INTERIM ADVICE NOTE 160/12 Revision 1

APPRAISAL OF TECHNOLOGY SCHEMES

Summary

This Interim Advice Note provides guidance on the appraisal of technology schemes, including: Closed-circuit television (CCTV), Motorway Incident Detection and Automatic Signalling (MIDAS) and Controlled Motorway (CM).

This document revises and supersedes IAN 160/12 Appraisal of Technology Schemes

Instructions for Use

This document shall be used in the appraisal of all CCTV, MIDAS and Controlled Motorway schemes which have not already been approved.

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Executive Summary

The IAN is a revised version of IAN 160/12 Appraisal of Technology Schemes. The revisions incorporate the August 2012 changes to WebTAG which include, amongst other things, a change of price base year and present value year from 2002 to 2012 and the measurement of greenhouse gases impacts in terms of carbon dioxide emissions rather than carbon. These changes have primarily affected the look up tables of benefits contained in Annex B of the IAN.

The IAN has also been revised to reflect the launch of a new piece of Highways Agency software called MyRIAD. MyRIAD is the replacement for the DfT's INCA software which is referred to extensively within the IAN in relation to assessing the reliability impacts of technology schemes. MyRIAD incorporates simplified processes for the assessment of technology schemes and these are described within the new revision in place of the previous INCA processes. All references in the document are now to MyRIAD rather than INCA.

The 2013 version of PAR has now been released (version 6.3) and this also addresses the August 2012 changes to WebTAG and the release of MyRIAD. The release of this version of PAR is reflected in the revised IAN.

The Interim Advice Note provides detailed guidance on the appraisal of technology schemes including Closed-Circuit television (CCTV), Motorway Incident Detection and Automatic Signalling (MIDAS) and Controlled Motorway (CM). It does not provide guidance on the appraisal of Managed Motorway schemes, which is issued separately for both MM - HSR (Managed Motorway – Hard Shoulder Running and MM-ALR (Managed Motorway – All Lanes Running).

The document provides an overview of the appraisal of technology schemes and discusses the sources of benefits and how they can be quantified and/or described.

The document then provides guidance on how the Project Appraisal Report (PAR) shall be completed for schemes costing less than £10 million and how the new Technology Scheme Appraisal Report (TSAR) shall be completed for those schemes costing £10 million upwards.

The appraisal now takes account of benefits from reductions in travel time variability in addition to other impacts upon the Economy, Environment and Society.

1 Introduction

1.1 Overview

This Interim Advice Note provides guidance on the appraisal of technology schemes, including:

- Closed-circuit television (CCTV)
- Motorway Incident Detection and Automatic Signalling (MIDAS)
- Controlled motorway (CM)

The reporting requirements for the appraisal depend on the type of scheme and the budget used. For schemes costing less than £10 million that are funded from the NDDD (Network Delivery and Development Directorate) technology budget the appraisal can be reported via the Project Appraisal Report (PAR). For all other schemes a Technology Scheme Appraisal Report (TSAR) should be produced.

The following table sets out the appraisal reporting requirements for technology schemes.

Table 1-1: Appraisal reporting requirements

Budget	Scheme cost	Appraisal report
NDDD technology	<£10 million	PAR
NDDD technology	>£10 million	TSAR
Programme of Major Schemes	All	TSAR

This document provides guidance on the completion of PAR and TSAR for technology schemes. It concentrates on highlighting issues specific to these schemes and should be seen as additional to, and not a replacement for, other guidance such as DMRB or WebTAG.

Section 2 contains an overview of the appraisal of technology schemes, discussing the key sources of user benefits, the tools that can be used to quantify these benefits and the potential impacts of the schemes.

Section 3 explains how to report the appraisal in PAR, with a sheet by sheet guide.

Section 4 explains how to report the appraisal in a TSAR.

1.2 Implementation

This IAN shall be implemented immediately for appraisal of technology schemes except where the procurement of works, at any stage from conception through design to completion of construction, has reached a stage at which, in the opinion of the HA, use of this document would result in significant additional expense or delay progress (in which case the decision must be recorded in accordance with the HA's procedures).

2 Appraising technology schemes

2.1 Types of technology covered by the guidance

Table 2-1 describes the types of technology covered by this guidance and it's purpose.

Table 2-1. Technology covered by the guidance and it's purpose

Technology	Description	Purpose
Variable Message Signs (VMS), e.g. Mk4 (MS4)	Used in tandem with the other technologies below. MS3 and MS4 VMSs can incorporate text panels of different sizes, with or without signals. Text messages can be tactical, e.g. to support/reinforce adjacent signals, or strategic, e.g. to provide advice and information. Signals on VMS signs will indicate speed limits and lane restrictions.	Depends on the system used to set messages, e.g. CCTV or MIDAS (see below).
Closed-circuit television (CCTV)	CCTV cameras, with control centre and operators, to monitor network. Needs to be used with VMS to be fully effective.	Faster response to incidents: quicker attendance of Traffic Officers and emergency services; faster provision of information to drivers with reduction in secondary accidents (if appropriate media such as VMS are in place); helps to ensure correct personnel/equipment are sent to incident.
Motorway Incident Detection and Automatic Signalling (MIDAS)	Inductive loops in the road to detect slow moving, queuing or stationary traffic. VMS used to display advisory speed limits and text-based information (e.g. 'Queue ahead'). Key component of controlled motorways.	Queue protection helps to prevent secondary accidents. May also lead to faster identification and more appropriate response to incidents, particularly when used in conjunction with CCTV.
Controlled motorway (CM)	As MIDAS, plus variable mandatory speed limits (VMSL) displayed on Advanced Motorway Indicator (AMI) signs via overhead gantries. Speed limit is set according to traffic data from MIDAS loops and enforced using automatic cameras. Usually includes CCTV.	As for MIDAS, together with a reduction in volume related flow breakdown and the resultant variability in journey times.

(Note: the terminology used in this table follows that used in DfT (2008).)

2.2 The impacts of technology

Technology potentially has impacts under all of the WebTAG appraisal headings of Economy, Environment and Society.

The main source of benefits of the technology covered in this guidance is a reduction in accident rates and/or incident durations[1]. This can lead to significant benefits under Economy in terms of reduced delay due to queuing at accidents and the associated improvement in journey time reliability. It can also lead to significant Accident benefits under the Society heading.

For controlled motorways there may also be benefits in reduced day to day variability, which is not related to incidents.

Table 2-2 describes and quantifies the main benefits of the technology covered by the guidance, together with the source of that information[2]. These derive from the use of technology on motorways, but can also be used for all purpose roads to provide an indication of the impacts.

[1] Here, 'incident' refers to an event that leads to the temporary closure of one or more running lanes of the carriageway. It includes accidents (damage only as well as PIAs), but also includes events like breakdowns, spillages, debris, animals on the road etc. The incident duration is the time between the incident first blocking the carriageway and the time when the incident is cleared and the full carriageway re-opened to traffic.

[2] This table does not include VMS per se – their benefits can only be realised when they are used as part of one of the other schemes that have been listed.

Table 2-2. Main benefits of technology

Technology	Quantified Benefit	Source
CCTV	• 2% reduction in accidents • 2% or 5 minute reduction in incident durations (selected incident types) The first of these does not apply if MIDAS is present or is installed at the same time as CCTV, or if there is no VMS installed to provide information to drivers; the second applies with or without MIDAS. These figures are for comprehensive CCTV coverage only[3].	Mouchel (2002b).
MIDAS	13% reduction in accidents	Tucker et al (2006)
CM	Additional 15% reduction in accidents if MIDAS already installed, but a total of 26% reduction where MIDAS and CM are installed together	Summersgill et al (2005), reported in Mott MacDonald (2007a)

The above table refers to accident reductions. In many cases the original source only gives reductions in personal injury accidents (PIAs). It is assumed that the same reduction rate applies to all accidents, including damage-only.

Combinations of technology, e.g. including CCTV with controlled motorways, offer the possibility of extra benefits, though it is important that there is no double counting. The impacts of combining different types of technology are presented later, in Table 2-8.

The following tables set out the full list of potential impacts of each type of technology under the headings of Economy, Environment and Society. It is important to note that these are only typical impacts of technology schemes. The type and scale of impacts can vary from scheme to scheme. The following tables should be supplemented by full consideration of local circumstances when completing the appraisal.

[3] Defined as a maximum camera spacing of 1.5km with each camera covering up to 750m of motorway and a maximum gap in coverage of 200m. Depending on the site closer camera spacing may be required to ensure comprehensive coverage.

Table 2-3. Typical economic impacts of technology.

Impact	Technology	Potential impacts
Public Accounts (Cost to broad transport budget)	General	Preparation of scheme costs for technology schemes should follow the same process as other schemes. As with any scheme there will be capital, maintenance and operating costs to be taken into account. For technology schemes it is important to include the costs of renewing equipment, which typically takes place every 15 years.
Transport Economic Efficiency (Business users and transport providers)	General	Business and non-business users will benefit from reduced delays and reduced vehicle operating costs as a result of fewer accidents and possible reductions in incident durations. However, they may experience delays during the installation, maintenance and renewal of the scheme.
Transport Economic Efficiency (Non-business users)	General	
Public Accounts (Indirect tax revenues)	General	There will usually be a reduction in indirect tax revenues received by the government. This is because the reduction in queuing due to accidents leads to a reduction in fuel consumption, and hence a reduction in government revenues from duty and VAT on fuel.
Reliability	General	Drivers will benefit from a reduction in incident-related variability which results from the reduction in the number of accidents and possible reductions in incident durations. For controlled motorways (CM) there will also be benefits from reduced day to day (non-incident) variability.
Regeneration	General	It can usually be assumed that the technology schemes covered by this guidance will have no impact on regeneration.
Wider impacts	General	It can usually be assumed that the technology schemes covered by this guidance will have no wider impacts.

Table 2-4. Typical environmental impacts of technology.

Impact	Technology	Potential impacts
Noise	General	Current appraisal methods for noise are based on average speeds and flows over an 18 hour period. These technology schemes are likely to have a minimal effect on this average. Studies have shown that while controlled motorways do reduce noise, the level of reduction is below what is usually considered noticeable (TRL, 2004).
Air Quality	General	The main pollutants of concern that are traffic related are oxides of nitrogen, usually measured as nitrogen dioxide (NO_2) and particulate matter having an aerodynamic diameter of 10 microns or less (PM_{10}). Their primary source is traffic and therefore any changes to traffic conditions would result in a change in these pollutants. Air quality is only affected when the traffic flow is altered in terms of speed and or volume. Increased speed and stop start traffic increase vehicle pollutant emissions, which has an adverse impact on local air quality. Conversely, decreasing the speed will have an overall beneficial impact on local air quality. Any adverse impact would be increased where schemes are located within Air Quality Management Areas.
	CCTV MIDAS	Would have no impact on traffic volume or average traffic speeds. Less stop/start traffic from queuing at accidents should have positive effect.
	CM	Vehicle pollutant emissions should be reduced through a combination of (i) more constant vehicle speeds (less acceleration and deceleration), (ii) less flow breakdown and (iii) fewer vehicles travelling at speeds in excess of the speed limit. Less stop/start traffic from queuing at accidents should also have positive effect.
Greenhouse Gases	General	CO_2 emissions are altered when the traffic flow is changed in terms of speed and or volume. Stop-start traffic increases vehicle CO_2 emissions. Conversely, reducing queuing would have an overall beneficial impact on greenhouse gas emissions.
	CCTV MIDAS	Would have no impact on traffic volume or average traffic speeds. Less stop/start traffic from queuing at accidents should have positive effect.
	CM	CO2 emissions should be reduced through a combination of (i) more constant vehicle speeds (less acceleration and deceleration), (ii) less flow breakdown and (iii) fewer vehicles travelling at speeds in excess of the speed limit. Less stop/start traffic from queuing at accidents should also have positive effect.
Landscape	General	Potential negative impact of additional lighting or lit signs.
	VMS	Impact on landscape character due to vegetation loss as a result of site access/working area requirements, excavation for cable runs and footprint of concrete base, control boxes etc. Potential for increasing 'urbanisation' of route with subsequent adverse effect on rural landscape character. Visual impact of VMS on nearby properties/ sensitive sites (Areas of Outstanding Natural Beauty (AONB), National Parks and Registered Parks and Gardens).
	CCTV	As for VMS, but note that the scale of impacts is likely to be less due to the reduced size of the infrastructure involved.
	MIDAS	Potential impact on landscape character due to vegetation loss caused by any site access/working area requirements within the soft estate, together with excavation for cable runs and the footprint of any control boxes etc. Visual impact is likely to be minimal since the majority of the operational system would be within the carriageway surface. See also the impact of VMS, which is a key component of MIDAS.

Impact	Technology	Potential impacts
	CM	CM would involve a combination of VMS, CCTV and MIDAS, the impacts noted for each of these should be considered together, noting that the potential cumulative impact of two or more of these systems would potentially result in a greater impact in terms of landscape/visual effects than if they were assessed in isolation.
Townscape	VMS	Impact on townscape character due to new infrastructure being visually discordant and/or out of scale with existing building facades and streetscape. Potential loss of street trees/ornamental vegetation due to site access/working area requirements, excavation for cable runs and footprint of concrete base, control boxes etc. Visual impact of VMS on nearby properties.
	CCTV	As for VMS, however, the scale of impacts is likely to be less due to the reduced size of the infrastructure involved.
	MIDAS	MIDAS is unlikely to have a significant adverse townscape effects due to the limited amount of visible infrastructure involved, but note any potential impacts due to the siting of control boxes etc., together with any street tree/ornamental vegetation loss caused by site access/working area requirements, and excavation for cable runs and control boxes etc (if these are sited within vegetated areas). Visual impact likely to be minimal since the majority of the operational system will be within the carriageway surface. See also the impact of VMS, which is a key component of MIDAS.
	CM	Since this will most likely involve a combination of VMS, CCTV and MIDAS the impacts noted for each of these should be considered together, noting that the potential cumulative impact of two or more of these systems could have a greater impact in terms of townscape effects than if they were assessed in isolation.
Heritage and Historical Resources	VMS	VMS would potentially result in an adverse impact on the Heritage of Historic Resources where schemes are located in, adjacent to or within close proximity to historic features and areas of high historic interest (Scheduled Ancient Monuments (SAM), Listed Buildings and Conservation Areas). The likelihood of archaeological finds is limited where works are within the highways boundary, however, where associated works are within previously undisturbed areas the potential would increase.
	CCTV	CCTV has similar impacts to VMS, although the scale of impacts is likely to be reduced due to the general smaller size of the CCTV posts.
	MIDAS	MIDAS works associated with the carriageway are unlikely to impact on heritage features, however, where works penetrate deeper than the existing road depth, there is the potential to impact under road features such as Roman roads. See also the impact of VMS, which is a key component of MIDAS.
	CM	CM involves a combination of VMS, CCTV and MIDAS therefore impacts noted above for each of these should be considered in combination, noting that the potential cumulative impact of two or more of these systems could have a greater impact. In addition, Gantries and MS4s associated with CM have the potential to impact on the visual setting of heritage features and designations where adjacent or within close proximity to the scheme. This should be carefully considered, however, it is important that any appraisal is set within the context of the existing road corridor.
Biodiversity	VMS	The main impacts on biodiversity associated with technology schemes are those that impact the soft estate i.e. highways verges. The introduction of VMS would require the removal of highways verge vegetation which has the potential to result in the disturbance of protected species (such as; badgers, dormice and nesting birds). Adverse impacts may also occur where verges are narrow and installation causes breaks in the continuity and connectivity of vegetation. Additional adverse impacts may occur where works are located in, adjacent or within close proximity to sensitive sites (Special Areas of Conservation (SAC), Special Protection Areas (SPA), RAMSARs, Sites of Special Scientific Interest (SSSIs), Ancient Woodland, National and Local Nature Reserves and Sites of Importance for Nature Conservation (SINCs)).
	CCTV	CCTV would result in similar impacts to VMS, however the scale of impacts would reduce in proportion to the size of the CCTV posts.

Impact	Technology	Potential impacts
	MIDAS	MIDAS works associated with the carriageway are unlikely to adversely impact on biodiversity, however, associated infrastructure and construction works within the soft estate such as cabinets and cabling may impact on protected species and habitats. In some locations of particularly high nature conservation value, where central reservations house dense and/or mature vegetation, further impacts to biodiversity may occur. Additional adverse impacts may occur where works are located in, adjacent or within close proximity to sensitive sites. See also the impact of VMS, which is a key component of MIDAS.
	CM	CM involves a combination of VMS, CCTV and MIDAS the impacts noted for each of these should be considered in combination, noting that the potential cumulative impact would have a greater impact on biodiversity.
Water Environment	General	No direct impact on rivers or other watercourses is anticipated; instead impacts to the Water Environment would principally be of a temporary nature and originate from construction. Potential impacts associated with construction include pollution risks to surface and ground water due to the disturbance of sediment and the accidental spillage of fuels, lubricants and hydraulic fluids. The introduction of additional infrastructure to the road corridor would increase hard standing which may in turn increase surface water runoff. The level of increase in surface water runoff would vary depending on the locality of the scheme together with the infrastructure being introduced (including its size and spacing). However, additional contributions to the surface water drainage system are likely to be negligible. Once operational, technology schemes such as CM may reduce the risks of accidents and therefore lower the risks of accidental vehicle spillage.

Table 2-5. Typical social impacts of technology.

Impact	Technology	Potential impacts
Physical activity	General	It can usually be assumed that the technology schemes covered by this guidance will have no impact on physical activity.
Journey quality	VMS	Potential improvement in the provision of en-route general travel information. For example, information on events or conditions affecting the highway (non directive and instructive) and information on issues affecting the highways other than the one on which they are travelling. Such improvements would result in an increase in Traveller Care. The introduction of the associated infrastructure would potentially degrade travellers' views; however, any impact would need to be assessed within the context of the existing road corridor.
	CCTV	Potentially limited impact on Travellers' Views. However, any impact would need to be assessed within the context of the existing road corridor.
	MIDAS	Improvement in Traveller Care due to the provision of information in the form of congestion and queue warnings.
	CM	Reduction in Traveller Stress due to a reduction in flow breakdown and the associated queuing delay. Increase in Traveller Stress due to the use of VMSL. Overall effect considered neutral.
Accidents	General	Most of the technology schemes covered by this guidance will reduce the number of accidents. The scale of the reduction depends on the scheme and what elements are already present in the do-minimum. See Table 2-8 for details.
Security	CCTV	For schemes involving CCTV, users will experience an improved level of formal surveillance.
Access to services	General	It can usually be assumed that the technology schemes covered by this guidance will have no impact on access to services.
Affordability	General	All the schemes covered by this guidance will result in a reduction in vehicle operating cost (VOC) as a result of reduced queuing at accidents. The distribution of VOC benefits by household income quintile is (lowest quintile first): 1:6%; 2:11%; 3: 20%; 4:28%; 5:35%
Severance	General	It can usually be assumed that the technology schemes covered by this guidance will have no impact on severance.
Option values	General	It can usually be assumed that the technology schemes covered by this guidance will have no impact on option values.

2.3 Quantifying the impacts

Many of the impacts of technology provision can and should be monetised. This includes the effects on travel time savings, vehicle operating costs, travel time reliability and accidents.

These monetised impacts should be calculated using methods consistent with the advice set out in DMRB and WebTAG. This can be done using appraisal software maintained by the HA, namely COBA, MyRIAD and QUADRO. However, alternative approaches are acceptable provided it can be shown that the methods used comply with DMRB and WebTAG. A fuller description of the HA's software can be found in Annex A.

The following table describes the methods available for quantifying the monetised impacts.

Table 2-6. Methods for quantifying the monetised impacts.

Impact		Method	Example software
Reduced numbers of accidents		DMRB Volume 13 (particularly Part 2)	PAR or COBA
Reduced queuing at incidents	Time savings	WebTAG Unit 3.5.7 The Reliability Sub-Objective	MyRIAD
	Vehicle operating cost and CO2 impacts	WebTAG Units 3.5.6 Values of Time and Operating Costs and 3.3.5 The Greenhouse Gases Sub-Objective	Look-up table
	Incident-related variability	WebTAG Unit 3.5.7 The Reliability Sub-Objective	MyRIAD
Reduction in day to day variability		WebTAG Unit 3.5.7 The Reliability Sub-Objective	MyRIAD
Delay and accident costs during construction and maintenance.		DMRB Vol 14	QUADRO

None of the HA programs gives the vehicle operating cost or CO2 impacts of reduced queuing at incidents, so a look-up table for inclusion in this guidance has been developed, based on WebTAG data.

Note that there are two sources of reliability/variability benefits. The first is related to reduced queuing at incidents (accidents specifically) and is therefore referred to as incident-related variability. The second is referred to as day to day variability. This includes all variability in journey times that is not caused by incidents or planned events and is typically caused by random changes in traffic flows or capacity (perhaps caused by weather conditions) from day to day. In this context, variability excludes all predictable variations in travel times such as the difference between peak and off-peak travel times or the difference between school holidays and school term times.

This guidance includes a number of look-up tables which have been generated from runs of COBA, MyRIAD and QUADRO for typical technology schemes. In certain cases these can be used instead of scheme-specific calculations to obtain the scheme benefits:

- At the option identification stage of any scheme where a TSAR is required, i.e. when only an outline business case is needed
- For any scheme where a Foundation PAR is required, but only in respect of the incident delays and journey time variability benefits. Accident savings should be based upon a scheme specific calculation and entered into PAR.

In all other cases (ie in the case of a TSAR after option identification stage and a Standard PAR), scheme-specific calculations will be required. For input to a TSAR a scheme-specific calculation of accident impacts using COBA is required. For a Standard PAR, the annual accident savings in opening year are calculated manually and entered into PAR, which will then calculate the monetised accident benefit over the whole appraisal period (ie in the same way as

for Foundation PAR).

This is summarised in the following table:

Table 2-7. Assessment methodologies by report type and scheme stage.

Reporting requirement	Scheme stage	Assessment methodology			
		Accidents (safety)	**Incident delays and variability**	**Incident-related VOC**	**Delays during construction and maintenance**
TSAR	Option identification	Look-up table	Look-up table	Look-up table	Look-up table
	Other	Scheme-specific calculation (e.g. COBA)	Scheme-specific calculation (e.g. MyRIAD)	VOC look-up table with scheme-specific delay savings.	Scheme-specific calculation (e.g. QUADRO)
Foundation PAR	All	PAR spreadsheet	Look-up table	Not required for Foundation PAR.	Not required for Foundation PAR.
Standard PAR	All	PAR spreadsheet	Scheme-specific calculation (e.g. MyRIAD)	VOC look-up table with scheme-specific delay savings.	Scheme-specific calculation (e.g. QUADRO)

2.4 Typical schemes and their impacts

Technology schemes or the 'Do Something (DS)' can involve the introduction of MIDAS, CCTV and CM individually or in combination. The impact of the scheme will then depend upon what other technology provision is already in place, the 'Do Minimum (DM)'. Table 2-8 lists the possible DM and DS permutations and describes the main monetised impacts of the DS scheme relative to the DM. These are the impacts which should be adopted when appraising such scenarios. These scenarios correspond to the typical schemes for which the look-up tables in Annex B have been prepared.

Table 2-8. Monetised impacts of typical schemes.

Scheme (Do Something)	Technology already present in the Do Minimum	Accident impacts	Incident impacts
1a. CCTV + VMS	None	2% reduction in accidents	2% reduction in accidents
1b. CCTV	VMS		2% reduction in some incident durations; 5 minute reduction in some others (see note below)
2. CCTV	MIDAS	No benefits	2% reduction in some incident durations; 5 minute reduction in some others (see note below)
3. CCTV	None	No benefits	2% reduction in some incident durations; 5 minute reduction in some others (see note below)
4a. MIDAS	None	13% reduction in accidents	13% reduction in accidents
4b. MIDAS + CCTV	None		13% reduction in accidents 2% reduction in some incident durations; 5 minute reduction in some others (see note below)
5. CM + MIDAS	None	26% reduction in accidents	26 % reduction in accidents
6. CM	MIDAS	15% reduction in accidents	15% reduction in accidents
7. CM + MIDAS + CCTV	None	26% reduction in accidents	26 % reduction in accidents; 2% reduction in some incident durations; 5 minute reduction in some others (see note below)
8. CM + CCTV	MIDAS	15% reduction in accidents	15% reduction in accidents; 2% reduction in some incident durations; 5 minute reduction in some others (see note below)

Notes:

1. All of the accident and incident impacts shown in the table represent the change between the Do Minimum and Do Something scenarios illustrated.

2. The accident impacts relate to reductions in accidents relative to the current personal injury accident rates. It should also be noted that the accident valuations used in PAR and COBA include an allowance for damage-only accidents per PIA so, in effect, an X% reduction in PIAs is equivalent to an X% reduction in all accidents.

3. In relation to the incident impacts, MyRIAD contains a set of incident rates for each possible combination of motorway technology provision. These are defined in terms of different motorway "road types" and the user need only select the "road type" which corresponds to each of the Do Minimum and Do Something ie there is no need for incident rates to be adjusted manually within the program. It should be noted that because only accident rates differ between different levels of technology provision, only the MyRIAD incident rates for single and multi lane accidents will differ between different motorway road types. Thus, incident rates for other incident types (with the exception of MM-ALR, which is not covered by this IAN, are the same for all motorway road types.

4. The incident duration reductions associated with CCTV for different MyRIAD incident types are as follows: 2% reduction applies to single lane and multi-lane accidents; 5 minute reduction applies to fire (HGV and non-HGV), load shedding and spillage; no reduction for other incident types. As with incident rates, the different incident durations which exist between road types with and without CCTV are built in to the incident parameters for the road type.

3 Completing the PAR

3.1 Overview

As discussed in the introduction, PAR can only be used for schemes costing less than £10m that are funded from the NDDD Technology budget.

Figure 3.1 gives an overview of using PAR for technology schemes, highlighting those aspects which require special treatment for these schemes. It includes references to key parts of this guidance. This guidance is based on PAR 6.3.

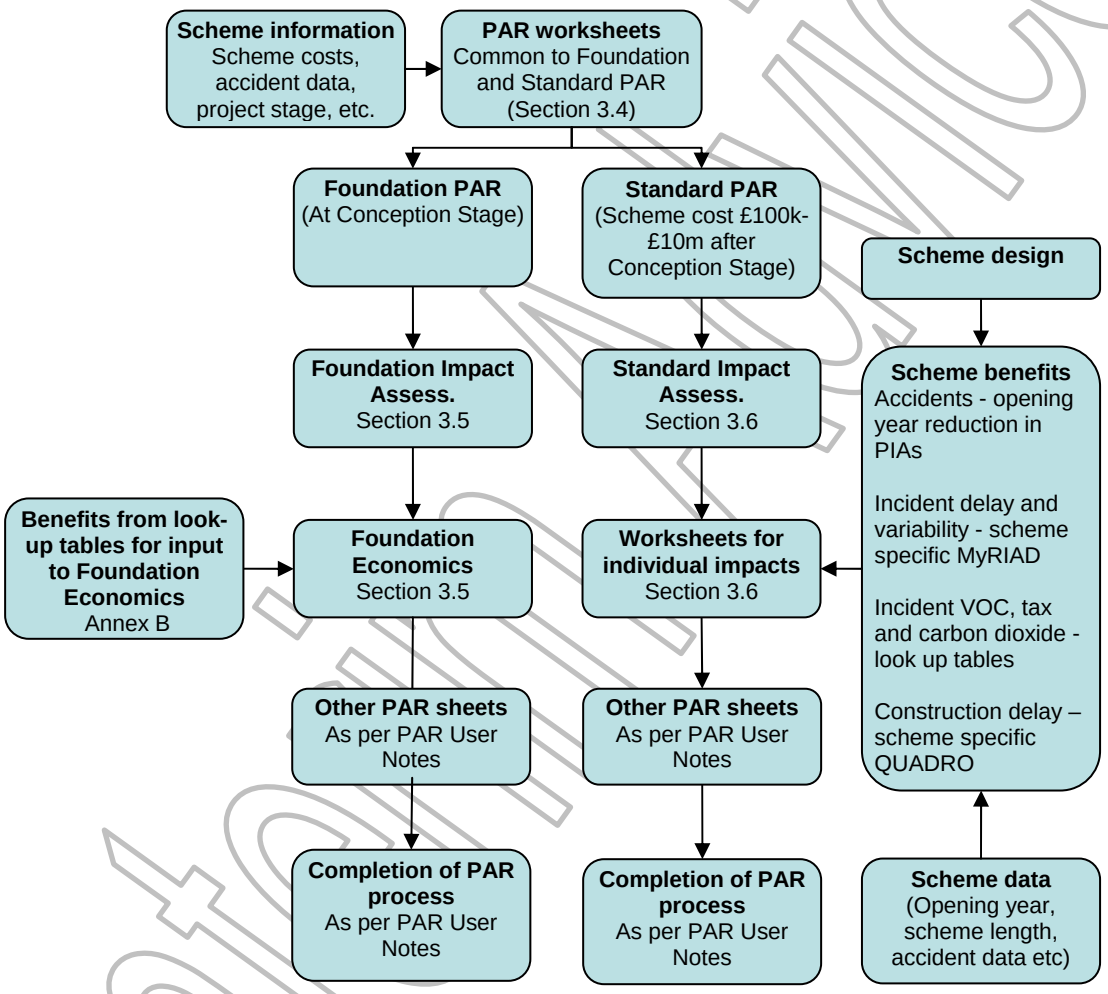

Figure 3.1. Overview of using PAR for technology schemes.

3.2 Reduced, Foundation or Standard PAR ?

In general, three different levels of PAR can be used: Reduced, Foundation or Standard. The appropriate level depends on the category of scheme, the current stage of progress (i.e. identification, design and construction) and the estimated total implementation cost.

The schemes covered by this guidance will fall into the 'Appraisable' category and the Reduced PAR is not therefore appropriate. Any technology scheme not covered by this guidance, may however be progressed as 'Non-Appraisable' using the Reduced PAR if it is not possible to robustly quantify the benefits.

In line with the HA's current value management requirements, a Foundation PAR will suffice at the conception stage for all schemes that cost up to £10 million. For schemes costing up to £100,000 no further PARs are required. For schemes between £100,000 and £10 million a Standard PAR must be completed at all subsequent stages.

Whenever a Foundation PAR can be used, it is also acceptable to complete a Standard PAR instead. This might be done if there are significant impacts that are not captured in a Foundation PAR, but which are critical in choosing between different scheme options. For example vehicle operating cost benefits, monetised CO2 emissions, indirect tax revenues or a need for more detail in the environmental appraisal.

PAR can only be used for schemes costing less than £10 million.

Table 3-1. Type of PAR to be completed depending on scheme cost and stage.

Scheme cost	Conception stage	Intermediate stage	Works Commitment stage
Up to £100,000	Foundation or Standard	Not required	Not required
£100,000 to £10 million	Foundation or Standard	Standard	Standard

3.3 Overview

The following sections go through a number of the PAR worksheets in turn. Only issues specific to technology schemes are discussed. Otherwise each worksheet should be completed by following the guidance given within the PAR spreadsheet and the PAR 6.3 User Notes document. The guidance given in this IAN is complementary to, not a replacement for, the PAR User Notes.

The first section (3.4) begins with sheets that are common to Foundation and Standard PARs. It contains advice specific to technology schemes for the following sheets:

- Title
- Project Details
- Traffic & Accidents
- Costs Master
- Attachments
- VM Non-NATA

Section 3.5 then goes through the sheets specific to the Foundation PAR while section 3.6 covers sheets specific to the Standard PAR.

Foundation PAR sheets affected include:

- Foundation Impact Assess
- Foundation Economics

Standard PAR sheets affected include:

- Standard Impact Assess
- TEE
- Reliability
- Noise
- Air Quality
- Greenhouse Gases
- Landscape
- Townscape
- Heritage and Historical Resources
- Biodiversity
- Water Environment
- Physical Activity
- Journey Quality
- Accidents
- Security
- Severance

Worksheets that require no user input (i.e. they present results calculated by the PAR spreadsheet from other inputs) are not listed here.

3.4 Worksheets common to Foundation and Standard PARs

Title
The 'Project Category' will be 'Safety' since most of the benefits stem from a reduction in accidents and/or incident delays.

Project Details
The 'Assessment Period' for technology schemes should normally be 30 years instead of the usual 60 years.

Traffic & Accidents
There are no issues here that are specific to technology schemes; this sheet should be completed in line with the PAR User Notes.

Costs Master
Generally the preparation of costs should follow the same process of any other scheme. It is important to include all scheme costs incurred during construction and the 30 year appraisal period following scheme opening, including:

- Implementation costs
- Renewal costs (typically required after 15 years). Entered as Item A17 of Part A in the same price base as implementation costs.
- Preparation and Supervision costs (defaults are available).
- Annual average maintenance and operating costs over the Assessment Period.

Input of cost data to PAR should otherwise follow the PAR User Notes.

Attachments
For both Foundation and Standard PARs, a report should be attached which explains details of the scheme to which the PAR relates. For Standard PARs, a description and justification of the key MyRIAD and QUADRO inputs should also be provided.

VM Non-NATA
Part A should normally be completed to reflect (a) the reduced risk to road workers from having to attend fewer incidents and (b) the increased risk from the increased maintenance requirements.

Without-scheme person hours should be estimated from the number of incidents attended, their duration, and the number of road workers attending each incident, plus the person hours required for maintenance during the appraisal period. The with-scheme person hours should then be adjusted to account for changes in the number of incidents **and** the increased maintenance requirements.

The net impact may be an increase or decrease in risk, depending on local circumstances.

Note that while CCTV may reduce the duration of incidents, this arises from a reduction in the time between the incident occurring and its being identified. There is no reduction in the duration for which road workers will attend the incident. Therefore, it is not possible to claim a reduced risk to road workers from the effect of CCTV on incident durations.

3.5 Foundation PAR

Foundation Impact Assess
The following table corresponds to the table that appears on the PAR worksheet. It shows whether each sub-impact should be marked as Not Applicable or Impact Assessed, whether the impact is beneficial, neutral or adverse (if Impact Assessed), and gives an indication of the qualitative comment that should be entered in Key Points column. In many cases, particularly the environmental impacts, the assessment will vary according to the type and/or location of the scheme

After completing this worksheet click on the arrow next to the Transport Economic Efficiency, Reliability or Accidents entries to open the Foundation Economics worksheet.

Table 3-2. Guide to completing the Foundation Impact Assessment worksheet (typical effects only – local circumstances may be different).

		Not Applicable/Impact Assessed	Suggested Key Points
ECONOMY	Transport Budget	Impact Assessed (Adverse)[4]	Implementation and maintenance costs will be incurred by the HA.
	Transport Economic Efficiency	Impact Assessed (Beneficial)	Any scheme with a reduction in accidents (refer Table 2-8) - Users will experience reduced time and operating costs as a result of fewer accidents and therefore less queuing. CCTV – less queuing because of reduced incident durations.
	Wider Public Finances (Indirect Tax Revenues)	Not Applicable (only considered in Standard PAR)	N/A
	Reliability	Impact Assessed (Beneficial)	Any scheme with a reduction in accidents (refer Table 2-8) - A reduction in accidents will improve the reliability of journeys. For controlled motorways, variable speed limits will lead to more uniform speeds and a reduction in flow breakdown.
	Regeneration	Not Applicable	N/A
	Wider Impacts	Not Applicable	N/A
ENVIRONMENT	Noise	Not Applicable (only considered in Standard PAR)	N/A
	Air Quality	Not Applicable[5]	N/A
	Greenhouse Gases	Not Applicable (only considered in Standard PAR)	N/A
	Landscape	Impact Assessed (Adverse) (Not Applicable for purely urban schemes)	The landscape character and visual amenity would be adversely impacted.
	Townscape	Impact Assessed (Adverse) (Not applicable for purely rural schemes)	The townscape character and visual amenity would be adversely impacted.
	Heritage and Historical Resources	Impact Assessed {Neutral (most cases); Adverse (exceptions)}	Works are unlikely to impact upon heritage, however, where works are located in, adjacent or within close proximity to a sensitive site an adverse impact may arise. Potential for archaeological finds, however this is reduced where works are confined to the highways boundary.
	Biodiversity	Impact Assessed (Adverse)	Works affecting the soft estate would potentially impact on protected species and habitats where vegetation clearance is required or where works are within or close to a sensitive site.

[4] This will be set automatically by PAR as soon as costs have been entered on the Costs Master worksheet.
[5] Although some possible benefits were set out in Table 2-4, these cannot be quantified within PAR and can be assumed to be negligible.

		Not Applicable/Impact Assessed	Suggested Key Points
ENVIRONMENT	Water Environment	Impact Assessed {Neutral (most cases); Adverse (exceptions)}	Impacts would principally be of a temporary nature and originate principally from construction. Impacts may arise where an increase in hard standing may in turn increase groundwater runoff. Where works are within close proximity to a watercourse or ditching or where existing drainage is to be impacted, the potential impact of the scheme may increase to adverse.
SOCIETY	Physical Activity	Not Applicable	N/A
	Journey Quality	Impact Assessed (Beneficial for VMS, MIDAS; Neutral for other schemes)	Increase in Traveller Care (VMS, MIDAS)
	Accidents	Impact Assessed (Beneficial)	Specify the reduction in accidents assumed.
	Security	Impact Assessed (Beneficial for CCTV; Neutral for other schemes)	For schemes involving CCTV, users will experience an improved level of formal surveillance.
	Access to Services	Not Applicable	N/A
	Affordability	Not Applicable (only considered in Standard PAR)	N/A
	Severance	Not Applicable	N/A
	Option Values	Not Applicable	N/A

Foundation Economics
In Foundation PAR only accidents, incident delays and journey time variability are considered. If vehicle operating costs or delays during construction and maintenance are significant then a Standard PAR must be completed instead.

This sheet should be filled in as follows:

Part A: Journey Time Variability

Select the Monetised option.

MyRIAD DDV (Day to Day Variability) Benefits: These will be zero for all except controlled motorway schemes, which are unlikely to be below the £10m threshold for using PAR. For a controlled motorway scheme below £10m these benefits will need to be obtained from a scheme-specific calculation using MyRIAD, or equivalent.

If look up tables are being used rather than a scheme-specific calculation, then the look up table values for Reliability benefits will include controlled motorway DDV benefits and IRV benefits as a combined total; this total should be entered as IRV benefits (see below).

MyRIAD IRV (Incident-Related Variability) Benefits: For a Foundation PAR it is acceptable to obtain the benefits for the appraisal period from the Reliability columns of the look-up tables in Annex B. It should be noted that for schemes excluding controlled motorway this includes only incident-related benefits. For controlled motorways it includes day to day variability as well.

Part B: Journey Times

In white box on the last line of the box 'Total value of journey time benefits in the opening year', enter the incident-related delay (time) savings for the opening year, from the look-up tables in Annex B.

The rest of this section can be left blank. The assumption is that technology schemes have no, or negligible, effects on average journey times.

Part C: Accidents

PIAs saved in opening year: This value should be calculated using local accident data (i.e. annual average PIAs from the Traffic & Accidents worksheet) along with the accident rate reductions specified in

Table 2-8. For example if there are an average of 50 PIAs a year and the scheme is expected to lead to a 10% reduction in accident rates then there will be 5 PIAs saved in the opening year.

Time of day of accident savings: All day

3.6 Standard PAR

Standard Impact Assess
The following table corresponds to the table that appears on the PAR worksheet. It shows whether each sub-impact should be 'Impact assessed' or 'Not applicable'.

For each 'Impact assessed' sub-impact it will then be necessary to click the Go To Worksheet button. Subsequent sections give guidance on completing each of the worksheets, where there are issues specific to technology schemes.

Table 3-3. Guide to completing the Standard Impact Assessment worksheet (typical effects only – local circumstances may be different).

		Not applicable or Impact assessed?
ECONOMY	Transport Budget	Impact assessed[6]
	Transport Economic Efficiency	Impact assessed
	Indirect Tax Revenues	Impact assessed[7]
	Reliability	Impact assessed[8]
	Regeneration	Not applicable
	Wider Impacts	Not applicable
ENVIRONMENT	Noise	Not applicable
	Air Quality	Not applicable[9]
	Greenhouse Gases	Impact assessed
	Landscape	Impact assessed
	Townscape	Impact assessed
	Heritage and Historical Resources	Impact assessed
	Biodiversity	Impact assessed
	Water Environment	Impact assessed
SOCIETY	Physical Activity	Not applicable
	Journey Quality	Impact assessed
	Accidents	Impact assessed
	Security	Impact assessed – if CCTV part of scheme Not applicable – other schemes
	Access to Services	Not applicable
	Affordability	Impact assessed[10]
	Severance	Not applicable
	Option Values	Not applicable

[6] This will be set automatically by PAR as soon as costs have been entered on the Costs Master worksheet.
[7] This will be set automatically by PAR as soon as an amount has been entered on the TEE worksheet.
[8] This will be set automatically by PAR as soon as either TEE or Accidents is set to 'Impact assessed'.
[9] Although some possible benefits were set out in Table 2-4, these cannot be quantified within PAR and can be assumed to be negligible.
[10] This will be set automatically by PAR as soon as a value for vehicle operating cost benefit has been entered on the TEE worksheet.

TEE

This sheet covers the following impacts:

- Business Users and Transport Providers
- Non-Business Users

Click 'Manual' on the row of buttons at the top of this sheet then click 'No' when asked whether you want to use the VOT/VOC Sheets. Several white boxes will then appear which have to be filled in. Table 3-4 shows the data to be used for completion of Transport Economic Efficiency page.

The boxes for USER BENEFITS (ie journey time savings) during normal operation should be zero or blank. Benefits (or rather disbenefits during construction and maintenance should be obtained from scheme-specific QUADROs (or equivalent).

In the INCIDENTS section, the benefits will relate to incident delay and VOC savings from reduced queuing at accidents and other incidents. Incident delay savings should be obtained from a scheme-specific MyRIAD run (or equivalent). VOC savings should be obtained from the look-up tables.

The incident contribution to the value for the Indirect Tax Revenues box can also be obtained from the look-up tables (which are based upon the tax impacts of the reduction in fuel consumption while queuing). This will be a negative number, representing a reduction in revenues and hence a disbenefit to the wider public finances. The number obtained from the look up tables should be added to that reported by a scheme-specific QUADRO, which may be positive or negative as reported by QUADRO.

Table 3-4. Data used for completion of TEE.

Box label	**Enter the following data:**
USER BENEFITS – normal operation	Zero
USER BENEFITS – during construction and maintenance	From a scheme-specific QUADRO run
INCIDENTS, MyRIAD Incident Delay Benefits	Incident delay time savings from a scheme-specific MyRIAD run
INCIDENTS, Incident VOC Benefits	From look-up table
Indirect Tax Revenues	From look-up table (for incidents) plus a scheme-specific QUADRO run

MyRIAD does not output the information required to complete the Metrics boxes so 'Unknown' should be entered here.

Key Points can refer to the reductions in accident rate and incident durations given in Table 2-8 and type and number of night closures assumed in QUADRO. They can also refer to the special traffic management considerations such as any deviations from standards.

Reliability
A scheme-specific MyRIAD (or equivalent) should be run to obtain reliability benefits. It is not appropriate to use the look-up tables in a Standard PAR - the non-linear nature of the MyRIAD calculations means the results cannot easily be scaled from one situation to another.

Select the "Input total benefits" option

Part A: Day to day travel time variability

Select the 'Monetised' option for CM schemes only.

The value of the benefits entered in the boxes should be those reported by MyRIAD (or equivalent).

Under Key Points mention that variable speed limits result in more uniform speeds and less flow breakdown.

For other types of technology scheme select the 'Un-monetised' option. Congestion Relief should be set to zero PCUs/week.

Part B: Incident-related travel time variability

Select the 'Monetised' option.

The value of the benefits entered in the boxes should be those reported by MyRIAD.

Under Key Points mention the reduction in incident rates and (for CCTV) durations brought about by the scheme.

NB: Although MyRIAD reports DTDV and incident-related variability separately, it is important to note that the split between the two is only a crude approximation and should not be given too much weight. However, the total variability benefits from MyRIAD are robust, so as long as both components of variability are included in PAR the overall results of the appraisal should be correct.

Environmental worksheets – general
Many of the environmental worksheets require the selection of an Assessment Score from a seven point scale. The selected score should be based on this interim advice note, local circumstances, PAR guidelines, and WebTAG.

Greenhouse Gases
Select the 'Monetised' option. As described in Section 2.3 the results from a scheme-specific MyRIAD can be used in conjunction with the table in Annex B.4 to provide values for the change in carbon dioxide emissions from reduced queuing.

A suitable Key Point is 'Fewer accidents, with a reduction in associated queuing, will reduce carbon dioxide emissions.' For CCTV it can also be stated 'Reduced incident durations will lead to less queuing and therefore a reduction in carbon dioxide emissions'.

For controlled motorway schemes, a further key point should be included along the lines of: 'Variable mandatory speed limits lead to more uniform speeds and a reduction in flow breakdown and associated queuing. This will lead to reduced carbon dioxide emissions, though it is not possible to quantify this effect.'

Landscape and Townscape
When completing both the Landscape and Townscape worksheets, a brief overview of the surrounding landscape/townscape and its associated features should be provided under the 'Description' heading, in addition to the character of the local highway. This will enable the scheme to be set within an overall landscape/townscape context which will better facilitate the assessment of the significance of any impacts resulting from the scheme on the other attributes (i.e. scale, rarity, importance and substitutability).

In addition, a note should be made in the 'Key Points' box of any significant visual impacts that would result from the scheme on surrounding properties, together with the likely effectiveness of any mitigation screening proposed. Potential impacts on Landscape and Townscape arising from technology schemes are outlined in Table 2-4.

Heritage and Historic Resources
When completing the PAR worksheet details should include the location of any designations, heritage features or records of heritage features.

Technology schemes generally tend to have a smaller impact on heritage than many other schemes as the majority of the works is retained within the carriageway and works within the neighbouring highway verge where significant features of heritage value such as archaeology and listed buildings are uncommon. However, certain infrastructure associated with technology schemes (for example gantries and MS4s) have the potential to impact on the visual setting of heritage features and designations. This should be carefully considered and set within the context of the existing corridor. Potential impacts on Heritage and Historic Resources technology schemes are outlined in Table 2-4.

The outcome of this consideration should be recorded on the worksheet.

Biodiversity
When completing the PAR worksheet relevant information should include the location of any designation or protected species records/habitat and details of the feature, its status and value.

Technology schemes generally tend to have a smaller impact on biodiversity than other schemes as the majority of the works are retained within the carriageway and works within areas of verge are generally within disturbed sections and restricted in scale. However, it is important to consider that many of these schemes cover a large linear distance and it is important to ensure all attributes along the route are considered. Some of the impacts may be off-network, e.g. the effect of the operation of technology on nearby breeding birds. Potential impacts on Biodiversity arising from technology schemes are outlined in Table **2-4**.

Water Environment
In general, the majority of impacts on the Water Environment resulting from technology schemes are likely to be of a temporary nature originating from construction. However, long term impacts may occur and as such a scheme's locality together with the infrastructure being introduced should be carefully considered. It is also important to acknowledge a scheme's potential to cover large linear distances. Impacts on the Water Environment would vary. Potential impacts on Water Environment arising from technology schemes are outlined in Table 2-4.

Journey Quality
Only schemes including VMS such as MIDAS will improve Journey Quality. In these cases, click the "Better" option button on the worksheet and enter the average number of vehicles per day that will encounter incidents that the signs will provide warning of. The "Key Points" box should contain the rationale for the entries to the worksheet.

Accidents

Part A
PIAs saved in opening year: This value should be calculated using local accident data (i.e. annual average PIAs from the Traffic & Accidents worksheet) along with the accident rate reductions specified in

Table 2-8. For example if there are an average of 50 PIAs a year and the scheme is expected to lead to a 10% reduction in accident rates then there will be 5 PIAs saved in the opening year.

Time of day of accident savings: All day

Part B
Select 'No' in response to the question 'Has COBA analysis been undertaken?'.

For a Standard PAR it will be necessary to carry out a QUADRO run (or equivalent) specific to the scheme being considered. This will provide results for the next two rows of the table concerning accident impacts during construction and maintenance[11]. Remember that where accident numbers and costs increase they should be entered as negative numbers in this table.

Under Key Points mention the assumed reduction in accident rates.

Security
Only schemes incorporating CCTV will have their impact assessed for Security.

Only Formal Surveillance will be affected by the introduction of CCTV. The relative importance can be set as 'medium' and the standards with and without the scheme High and Poor respectively (assuming no CCTV exists in the without-scheme scenario). Other security indicators will be unaffected by the scheme so the values specified in this table are of no relevance.

Enter the average number of pedestrians per day who will benefit from improved formal surveillance on the section(s) of road concerned. On motorways, this will be limited to those using the hard shoulder in an emergency.

Under Key Points refer to the level of coverage of the CCTV scheme and how it is to be monitored.

Affordability
This sheet will be completed automatically by PAR.

[11] This can be found in the QUADRO output file in the table headed 'TOTAL PROFILE ACCIDENT NUMBERS AND COSTS'

4 Completing the Technology Scheme Appraisal Report (TSAR)

4.1 Structure of the report

The Technology Scheme Appraisal Report should be structured as follows:

1 Introduction

2 Scheme objectives

3 Scheme description(s)

4 Scheme appraisal

4.1 Economy
- 4.1.1 Cost to Broad Transport Budget (Scheme Costs)
- 4.1.2 Transport Economic Efficiency
- 4.1.3 Wider Public Finances (Indirect Tax Revenues)
- 4.1.4 Reliability
- 4.1.5 Regeneration
- 4.1.6 Wider Impacts

4.2 Environment
- 4.2.1 Noise
- 4.2.2 Air Quality
- 4.2.3 Greenhouse Gases
- 4.2.4 Landscape
- 4.2.5 Townscape
- 4.2.6 Heritage and Historical Resources
- 4.2.7 Biodiversity
- 4.2.8 Water Environment

4.3 Society
- 4.3.1 Physical Activity
- 4.3.2 Journey Quality
- 4.3.3 Accidents
- 4.3.4 Security
- 4.3.5 Access to Services
- 4.3.6 Affordability
- 4.3.7 Severance
- 4.3.8 Option Values

4.4 Conclusions

4.2 Guidance on completing the report

Table 4-1 provides guidance on completing each section of the TSAR. A WebTAG worksheet should be completed for each impact that is affected by the scheme and included in the corresponding section of the TSAR, along with any required supporting information as detailed in 4.3 below. The table provides specific guidance on completing these worksheets for technology schemes, a link to the blank worksheet and a link to the general WebTAG guidance for completing the sheet.

The worksheets can also be accessed via the worksheets index page of WebTAG: http://www.dft.gov.uk/webtag/documents/worksheets.php. An appropriate worksheet does not exist for some impacts, in which case the appraisal information can be summarised in the TSAR in a brief table.

For some of the impacts further supporting information should be included in the TSAR, in addition to the completed WebTAG worksheets. Table 4-1 indicates where supporting information is required and section 4.3 describes the details of what is required.

Table 4-1 explains that some sub-impacts are unlikely to be relevant for technology schemes and that the corresponding WebTAG worksheet does not need to be completed. However, this should still be reported in the TSAR, with reference made to this IAN to justify the lack of a worksheet.

In some instances the table indicates that a sub-impact is relevant but a WebTAG worksheet is not required, in which case it should be reported in accordance with the guidance in the table.

Table 4-1. Guidance for completing the TSAR.

Report heading	Guidance
1 Introduction	
2 Scheme objectives	Describe the problems the scheme seeks to address, how it is anticipated that the scheme will resolve these problems, and to what extent. Any other objectives should also be explained. For further guidance see: DMRB Vol 12.1.1, paras 2.3.1 to 2.3.5; DMRB Vol 12.2.1 para 2.1.2; WebTAG Unit 2.2 section 1.1 to 1.2
3 Scheme description(s)	Provide full details of the schemes being appraised, including maps and plans where appropriate. Include assumptions about the impact of scheme on accident rates and incident duration (Table 2-8)

Report heading	WebTAG worksheet	WebTAG guidance	Guidance specific to technology schemes
4,1 Economy			
4.1.1 Cost to Broad Transport Budget (Scheme Costs)	http://www.dft.gov.uk/webtag/documents/expert/xls/unit3.5.1-public-accounts-hws.xls	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.1.php http://www.dft.gov.uk/webtag/documents/expert/unit3.5.9.php	In most cases HA technology schemes do not involve local authorities so only the Central Government Funding section of the Public Accounts table is relevant. This has four elements: • Operating Costs • Investment Costs • Developer and Other Contributions • Indirect Tax Revenues Renewal costs after 15 years should be included as Investment Costs, though it might be argued that they are Operating Costs. Maintenance costs will represent the Operating Costs. All costs exclude VAT (recoverable or not). All costs should be in 2010 market prices, discounted to 2010. Refer to Section 4.3 for the required supporting information.

Report heading	WebTAG worksheet	WebTAG guidance	Guidance specific to technology schemes
4.1.2 Transport Economic Efficiency	http://www.dft.gov.uk/webtag/documents/expert/xls/unit3.5.2-tee.xls	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.2.php	At the Option Identification stage, benefits may be estimated using the look-up tables in Annex B. At later stages, journey time (incident delay) benefits from the reduced time spent queuing should be calculated from a scheme-specific MyRIAD (or equivalent), with the corresponding VOC benefits calculated from the MyRIAD results and the look-up table in Annex B.4 B.4. In some cases there may be developer or other contributions to be included in the TEE table. Delays (time and VOC impacts) during construction and maintenance should be calculated using QUADRO (or equivalent) and included here. See Section 2.3. In most cases it is sufficient to consider delays during construction and renewal only – the impact during routine maintenance will be negligible. Variability impacts from reduced queuing at accidents, or improvements in day to day variability, should be included under the Reliability impact. Refer to Section 4.3 for the required supporting information.
4.1.3 Wider Public Finances (Indirect Tax Revenues)	Included in the Public Accounts table (see 4.1.1 of the TSAR).	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.1.php	At the Option Identification stage, the reduction in indirect tax revenues may be estimated using the look-up tables in Annex B. At later stages, the reduction in indirect tax revenues should be calculated from a scheme-specific MyRIAD (or equivalent), used in conjunction with Annex B.4. Since there is a reduction in tax revenues (arising from a reduction in fuel consumption while queuing), the value will be a positive number because it represents a cost to government through reduced revenues. It should be noted however that when the value is transferred to the AMCB table, the sign of the value should be reversed to a negative value i.e. the reduction in indirect tax revenues is a disbenefit to the Wider Public Finances.
4,1,4 Reliability	None applicable	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.7.php	At the Option Identification stage, reliability (variability) benefits may be estimated using the look-up tables in Annex B. At later stages, reliability (variability) benefits should be calculated from a scheme-specific MyRIAD (or equivalent). Only the journey time variability benefits are relevant to the Reliability impact. Refer to Section 4.3 for the required supporting information.
4.1.5 Regeneration	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.5.10-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.8.php	Based on current WebTAG guidance this impact is not relevant to technology schemes. It is therefore not necessary to complete the WebTAG worksheet for any technology scheme.
4.1.6 Wider Impacts	None applicable	http://www.dft.gov.uk/webtag/documents/expert/unit3.5.14.php	Based on current WebTAG guidance this sub-impact is not relevant to technology schemes.

Report heading	WebTAG worksheet	WebTAG guidance	Guidance specific to technology schemes
4.2 Environment			
4.21 Noise	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.2-worksheet01.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.2.php	Only controlled motorway schemes will have an impact upon noise levels. However, although controlled motorways would achieve a reduction in noise level, this reduction is considered too small to be noticeable. It is therefore not necessary to complete the WebTAG worksheet for any technology scheme.
4.2.2 Air Quality	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.3-plws.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.3.php	There are reasons to suppose that all technology schemes will achieve an improvement in air quality. However, with the possible exception of controlled motorway schemes, the improvement would be negligible and, in the case of controlled motorway schemes, there will not be sufficient data available on the likely change in engine loadings to assess the impact. It is not therefore necessary to complete the WebTAG worksheet for any technology scheme.
4.2.3 Greenhouse Gases	http://www.dft.gov.uk/webtag/documents/expert/xls/unit3.3.5.xls	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.5.php	At the Option Identification stage, greenhouse gas (carbon dioxide) benefits may be estimated using the look-up tables in Annex B. At later stages, greenhouse gas (carbon dioxide) benefits should be calculated from a scheme-specific MyRIAD (or equivalent), used in conjunction with Annex B.4 B.4. It should be noted that it is not necessary to complete the WebTAG worksheet for any technology scheme.
4.2.4 Landscape	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.7-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.7.php	See Table 2-4 and Section 3.6.
4.2.5 Townscape	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.8-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.8.php	See Table 2-4 and Section 3.6.
4.2.6 Heritage and Historical Resources	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.9-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.9.php	See Table 2-4 and Section 3.6.
4.2.7 Biodiversity	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.10-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.10.php	See Table 2-4 and Section 3.6.
4.2.8 Water Environment	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.11-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.11.php	See Table 2-4 and Section 3.6.
4.3 Society			
4.3.1 Physical Activity	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.12-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.12.php	Based on current WebTAG guidance this sub-impact is not relevant to technology schemes. It is therefore not necessary to complete the WebTAG worksheet for any technology scheme.

Report heading	WebTAG worksheet	WebTAG guidance	Guidance specific to technology schemes
4.3.2 Journey Quality	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.3.13-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.3.13.php	See Table 2-4 and Section 3.6.
4.3.3 Accidents	None, but the numbers calculated here feed into the AST	http://www.dft.gov.uk/webtag/documents/expert/unit3.4.1.php	At the Option Identification stage, accident benefits may be estimated using the look-up tables in Annex B. At later stages, accident benefits should be calculated from a scheme-specific COBA (or equivalent). Refer to Section 4.3 for the required supporting information.
4.3.4 Security	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.4.2-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.4.2.php	Only schemes incorporating CCTV have an impact on security. Following WebTAG guidance, only Formal Surveillance in the worksheet will be affected by the introduction of CCTV. The relative importance can be set as 'medium' and the standards with and without the scheme High and Poor respectively (assuming no CCTV exists in the without-scheme scenario). Other security indicators will be unaffected by the scheme and these sections of the table can be left blank, with a note to this effect in the accompanying text. The number of users affected should be the average number of pedestrians per day benefiting from formal surveillance. On motorways this will be those using the hard shoulder in an emergency. The overall assessment can be reported as Slight Positive. The Reference Source box should normally refer to this guidance. Qualitative Comments should explain the rationale for the entries to the worksheet based upon the advice given here.
4.3.5 Access to Services	None applicable	http://www.dft.gov.uk/webtag/documents/expert/unit3.6.3.php	Based on current WebTAG guidance this sub-impact is not relevant to technology schemes.
4.3.6 Affordability	None applicable	http://www.dft.gov.uk/webtag/documents/expert/unit3.6.4.php	See Table 2-5 and refer to Section 4.3 for the required supporting information.
4.3.7 Severance	http://www.dft.gov.uk/webtag/documents/expert/doc/unit3.6.2-ws1.doc	http://www.dft.gov.uk/webtag/documents/expert/unit3.6.2.php	Based on current WebTAG guidance this sub-impact is not relevant to technology schemes. It is therefore not necessary to complete the WebTAG worksheet for any technology scheme.
4.3.8 Option Values	None applicable	http://www.dft.gov.uk/webtag/documents/expert/unit3.6.1.php	Based on current WebTAG guidance this sub-impact is unlikely to be relevant for technology schemes.

Report heading	WebTAG worksheet	WebTAG guidance	Guidance specific to technology schemes
4.4 Conclusions	http://www.dft.gov.uk/webtag/documents/project-manager/xls/U2_7_2-appraisal-summary-table110418.xls	http://www.dft.gov.uk/webtag/documents/expert/expert/unit3.2.php	Provide a summary of the scheme appraisal in an AST.
	http://www.dft.gov.uk/webtag/documents/project-manager/xls/unit2.7.1-analysis-of-monetised-costs-and-benefits.xls	http://www.dft.gov.uk/webtag/documents/project-manager/project-manager/unit2.7.1.php	Provide a summary of the monetised impacts in an Analysis of Monetised Costs and Benefits table.

4.3 Supporting information to be provided

TSAR Section 4.1.1 Cost to Broad Transport Budget

The source of all cost information should be stated.

Unless TUBA[12] has been used, details of the conversion of the Investment Costs to present values should be included:

Table 4-2. Calculation of Present Value of Investment Costs

Year	*Year 1*[1]	*Year 2*	*etc.*	Total
Construction (£m) *(a)*				
Preparation (£m) *(b)*				
Supervision (£m) *(c)*				
Renewal (£m) *(d)*				
Risk & Optimism Bias (£m) *(e)*				
Construction Cost Growth Factor *(f)*[2]				
Total (£m) (g)=((a)+(b)+(c)+(d)+(e))x(f)				
Total in 2010 factor prices (£m)[3]				
Discount factor to 2010[4]				
Present value 2010 factor prices (£m)[5]				
Present value 2010 market prices (£m)[6]				

[1] *Replace Year 1, Year 2, etc. by actual calendar years*
[2] *The construction cost growth factors in Annex C give construction inflation, excluding general inflation, between the Q2 2006 and future years and can be used to calculate (f). Values relative to other bases can be derived by dividing factors, e.g. to get the appropriate factor between Q1 2009 and Q2 2010 divided the factor for the latter period in the table by that for the earlier period. It is important to note that after applying the factors the works cost still remain in the same works cost year prices.*
[3] *i.e. deflate total in previous row using RPI factors in Annex C. RPI factors convert works costs from works cost price year to 2010.*
[4] *Discount rates and how to calculate discount factors can be found in Section 4.1 of WebTAG3.5.4.*
[5] *i.e. multiply the figures in the two previous rows*
[6] *i.e. multiply total in previous row by 1.19*

The price base of the cost estimates (a) to (d) should be stated (e.g. Q1 2013).

Similarly, the calculation of the present value of operating costs in 2010 market prices should be presented when TUBA is not being used, following the steps of deflating, discounting and conversion to market prices. Capitalisation factors (see Annex D) should be provided. These processes are included in the following equation:

Operating costs = A x B x C x D x 1.19

Where

A = Additional annual average maintenance costs (excluding renewals) over the Assessment Period
B = RPI deflator from works cost price year to 2010 (see Annex C)
C = Capitalisation factor (see Annex D)
D = Discount factor from opening year to 2010

The operating cost calculations should be presented in the TSAR.

[12] TUBA is the Department for Transport's economic appraisal software http://www.dft.gov.uk/tuba/

If TUBA has been used to calculate the data for the Public Accounts table then information should be provided on the allowances for risk and optimism bias, and for real increase in construction costs. The cost profiles input to TUBA should be reported in the TSAR.

TSAR Section 4.1.2 Transport Economic Efficiency

Details of the roadworks associated with scheme construction and renewal should be included, whether a scheme-specific QUADRO (or equivalent) is run or the look-up tables used:

Table 4-3. Roadworks associated with scheme construction and renewal.

Roadworks operation/ maintenance job	Traffic management arrangements	Location and length of works	Year of job	Duration of job	Times when TM in place	Diversion route (QUADRO)
	Number of lanes closed and direction					*Real or notional*

Information on the flow data used in QUADRO or the look up tables should also be provided:

Table 4-4. Source of flow data used.

	AADT	Year of AADT	Source of AADT
Link 1			
Link 2			
Etc…			

TSAR Section 4.1.4 Reliability

The year and source of all base year AADTs used for scheme-specific MyRIADs (or equivalent) or in the look-up tables should be stated.

If a scheme-specific MyRIAD has been run, the DM and DS road types specified in MyRIAD for the scheme links should be stated

The MyRIAD network diagram should be included. This should show which are the feeder links and which are the scheme links. The following data should be shown:

- Node/junction names
- Link lengths
- AADTs (base year, two-way)
- Flow to capacity ratios on the feeder links should be shown for the busiest flow group.

If it has been necessary to combine two or more real links into a single MyRIAD network then details should be included of the calculation of the combined AADT (should be a distance-weighted average).

Traffic growth factors from base year to opening year and any other modelled years and the source of those traffic growth factors used in MyRIAD should be stated.

The trip matrix used in MyRIAD should be included in the TSAR. The source of this, and the implied trip length distribution should be described.

All variability impacts should be reported and summarised in a table of the following format:

Table 4-5. Summary of reliability impact.

Incident-Related Variability	(a)
Day to Day Variability	(b)
Total reliability impact	(a)+(b)

Include the following caveat: 'NB: The split between incident-related and day to day variability in MyRIAD is only a crude approximation.'

TSAR Section 4.3.3 Accidents

Provide the following tables:

Historic accident data for each link in the scheme (number of accidents) for a minimum of 3 years, but preferably 5 years:

Table 4-6. Historic accident data.

12 month period from	**1 Jan 2010**			**1 Jan 2009 etc**			**Total over years**		
	Fatal	**Serious**	**Slight**	**Fatal**	**Serious**	**Slight**	**Fatal**	**Serious**	**Slight**
Link 1									
Link 2									
…									
Total									

(replace *Link 1, Link 2 etc*. by more appropriate descriptions*)*

Table 4-7. Summary of link data.

	Link length (km)	**AADT for accident rate[1]**	**Observed accident rate (per million veh kms)**	**National average accident rate for this link type**	**AADT used in COBA (or equivalent)**	**Do-Something accident rate used in COBA (or equivalent)[2]**
Link 1						
Link 2						
…..						

[1] Average over the period for which historic accident data has been provided.
[2] Only required when a scheme-specific COBA has been run.

The year and source of the AADT data used in COBA (or equivalent) should be stated.

Table 4-8. Summary of accident impacts of scheme (over full appraisal period)

Scheme impact[1]	Reduction in PIAs	
	Reduction in casualties	
During construction and maintenance[2]	Reduction in PIAs	
	Reduction in casualties	
PVB of accident benefits[3] (£)		

[1] From COBA
[2] From QUADRO
[3] Combined impact of COBA and QUADRO. In 2010 market prices discounted to 2010.

TSAR Section 4.3.6 Affordability

Include the following table:

Table 4-9. Affordability analysis

	Household income quintile				
	1	**2**	**3**	**4**	**5**
Proportion of population	20%	20%	20%	20%	20%
Share of vehicle operating cost decrease	6%	11%	20%	28%	35%
Assessment	✓	✓	✓✓	✓✓✓	✓✓✓

Glossary of abbreviations

AADT	Annual Average Daily Traffic
AMCB	Analysis of Monetised Costs and Benefits
AMI	Advanced Motorway Indicator
AONB	Area of Outstanding Natural Beauty
AST	Appraisal Summary Table
ATM	Active Traffic Management
CCTV	Closed-circuit television
CM	Controlled Motorway
COBA	COst Benefit Analysis (software)
DfT	Department for Transport
DHS	Dynamic Hard Shoulder running
DM	Do Minimum
DDV/DTDV	Day To Day Variability
EIR	Economic Impact Report
FYRR	First Year Rate of Return
HA	Highways Agency
HSR	Hard Shoulder Running
MyRIAD	Motorway RelIability Incidents And Delays
IRV	Incident Related Variability
MIDAS	Motorway Incident Detection and Automatic Signalling
MM-HSR	Managed Motorway – Hard Shoulder Running
MS3, MS4	Motorway Signals 3 and 4 (variable message signs)
NATA	New Approach to Appraisal
NDDD	Network Delivery and Development Directorate
NTCC	National Traffic Control Centre
PA	Public Accounts
PAR	Project Appraisal Report
PCF	Project Control Framework
PIA	Personal Injury Accident
PSA	Public Service Agreement
PVB	Present Value of Benefits
PVC	Present Value of Costs
QUADRO	QUeues And Delays at ROadworks (software)
RAMSAR	Convention on Wetlands of International Importance
RPI	Retail Price Index
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument
SINC	Site of Importance for Nature Conservation
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
TEE	Transport Economic Efficiency
TRL	Transport Research Laboratory
TSAR	Technology Scheme Appraisal Report
TTV	Travel Time Variability
TUBA	Transport Users Benefits Appraisal
VAT	Value Added Tax
VMS	Variable Message Sign *or* Value Management Score
VMSL	Variable Mandatory Speed Limit
VOC	Vehicle Operating Cost
VOT	Value of Time
WebTAG	Web-based Transport Analysis Guidance

5 Normative References

DfT (2006). The COBA Manual.

DfT (2006b). The QUADRO Manual.

Highways Agency (2013). PAR 6.3 User Notes

Highways Agency (2013). Motorway Reliability Incidents And Delays (MyRIAD) software User Manual.

6 Informative References

DfT (2008). Advanced motorway signalling and traffic management feasibility study: A report to the Secretary of State for Transport

Hounsell N. (2007). Controlled motorways: a review of the methodology for estimating journey time impacts. Report to Mott MacDonald. (Available from HA on request)

Mott MacDonald (2007a). Thames Valley Journey Time Quality and Reliability Study: RCM Accident Rates. Report to the Highways Agency. (Available from HA on request)

Mouchel (2002a). Appraisal of technology projects: Environmental assessment and appraisal of motorway signals MK 3 (MS3): Guide. 42525/AAY/DOC/003 Issue A. Report to the Highways Agency. (Available from HA on request)

Mouchel (2002b). Appraisal of technology projects: Guidance for CCTV Schemes. 42525/AAY/DOC/007 Issue: C. Report to the Highways Agency. (Available from HA on request)

Mouchel (2002c). Appraisal of technology projects: Appraisal of CCTV Schemes. 42525/AAY/DOC/002 Issue: B. Report to the Highways Agency. (Available from HA on request)

Summersgill I., Mustard, D., and Fletcher, J (2005). M25 Controlled Motorway: Safety Benefits, Unpublished TRL project report UPR T/097/05. (Available from HA on request)

TRL (2004). Speed control and incident detection on the M25 controlled motorway. PPR 033. (Available from HA on request)

Tucker S, Summersgill I, Fletcher J and Mustard D. (2006). Evaluating the benefits of MIDAS automatic queue protection. Traffic Engineering and Control, Vol 47, No. 9, Oct 2006

Annex A Description of the Highways Agency's appraisal software

The following sections describe each of the HA's appraisal software programs, along with some important points to note if they are being used for the calculation of user impacts for technology schemes. Equivalent programmes may be used provided they deliver equivalent outcomes that comply with DMRB and WebTAG. Even if these programs are not being used, many of these points are still relevant.

COBA

COBA (DfT, 2006) stands for COst Benefit Analysis. It is used for the appraisal of road schemes and can calculate economic and safety benefits and carbon dioxide emissions. It is often used in a cut-down version just to calculate safety benefits, with other software used for the other impacts.

To calculate safety benefits COBA uses various inputs including Do Minimum and Do Something accident rates and traffic flows. Observed accident rates should be used for the Do-Minimum and reduced in the Do-Something as set out in Table 2-8. It should be noted that technology schemes are assumed not to affect the volume of traffic on the sections of carriageway concerned and that the Do Minimum and Do Something flows will therefore be the same.

Technology schemes should be appraised for a period of 30 years after scheme opening. By default COBA will calculate benefits for 60 years. A 30 year appraisal can be selected by explicitly specifying the last year of the appraisal period on the KEY 003 record of the COBA input file.

The look-up tables in Annex B.2 contain COBA calculated accident benefits for various Do Minimum and Do Something configurations for different values of AADT, based on default Do-Minimum motorway accident rates. Results for intermediate values of AADT can be interpolated from the values given. The values are given per 10 kilometre length for both carriageways combined and can simply be factored according to the length of the scheme being considered.

The look-up tables should only be used in the circumstances set out in the table in Annex B.1 ie in the option identification and selection stages of schemes requiring a TSAR, not in the later stages, nor in projects for which PAR is used.

MyRIAD

MyRIAD (Highways Agency, 2013) stands for Motorway Reliability Incidents And Delays. It is a Microsoft Excel-based application and can be obtained by contacting HA TAME Group.

Whilst COBA covers many of the costs relating to accidents it does not include the costs of delays to traffic while one or more of the running lanes are blocked ('incident delays'). These can be calculated using MyRIAD, which will also calculate the impact of these delays on travel time variability (TTV). MyRIAD can calculate delay-related benefits for a range of incident types, not just accidents. MyRIAD will also calculate any changes to day to day variability (DTDV).

MyRIAD contains a set of incident rates for each possible combination of motorway technology provision. These are defined in terms of different motorway "road types" and the user need only select the "road type" which corresponds to each of the Do Minimum and Do Something ie there is no need for incident rates to be adjusted manually within the program. It should be noted that because only accident rates differ between different levels of motorway technology provision, only the MyRIAD incident rates for single and multi lane accidents will differ between different motorway road types. Thus, incident rates for other incident types (with the exception of MM-ALR, which is not covered by this IAN), are the same for all motorway road types.

The incident duration reductions associated with CCTV for different MyRIAD incident types are as follows: 2% reduction applies to single lane and multi-lane accidents; 5 minute reduction applies to fire (HGV and non-HGV), load shedding and spillage; no reduction for other incident types. As with incident rates, the different incident durations which exist between road types with and without CCTV are built in to the incident parameters for the motorway road type.

MyRIAD contains the following motorway road types from which the user can select a Do Minimum and Do Something. This is done on the Link and Route Information Worksheet.

1. D2M/D3M/D4M, Without MIDAS, Without CCTV, Without VMS
2. D2M/D3M/D4M, Without MIDAS, Without CCTV, With VMS
3. D2M/D3M/D4M, Without MIDAS, With CCTV, Without VMS
4. D2M/D3M/D4M, Without MIDAS, With CCTV, With VMS
5. D2M/D3M/D4M, With MIDAS, Without CCTV, With VMS
6. D2M/D3M/D4M, With MIDAS, With CCTV, With VMS
7. D3CM/D4CM, With MIDAS, With CCTV, With VMS
8. MM-ALR With MIDAS, With CCTV, With VMS (not covered by this IAN)

In recent years, MIDAS has started to be deployed on the all purpose trunk road network. In order to facilitate the assessment of such schemes, MyRIAD also contains the following all purpose road types.

9. D2AP, Without MIDAS, Without CCTV, Without VMS
10. D2AP, With MIDAS, Without CCTV, With VMS

Because of limited evaluation data concerning MIDAS schemes on all purpose roads, it has been assumed that the impact of deploying MIDAS on an all purpose road is the same as that on a motorway ie a reduction of 13% in the default accident rate with MIDAS. It should be noted that, with the exception of accident rates, the default incident rates and durations for all purpose roads within MyRIAD are the same as those for motorways. The default accident rates for all purpose roads are however higher than the rates for motorways as recommended in COBA.

A Single Year MyRIAD Excel workbook must be completed for each assessment year. The assessment years should be opening year and usually 15 years after opening year. Each workbook contains five worksheets which require completion:

- Link and Route Information
- Flow Groups
- Incident Parameters
- Values of time
- Speed-flow and DTDV Curves.

The Flow Groups worksheet is used to specify the proportion of AADT represented by the average hourly flow in each flow group. Care should be taken when applying simple traffic growth factors to AADT values to ensure that the average hourly flow in any flow group does not exceed the available capacity ie the growth forecasts should be realistic. It should be noted that MyRIAD will automatically cap link flows to 95% of capacity where hourly flows exceed this value.

It is not usual practice to adjust the default accident rates in MyRIAD to match observed levels, mainly because the MyRIAD rates include damage-only accidents for which robust local data is unlikely to be available. However, it may be advisable to make some adjustment if local injury

accident rates are significantly different from the national average for motorways (upon which MyRIAD is based). In these cases the following procedure should be followed:

1. Calculate the local accident rate (PIAs per million vehicle kms). Call this A1.
2. Calculate the national average accident rate for motorways (this can be obtained from the COBA manual, allowing for any predicted change over time). Call this A2.
3. On the Incident Parameters Worksheet of MyRIAD, multiply the incident rates for 'Single lane accident' and 'Multi-lane accident' by the local accident adjustment factor (A1/A2). This should be done for both the Do Minimum and Do Something road types. Do not adjust the rates for any other incidents.

The MyRIAD results for each assessment year are contained in the Model Year Results worksheet of the Single Year workbook. To obtain results for the whole appraisal period, the user should complete the MyRIAD Master workbook to combine the results for individual assessment years. Between two and six forecast years can be combined in the Master workbook. Although most HA road schemes are assessed over 60 years, CCTV, MIDAS and Controlled Motorway schemes are assessed over 30 years. MyRIAD allows the user to specify the length of the appraisal period in the Master workbook (between 30 and 60 years).

Results from the single year MyRIAD workbooks are interpolated to obtain results for the years between assessment years and extrapolated for the years beyond the last assessment year to cover the appraisal period. The results for each year are then discounted and added together to provide results for the full appraisal period in 2010 market prices, discounted to 2010.

The look up tables in Annex B.2 contain MyRIAD calculated incident delay and travel time variability benefits for various Do Minimum and Do Something configurations for different values of AADT. Results for intermediate values of AADT can be interpolated from the values given. The values are given per 10 kilometre length for both carriageways combined and incident delay benefits can be factored according to the length of the scheme being considered. TTV benefits are however non-linear and cannot easily be factored (e.g. doubling the scheme length will not double the TTV benefits). If the actual scheme is reasonably close in length to the 10km assumed in the example (say between 5 and 15km) then the look-up table results can be factored accordingly. Otherwise it will be necessary to run a scheme-specific MyRIAD.

The look-up tables should only be used in the circumstances set out in the table in Annex B.1 ie in the option identification and selection stages of schemes requiring a TSAR and for schemes using Foundation PAR.

The non-time benefits of reduced queuing at accidents have also been calculated to supplement the MyRIAD benefits. These are mostly associated with reduced fuel consumption and include user benefits, government indirect tax impacts and carbon dioxide emissions. They also include non-fuel vehicle operating cost benefits for business trips. All the calculations have been based on the parameters in WebTAG Units 3.3.5 'The Greenhouse Gases Sub-Objective' and 3.5.6 'Values of Time and Operating Costs'. The tables in Annex B.2 give the results for use where a scheme-specific MyRIAD is not required. The table in Annex B.4 gives the VOC, tax and CO2 impacts per vehicle hour of delay saved. They can be applied to results for the vehicle hours saved from the scheme-specific MyRIAD as follows: the vehicle hours saved in each modelled year (as reported by MyRIAD) can be used to obtain vehicle hours saved for each year of the appraisal period by interpolating and extrapolating. These can then be multiplied by the corresponding values given in Annex B.4 to get corresponding yearly benefits which should then be summed over the appraisal period.

QUADRO

QUADRO (QUeues And Delays at ROadworks) is used to calculate the costs of delays and accidents at roadworks during the construction, maintenance and renewal of a scheme.

These disbenefits tend to be very scheme-specific and depend on the precise details of the traffic management arrangements required for construction and renewal of the scheme.

Annex B.3 contains example QUADRO results for delay and accident costs during construction and renewal. These are based on a number of assumptions, which are set out in the Annex.

The QUADRO results are per week (7 days), assuming night time (from 2200-0600hrs) working only, and are given for a total closure and for one and two running lanes remaining opening. They need to be factored according to the number of weeks of each type of closure that would be required for construction and renewal of the scheme. The following table gives a rough indication of the type of closure required to carry out the work for various different components of technology scheme.

Table A.1 Example traffic management assumptions for different elements of technology schemes.

Item	Used by[#]	Traffic management
CCTV	CCTV, MIDAS, CM	Hard shoulder closure
MS4/Verge mounted AMIs	MIDAS	Hard shoulder plus lane 1 closure
MIDAS loop	MIDAS, CM	Combination of single and two lane closures[*]
Gantry (includes AMIs)	CM, MIDAS on D4M roads	Full closure of both directions

[#] In many cases the item will already exist, e.g. many motorways being considered for controlled motorways will already have MIDAS installed.

[*] Done in stages: the number of lanes open to traffic will depend on which lane is being worked on. This will determine whether the hard shoulder can be used as a running lane and which lanes need to be closed, allowing for an appropriate lateral clearance between the works and live traffic.

Depending on the length of road closed it may be possible to work at more than one site per night.

The traffic management assumed in each case is just an example and should not be interpreted as definitive guidance on what is appropriate. This will depend on local circumstances.

Note that the figures in Annex B.3 do not include the cost of implementing the traffic management, which should be included with other construction and renewal costs.

Annex B Look-up tables

B.1 Using the look-up tables

A number of look-up tables are provided which give approximate benefits for the different Do Minimum and Do Something scenarios, or 'schemes' described in Table 2-8. The results have been generated using COBA, MyRIAD and QUADRO and are presented for different levels of AADT on the scheme section.

A further table has been produced giving vehicle operating cost, indirect tax revenue, and carbon dioxide impacts per hour of queuing delay. This can be used in conjunction with a scheme-specific MyRIAD.

Which look-up tables can be used depends on the appraisal report being used (Foundation PAR, Standard PAR, or TSAR) and, if a TSAR is being produced, on whether the scheme is at the Option Identification stage. This is set out in the following table:

Report	Scheme stage	Can a look-up table be used?			
		COBA	MyRIAD	QUADRO	VOC/ indirect tax/ CO2[13]
TSAR	Option identification	✓	✓	✓	×[14]
	Other	×	×	×	✓
Foundation PAR	All	×	✓	Not required	Not required
Standard PAR	All	×	×	×	✓

The look-up tables have been generated with the following assumptions:

- Current year of 2013
- Scheme opening year of 2015
- Traffic base year of 2011 (i.e. AADTs are for 2011)
- 30 year appraisal period
- D3M carriageway (though the results should be acceptable for use in a Foundation PAR or a TSAR at the Option Identification stage for schemes on different carriageway standards)

For COBA:

- Link-only accident rates used (accidents at junctions should not be affected by the schemes concerned)
- NTM09 traffic growth
- 10km link length

For MyRIAD:

- 10km scheme length
- 15km feeder link

[13] Always applied to the delay savings from a scheme-specific MyRIAD (or equivalent). Otherwise VOC/indirect tax/CO2 results are included in the MyRIAD look-up tables.
[14] Equivalent results are included in the MyRIAD look-up tables.

For QUADRO:

- 4km of roadworks with speed limit of 50mph
- Works carried out on both carriageways simultaneously (results can be halved to obtain costs for one direction only)
- 4km single carriageway diversion route

Each look-up table gives results for a range of AADTs from 60,000 to 180,000 in increments of 20,000. These are two-way AADTs and the results are for both directions of flow. Results for intermediate levels of flow can be interpolated from the reported results.

The tables are presented in three groups. The first group in Annex B.2 gives COBA and MyRIAD tables for each type of scheme. They are labelled 'Accident Impacts' and 'Economy and Greenhouse Gases Impacts' respectively.

The COBA tables give results per 10km scheme length and should be factored according to the number of kilometres covered by the scheme.

The MyRIAD tables give total TTV results for the assumed 10km scheme length. These results can be adjusted for small variations from this length (say between 5 and 15km), otherwise it will be necessary to run a scheme-specific MyRIAD. This is a consequence of the high degree of non-linearity in the MyRIAD calculations. It is safe to factor delay time and VOC savings and indirect tax and carbon dioxide impacts.

The second group of tables in Annex B.3 gives QUADRO results. These are the costs per week for a single lane, two lane or complete closure. These costs should be factored up according to the number of nights of each type of closure that will be required during construction and renewal of the scheme.

The third group of tables in Annex B.4 (in fact just a single table) gives incident VOC benefits, indirect tax impacts and carbon dioxide emissions per vehicle hour of delay saved. These should be used in conjunction with a scheme specific MyRIAD which does not presently calculate such impacts. To do so, the vehicle hours (incident delays) saved in each modelled year (as reported by MyRIAD) can be used to obtain vehicle hours saved for each year of the appraisal period by interpolating and extrapolating. These can then be multiplied by the corresponding values given in the table to get corresponding yearly benefits which should then be summed over the appraisal period.

B.2 COBA and MyRIAD tables

B.2.1 CCTV with MIDAS not present; VMS present in DM or included with scheme

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	0.5	0.3	1.5	26.8	16.6	1,282
80,000	0.6	0.3	1.9	35.8	22.1	1,708
100,000	0.8	0.4	2.4	44.7	27.7	2,136
120,000	0.9	0.5	2.9	53.6	33.2	2,562
140,000	1.1	0.6	3.4	62.6	38.7	2,990
160,000	1.2	0.7	3.9	71.5	44.3	3,416
180,000	1.4	0.8	4.4	80.5	49.8	3,843

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	2	1	40	104	10	1517	3	18	1
80,000	7	2	89	371	33	3015	12	62	3
100,000	20	3	147	894	82	4580	30	147	7
120,000	42	5	206	1477	137	5787	50	239	10
140,000	65	8	251	2264	211	6893	77	363	17
160,000	84	10	284	2568	241	6957	89	415	18
180,000	122	15	326	2857	274	6935	100	459	20

B.2.2 CCTV with MIDAS present in DM

Accident impacts

There are no COBA-related benefits. Because of the presence of MIDAS in the DM there is no further reduction in accident rates as a result of the introduction of CCTV.

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	2	1	25	63	5	956	2	11	1
80,000	5	1	57	242	22	1947	8	40	2
100,000	13	2	95	585	53	3013	20	95	5
120,000	27	3	135	964	90	3840	33	158	7
140,000	42	5	167	1464	137	4587	50	235	10
160,000	55	7	189	1651	155	4619	57	264	12
180,000	79	10	217	1828	175	4590	65	294	13

B.2.3 CCTV with no other technology in either DM or DS

Accident impacts
There are no COBA-related benefits. Without VMS as well there is no reduction in accident rates.

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	2	0	28	70	7	1068	2	11	1
80,000	5	1	63	264	23	2164	8	44	2
100,000	13	2	105	633	58	3330	22	103	5
120,000	28	3	150	1041	97	4229	35	169	7
140,000	45	5	184	1579	147	5037	53	253	12
160,000	58	8	209	1781	167	5073	62	286	13
180,000	84	10	237	1972	189	5045	70	316	15

B.2.4 MIDAS

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	2.7	1.5	8.7	160.9	99.6	7685
80,000	3.6	2.0	11.6	214.5	132.8	10247
100,000	4.5	2.5	14.5	268.2	166.0	12809
120,000	5.4	3.0	17.4	321.8	199.2	15370
140,000	6.3	3.5	20.3	375.4	232.4	17932
160,000	7.2	4.0	23.2	429.1	265.6	20494
180,000	8.1	4.5	26.1	482.7	298.8	23055

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	5	1	84	227	22	3058	8	37	2
80,000	15	2	175	725	67	5790	23	117	5
100,000	37	5	279	1741	160	8494	58	283	13
120,000	80	106	381	2906	271	10562	99	470	22
140,000	127	17	458	4567	424	12568	155	738	33
160,000	165	21	515	5245	491	12738	179	844	38
180,000	252	32	597	5907	566	12784	209	951	42

B.2.5 Controlled Motorway + MIDAS

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	5.2	2.9	16.7	308.4	190.9	14730
80,000	6.9	3.8	22.2	411.2	254.5	19640
100,000	8.6	4.8	27.8	514.0	318.2	24549
120,000	10.4	5.8	33.4	616.8	381.8	29461
140,000	12.1	6.7	38.9	719.6	445.4	34370
160,000	13.8	7.7	44.5	822.4	509.1	39280
180,000	15.5	8.6	50.0	925.2	572.7	44189

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	10	2	-15	455	42	1452	15	73	3
80,000	30	3	140	1450	134	8118	48	235	10
100,000	75	10	433	3482	321	20719	117	565	25
120,000	160	20	909	5810	541	44971	197	940	42
140,000	256	33	1790	9134	849	77371	309	1472	65
160,000	331	42	2919	10489	983	113586	359	1688	75
180,000	505	65	4380	11814	1133	155519	418	1897	85

B.2.6 Controlled Motorway, MIDAS already present in DM

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	2.5	1.3	8	147.5	91.3	7045
80,000	3.3	1.7	10.7	196.7	121.7	9393
100,000	4.2	2.2	13.3	245.8	152.2	11742
120,000	5.0	2.6	16.0	295.0	182.6	14090
140,000	5.8	3.0	18.7	344.2	213.0	16438
160,000	6.7	3.5	21.3	393.3	243.5	18788
180,000	7.5	3.9	24.0	442.5	273.9	21135

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	5	1	-99	227	22	-1594	8	37	2
80,000	15	2	-33	729	67	2351	25	117	5
100,000	38	5	154	1748	162	12259	58	286	13
120,000	80	10	529	2916	272	34452	99	473	22
140,000	129	17	1333	4585	426	64855	155	738	33
160,000	167	22	2406	5265	493	1008980	180	848	38
180,000	252	32	3787	5929	568	142789	209	954	43

B.2.7 Controlled Motorway + MIDAS + CCTV

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	5.2	2.9	16.7	308.4	190.9	14730
80,000	6.9	3.8	22.2	411.2	254.5	19640
100,000	8.6	4.8	27.8	514.0	318.2	24549
120,000	10.4	5.8	33.4	616.8	381.8	29461
140,000	12.1	6.7	38.9	719.6	445.4	34370
160,000	13.8	7.7	44.5	822.4	509.1	39280
180,000	15.5	8.6	50.0	925.2	572.7	44189

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	10	2	7	511	47	2283	17	84	5
80,000	33	5	190	1671	154	9846	55	272	12
100,000	87	12	516	4021	371	23438	134	653	28
120,000	185	23	1031	6698	625	48477	227	1086	48
140,000	294	38	1942	10484	974	81606	354	1692	75
160,000	383	48	3093	12010	1125	117889	411	1934	87
180,000	577	74	4582	13497	1295	159829	478	2169	97

B.2.8 Controlled Motorway + CCTV, MIDAS already present in DM

Accident impacts per 10km scheme length (COBA results)

AADT	Opening year	30 year total				
	PIAs saved	Casualties saved			PIAs saved	Benefits (£thousands, 2010 prices discounted to 2010)
		Fatal	Serious	Slight		
60,000	2.5	1.3	8	147.5	91.3	7045
80,000	3.3	1.7	10.7	196.7	121.7	9393
100,000	4.2	2.2	13.3	245.8	152.2	11742
120,000	5.0	2.6	16.0	295.0	182.6	14090
140,000	5.8	3.0	18.7	344.2	213.0	16438
160,000	6.7	3.5	21.3	393.3	243.5	18788
180,000	7.5	3.9	24.0	442.5	273.9	21135

Economy and Greenhouse Gases Impacts (from reduced queuing) per 10km scheme length (MyRIAD results) (£thousands, 2010 prices discounted to 2010, unless otherwise stated)

AADT	Opening year			30 year total					
	User benefits			User benefits			Reduction in indirect tax revenues	Reduction in CO2 emissions	
	Time	VOC	Reliability	Time	VOC	Reliability		Tonnes	£k
60,000	7	1	-77	284	27	-762	10	48	2
80,000	18	2	15	947	87	4077	32	154	7
100,000	48	7	24	2284	211	14978	77	371	17
120,000	105	13	652	3803	354	37954	129	617	27
140,000	167	22	1486	5934	551	69086	201	958	43
160,000	217	28	2580	6784	637	105268	232	1094	48
180,000	326	42	3987	7612	730	147096	269	1222	55

B.3 QUADRO tables

B.3.1 Full closure

Accident impacts per week of night working

AADT	Increase in casualties			Increase in PIAs	Disbenefits (£thousands, 2010 prices discounted to 2010)
	Fatal	Serious	Slight		
60,000	0	0.02	0.11	0.09	22
80,000	0	0.04	0.14	0.12	30
100,000	0	0.04	0.18	0.15	37
120,000	0.01	0.05	0.22	0.18	45
140,000	0.01	0.06	0.25	0.21	52
160,000	0.02	0.07	0.29	0.24	60
180,000	0.02	0.07	0.33	0.27	67

Economy and Greenhouse Gases Impacts per week of night working
(all values £ thousands, 2010 prices discounted to 2010)

AADT	User disbenefits		Reduction in indirect tax revenue	Reduction in CO2 emissions
	Travel time	VOC		
60,000	28	-8	2	-2
80,000	53	-12	3	-3
100,000	79	-15	5	-5
120,000	99	-18	7	-5
140,000	119	-22	8	-7
160,000	142	-27	10	-8
180,000	174	-30	12	-10

B.3.2 Two running lanes open (may include hard shoulder)

Accident impacts per week of night working

AADT	Increase in casualties			Increase in PIAs	Disbenefits (£thousands, 2010 prices discounted to 2010)
	Fatal	Serious	Slight		
60,000	0	0	0.02	0.02	0
80,000	0	0	0.02	0.02	2
100,000	0	0	0.02	0.02	2
120,000	0	0	0.02	0.02	2
140,000	0	0	0.02	0.02	2
160,000	0	0	0.03	0.02	2
180,000	0	0	0.03	0.02	2

Economy and Greenhouse Gases Impacts per week of night working
(all values £ thousands, 2010 prices discounted to 2010)

AADT	User disbenefits		Reduction in indirect tax revenue	Reduction in CO2 emissions
	Travel time	VOC		
60,000	17	-5	2	-2
80,000	22	-7	2	-2
100,000	28	-10	3	-2
120,000	33	-12	3	-3
140,000	40	-13	3	-3
160,000	48	-15	5	-3
180,000	63	-18	5	-5

B.3.3 One running lane open (may include hard shoulder)

Accident impacts per week of night working

AADT	Increase in casualties			Increase in PIAs	Disbenefits (£thousands, 2010 prices discounted to 2010)
	Fatal	Serious	Slight		
60,000	0	0	0.02	0.02	1
80,000	0	0	0.02	0.02	2
100,000	0	0	0.02	0.02	2
120,000	0	0.01	0.04	0.03	7
140,000	0	0.01	0.05	0.04	7
160,000	0	0.02	0.07	0.06	13
180,000	0	0.02	0.09	0.07	15

Economy and Greenhouse Gases Impacts per week of night working
(all values £ thousands, 2010 prices discounted to 2010)

AADT	User disbenefits		Reduction in indirect tax revenue	Reduction in CO2 emissions
	Travel time	VOC		
60,000	22	-7	2	-2
80,000	33	-8	3	-2
100,000	58	-12	3	-3
120,000	69	-15	5	-3
140,000	117	-18	7	-5
160,000	99	-20	7	-5
180,000	145	-25	8	-7

B.4 Incident delay VOC and CO2 emission table

All values are 2010 market prices discounted to 2010, per vehicle hour of queuing time saved.

Year	Vehicle operating cost benefit (pence)	Reduction in indirect tax revenue (pence)	Reduced CO2 impacts	
			grams	pence
2013	196.7	79.4	2463.3	3.4
2014	189.0	76.2	2421.1	3.3
2015	182.6	73.4	2385.9	3.2
2016	175.2	69.8	2333.0	3.1
2017	167.8	66.5	2280.9	2.9
2018	160.8	63.0	2229.9	2.8
2019	153.7	60.0	2180.3	2.7
2020	147.0	56.5	2131.5	2.6
2021	140.5	53.3	2081.6	2.5
2022	134.2	50.3	2032.8	2.4
2023	128.3	47.5	1985.1	2.3
2024	122.6	44.8	1938.4	2.2
2025	117.1	42.1	1893.0	2.1
2026	112.3	40.1	1859.6	2.0
2027	107.8	37.9	1826.9	2.0
2028	103.3	36.1	1794.6	1.9
2029	99.1	34.3	1763.1	1.8
2030	95.1	32.4	1731.9	1.7
2031	91.2	31.2	1721.2	1.8
2032	88.1	29.9	1710.2	1.9
2033	84.9	28.7	1699.6	2.0
2034	81.8	27.6	1688.9	2.0
2035	78.7	26.6	1678.7	2.1
2036	76.0	25.6	1678.7	2.1
2037	73.5	24.7	1678.7	2.1
2038	71.0	23.9	1678.7	2.2
2039	68.5	23.1	1678.7	2.3
2040	66.3	22.2	1678.7	2.3
2041	64.3	21.7	1678.7	2.3
2042	62.5	21.1	1678.7	2.4
2043	60.7	20.4	1678.7	2.4
2044	58.8	19.9	1678.7	2.5
2045	57.1	19.2	1678.7	2.5
2046	55.5	18.7	1678.7	2.5
2047	53.8	18.2	1678.7	2.5
2048	52.3	17.5	1678.7	2.5
2049	50.8	17.0	1678.7	2.5
2050	49.3	16.5	1678.7	2.5

All values are 2010 market prices discounted to 2010, per vehicle hour of queuing time saved.

Annex C Construction Cost Growth and RPI Factors

The following is taken from PAR 6.3.

Year & Quarter	Construction Cost Growth Factor	RPI Factor to 2010
2006 Q2	1	1.1316
2006 Q3	1.0054	1.1219
2006 Q4	1.0088	1.1103
2007 Q1	1.0149	1.1016
2007 Q2	1.0126	1.0839
2007 Q3	1.0228	1.0797
2007 Q4	1.0243	1.0658
2008 Q1	1.0327	1.0593
2008 Q2	1.0273	1.0386
2008 Q3	1.0321	1.0285
2008 Q4	1.0562	1.0375
2009 Q1	1.0562	1.0601
2009 Q2	1.0562	1.0516
2009 Q3	1.0562	1.0427
2009 Q4	1.0562	1.0307
2010 Q1	1.0562	1.0194
2010 Q2	1.0562	1.0002
2010 Q3	1.0562	0.9957
2010 Q4	1.0562	0.9848
2011 Q1	1.0562	0.9681
2011 Q2	1.0562	0.9516
2011 Q3	1.0562	0.9464
2011 Q4	1.0562	0.9369
2012 Q1	1.0562	0.9330
2012 Q2	1.0562	0.9229
2012 Q3	1.0562	0.9168
2012 Q4	1.0562	0.9107
2013 Q1	1.0562	0.9047
2013 Q2	1.0562	0.8986
2013 Q3	1.0562	0.8927
2013 Q4	1.0562	0.8868
2014 Q1	1.0562	0.8809
2014 Q2	1.0562	0.8750
2014 Q3	1.0562	0.8692
2014 Q4	1.0562	0.8635
2015 Q1	1.0562	0.8577
2015 Q2	1.0562	0.8520
2015 Q3	1.0562	0.8464
2015 Q4	1.0562	0.8408
2016 Q1	1.0562	0.8352
2016 Q2	1.0562	0.8296
2016 Q3	1.0562	0.8241
2016 Q4	1.0562	0.8187
2017 Q1	1.0562	0.8132
2017 Q2	1.0562	0.8078
2017 Q3	1.0562	0.8025
2017 Q4	1.0562	0.7972

Annex D Capitalisation Factors for Maintenance Costs

The following is taken from PAR 6.3.

Capitalisation factors[1] for assessment periods[2]				
5 years	**10 years**	**20 years**	**30 years**	**60 years**
4.9	9.6	18.2	25.8	45.7

[1] Based on a 3.5 discount rate and a 2010 base year

[2] These are applicable for all opening years