consequences or other environmental impacts	Aside from a slight increase to journey times, reducing the speed limit will not have any adverse consequences or other environmental impacts.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and provide additional noise benefits.	
Other Issues	Acceptability	A reduction in speed limit has been opposed by some groups and individuals within the Consultation.	
	Technical, Operational & Financial Feasibility	Temporary 50mph speed limit order implemented June 2018. Ongoing discussions with the Police regarding enforcement are taking place.	
	Deliverability & Risk	None identified as measure has already been implemented.	

Date Produced - 31/08/2018

Appraisal Summary Table **Measure No.** 002

Name of measure:	**Enforce/Reduce Speed Limit + Junction Closures (Option A)**
Location:	**M4 Newport**
Description of measure:	**As well as reducing the speed limit to 50mph, close Junction 25A westbound off-slip.**
Key Criteria – Effectiveness:	**Roadside concentrations reduced by up to 1.4µg/m3 on M4.**
Key Criteria – Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
Key Criteria – Deliverability:	**Junction closures can be managed by WG Network Management Division.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the M4 study corridor by removing traffic from the link and is targeted at encouraging vehicles to leave the westbound carriageway at Junction 25 and use the B4596 to Junction 25A and Grove Park roundabout. The measure has an effect throughout the day and is not limited to peak hours. On the M4, emissions reduced by up to 7%; Roadside pollutant concentrations reduced by up to 1.4µg/m3, which is 3.5% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. This measure would displace traffic onto local roads, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	With the closure of the off-slip at the Junction 25A, through traffic using the strategic network may benefit from improved journey quality due to a reduction in delay on the study corridor. However, the displacement of traffic may cause congestion on local roads and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the off-slip closure should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the off-slip at Junction 25A is likely to cause some congestion at Junction 25; which may have an impact on local trips to services, employment, and healthcare.	Slight Adverse
Economy	Journey Time Changes	Reducing speed limits on the M4 increases total travel time for users. The addition of the off-slip closure would displace traffic from Junction 25A onto Junction 25, removing traffic from the M4 study corridor and onto the B4596, to prevent the weaving that occurs between the two junctions. The modelling showed that the closure of the off-slip may marginally improve journey times and reduce delay on the strategic route during the PM peak hour only; however, it shows increased journey times during the AM and IP periods. The model has shown that this measure significantly increases journey times for local road users at Junction 25, as the increased demand pushes the junction over capacity. Overall, this measure is considered to have a large adverse impact.	Large Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. Up to £10m for junction closures, to include physical measures at the slip, but also the need for mitigation measures on the local roads. It is possible that Newport City Council would either not support this measure or at minimum ask for mitigation measures on the local road network to avoid rat-running and to take into account the additional volume of traffic likely to be using the 'alternative' routes to head into the City Centre – presumed to be the B4237 Chepstow Road (via J24), B4596 Caerleon Road (via J25) and/or A4051 Malpas Road (via J26).	£10,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and closing westbound off-slip at Junction 25A will reduce the roadside concentrations by up to 1.4µg/m3, at a combined cost of £10.2m. This measure will therefore be a cost of approximately £7.3m/µg.	£7.3m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Reducing the speed limit will reduce emissions. Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be adverse impacts on noise levels, journey time and journey quality with the speed reduction and closure of the slip-road at the Junction 25A due to the displacement of traffic.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the off-slip at Junction 25A should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. Junction closures will not have an additional overall positive impact on the wider public health and inequalities, as it will displace traffic onto local roads, causing NO2 and noise levels to rise on more heavily populated roads.	
Other Issues	Acceptability	The intention of closing the westbound off-slip at Junction 25A is to remove westbound traffic from the motorway at Junction 25. This will have minimal impact on road users as they are able to access Junction 25 via the B4596; however there may still be some opposition from local residents.	
	Technical, Operational & Financial Feasibility	SWTRA officers have commented that if implemented, a redesign of the westbound carriageway is necessary, as this off-slip acts as the lane drop from 3 to 2 in advance of Usk River Bridge and the Tunnels.	
	Deliverability & Risk	Displacement of traffic onto local roads would require collaboration with the local authority.	

Date Produced - 31/08/2018

Appraisal Summary Table

Measure No. 003

	Name of measure:	**Enforce/Reduce Speed Limit + Junction Closures (Option B)**
	Location:	**M4 Newport**
	Description of measure:	**As well as reducing the speed limit to 50mph, close Junction 26 westbound off-slip.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 1.2µg/m3 on M4.**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Junction closures can be managed by WG Network Management Division.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the M4 study corridor by removing traffic from the link and is targeted at encouraging vehicles to leave the westbound carriageway at Junction 25A and use an alternative route via the A4042. The measure has an effect throughout the day and is not limited to peak hours. On the M4, emissions reduced by up to 4%; Roadside pollutant concentrations reduced by up to 1.2µg/m3, which is 3% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. This measure would displace traffic onto local roads, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	With the closure of the off-slip at Junction 26, through traffic using the strategic network may benefit from improved journey quality due to a reduction in vehicle numbers and delay on the study corridor. However, the displacement of traffic will cause congestion on local roads and the A4042 and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the off-slip closure should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the off-slip at Junction 26 is likely to cause congestion as westbound traffic diverts on to other local roads, for instance the A4042. It is anticipated that this would impact on local trips to services, employment, and healthcare. Road users may experience increased journey times and find some services less accessible. The impact is considered to be slightly adverse.	Slight Adverse
Economy	Journey Time Changes	Reducing speed limits on the M4 increases total travel time for users. The addition of the off-slip closure at Junction 26 would displace westbound traffic onto the A4042 via Junction 25A. This may marginally improve journey times and reduce delay on the strategic route, but would increase journey times for the displaced road users. Overall, this measure is considered to have a moderate adverse impact.	Moderate Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. Up to £10m for junction closures, to include physical measures at the slip, but also the need for mitigation measures on the local roads.	£10,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and closing the westbound off-slip at Junction 26 will reduce the roadside concentrations by up to 1.2µg/m3, at a combined cost of £10.2m. This measure will therefore be a cost of approximately £8.5m/µg.	£8.5m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Reducing the speed limit will reduce emissions. Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be slight adverse impacts on noise levels, journey quality, and access to employment and services, and moderate adverse impacts on journey times with the speed reduction and closure of the slip-road, due to the displacement of traffic onto local roads.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the off-slip at Junction 26 should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. Junction closures will not have an additional overall positive impact on the wider public health and inequalities, as it will displace traffic causing NO2 and noise levels to rise on local roads.	
Other Issues	Acceptability	This slip road takes little in the way of traffic, as most heading into Newport or north towards Cwmbran leave the M4 at Junction 25a. There may be some local opposition from businesses (IBIS Hotel).	
	Technical, Operational & Financial Feasibility	It may be necessary to improve the alternative route(s), which would increase scheme costs.	
	Deliverability & Risk	Displacement of traffic onto local roads would require collaboration with the local authority.	

Date Produced - 31/08/2018

Appraisal Summary Table **Measure No.** 004

	Name of measure:	**Enforce/Reduce Speed Limit + Junction Closures (Option C)**
	Location:	**M4 Newport**
	Description of measure:	**As well as reducing the speed limit to 50mph, close Junction 26 eastbound on-slip.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 1.4µg/m3 on M4.**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Junction closures can be managed by WG Network Management Division.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the M4 study corridor by removing traffic from the link and is targeted at encouraging vehicles to use an alternative route via the A4042 to access the eastbound carriageway at Junction 25A. The measure has an effect throughout the day and is not limited to peak hours. On the M4, emissions reduced by up to 4.5%; Roadside pollutant concentrations reduced by up to 1.4µg/m3, which is 3.5% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. This measure would displace traffic onto local roads, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	With the closure of the on-slip at Junction 26, through traffic using the strategic network may benefit from improved journey quality due to a reduction in vehicle numbers and delay on the study corridor. However, the displacement of traffic will cause congestion on local roads and the A4042 and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the on-slip closure should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the on-slip at Junction 26 is likely to cause congestion as eastbound traffic diverts on to other local roads, for instance the A4042. It is anticipated that this would impact on local trips to services, employment, and healthcare. Road users may experience increased journey times and find some services less accessible. The impact is considered to be slightly adverse.	Slight Adverse
Economy	Journey Time Changes	Reducing speed limits on the M4 increases total travel time for users. The addition of the on-slip closure at Junction 26 would displace eastbound traffic onto the A4042 via Junction 25A. This may marginally improve journey times and reduce delay on the strategic route, but would increase journey times for the displaced road users. Overall, this measure is considered to have a moderate adverse impact.	Moderate Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. Up to £10m for junction closures, to include physical measures at the slip, but also the need for mitigation measures on the local roads.	£10,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and closing the eastbound on-slip at Junction 26 will reduce the roadside concentrations by up to 1.4µg/m3, at a combined cost of £10.2m. This measure will therefore be a cost of approximately £7.3m/µg.	£7.3m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Reducing the speed limit will reduce emissions. Closure of the slip-road would result in reassignment of traffic onto local roads between routes of equivalent or longer length. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be slight adverse impacts on noise levels, journey quality, and access to employment and services, and moderate adverse impacts on journey times with the speed reduction and closure of the slip-road due to the displacement of traffic onto local roads.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the on-slip at Junction 26 should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. Junction closures will not have an additional overall positive impact on the wider public health and inequalities, as it will displace traffic causing NO2 and noise levels to rise on local roads.	
Other Issues	Acceptability	This slip road takes little in the way of traffic, as most heading onto the M4 from Newport or south from Cwmbran join the M4 at Junction 25a. There may be some local opposition from businesses (IBIS Hotel).	
	Technical, Operational & Financial Feasibility	Access to the slip road is likely to be required by South Wales Fire and Rescue Service, as Malpas Station is less than half a mile away. This would be their quickest and main route to the M4 eastbound carriageway and access control equipment is most likely necessary if the closure is implemented.	
	Deliverability & Risk	Displacement of traffic onto local roads would require collaboration with the local authority.	

Date Produced - 31/08/2018

Appraisal Summary Table

Measure No. 005

	Name of measure:	**Enforce/Reduce Speed Limit + Junction Closures (Option D)**
	Location:	**M4 Newport**
	Description of measure:	**As well as reducing the speed limit to 50mph, close Junction 26 westbound off-slip and eastbound on-slip.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 1.7µg/m3 on M4.**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Junction closures can be managed by WG Network Management Division.**

	Impacts	Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of the junction closure further reduces emissions on the M4 study corridor by removing traffic from the link and is targeted at encouraging vehicles to use an alternative route via the A4042 to access the M4 at Junction 25A. The measure has an effect throughout the day and is not limited to peak hours. On the M4, emissions reduced by up to 5.9%; Roadside pollutant concentrations reduced by up to 1.7µg/m3, which is 4% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. This measure would displace traffic onto local roads, which are closer to the sensitive noise receptors, therefore has the potential to generate additional noise impacts.	Slight Adverse
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	With the closure of the slip roads at Junction 26, through traffic using the strategic network may benefit from improved journey quality due to a reduction in vehicle numbers and delay on the study corridor. However, the displacement of traffic will cause congestion on local roads and the A4042 and increase journey times and delay, negatively affecting overall journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of the closures should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	The closure of the slip roads at Junction 26 is likely to cause congestion as eastbound and westbound traffic diverts on to other local roads, for instance the A4042. It is anticipated that this would impact on local trips to services, employment, and healthcare. Road users are likely to experience increased journey times and find some services less accessible. The impact is considered to be moderately adverse.	Moderate Adverse
Economy	Journey Time Changes	Reducing speed limits on the M4 increases total travel time for users. The addition of the closure of the slip roads at Junction 26 would displace westbound and eastbound traffic onto the A4042 via Junction 25A, which has the potential to cause congestion on local roads, and significantly increase journey times. The measure may marginally improve journey times and reduce delay on the strategic route over the reduced speed limits alone, but it is anticipated that some users trip length could increase by up to 2 miles, and therefore this measure is considered to have a large adverse impact.	Large Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. Up to £10m for junction closures, to include physical measures at the slips, but also the need for mitigation measures on the local roads. Neither slips are heavily used, but mitigation measures are likely to be necessary along with access control measures at the bottom of the eastbound on-slip for fire service access to the M4.	£10,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and closing the slips at Junction 26 will reduce the roadside concentrations by up to 1.7µg/m3, at a combined cost of £10.2m. This measure will therefore be a cost of approximately £6m/µg.	£6m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Reducing the speed limit will reduce emissions. Closure of the slip-roads would result in reassignment of traffic onto local roads between routes of equivalent or longer length. This would result in no net change or a slight increase in overall emissions, over and above what would be achieved through reducing the speed limit.	
	Will the measure result in unintended consequences or other environmental impacts	There is anticipated to be slight adverse impacts on noise levels, journey quality, and access to employment and services, and large adverse impacts on journey times with the speed reduction and closure of the slip-roads.	
	Will the measure impact equally across multiple vehicle classes and journey types	Reducing the speed limit and closing the on-slip at Junction 26 should have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. Junction closures will not have an additional overall positive impact on the wider public health and inequalities, as it will displace traffic causing NO2 and noise levels to rise on local roads.	
Other Issues	Acceptability	There may be some local opposition from businesses (IBIS Hotel).	
	Technical, Operational & Financial Feasibility	Access is likely to be required by South Wales Fire and Rescue Service, as Malpas Station is less than half a mile away. This would be their quickest and main route to the M4 eastbound carriageway and access control equipment is most likely necessary if the closure is implemented.	
	Deliverability & Risk	Displacement of traffic onto local roads would require collaboration with the local authority.	

Date Produced - 06/09/2018

Appraisal Summary Table

Measure No. 006

	Name of measure:	**Enforce/Reduce Speed Limit + Variable Diversions**
	Location:	**M4 Newport**
	Description of measure:	**As well as reducing the speed limit to 50mph, implement variable diversions within set NO2 limits for local traffic, utilising the Southern Distributor Road (SDR), through signage to reduce cars from the study corridor in the AM and PM peak hours (using continuous monitoring equipment). The routes would be signed, for instance 'Newport - all destinations' ahead of Junctions 23/24 westbound and Junction 28 eastbound.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 1.6µg/m3**
	Timescales:	**End of 2019 (can be implemented with temporary infrastructure ahead of permanent installations)**
	Deliverability:	**Traffic management is within WG Network Management Division scope.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. The addition of variable diversions further reduces emissions on the M4 study corridor in the peak hours only by removing traffic from the link. The measure will increase flows on the SDR and A4810. There is a potential increase in exposure on SDR; however, NCC monitoring demonstrates that concentrations along the SDR are not at risk of exceedance of the limit value and therefore the risk of diverted traffic resulting in new or worsened exceedances of limit values is low. Emissions reduced by up to 3.6%; Roadside pollutant concentrations on the M4 reduced by up to 1.6µg/m3, which is 4% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. With the variable diversions, the traffic would be displaced onto other roads, and therefore it is considered that this measure does not have any additional impact on overall noise levels.	Slight Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	The advisory variable diversion route has the potential to increase journey times for road users that they affect and therefore, along with the change in speed limits, there may be a slight adverse impact on journey quality.	Slight Adverse
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. Implementing variable diversions should not have any additional impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	Diversions on to local roads have the potential to lead to congestion; however, as they are advisory they are unlikely to have a significant impact on access to services, employment, and healthcare as traffic is likely to find an equilibrium.	Neutral
Economy	Journey Time Changes	Variable diversions are likely to increase journey times for some car drivers during the peak hours when the diversions are in operation, although, as they are advisory, drivers are able to remain on the M4 if they wish to do so. Reducing speed limits on the strategic route increases total travel time for users, which is considered to be a slight adverse impact.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. £6m for variable diversions onto the SDR taking into account the equipment needed, ongoing maintenance and an estimate for measures that the Council may want implemented on the local road network and the prescribed 'diversion' route. If the Council have concerns that this will increase NO2 levels on the A48 SDR, they may prefer traffic to come on and off the M4 at Junction 23, Magor and use the A4810 Steelworks Access Road.	£6,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and implementing variable diversions will reduce the roadside concentrations by up to 1.6µg/m3, at a combined cost of £6.2m. This measure will therefore be a cost of approximately £3.9m/µg.	£3.9m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	Reducing the speed limit will reduce emissions. Variable diversions would result in reassignment of traffic onto other roads of equivalent or longer length. The diversions will result in further minor reductions in emissions on the M4, but will be offset by the increase on local roads.	
	Will the measure result in unintended consequences or other environmental impacts	Variable diversions are predicted to have a slight adverse impact on journey times and journey quality, and limit access to services due to congestion.	
	Will the measure impact equally across multiple vehicle classes and journey types	It is anticipated that variable diversions will only be implemented for car drivers during the AM and PM peak periods, and therefore this measure may not have an equal impact on all vehicle classes and journey types.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and additional noise benefits. The addition of variable diversions will have limited further positive impacts with reductions in exposure to pollution on the M4 partially offset by increases in exposure on local roads.	
Other Issues	Acceptability	Given the nature of the proposals, this measure is anticipated to be opposed by the local authority and local residents.	
	Technical, Operational & Financial Feasibility	It may be necessary to improve the alternative route(s), which would increase scheme costs.	
	Deliverability & Risk	Displacement of traffic onto local roads would require collaboration with the local authority.	

Date Produced - 31/08/2018

Appraisal Summary Table **Measure No.** 007

	Name of measure:	**Enforce/Reduce Speed Limit + Clean Air Zones**
	Location:	**M4 Newport**
	Description of measure:	**As well as reducing the speed limit to 50mph, operate a Clean Air Zone to prevent vehicles of Euro 4 / IV or older using the M4 study corridor throughout the day, resulting in accelerated fleet turnover. The measure would be most effective if linked to road charges and scrappage scheme.**
Key Criteria	**Effectiveness:**	**Roadside concentrations reduced by up to 0.9µg/m3**
	Timescales:	**End of 2022**
	Deliverability:	**Measure would need to be delivered by the local authority in collaboration with WG network management division.**

Impacts		Summary of key impacts	Assessment
Environmental	Air Quality	Reducing the speed limit reduces emissions and hence roadside pollutant concentrations where vehicles currently travel at high speed. In the year of implementation (2022), the addition of a Clean Air Zone should improve air quality through acting as a deterrent for older/more polluting vehicles to use the strategic network. The combination of the reduced speed limit and CAZ will reduce emissions by up to 3.9%; Roadside pollutant concentrations on the M4 reduced by up to 0.9µg/m3, which is 2% of the limit value.	Slight Beneficial
	Noise	There are three noise important areas on the J25-26 route at Brynglas in Newport. The scheme runs between Brynglas and St Julians and is surrounded by sensitive receptors including residential housing and a community centre. With a proposed reduction in traffic speeds and the fleet turnover associated with a Clean Air Zone, there will be a corresponding reduction in noise that could result in a moderate beneficial impact.	Moderate Beneficial
	Landscape	The study corridor is not situated within 1km of or within close proximity to an AONB, Special Landscape Area, National Nature Reserve or Country Park. This measure is unlikely to generate an impact upon the landscape of the surrounding area.	Neutral
	Historic Environment	There are no scheduled ancient monuments within 1km of the study corridor with only Crindau Bridge being a listed building at the western extent of the site. There are no World Heritage Sites, registered battlefields or parks and gardens within 1km of the study corridor. This measure is unlikely to generate an impact upon the historic environment.	Neutral
	Biodiversity	The River Usk SSSI, SAC site is located at the eastern extent of the route and passes under the M4. No SPAs, RAMSAR sites or National Nature Reserves are located within 1km of the study corridor. This measure is unlikely to produce any impacts on ecology due to the lack of vegetation clearance and works confined within the hard estate.	Neutral
	Water Environment	The River Usk runs beneath the M4 at the eastern extent of the study corridor. Monmouthshire and Brecon Canal runs immediately west of J26 underneath the M4. With the use of best practise and the pollution prevention guidelines during construction, no significant impact is anticipated to occur as a result of this measure.	Neutral
	Townscape	No conservation areas have been identified within 1km of the study corridor and only one listed building Crindau Bridge is present at the western extent. This measure is unlikely to generate any impacts on townscape.	Neutral
S&C	Journey Quality	Reducing speed limits on the strategic route reduces the occurrence of flow breakdown during congested periods, and results in an overall better environment. The effect on traveller stress will depend on each road user; some may be less stressed as there will be a reduced fear of potential accidents, however others may be frustrated with having to reduce their speed without understanding the benefits to air quality. The addition of the complementary 'soft' measures should increase public acceptability for the measure. Furthermore, it is considered that the operation of a Clean Air Zone should further improve journey quality, associated with fewer and/ or newer HGVs.	Moderate Beneficial
	Accidents	Reducing the speed limit should have a benefit on the number and severity of recorded accidents. The addition of a Clean Air Zone should not have any further impact on the number nor severity of accidents.	Slight Beneficial
	Access to Employment and Services	It is likely that the operation of a Clean Air Zone may impact upon journeys, in particular for local business, thus it is considered that there may be a moderate adverse impact to access to services, employment, and healthcare along the study route.	Moderate Adverse
Economy	Journey Time Changes	The operation of a Clean Air Zone is not expected to affect journey times over and above the increased travel time for users associated with reducing speed limits on the strategic route.	Slight Adverse
	Land	The measure can be accommodated within the verge, and on existing infrastructure, and is not anticipated to have any requirements for additional land.	Neutral
	Capital and Revenue Costs	£200k for speed limit enforcement. £22m to implement a Clean Air Zone. Newport CC may have concerns about this measure, as they may not want drivers of non-permitted vehicles on 'alternative routes' on the assumption that we are looking at a charging regime or limiting classes of vehicles. However, cost estimate takes into account all equipment needed, ongoing maintenance and management and an estimate for measures that the Council may want implemented on the local road network and other routes that non-permitted vehicles may seek to use.	£22,200,000
VfM	Value For Money	Reducing the speed limit to 50mph and operating a Clean Air Zone will reduce the roadside concentrations by up to 0.9µg/m3, at a combined cost of £22.2m. This measure will therefore be a cost of approximately £24.7m/µg.	£24.7m/µg
Secondary Criteria of the Objective	Will the measure deliver an overall reduction in NO2 emissions to air	There may potentially be an overall reduction to NO2 though it is likely that there may be localised increases in NO2 elsewhere. The addition of a Clean Air Zone should deliver an overall reduction in NO2 emissions over and above those from the imposition of speed limits alone by the end of 2022.	
	Will the measure result in unintended consequences or other environmental impacts	Aside from a slight increase to journey times with the speed reduction, there are not considered to be any adverse consequences to environmental impacts as a consequence of operating a Clean Air Zone.	
	Will the measure impact equally across multiple vehicle classes and journey types	This measure will target older vehicles, which may unequally impact local businesses.	
	Will the measure have a positive impact on wider public health and inequalities	A reduction in speed and the operation of a Clean Air Zone will have a positive impact on public health (related to air quality), a reduction on the number and severity of accidents, and provide additional noise benefits.	
Other Issues	Acceptability	Given the nature of the proposals, this measure is anticipated to be opposed by the local authority and by some groups or individuals.	
	Technical, Operational & Financial Feasibility	A Consultation for a Clean Air Zone Framework for Wales was undertaken between 25 April 2018 to 19 June 2018. This process should help to identify the feasibility of a Clean Air Zone on the M4 study corridor.	
	Deliverability & Risk	Potential for displacement of impacts onto local roads if fleet turnover is not achieved with vehicles using local roads instead of the M4.	

Table 9: Summary of WelTAG Stage Three Appraisals

	Key Criteria			Environment							Social and Cultural			Economy			VfM	
Measures	Effectiveness	Timescales	Deliverability	Air Quality	Noise	Landscape	Historic Environment	Biodiversity	Water Environment	Townscape	Journey Quality	Accidents	Access to Services	Journey Time Changes	Land	Capital and Revenue Costs	Value for Money	Outcome
001: Enforce / Reduce Speed Limit (50mph)	✓	✓	✓	+1	+1	0	0	0	0	0	+1	+1	0	-1	0	£200,000	£220,000/µg	Unlikely Measure *Mutually exclusive with 006*
002: Junction Closures (Option A - Junction 25A WB off-slip), plus 50mph Speed Limit	✗	✓	=	+1	-1	0	0	0	0	0	-1	+1	-1	-3	0	£10,200,000	£7.3m/µg	Unlikely Measure
003: Junction Closures (Option B - Junction 26 WB off-slip), plus 50mph Speed Limit	✗	✓	=	+1	-1	0	0	0	0	0	-1	+1	-1	-2	0	£10,200,000	£8.5m/µg	Unlikely Measure
004: Junction Closures (Option C - Junction 26 EB on-slip), plus 50mph Speed Limit	✗	✓	=	+1	-1	0	0	0	0	0	-1	+1	-1	-2	0	£10,200,000	£7.3m/µg	Unlikely Measure
005: Junction Closures (Option D - Junction 26 WB off-slip and EB on-slip), plus 50mph Speed Limit	✓	✓	=	+1	-1	0	0	0	0	0	-1	+1	-2	-3	0	£10,200,000	£6m/µg	Unlikely Measure *Mutually exclusive with 006*
006: Variable Diversions (e.g. SDR), plus 50mph Speed Limit	✓	✓	✓	+1	+1	0	0	0	0	0	-1	+1	0	-1	0	£6,200,000	£3.9m/µg	Likely Measure
007: Clean Air Zone, plus 50mph Speed Limit	✓	=	=	+1	+2	0	0	0	0	0	+2	+1	-2	-1	0	£22,200,000	£24.7m/µg	Precautionary Retained Measure

Where +3 *Large Beneficial*, +2 *Moderate Beneficial*, +1 *Slight Beneficial*, 0 *Neutral*, -1 *Slight Adverse*, -2 *Moderate Adverse*, -3 *Large Adverse*

✓ Pass, ✗ Fail, = Risks identified, see ASTs for more information

4.5 APPRAISAL OUTCOME

4.5.1 LIKELY MEASURES

These are measures for which the evidence supports the conclusion that the measure is **likely** to bring forward compliance with limit values on the basis of its effectiveness, timeliness and deliverability, and for which there is no reasonable scientific doubt as to the efficacy or unintended consequences.

006 – Variable Diversions, plus 50mph Speed Limit

000 – Complementary Package of Soft Measures

The Speed Limit measure, 001, is, in part, installed on the M4. The realisation of the benefits of the measure are, however, dependent on the enforcement of the measure. At the time of writing, discussions are ongoing to install the infrastructure and procedures for the speed limit to be enforced effectively. Furthermore, measure 006 incorporates measure 001 but has greater effectiveness without unacceptable adverse impacts.

4.5.2 UNLIKELY MEASURES (DISCOUNTED)

These measures have been discounted on account of reasonable scientific doubt as to their efficacy, mutual exclusivity with more effective measures, or their unintended adverse consequences

001 – Enforce/Reduce Speed Limit (50mph) – Fails on efficacy due to greater benefits being achieved when measure is combined with Variable Diversions (006)

002 – Closure of J25A Westbound Off-slip, plus 50mph Speed Limit – Fails on efficacy due to negligible increase in benefits over and above that achieved through the imposition of the speed limit alone.

003, 004 – Closure of J26 Westbound Off-slip OR Eastbound On-slip, plus 50mph Speed Limit – Fail due to there being a more effective measure that is mutually exclusive with these measures. Closure of either of the westbound off-slip or eastbound on-slip is less effective than closing both.

005 – Closure of both Westbound Off-slip and Eastbound On-slip at J26, plus 50mph Speed Limits – Fails on overall appraisal outcome. Measure is equally effective as the 006 Variable Diversion package but has greater dis-benefits in relation to, in particular, access to employment and services and journey time changes.

4.5.3 'PRECAUTIONARY' RETAINED MEASURES

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the M4 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. The following measure has been identified in the analysis as likely to give rise to significant benefits but will only be of benefit in bringing forward compliance if compliance is delayed beyond 2022 due to the relatively long implementation timescales of the measure.

It is recommended that work on the implementation of the measure is progressed until such time as the links become compliant or the retained measure is implemented:

007 - Clean Air Zone - Measures to consider for a Clean Air Zone were set out in Welsh Government's CAZ Framework for Wales. This measure here specifically relates to the imposition of restrictions on the most polluting vehicles, whether as absolute bans or via charging.

5 FINANCIAL CASE

5.1 OVERVIEW

The financial case 'tells you 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 SCHEME COSTS

Capital and revenue costs have been considered for the 'hard measures' included within this Stage Three Full Business Case. The costs of likely measures are detailed below. The costs for all other measures are detailed within the ASTs.

5.2.1 006: VARIABLE DIVERSIONS, PLUS 50MPH SPEED LIMIT

It is estimated that implementing the reduced speed limit on the M4 study corridor would cost in the region of £200,000. This would include the cost of providing additional spot speed enforcement cameras, with the limit set via the VSL system.

The addition of the variable diversions would cost approximately £6m taking into account the equipment needed, ongoing maintenance and an estimate for measures that the Council may want implemented on the local road network and the prescribed 'diversion' route. If the Council have concerns that this will increase NO_2 levels on the A48 SDR, they may prefer traffic to come on and off the M4 at Junction 23, Magor and use the A4810 Steelworks Access Road. Discussions are ongoing with NCC and will be continued throughout the consultation period.

6 COMMERCIAL CASE

6.1 OVERVIEW

The commercial case ‘tells you if a scheme will be commercially viable, whether it is going to be possible to procure the scheme and then to continue it in to the future’.

6.2 ASSESSMENT

For this assessment, it is considered that all of the ‘soft’ and ‘hard’ measures considered at Stage Three are commercially viable and can be procured by the existing Trunk Road Agent through their supply chain partners.

7 MANAGEMENT CASE

7.1 SUMMARY OF MANAGEMENT CASE FROM STAGE ONE AND TWO

The management case tells you 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.'

The WelTAG Stage One and Two reports outlined:

- Project Planning – Governance, organisational Structure
- Key Project Parties & Roles
- Identified the Review Group
- Communications & Stakeholder Management Plan

As part of the stakeholder and public engagement strategy, Welsh Government published the WelTAG Stage One and Stage Two reports, Stage Two Impact Assessment Report, and Effectiveness Review as part of the consultation on the 'Welsh Government Interim Supplemental Plan' (WGSP).

7.2 WELSH GOVERNMENT INTERIM SUPPLEMENTAL PLAN TO THE UK PLAN FOR TACKLING ROADSIDE NITROGEN DIOXIDE CONCENTRATIONS 2017

The Welsh Government is working alongside the other devolved administrations to meet their joint objective with the UK Government to transform the UK's most polluted towns and cities into clean and healthy urban spaces, supporting those most directly affected and ensuring the vehicle manufacturers play their part to improve the nation's air quality.

The Welsh Ministers accept the 2017 Plan does not, insofar as it relates to Wales, satisfy the requirements of the Ambient Air Quality Directive or the Air Quality Standards (Wales) Regulations 2010. This is because the Welsh Government did not, at the time when the 2017 Plan was drawn up, have sufficient information to properly consider what measures within their devolved competence (if any) would ensure compliance with the limit values for NO_2 laid down by the Directive and the Regulations within the shortest possible time. As such, the Welsh Ministers have published and consulted on a draft supplement to the 2017 Plan which satisfies the Directive and the Regulations.

This consultation was launched on the 25th April 2018 (and 19th June 2018) seeking views on the Welsh Government supplemental plan to the 'UK plan for tackling roadside nitrogen dioxide concentrations 2017 ("the 2017 Plan")'. The WGSP builds on Section 7.6 (Additional Actions in Wales) of the 2017 Plan and sets out actions the Welsh Government will take to ensure compliance within the shortest possible time with the limit values for nitrogen dioxide (NO_2) laid down by the Ambient Air Quality Directive (2008/50/EC) and the Air Quality Standards (Wales) Regulations 2010.

In total, the Welsh Government received 35 responses from a range of stakeholders from various sectors, including members of the public, commercial entities, non-governmental organisations, registered charities, and public bodies. One response was subsequently withdrawn. Not all respondents commented on every question in the consultation document, and some respondents did not clearly express whether they agreed or disagreed with measures proposed within the WGSP.

7.3 MEASURE IMPLEMENTATION

There are a number of options available to facilitate the implementation of the likely measures.

It is envisaged that measures that involve physical works, e.g. painting, installation of fencing, signing, are likely to be procured through the appropriate Trunk Road Agent (TRA) for geographical location of the site.

The TRAs have further options to procure construction directly through their maintenance partnerships, or via existing Consultant and Contractor Frameworks.

Proposals associated with the use of Traffic Officers or which involve policy, publications, communication and advertising are likely to be undertaken jointly between the Welsh Government and Traffic Wales.

Traffic Wales also have the capability to implement ITS solutions themselves or via their own supply chain. The supply chain could also extend to the TRA's Consultant and Contractor Frameworks.

By adopting a flexible approach to implementation and integrating robust measurement and evaluation of the performance of these measures to meet the objective, measures can be adjusted based on an improving evidence base. As such, measures which have been identified as 'likely measures' will be implemented as soon as is practicably possible, whilst 'precautionary retained measures' will be implemented if compliance on the M4 is delayed beyond current projections.

7.4 MONITORING AND EVALUATION PLAN

As per the five stages of WelTAG, it will be critical to monitor the impacts of the measures during and post implementation. The monitoring of outcomes during implementation in Stage Four will allow for adjustments to be made, if required, to realise the benefits of the intervention and mitigate any unforeseen adverse impacts. The longer-term evaluation provided in Stage Five covers both the process of delivering the scheme and the outcomes achieved. This makes WelTAG a learning process and future WelTAG appraisals will benefit from the sharing of experience gained elsewhere.

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the M4 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. As such, measures will be considered for implementation as per the following:

7.4.1 AIR QUALITY MONITORING

Air quality monitoring along the M4 study corridor should comprise a combination of reference and indicative methods.

The reference method for the measurement of nitrogen dioxide and oxides of nitrogen is that described in EN 14211:2005 'Ambient air quality — Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence.'

Reference method monitoring will be undertaken at a minimum of one location within the study corridor, with the recommended location being shown in Figure 3. This location has been selected with regard to the criteria in Annex III of the Directive and specifically the criteria that:

Sampling should be directed at locations where the highest concentrations occur to which the population is likely to be directly or indirectly exposed for a period which is significant in relation to the averaging period of the limit value (Para B.1a)

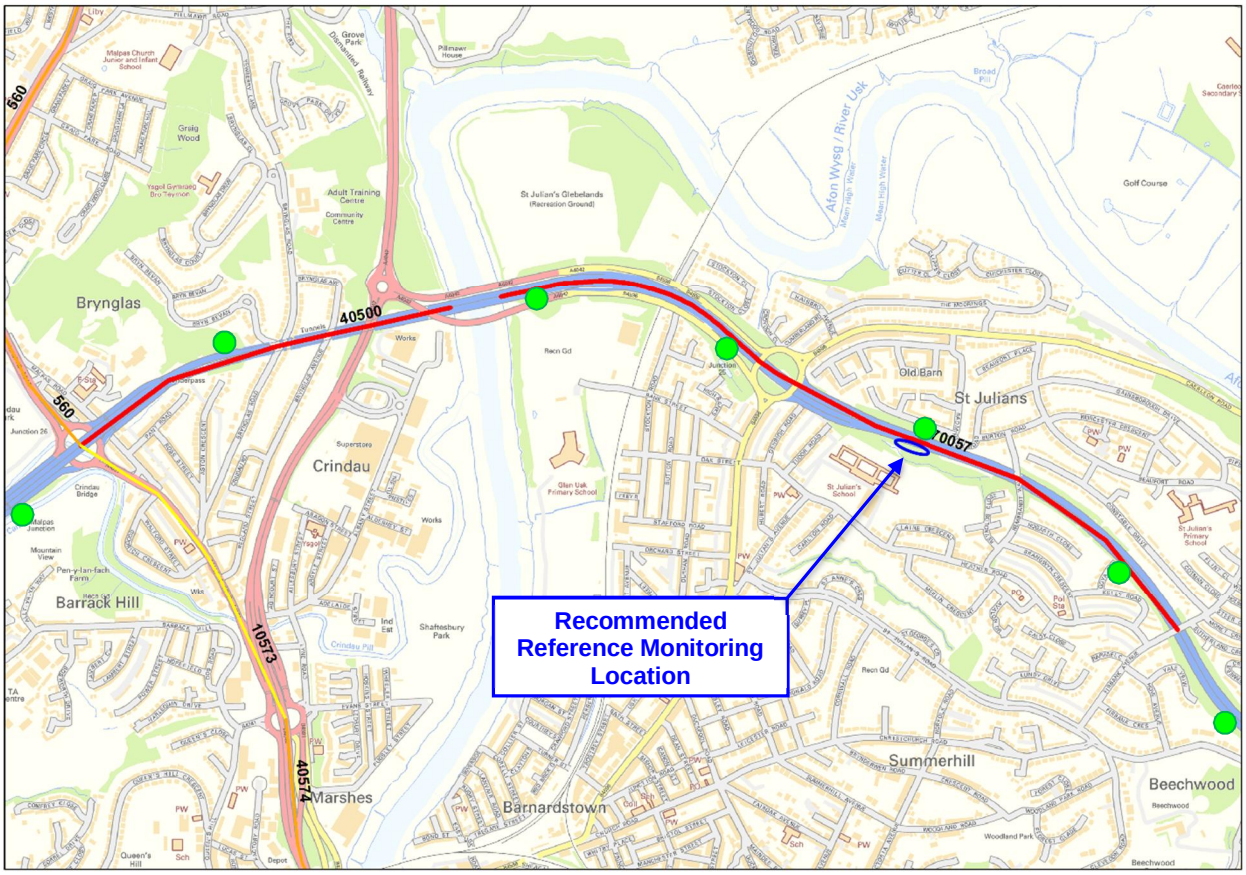
For all pollutants, traffic-orientated sampling probes shall be at least 25 m from the edge of major junctions and no more than 10 m from the kerbside (Para C)

The final choice for the reference monitoring location will need to take account of Health and Safety and provision of infrastructure.

In addition to the reference monitoring, it is recommended that indicative diffusion tube monitoring is continued. The existing monitoring locations are provided in Figure 3. The number of monitoring locations should be expanded to include a minimum of a further 10 sites: 2 locations on the M4 to the east of Junction 23A (Magor); 2 locations on the M4 between Junction 23A (Magor) and Junction 24 (Coldra); 2 locations on Link 70057 outside of the motorway cutting (St Julians); 2 locations on the M4 to the between J27 (High Cross) and Junction 28 (Tredegar Park); 2 locations on the M4 to the west of Junction 28 (Tredegar Park).

Diffusion tubes should be exposed in triplicate, with tubes changed monthly.

Figure 3: Existing monitoring locations (green circles) and proposed location for reference method (automatic) monitoring (blue oval)



7.4.2 TRAFFIC MONITORING

This study has highlighted the intrinsic link between air quality and traffic volumes, speeds and fleet mix. As such, it is recommended that the air quality monitoring is supplemented with either long term or regular short-term traffic monitoring in order to better understand any observed change in air quality. The following surveys should be considered:

Classified Link (Volume) Counts

This would require at least 1 full week (24 hours a day) of data for a DMRB neutral period. This data would be used to infer changes in Annual Average Daily Traffic (AADT) over time. Long term permanent count site data would be preferable so that the data would not need to be corrected for seasonality and the impacts of any incidents on the network could be fully understood.

Speed Data

The effectiveness of reduced speed limits is a function of compliance. Traffic speeds should be monitored post implementation to identify the real impacts of a change in speed limit and the speed data should be used to inform any decision on the requirement for and nature of enforcement. INRIX traffic data could be used to monitor speeds post implementation of measures though where possible should be backed up with surveyed data. Whilst undertaking surveys would potentially provide more robust data (larger sample size), it will be important to consider whether the survey is likely to impact upon typical driver behaviour and could underestimate real speeds on the corridors.

Automatic Number Plate Recognition

In addition to the classified link count data, there would be significant benefit in undertaking ANPR surveys. This data can be linked back to the DVLA database to determine not only vehicle classification, but also emission standards of vehicles. The data could be used to identify the rate of change of the fleet towards cleaner, newer, low emissions vehicles and could be used to evidence the need for additional measures to accelerate the rate of change, e.g. a scrappage scheme.

8 SUMMARY AND NEXT STEPS

8.1 OVERVIEW

The European Union Ambient Air Quality Directive (2008/50/EC) sets legally binding limits for concentrations of certain air pollutants in outdoor air, termed 'limit values'. The Directive requires that Member States report annually on air quality within zones designated under the Directive and, where the concentration of pollutants in air exceeds limit values, to develop air quality plans that set out measures in order to attain the limit values.

The M4 lies within the South Wales zone for the purpose of the assessment of compliance with the EU Air Quality Directive. The national assessment[1] of roadside NO_2 undertaken for the South Wales zone indicates that the annual limit value was exceeded on the M4 around Newport in 2015 but it is likely to be achieved by 2021 through the introduction of committed measures. WG are investigating additional network management measures for the Strategic Trunk Road and Motorway Network that could bring forward the projected compliance date.

The compliance date of the South Wales zone (2026 without additional measures) is, in current projections, determined by the compliance of the A472 in Hafod-yr-Ynys.

This report has presented the Stage Three: Full Business Case of the WelTAG process for reducing the levels of NO_2 on the M4 J25-J26 motorway network in South East Wales. Elevated concentrations of NO_2 on this study corridor are due to a combination of high traffic volumes, large volumes of HGVs, and routine peak period congestion.

The appraisal of measures has been undertaken in accordance with the Welsh Government's WelTAG [2017] guidance.

A more detailed quantitative analysis of traffic and air quality has been undertaken at Stage Three. The preferred measures have been re-appraised against the key criteria and secondary criteria for the objective and the four WelTAG aspects of well-being. The likely measures have been determined to reflect the more detailed appraisal work undertaken at Stage Three, and the outcome of the appraisal of measures is included in Table 10.

Table 10: Appraisal Outcome

Measure	Outcome
001: Enforce / Reduce Speed Limit (50mph)	Unlikely Measure
002: Junction Closures (Option A - Junction 25A WB off-slip), plus 50mph Speed Limit	Unlikely Measure
003: Junction Closures (Option B - Junction 26 WB off-slip), plus 50mph Speed Limit	Unlikely Measure
004: Junction Closures (Option C - Junction 26 EB on-slip), plus 50mph Speed Limit	Unlikely Measure
005: Junction Closures (Option D - Junction 26 WB off-slip and EB on-slip), plus 50mph Speed Limit	Unlikely Measure
006: Variable Diversions (e.g. SDR), plus 50mph Speed Limit	Likely Measure
007: Clean Air Zone, plus 50mph Speed Limit	Precautionary Retained Measure

8.2 PREFERRED MEASURES

8.2.1 LIKELY MEASURES

For the M4 J25-J26 these include:

- 006: Variable Diversions, plus 50mph Speed Limit
- 000: Complementary Package of Soft Measures
  - Behaviour Change
  - Intelligent Traffic Management
  - Signage
  - Air Quality Areas
  - Air Quality Communications

The Speed Limit aspect of measure 006 is, in part, installed on the M4. The realisation of the benefits of the measure are, however, dependent on enforcement. Work is currently ongoing to install the infrastructure and procedures for the speed limit to be enforced effectively.

8.2.2 PRECAUTIONARY RETAINED MEASURES

It is recognised that there is uncertainty in both the national PCM modelling and Welsh Government's indicative monitoring. As such, should compliance on the M4 be delayed beyond current projections, additional measures may be required to keep the time of exceedance of the limit values as short as possible. The following measure has been identified in the analysis as likely to give rise to significant benefits but will only be of benefit in bringing forward compliance if compliance is delayed beyond 2022 due to the relatively long implementation timescales of the measures.

It is recommended that work on the implementation of this measures is progressed until such time as the links become compliant or the measure is implemented:

- 007 Clean Air Zone

Taking account of the strategic nature of the M4 and measures already considered during the WelTAG process to reduce overall emissions, the specific Clean Air Zone measure considered here was a restriction on access for the most polluting vehicles. It has been modelled as the elimination of all Euro 4/IV vehicles and older. This is likely to be a conservative assessment of the potential benefits of a CAZ but further work is required to identify, amongst other things, the local fleet mix to optimise and appropriately target the potential vehicle restrictions.

8.3 NEXT STEPS

All likely measures will be fully implemented (WelTAG Stage Four) by the end of 2019. These are:

- 006: Variable Diversions, plus 50mph Speed Limit
- 000: Complementary Package of Soft Measures
  - Behaviour Change
  - Intelligent Traffic Management
  - Signage
  - Air Quality Areas
  - Air Quality Communications

There will be a significant communications campaign made on the likely measures using social media, radio and signs on the network. This campaign will be reiterated at key times on an ongoing basis along with key announcements made on the air quality results.

Post implementation and analysis of 12 months of monitoring data, an updated EU Directive Compliance Report will be prepared (WelTAG Stage Five) based on post implementation and analysis of 12 months of monitoring data. This will include a review of the performance of the likely measures and the requirement for additional retained measures.

Furthermore, ANPR surveys should be undertaken to baseline and further explore the potential benefits of the retained measures, and a further study to aid the detailed development of a Clean Air Zone should be progressed.

Appendix A

WELTAG 2017 GUIDANCE UPDATE

WELTAG 2017 GUIDANCE UPDATE

The main changes in the final WelTAG 2017 relative to the Consultation Draft used for Stage One and Two are as follows:

- The application of the **five ways of working** to the consideration of possible solutions;
- A consideration of how solutions enable public bodies to maximise their contribution to each of the **seven national well-being goals**: A prosperous Wales, a resilient Wales, a healthier Wales, a more equal Wales, a Wales of cohesive communities, a Wales of vibrant culture and Welsh language, and a globally responsible Wales.
- A commitment towards the **four aspects of well-being** in Wales: economic, social, environmental and cultural; and
- A move from Delivery Case to **Management Case**.

WelTAG 2017 combines the principles of the HM Treasury Green Book and WG's Five Case Model for Better Business Cases, represented by the five WelTAG Stage Reports. The 2017 guidance also differs from the previous consultation version wherein the five case business model now more closely reflects the model adopted by the DfT WebTAG guidance.

The contents of each Stage Report must be presented using the structure of the Five Cases Model as follows:

- **Strategic case:** the case for change, fit with other policies and objectives
- **Transport case:** does the proposal offer good public value for money and maximise contribution to the well-being goals?
- **Financial case:** is the proposed spend affordable?
- **Commercial case:** how can the scheme be procured? Is it commercially viable?
- **Management case:** is the scheme achievable? Can it be delivered?

Whilst WelTAG provides a fixed framework for appraisal, the guidance acknowledges that the level of detail provided in the WelTAG reports should be proportionate to the impacts under consideration and using the five ways of working set out in the Well-being of Future Generations Act. All major impacts and issues that could have a significant influence on delivery should be presented, but the level of detail in any analytical work should be proportionate to the scale and significance of the impact and sufficiently accurate for the decisions that need to be made.

The WelTAG Guidance has also been revised to reflect the Well-being of Future Generations (Wales) Act, which strives to improve the social, economic, environmental and cultural well-being of Wales and identifies seven well-being goals:

A prosperous Wales: An innovative, productive and low carbon society which recognises the limits of the global environment and therefore uses resources efficiently and proportionately (including acting on climate change); and which develops a skilled and well-educated population in an economy which generates wealth and provides employment opportunities, allowing people to take advantage of the wealth generated through securing decent work.

A resilient Wales: A nation which maintains and enhances a biodiverse natural environment with healthy functioning ecosystems that support social, economic and ecological resilience and the capacity to adapt to change (for example climate change).

A healthier Wales: A society in which people's physical and mental well-being is maximised and in which choices and behaviours that benefit future health are understood.

A more equal Wales: A society that enables people to fulfil their potential no matter what their background or circumstances (including their socio economic background and circumstances).

A Wales of cohesive communities: Attractive, viable, safe and well-connected communities.

A Wales of vibrant culture and thriving Welsh language: 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.

A globally responsible Wales: A nation which, when doing anything to improve the economic, social, environmental and cultural well-being of Wales, takes account of whether doing such a thing may make a positive contribution to global well-being.

Appendix B

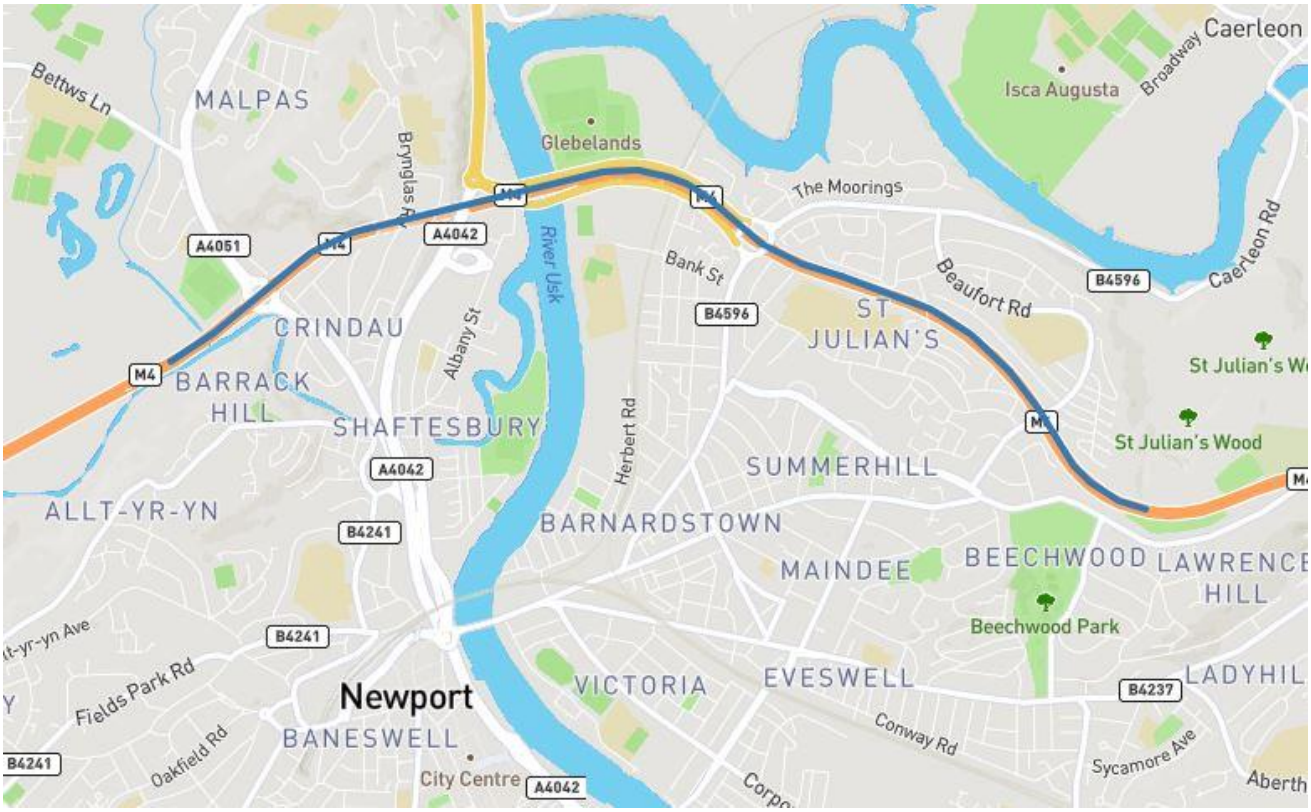
INRIX TRAFFIC DATA

INRIX – TRAFFIC SPEED DATA

INRIX ANALYTICS

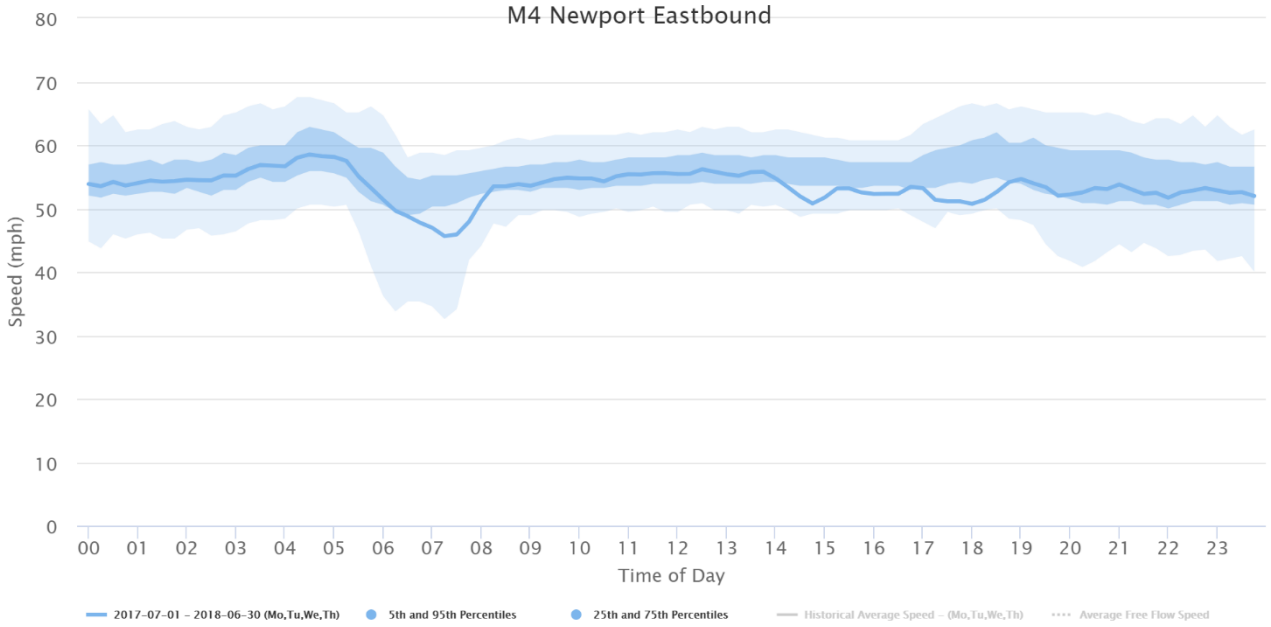
As part of the Stage Three WelTAG appraisal, INRIX data has also been considered. INRIX gathers real-time, predictive and historical data from more than 300 million sources, including commercial fleets, GPS, mobile devices and cameras. This data has been used to establish speed and travel time throughout the day in both directions on the corridor, which is as closely aligned to this M4 study corridor as possible.

INRIX M4 J25-J26 Corridor



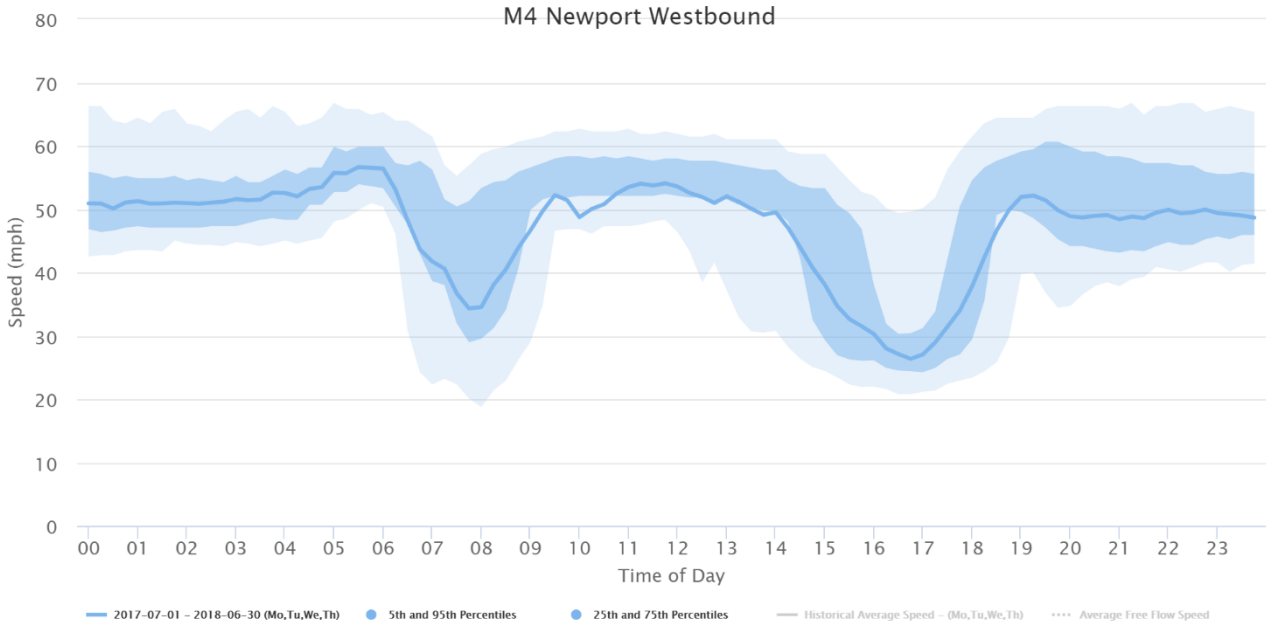
Speed data has been extracted for the M4 eastbound and westbound corridors for the period 1st July 2017 to 30th June 2018 (Monday-Thursday), as shown in Figure 1 and Figure 2, respectively.

Figure 1: M4 Eastbound Speeds (mph)



This data shows the average speeds are between 50 and 60mph throughout the day for vehicles travelling eastbound on the M4 study corridor, except for the AM period between 06:15 and 08:00 where speeds reduce to below 50mph.The lowest average speed of approximately 45mph occurs between 07:15 and 07:30.

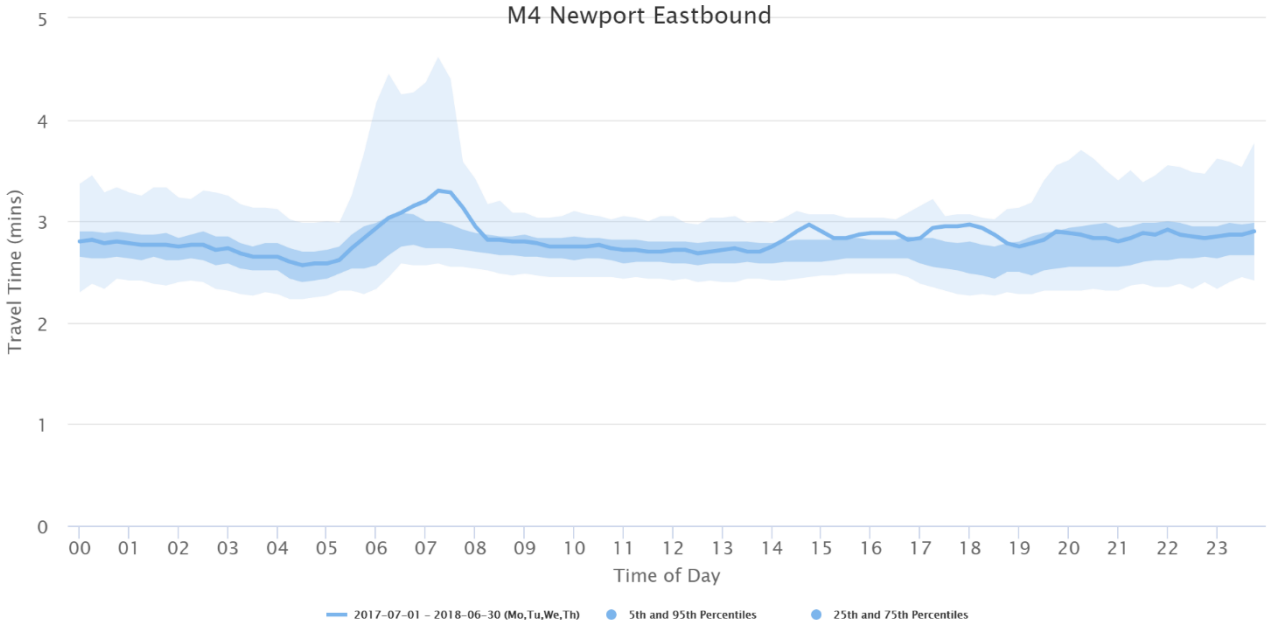
Figure 2: M4 Westbound Speeds (mph)



The data shows that speeds drastically reduce for vehicles travelling westbound during the AM and PM peak periods from approximately 06:30 to 09:00, and 14:15 to 18:30, with the lowest average speed of 26mph occurring at 16:45. Free-flow speeds in the inter-peak and off-peak periods are approximately 50mph.

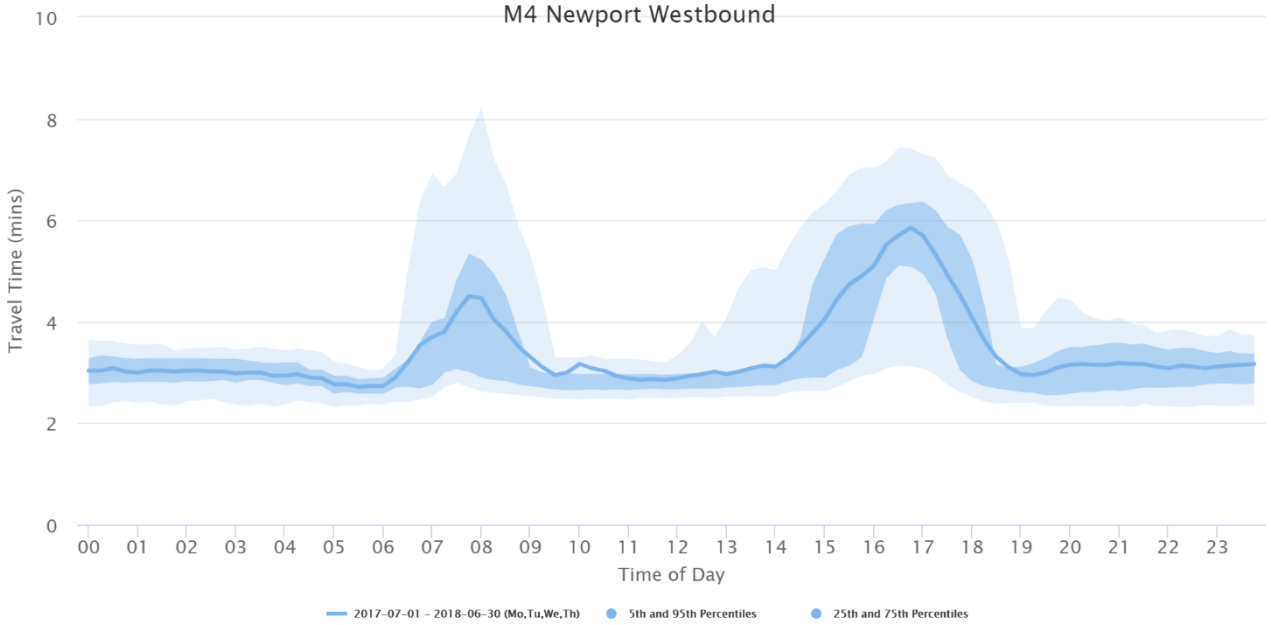
Travel times have also been extracted from INRIX for the M4 corridor for the same period, as shown in Figure 3 and Figure 4.

Figure 3: M4 Eastbound Travel Time (mins)



Travel time on the eastbound carriageway increases during the AM peak period, from an approximate free-flow time of 2 minutes 45 seconds to an average of 3 minutes 18 seconds at 07:15. Delay in this direction on the corridor can therefore be inferred as an average of approximately 30 seconds during the AM peak. The 95th percentile, however, shows that travel times can reach 4 minutes 37 seconds, therefore delays could be in the region of 2 minutes.

Figure 4: M4 Westbound Travel Times (mins)



For the M4 westbound corridor, INRIX shows that free-flow travel time is approximately 3 minutes, which increases to an average of 4 minutes 30 seconds in the AM peak and 5 minutes 50 seconds in the PM peak. Delay in this direction on the corridor can therefore be inferred as approximately 1 minute 30 seconds during the AM peak, which could increase to 4 minutes when considering the 95th percentile travel times. In the PM peak, average delay is approximately 3 minutes, which could increase to around 4 minutes 30 seconds.

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