Model Auditing Process

Version 3.5

Overview

Management System Document - Procedure

Model Auditing Process (MAP) Overview – Traffic Schemes in London Urban Networks

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1 Introduction to the Model Auditing Process

Clients of traffic schemes will usually commission an external expert to undertake traffic modelling. There is therefore a need for the client to audit such models to confirm they are fit for purpose. Traffic model development is a complex task that can be completed in a variety of ways, and the process of auditing a model can also therefore be challenging.

The Model Auditing Process (MAP) has been created by Transport for London (TfL) to simplify this process by providing a transparent and structured framework which leads all interested parties through model development, submission and auditing. Following this process should aid effective communications between those involved, resulting in efficient and streamlined progress towards model approval.

The purpose of this document is to explain MAP to all the parties involved and provide them with the necessary documents and guidance for submitting traffic modelling to TfL, at the detailed design stage, for auditing.

1.1 Traffic Management Act

The Traffic Management Act (TMA) was introduced in 2004 to control congestion and disruption on the road network. The Act places a duty on local traffic authorities to ensure the expeditious movement of traffic on their or adjacent road networks through the appointment of a Traffic Manager.

Transport for London has traffic management responsibilities for the Transport for London Road Network (TLRN) and the Strategic Road Network (SRN). Other parts of London's road network are managed by the London Boroughs and Highways England.

Under the TMA, the Traffic Manager has a Network Management Duty (NMD). Within TfL, the Road Space Management Operations Team (RSM-Operations) work on behalf of the Traffic Manager to ensure that the NMD has been fully complied with in the development, design and implementation of highway and traffic proposals impacting on London's major roads - the SRN and TLRN.

Part of the NMD is to ensure the best possible movement of all modes of transport at signal-controlled junctions in the network. The modes of transport that need to be considered are, in alphabetical order: cyclists, pedestrians, private vehicles (including freight) and public vehicles (including taxis).

Modelling can be a powerful tool in understanding the potential traffic impacts of proposals if used in an appropriate way. It can also enable strategies to be developed to mitigate adverse impacts.

TfL provides independent technical support to scheme promoters, in the form of a Scheme Impact Assessment Report (SIAR), previously the Traffic Scheme Supplmentary Report (TSSR), to enable Surface Transport to make informed decisions when executing this part of the NMD. Paramount in any decision is whether the

scheme has a detrimental impact on average pedestrian maximum wait times or bus journey times.

1.2 MAP Applicability

MAP applies in all circumstances where RSM-Operations require traffic modelling to assess impact on the TLRN or SRN. However, where a Borough is the promoter of a scheme that does not impact on the TLRN or the SRN the use of MAP is advisory. All traffic models commissioned by and submitted to TfL are audited in accordance with MAP.

1.3 MAP and the TfL Traffic Modelling Guidelines

The TfL Traffic Modelling Guidelines and MAP are complementary. As illustrated within Figure 1 they provide a framework to deliver the modelling quality required by TfL for both base and proposed models from scheme consideration through to a detailed design.

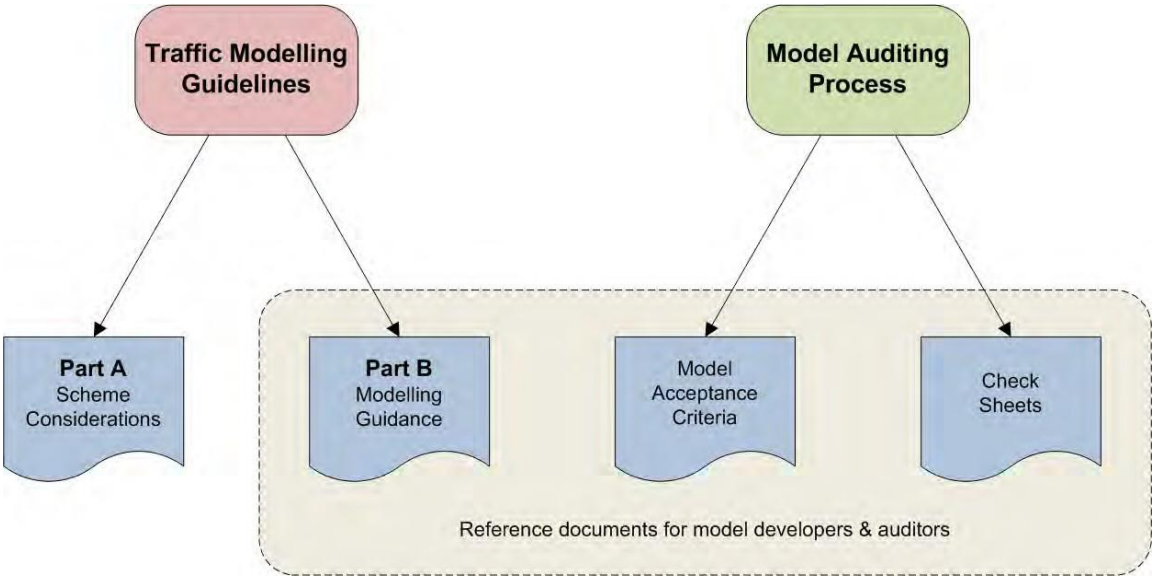


Figure 1 : The traffic modelling support provided by TfL through MAP.

MAP defines the standards expected for all modelling submitted for TfL-sponsored schemes. The TfL Traffic Modelling Guidelines indicate recommended 'Best Practice' relating to the approach and methodology of model development in order to reach those standards. In this context MAP provides a structural procedure for auditing models against software-specific modelling standards prior to further phases of development. The TfL Traffic Modelling Guidelines provide overarching guidance on approaches which may be adopted to efficiently meet the standards defined by MAP.

MAP requires modellers and auditors to communicate at early stages of model development, to ensure a positive outcome within the modelling process. While TfL will audit the final scheme models and prepare the SIAR, scheme sponsors and their

agents have a responsibility to ensure that all scheme models meet the requirements set out within MAP. For this reason the Traffic Modelling Guidelines work alongside MAP to provide practical advice on the choice of modelling software and how to maximise the efficiency of the scheme design process for each tool (see Figure 2).

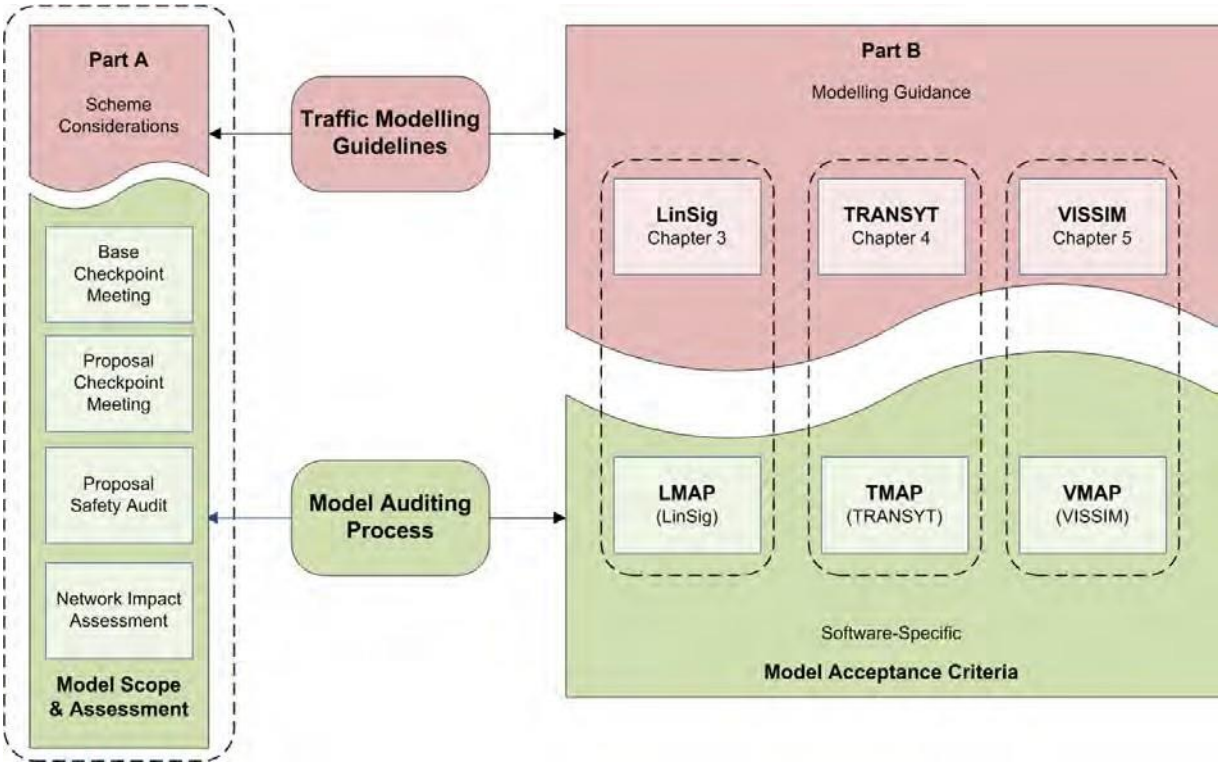


Figure 2: The detailed association between the guidance provided within the TfL Traffic Modelling Guidelines and MAP[I] .

1.4 Fit for Purpose Modelling

The level of detail and the accuracy of a model must reflect the purpose for which the model is intended. The objectives of a scheme will directly influence the type and purpose of any prerequisite modelling and what software will provide the most appropriate comparative data. These will be agreed during MAP Stage 1 to define what modelling will be deemed 'fit for purpose' to assess the proposed design.

For a specific scheme a model may pass through a number of development phases, and at each subsequent stage the required level of detail and modelling accuracy increases. Common stages of development can be expressed as; study phase, business case support, option testing, developing preferred option and scheme approval. MAP formally applies to the final approval stage of the process but TfL may be engaged during previous design phases within MAP Stage 1 as described in section 2.3.

[I] Guidance for Aimsun will be included in TfL Traffic Modelling Guidelines version 4.

1.5 Reference Documents

Document Number	Title
SQA-0507	Guidance Note: Traffic Modelling Guidelines – TfL Traffic Manager and Outcome Delivery Best Practice
SQA-0685	MAP Engineer Guide for DE, CE & MAE
SQA-0544	Model Auditing Process – Stage 1 Check Sheet
SQA-8670	Aimsun Model Auditing Process – Stage 2a Check Sheet
SQA-8671	Aimsun Model Auditing Process – Stage 2b Check Sheet
SQA-8672	Aimsun Model Auditing Process – Stage 3 Check Sheet
SQA-8673	Aimsun Model Auditing Process – Stage 4 Check Sheet
SQA-8674	Aimsun Model Auditing Process – Stage 5 Check Sheet
SQA-0545	LinSig Model Auditing Process – Stage 2 Check Sheet
SQA-0546	LinSig Model Auditing Process – Stage 3 Check Sheet
SQA-8675	LinSig Model Auditing Process – Stage 4 Check Sheet
SQA-0547	LinSig Model Auditing Process – Stage 5 Check Sheet
SQA-0523	TRANSYT Model Auditing Process – Stage 2 Check Sheet
SQA-0524	TRANSYT Model Auditing Process – Stage 3 Check Sheet
SQA-8676	TRANSYT Model Auditing Process – Stage 4 Check Sheet
SQA-0525	TRANSYT Model Auditing Process – Stage 5 Check Sheet
SQA-0526	Vissim Model Auditing Process – Stage 2a Check Sheet
SQA-0527	Vissim Model Auditing Process – Stage 2b Check Sheet
SQA-0528	Vissim Model Auditing Process – Stage 3 Check Sheet
SQA-8677	Vissim Model Auditing Process – Stage 4 Check Sheet
SQA-0529	Vissim Model Auditing Process – Stage 5 Check Sheet
SQA-0530	MAP Stage 5 SQA-0640 Compliance Check Sheet
SQA-0448	TfL Signal Design Review Sheet
SQA-0640	Policy, Standards and Guidance to Procedures for the Design of Traffic Signals
SQA-8569	Scheme Impact Assessment Report

2 MAP Overview and Involved Parties

There are six stages to a MAP submission:

Stage 1 : Scheme & Network Scope Meeting (Base Models);
Stage 2: Calibrated Base Model Submission;
Stage 3: Validated Base Models Submission;
Stage 4: Proposed Models Checkpoint Meeting;
Stage 5: Proposed Models Submission; and
Stage 6: Submission of Scheme Impact Assessment Report (SIAR).

The parties involved in these MAP Stages are described in Table 1 along with a basic description of the role.

Table 1 : Task description for the different parties involved in MAP.

Role	Title	Description
Promoter	P	The person responsible for delivering and project managing the proposal.
Design Engineer	DE	The engineer responsible for creating the modelling for the Promoter.
Checking Engineer	CE	The engineer responsible for checking and signing off the Design Engineer's work as fit-for-purpose for the Promoter.
TfL Signals Auditing Engineer	SAE	The engineer responsible for checking and safety approving the Proposal.
TfL Model Auditing Engineer	MAE	The engineer responsible for auditing the modelling and assessing the network impact of the scheme.
TfL Network Assurance Engineer	NAE	The RSM-Operations engineer responsible for assessment, then approval/rejection of the Promoter's proposal (under the TMA).

Lack of experience on behalf of the Design Engineer (DE) is a common reason for modelling to not successfully pass through scheme audit. The scheme Promoter (P) is advised to ensure that the person(s) engaged to develop the modelling related to any scheme meet the following requirements:

- Considerable modelling experience with relevant software;
- Considerable experience in on-site data collection of traffic control parameters identified in the TfL Traffic Modelling Guidelines, including saturation flows, degrees of saturation, lane utilisation identification and measurement of Underutilised Green Time;
- A good understanding of the capabilities of microprocessor-based controllers, particularly with respect to interstage design and phase delays; and
- Experience of modelling microprocessor-based controllers using modelling products such as LinSig.

The skills outlined above should also exist at a senior (i.e. Checking Engineer) level for preliminary auditing prior to delivery of any traffic modelling within MAP.

2.1 Software-Specific MAP

MAP is designed to give a common structure for all model submissions. However, for different software types an auditor will apply distinct criteria during MAP Stages 2, 3 and 5 when assessing the quality of the traffic modelling. MAP is therefore currently available for the four most common traffic modelling packages used for scheme appraisal within TfL:

- Aimsun Model Auditing Process (AMAP) – see section 4.
- LinSig Model Auditing Process (LMAP) – see section 5.
- TRANSYT Model Auditing Process (TMAP) – see section 6.
- Vissim Model Auditing Process (VMAP) – see section 7.

2.2 Scheme Progression through MAP

The following section contains an idealised representation of each party's involvement during the progression of MAP.

In summary, the P engages a DE to develop traffic modelling for their proposed scheme. The traffic modelling is internally assessed by a Checking Engineer (CE), before being submitted to the Model Auditing Engineer (MAE) for auditing.

Standardised check sheets are used for communication between the DE, MAE and SAE during MAP Stages 1 to 5.

2.3 MAP Stage 1

On initiation of the modelling works for a scheme, the P or his/her representative sets up a Scheme & Network Scope Meeting with all parties listed in Table 1 . This meeting discusses the scheme, and the modelling work that is required for both base and proposed modelling stages.

It is recommended that Stage 1 meetings occur prior to the scheme detailed design being developed. This is to ensure that all TfL knowledge and requirements are known

to the P and DE prior to development of the scheme. It provides an opportunity for the DE to record details for future submission and to ensure all parties understand their roles and responsibilities within MAP.

Agreed details of the modelling works and notes from the Stage 1 meeting are to be compiled by the DE and distributed to all parties. The MAE will then verify the contents to ensure all relevant information has been placed on record for future reference. If there are incomplete checks the MAE will contact the DE, as a representative of the P, for further information.

A Modelling Expectations Document (MED), which summarises the agreed modelling requirements, is to be produced by the MAE with contributions from the P, DE and SAE. A template to assist the MAE in producing an MED is available if required. A submission cannot progress onto the software-specific MAP Stage 2 without a completed MAP Stage 1 check sheet (SQA-0544) and MED.

2.4 MAP Stage 2

For LMAP and TMAP, a single calibrated base model is prepared by the DE. For AMAP and VMAP, the DE prepares a single, non time-specific skeleton base model submission for Stage 2a, and a calibrated Aimsun/Vissim base model submission for all time periods for Stage 2b. For AMAP, LMAP, TMAP and VMAP the modelling should be assessed by the CE, and signed off as fit for purpose by both the DE and CE prior to submission to TfL.

The fit for purpose modelling is then submitted to TfL for audit by the MAE. The MAE will then accept or reject the submission based upon known criteria. If a submission is rejected it will be returned to both the P and DE, with MAP Stage 2 check sheets indicating required areas of further development. In instances where models are rejected at this stage, the DE and MAE will liaise to ensure the MAE is satisfied with the standard of resubmitted models.

2.5 MAP Stage 3

Validated base models for each time period under consideration should be prepared by the DE, authorised by the CE and signed off by both using the MAP Stage 3 check sheet. A check sheet should be provided for each base model during MAP Stage 3.

The models and check sheets are then submitted to TfL for audit by the MAE. The MAE will then accept or reject the models. In instances where models are rejected at this stage, the DE and MAE should liaise to ensure the MAE can become satisfied with the standard of the model development in order to accept the modelling as validated and thus fit for purpose.

2.6 MAP Stage 4

Following approval of the base models within MAP Stage 3, the P, or his/her representative, should set up a meeting with all parties listed in Table 1 on page 8. The meeting should continue from details documented in Stage 1, and shall discuss the scheme proposals and accordingly, the requirements for the proposed models (if different to those identified in Stage 1). At this stage the proposed model outputs should be discussed with specific reference to an agreed strategy for signal timing optimisation, and the optional provision of usable controller signal timing plans. The DE and CE can reference the TfL Traffic Modelling Guidelines for further information on proposed model optimisation.

Minutes of the Stage 4 meeting, and agreed details of the modelling works, are to be compiled by the DE and distributed to all parties listed in Table 1. The MED is to be updated where necessary and the Stage 4 check sheet completed by the DE and MAE.

2.7 MAP Stage 5

The DE will submit proposed method of control changes that are compliant with SQA-0640[2]. These will be accompanied by a MAP Stage 5 SQA-0640 Compliance check sheet (SQA-0530) to the TfL Signal Auditing Engineer (SAE) for all junctions affected within the scheme.

The SAE will assess changes to junction design using information contained within SQA-0448[3]. Where the proposals meet TfL standards the SAE will submit the MAP Stage 5 SQA-0640 Compliance check sheet to the P/DE and MAE, thus authorising the design and allowing progression into MAP Stage 5. The MAE cannot undertake a MAP Stage 5 audit without a completed SQA-0640 Compliance check sheet.

Proposed models (based on the validated base models approved during MAP Stage 3) for each time period under consideration are prepared by the DE, endorsed by the CE, and signed off by both parties as fit for purpose. These models and accompanying MAP Stage 5 check sheets are then submitted to TfL for audit by the MAE. A software-specific check sheet should be used for <u>each</u> proposed model.

In instances where models are rejected at this stage, the DE and MAE will liaise to encourage development of fit for purpose modelling. This will ensure the MAE is satisfied with the standard of the models and can accept them for assessment.

2.8 MAP Stage 6

The P will prepare a partially completed SIAR with help from the DE, and submit this to TfL. The MAE and SAE will complete their respective components of the SIAR and return it to the P.

[2] Policy, Standards and Guidance to Procedures for the Design of Traffic Signals, Specification SQA-0640, Issue 1, Asset Management Directorate, Transport for London, 2016.
[3] TfL Signal Design Review Sheet, Specification SQA-0448, Issue 6, Transport for London, 2013.

The P can respond to both TfL auditors to discuss any issues they may have with the content of the SIAR and, at the auditors' discretion, amendments can be made prior to closure.

The MAP is completed when the P submits the SIAR to RSM-Operations.

It is possible, but not common, that the P will choose not to submit the proposal to RSM-Operations. If this is the case, it is recommended that the P or DE provides written confirmation to the MAE and SAE stating that the proposal has completed MAP Stage 6 and that no further work is required.

If the proposals are to be submitted at a later date, this date should be no later than two years after the completion of the initial MAP. If a submission is delayed the road network should be reviewed by the DE and MAE to ensure that the network has not undergone major changes prior to submission of the SIAR.

2.9 Communication

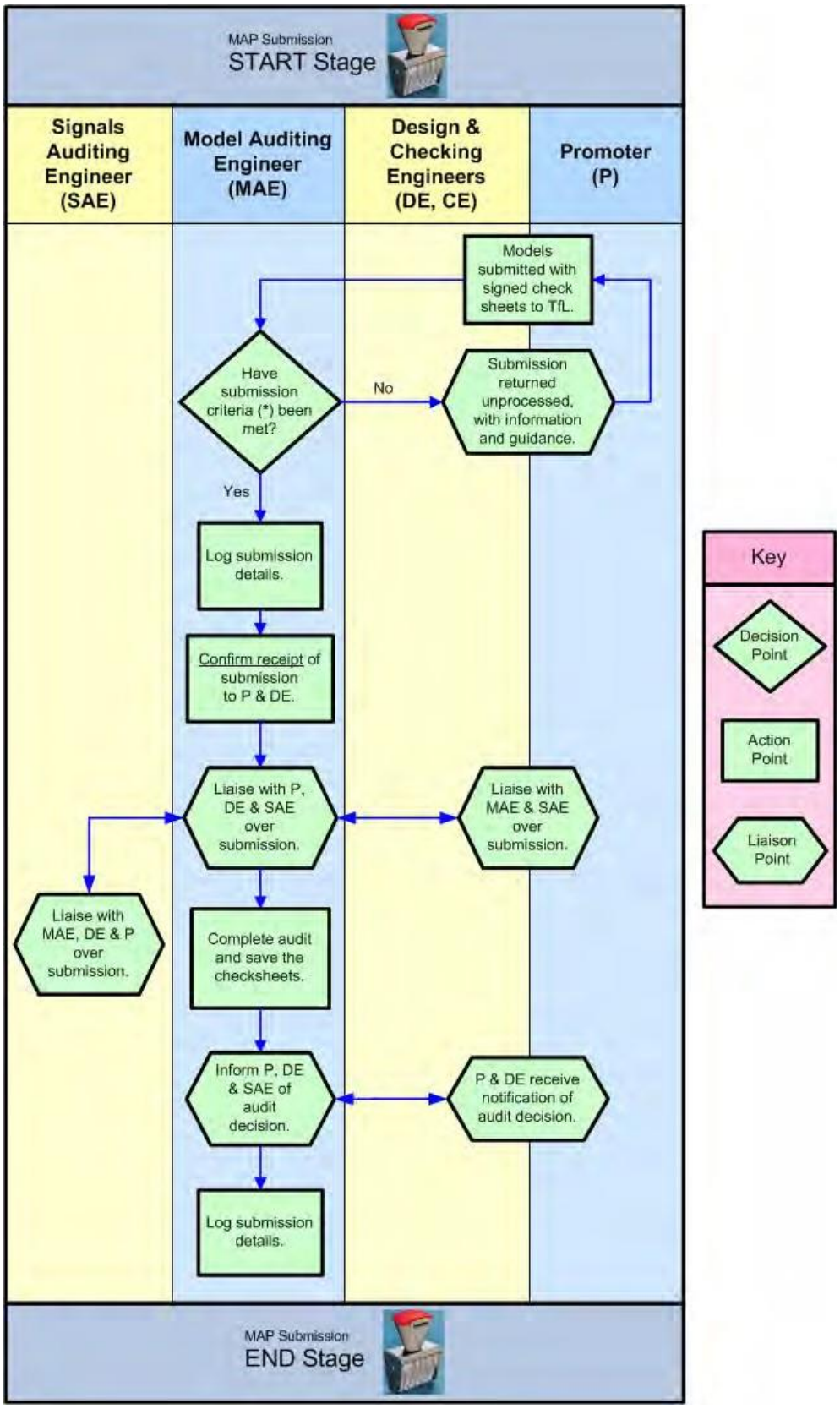
Formal submissions at all MAP stages should be sent to the following email address: RSMSchemeAssessments@tfl.gov.uk. Formal responses from the MAE and SAE will also be copied to this address. Failure to formally submit modelling works at all stages of MAP may result in delays in progress of the model audit.

The P, DE and CE are positively encouraged to contact the MAE to clarify any issues relating to MAP, their role responsibilities, stage submission requirements or check sheets (as detailed in section 4 for AMAP, section 5 for LMAP, section 6 for TMAP and section 7 for VMAP).

2.10 Submission Process

Information and traffic model submissions are required during three of the six MAP stages outlined in section 2.2.

Whilst each MAP stage has individual auditing requirements, a uniform administration process is used to handle the information submissions associated with each stage, as illustrated in Figure 3. This outlines key points for decision, liaison and action for all interested parties following a complete MAP. Figure 4 shows the acceptance criteria which determine whether a TfL auditor will complete a MAP stage for the submission.



(*) – Submission criteria shown in Figure 4

Figure 3: Submission process associated with MAP.

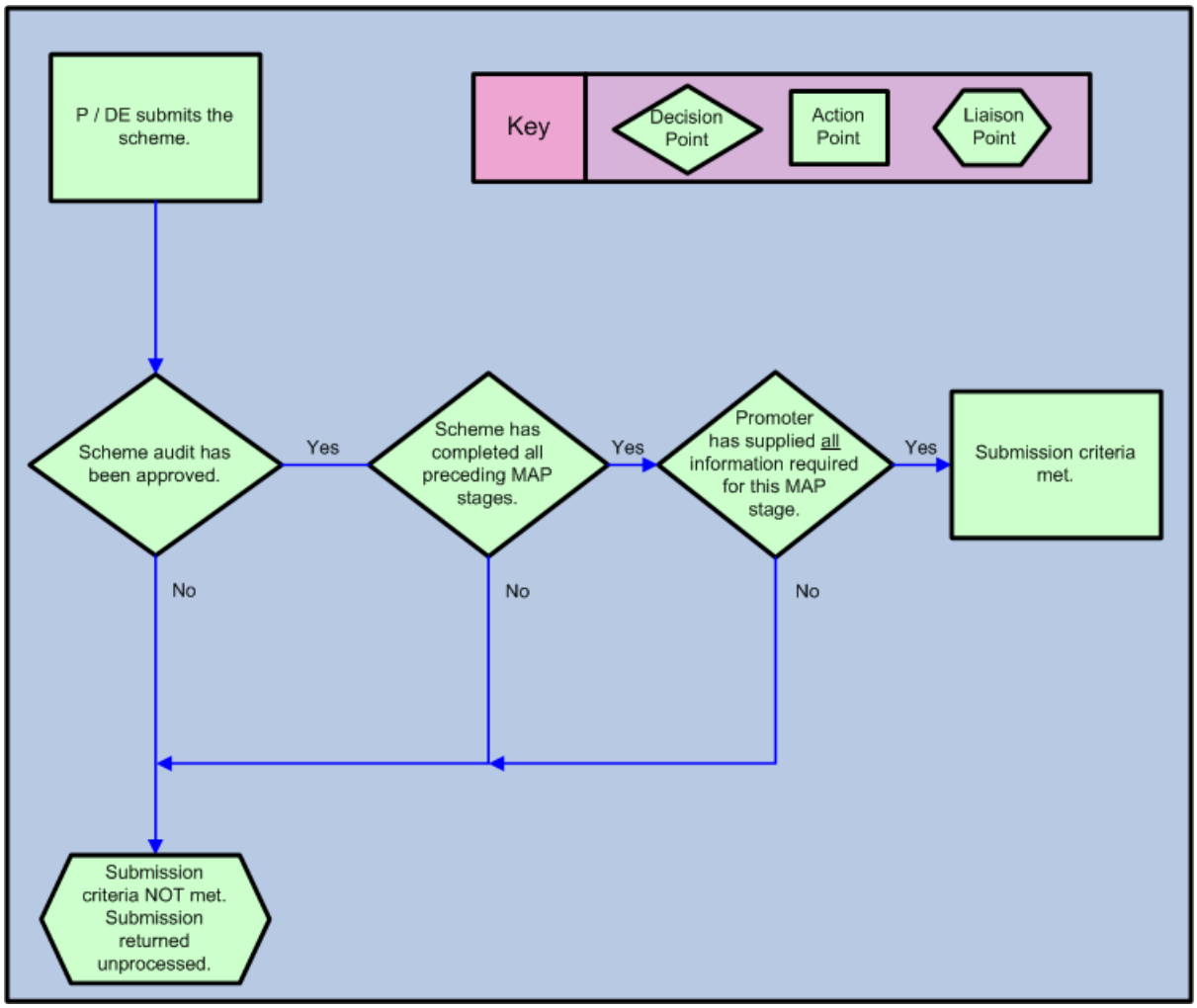


Figure 4: Criteria for accepting MAP submissions.

3 Generic MAP Stages

MAP is structured to include non-software-specific stages at the onset (Stage 1) and completion (Stage 6) of the scheme design and approval process (see Figure 5).

These stages are software independent because they collate information from several streams to both determine the overall purpose of the scheme and finally to assess whether that purpose has been satisfied within the proposed design.

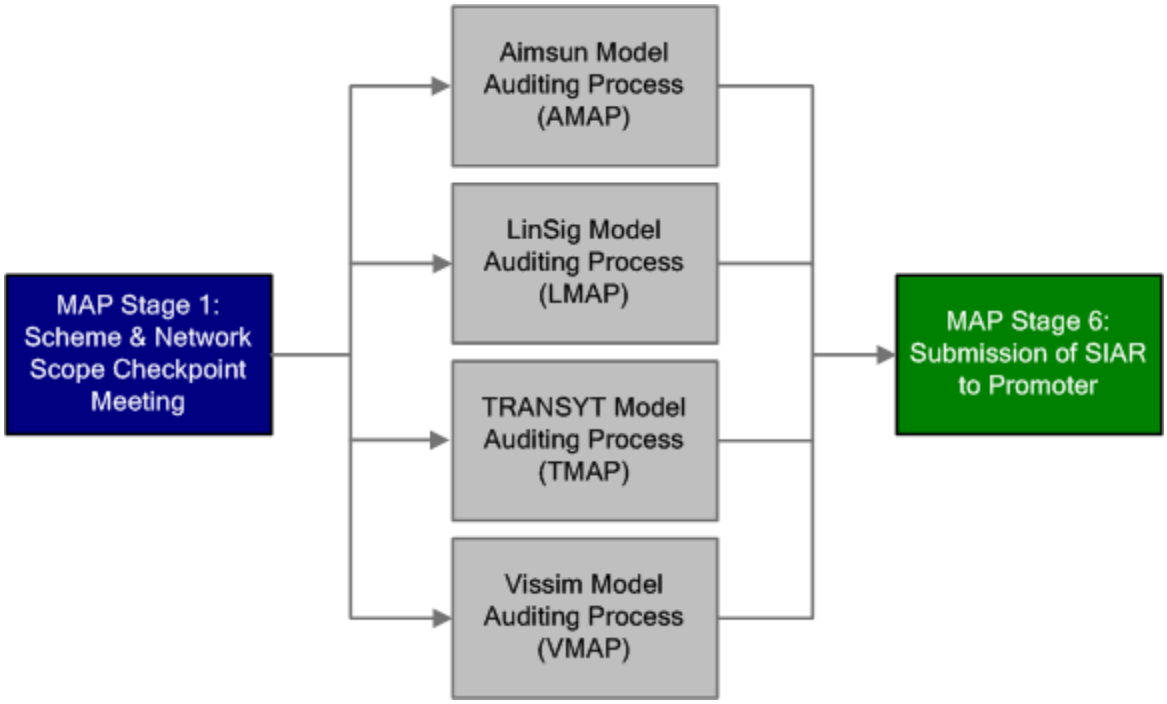


Figure 5: Software-independent stages within MAP.

The roles and responsibilities of MAP participants within these software-independent stages are summarised in Table 2 and Table 3. A formal check sheet (SQA-0544) and the MED are retained after the completion of MAP Stage 1 to provide a benchmark for discussions during MAP Stage 4. An SIAR is produced during MAP Stage 6 and the process is declared complete when the P submits the SIAR to RSM-Operations.

Table 2: TfL Model Auditing Process (MAP) Summary Sheet - Stage 1 .

MAP Stage 1 - Scheme & Network Scope Meeting		
Roles		Key Responsibilities
Promoter Representatives	P	1 . Attend meeting to understand the process, roles, and responsibilities under MAP. 2. Agree MED content with the MAE.
	DE	1 . In conjunction and with agreement of P/SAE/MAE, compile a Baseline List of all TfL-referenced junctions for which there are proposals affecting the Method of Control and/or the road layout. 2. In conjunction and with agreement of the P/SAE/MAE, compose a Baseline List of all TfL-referenced junctions which are to be included in the Network as the 'Study Area'. 3. In conjunction and with agreement of the P/SAE/MAE, document the software version to be used for modelling and whether controller-compliant timings are a required output. 4. Formally submit the 'Fit for Purpose Statement' for each Base Model and the agreed details of the scheme/modelling, as set out above, to P/SAE/MAE. 5. Agree MED content with the MAE. 6. Formally submit the DE-signed MAP Stage 1 check sheet (SQA-0544) to the P/MAE.
	CE	None.
TfL Representatives	SAE	1 . Agree and obtain the DE-created Baseline List of all TfL-referenced junctions for which there are proposals affecting the Method of Control and/or the road layout. 2. Agree MED content with the MAE.
	MAE	1 . In conjunction and with agreement of P/SAE/DE, compile a Baseline List of all TfL-referenced junctions for which there are proposals affecting the Method of Control and/or the road layout. 2. In conjunction and with agreement of the P/SAE/DE, compose a Baseline List of all TfL-referenced junctions which are to be included in the Network as the 'Study Area'. 3. In conjunction and with agreement of the P/SAE/DE, document the software version to be used for modelling and whether controller compliant timings are a required output. 4. In conjunction and with agreement of the P/SAE/DE write the 'Purpose Statement' for each Base Model and the agreed details of the scheme/modelling. 5. Produce the MED with input and agreement from the P/SAE/DE. 6. Complete the MAE section of the MAP Stage 1 check sheet (SQA-0544).
	NAE	Attend meeting to understand the process, roles, and responsibilities under MAP.

Table 3: TfL Model Auditing Process (MAP) Summary Sheet - Stage 6.

MAP Stage 6 – Submission of SIAR		
Roles		Key Responsibilities
Promoter Representatives	P	1. Complete relevant sections within the SIAR with help from the DE. 2. Formally submit the partially completed SIAR to SAE/MAE. 3. Liaise with the SAE/MAE to receive the completed SIAR. 4. Decide whether to submit the Proposal to RSM-Operations.
	DE	1. Assist P in development of partially completed SIAR. Include all model output tables required. 2. Contact the SAE and/or MAE if you have any queries, need further clarification or disagree with the contents of the completed SIAR received from the SAE/MAE (NB these issues are ideally resolved through discussion prior to the writing of the report).
	CE	None.
TfL Representatives	SAE	1. Complete the relevant sections of the SIAR. 2. Agree SIAR content with the MAE. 3. Liaise with the P/DE/MAE should they have any queries, need clarification or disagree with the contents of the SIAR.
	MAE	1. Complete the relevant sections of the SIAR. 2. Agree SIAR content with the SAE. 3. Liaise with the P/DE/SAE should they have any queries, need clarification or disagree with the contents of the SIAR. 4. Submit the completed SIAR back to P/DE/SAE.
	NAE	None.

4 Aimsun MODEL AUDITING PROCESS (AMAP)

An overview of AMAP is given in Figure 6, identifying the seven AMAP stages and the intermediate sequence of events that occur during the auditing process. This includes when formal meetings between MAP parties should occur, when model submissions should be made and what criteria need to be met before proceeding to the next MAP stage.

The roles and responsibilities of all AMAP participants are summarised in Table 4 to Table 7.

Formal check sheets are submitted at the end of all MAP Stages. Stages 1 and 4 are considered complete when the P and DE have received a signed and dated check sheet from the MAE. Stages 2a, 2b, 3 and 5 are considered complete when the relevant check sheets are signed as "Accepted" by the MAE. The version of the model to which an "Accepted" sheet applies is the only one admissible as part of AMAP. If for any reason modelling for a particular stage has to be amended, it will have to be fully re-submitted at that stage of the process and a new check sheet signed as "Accepted".

Signed copies of the completed check sheets and the "MAP Stage 5 SQA-0640 Compliance Sheet(s)" (SQA-0530) will be scanned and archived by TfL for Quality Assurance (QA) purposes. This provides a reference for the MAE when auditing the signal control data in the DE's models.

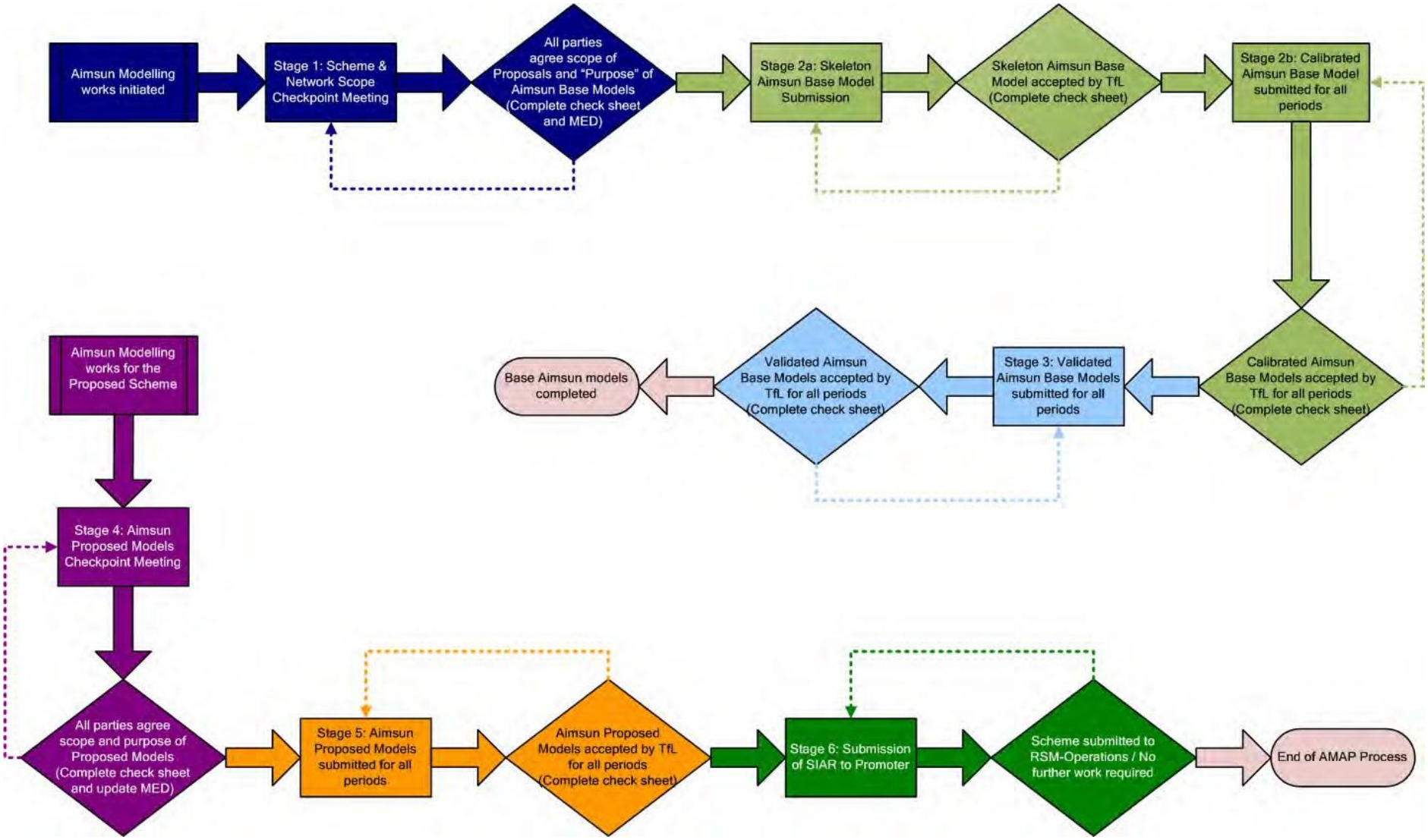


Figure 6: TfL Aimsun Model Auditing Process (AMAP) Flow Chart.

Table 4: TfL Aimsun Model Auditing Process (AMAP) Summary Sheet - Stage 2a (Skeleton Model) & Stage 2b (Calibrated Model).

AMAP Stage 2a Skeleton & 2b Calibrated Aimsun Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Aimsun modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Build Skeleton Aimsun Base Model. 2. Complete the DE section of the AMAP Stage 2a check sheet (SQA-8670) and provide to the CE. 1. Formally submit the Skeleton Aimsun Base Model (with the DE & CE-signed AMAP Stage 2a check sheet) to the P/MAE. 3. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the AMAP Stage 2a check sheet. 4. Develop Calibrated Aimsun Base Models for all time periods based on the "Accepted" Skeleton Model. 5. Complete the DE section of the AMAP Stage 2b check sheet (SQA-8671, one for each time period under consideration) and provide to the CE. 6. Formally submit the Calibrated Aimsun Base Models (with the DE & CE-signed AMAP Stage 2b check sheet) to the P/MAE. 7. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the AMAP Stage 2b check sheet.
	CE	1. Audit the Skeleton/Calibrated Aimsun Base Models submitted by the DE. 2. Complete, sign and return the AMAP Stage 2a Skeleton (SQA-8670) or 2b Calibrated Aimsun Base Model (SQA-8671) submission check sheets to the DE. 3. Audit any further models in the event of the original submissions being "Rejected" by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Skeleton and Calibrated Aimsun Base Models. 2. Complete the MAE's part of the "AMAP Stage 2a (SQA-8670) and AMAP Stage 2b (SQA-8671) check sheets". 3. Send completed check sheet to P/DE with an "Accepted" or "Rejected". 4. Carry out any further auditing work in the event of a "Rejected" model, until you can return an "Accepted" Check Sheet.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table 5: TfL Aimsun Model Auditing Process (AMAP) Summary Sheet - Stage 3.

AMAP Stage 3 – Validated Aimsun Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Aimsun modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Develop Validated Aimsun Base Models for all time periods derived from the accepted AMAP Stage 2b Calibrated Aimsun Base Model. 2. Complete the DE section of the AMAP Stage 3 check sheet (SQA-8672, one for each time period under consideration) and provide to the CE. 3. Formally submit the Validated Aimsun Base Models (with the DE & CE-signed AMAP Stage 3 check sheet) to the P/MAE. 4. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the AMAP Stage 3 check sheets.
	CE	1. Audit the Validated Aimsun Base Model for each time period prior to submission by the DE. 2. Complete, sign and return the AMAP Stage 3 check sheet (SQA-8672) to the DE. 3. Assess any further iterations of the model in the event of the submission being "Rejected" by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Validated Aimsun Base Model for each time period. 2. Complete the MAE section of the AMAP stage 3 check sheet (SQA-8672). 3. Send completed Check Sheet to P/DE with an "Accepted" or "Rejected". 4. Conduct further audits on a rejected model, proceed until you can return an accepted AMAP Stage 3 check sheet. 5. Upload the approved base models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table 6: TfL Aimsun Model Auditing Process (AMAP) Summary Sheet - Stage 4.

AMAP Stage 4 – Aimsun Proposed Model Meeting		
Roles		Key Responsibilities
Promoter Representatives	P	Attend meeting to confirm the scope of the proposals as discussed during MAP Stage 1 . Confirm understanding that the MAE will not begin any audit until the SAE has completed a Signal Safety Audit of the proposals.
	DE	1 . In conjunction with and agreement of the P/SAE/MAE, produce a statement detailing the scope for each of the Aimsun Proposed Models. 2. In conjunction with and agreement of the P/SAE/MAE, supply a record of the work requiring completion prior to submission of the Aimsun Proposed Models. 3. In conjunction and agreement with the P/SAE, agree when proposals will be submitted for SAE Signal Safety Audit. Confirm understanding that the MAE will not begin an audit until completion of the SAE Signal Safety Audit. 4. Formally submit the final 'Purpose Statement' derived from MAP Stage 1 and the agreed details of the scheme/modelling, as set out above, to P/SAE/MAE. 5. Complete the DE's section of the AMAP Stage 4 check sheet (SQA-8673).
	CE	None.
TfL Representatives	SAE	Obtain the DE-created submission dates for all junctions in the Baseline List agreed in MAP Stage 1 in order to conduct Signals Safety Audit.
	MAE	1 . Obtain and agree the DE-created statement detailing the 'Purpose' for each of the Aimsun Proposed Models. 2. Obtain and agree the DE-created record of the work required, prior to submission of the Aimsun Proposed Models. 3. Confirm that the P/DE understand an audit will not begin until the SAE has completed a Signal Safety Audit of the proposals. 4. Review/update the MED. 5. Complete the MAE section of the AMAP Stage 4 check sheet (SQA-8673).
	NAE	Attend meeting to agree the scope of the proposals as previously discussed during MAP Stage 1 .

Table 7: TfL Aimsun Model Auditing Process (AMAP) Summary Sheet - Stage 5.

AMAP Stage 5 – Aimsun Proposed Models Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Aimsun modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions.
	DE	1. Formally submit the proposed Method of Control changes to the P/SAE for auditing and approval, using the MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530). 2. Obtain the approved MAP Stage 5 SQA-0640 Compliance Check Sheet sheets from the SAE. 3. Develop Aimsun Proposed Models for all periods based on "Accepted" AMAP Stage 3 Validated Aimsun Base Models. 4. Complete the DE's section of the AMAP Stage 5 check sheet (SQA-8674, one for each time period under consideration) and provide to CE. 5. Formally submit the DE & CE-signed AMAP Stage 5 check sheet to the P/MAE. 6. Complete modelling work as required by the MAE in the event of the submission being rejected until it is accepted, as documented in the AMAP Stage 5 check sheet.
	CE	1. Audit the Aimsun Proposed Model for each time period prior to submission by the DE. 2. Complete, sign and return the AMAP Stage 5 check sheet (SQA-8674) to the DE. 3. Assess any further iterations of the model in the event of the submission being rejected by the MAE.
TfL Representatives	SAE	1. Audit SQA-0640 compliance for each method of control change within the scheme. 2. Complete, sign and return a MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each method of control change within the scheme to the DE/MAE. 3. Indicate to the MAE that the proposals are SQA-0640 compliant and submitted modelling may be audited within AMAP Stage 5.
	MAE	1. Obtain a SAE-signed MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each scheme method of control change. 2. Audit DE-submitted Aimsun Proposed Models. 3. Complete the MAE section of the AMAP Stage 5 check sheet (SQA-8674, one for each time period under consideration). 4. Send completed AMAP Stage 5 check sheet to P/DE. 5. Conduct further audits on a rejected model and proceed until you can return an accepted AMAP Stage 5 check sheet. 6. Upload the approved proposed models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

5 LinSig MODEL AUDITING PROCESS (LMAP)

An overview of LMAP is provided within Figure 7, which identifies the six MAP stages and the intermediate sequence of events that occur during the auditing process.

LMAP will only be applied to models where LinSig has been applied to simulate networks using multiple traffic signal controllers.

Figure 7 illustrates when formal meetings between MAP parties should occur, when model submissions should be made and what criteria should be met before proceeding to the next LMAP stage.

The roles and responsibilities of LMAP participants are summarised below in Table 8 to Table 11 .

Formal check sheets are submitted at the end of all MAP Stages. Stages 1 and 4 are considered complete when the P and DE have received a signed and dated check sheet from the MAE. Stages 2, 3 and 5 are considered complete when the relevant check sheets are signed as "Accepted" by the MAE. The version of the model to which an "Accepted" sheet applies is the only one admissible as part of LMAP. If for any reason modelling for a particular stage has to be amended, it will have to be fully re-submitted at that stage of the process and a new check sheet signed as "Accepted" by the MAE.

Signed copies of the completed check sheets and the MAP Stage 5 SQA-0640 Compliance Sheet(s) (SQA-0530) will be scanned and archived by TfL for quality assurance purposes. This provides a reference for the MAE when auditing the signal control data in any accompanying traffic models.

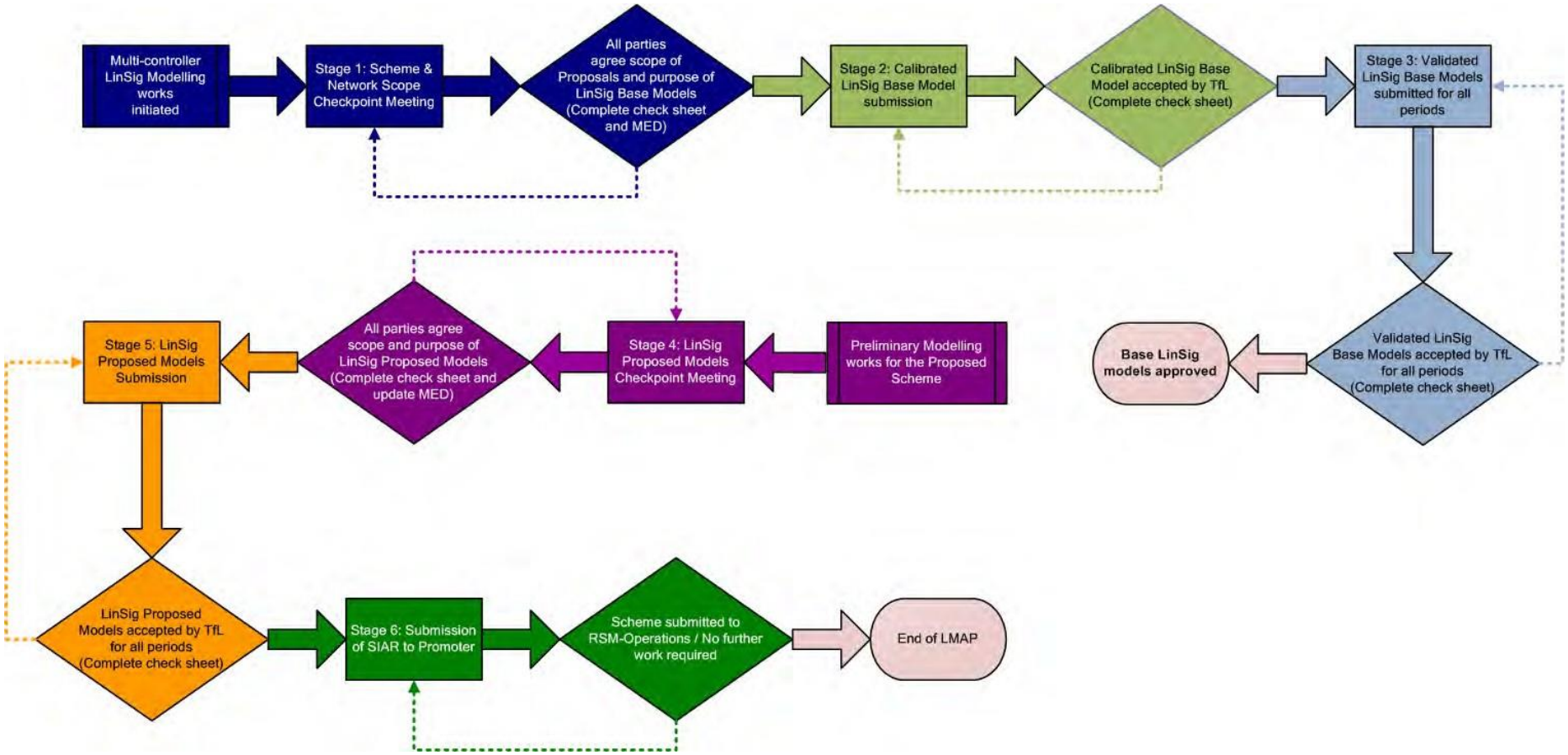


Figure 7: TfL LinSig Model Auditing Process (LMAP) Flow Chart.

Table 8: TfL LinSig Model Auditing Process (LMAP) Summary Sheet - Stage 2.

LMAP Stage 2 - Calibrated LinSig Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits LinSig modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Build Calibrated LinSig Base Model. 2. Complete the DE section of the LMAP Stage 2 check sheet (SQA-0545) and provide to the CE. 3. Formally submit the Calibrated LinSig Base Model (with the DE & CE-signed LMAP Stage 2 check sheet) to the P/MAE. 4. Complete all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the LMAP Stage 2 check sheet.
	CE	1. Audit the Calibrated LinSig Base Model prior to submission by the DE. 2. Complete, sign and return the LMAP Stage 2 check sheet (SQA-0545) to the DE. 3. Assess any further iterations of the model in the event of the submission being "Rejected" by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Calibrated LinSig Base Model. 2. Complete the MAE section of the LMAP Stage 2 check sheet (SQA-0545). 3. Send completed check sheet to P/DE with an "Accepted" or "Rejected". 4. Conduct further audits on a rejected model, proceed until you can return an accepted LMAP Stage 2 check sheet.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table 9: TfL LinSig Model Auditing Process (LMAP) Summary Sheet - Stage 3.

LMAP Stage 3 – Validated LinSig Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits LinSig modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Develop Validated LinSig Base Models for all time periods derived from the accepted LMAP Stage 2 Calibrated LinSig Base Model. 2. Complete the DE section of the LMAP Stage 3 check sheet (SQA-0546, one for each time period under consideration) and provide to the CE. 3. Formally submit the Validated LinSig Base Models (with the DE & CE-signed LMAP Stage 3 check sheet) to the P/MAE. 4. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the LMAP Stage 3 check sheets.
	CE	1. Audit the Validated LinSig Base Model prior to submission by the DE. 2. Complete, sign and return the LMAP Stage 3 check sheet (SQA-0546) to the DE. 3. Assess any further iterations of the model in the event of the submission being "Rejected" by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Validated LinSig Base Model. 2. Complete the MAE section of the LMAP stage 3 check sheet (SQA-0546). 3. Send completed Check Sheet to P/DE with an "Accepted" or "Rejected". 4. Conduct further audits on a rejected model, proceed until you can return an accepted LMAP Stage 3 check sheet. 5. Upload the approved base models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table 1 0: TfL LinSig Model Auditing Process (LMAP) Summary Sheet - Stage 4.

LMAP Stage 4 – LinSig Proposed Model Meeting		
Roles		Key Responsibilities
Promoter Representatives	P	Attend meeting to confirm the scope of the proposals as discussed during MAP Stage 1 . Confirm understanding that the MAE will not begin any audit until the SAE has completed a Signal Safety Audit of the proposals.
	DE	1 . In conjunction with and agreement of the P/SAE/MAE, produce a statement detailing the scope for each of the LinSig Proposed Models. 2. In conjunction with and agreement of the P/SAE/MAE, supply a record of the work requiring completion prior to submission of the LinSig Proposed Models. 3. In conjunction and agreement with the P/SAE, agree when proposals will be submitted for SAE Signal Safety Audit. Confirm understanding that the MAE will not begin an audit until completion of the SAE Signal Safety Audit. 4. Formally submit the final 'Purpose Statement' derived from MAP Stage 1 and the agreed details of the scheme/modelling, as set out above, to the P/SAE/MAE. 5. Complete the DE's section of the LMAP Stage 4 check sheet (SQA-8675).
	CE	None.
TfL Representatives	SAE	Obtain the DE-created submission dates for all junctions in the Baseline List agreed in MAP Stage 1 in order to conduct Signals Safety Audit.
	MAE	1 . Obtain and agree the DE-created statement detailing the 'Purpose' for each of the LinSig Proposed Models. 2. Obtain and agree the DE-created record of the work required, prior to submission of the LinSig Proposed Models. 3. Confirm that the P/DE understand an audit will not begin until the SAE has completed a Signal Safety Audit of the proposals. 4. Review/update the MED. 5. Complete the MAE section of the LMAP Stage 4 check sheet (SQA-8675).
	NAE	Attend meeting to agree the scope of the proposals as previously discussed during MAP Stage 1 .

Table 1 1 : TfL LinSig Model Auditing Process (LMAP) Summary Sheet - Stage 5.

LMAP Stage 5 – LinSig Proposed Models Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits LinSig modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions.
	DE	1. Formally submit the proposed Method of Control changes to the P/SAE for auditing and approval, using the MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530). 2. Obtain the approved MAP Stage 5 SQA-0640 Compliance Check Sheet from the SAE. 3. Develop LinSig Proposed Models for all periods based on "Accepted" LMAP Stage 3 Validated LinSig Base Models. 4. Complete the DE's section of the LMAP Stage 5 check sheet (SQA-0547, one for each time period under consideration) and provide to the CE. 5. Formally submit the DE & CE-signed LMAP Stage 5 check sheet to the P/MAE. 6. Complete modelling work as required by the MAE in the event of the submission being rejected until it is accepted, as documented in the LMAP Stage 5 check sheet.
	CE	1. Audit the LinSig Proposed Model for each time period prior to submission by the DE. Complete, sign and return the LMAP Stage 5 check sheet (SQA-0547) to the DE. 2. Assess any further iterations of the model in the event of the submission being rejected by the MAE.
TfL Representatives	SAE	1. Audit SQA-0640 compliance for each method of control change within the scheme. 2. Complete, sign and return a MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each method of control change within the scheme to the DE/MAE. 3. Indicate to the MAE that the proposals are SQA-0640 compliant and submitted modelling may be audited within LMAP Stage 5.
	MAE	1. Obtain a SAE-signed MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each method of control change within the scheme. 2. Audit DE-submitted LinSig Proposed Models. 3. Complete the MAE section of the LMAP Stage 5 check sheet (SQA-0547, one for each time period under consideration) and provide to P/DE. 4. Conduct further audits on a rejected model until you can return an accepted LMAP Stage 5 check sheet. 5. Upload the approved proposed models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

6 TRANSYT MODEL AUDITING PROCESS (TMAP)

An overview of TMAP is given in Figure 8, identifying the six MAP stages and the intermediate sequence of events that occur during the auditing process. This includes when formal meetings between MAP parties should occur, when model submissions should be made and what criteria need to be met before proceeding to the next MAP stage.

The roles and responsibilities of all TMAP participants are summarised in Table I 2 to Table I 5.

Formal check sheets are submitted at the end of all MAP Stages. Stages 1 and 4 are considered complete when the P and DE have received a signed and dated check sheet from the MAE. Stages 2, 3 and 5 are considered complete when the relevant check sheets are signed as "Accepted" by the MAE. The version of the model to which an "Accepted" sheet applies is the only one admissible as part of MAP. If for any reason modelling for a particular stage has to be amended, it will have to be fully re-submitted at that stage of the process and a new check sheet signed as "Accepted".

Signed copies of the completed check sheets and the "MAP Stage 5 SQA-0640 Compliance Sheet(s)" (SQA-0530) will be scanned and archived by TfL for Quality Assurance (QA) purposes. This provides a reference for the auditor when appraising the signal control data in the DE's models.

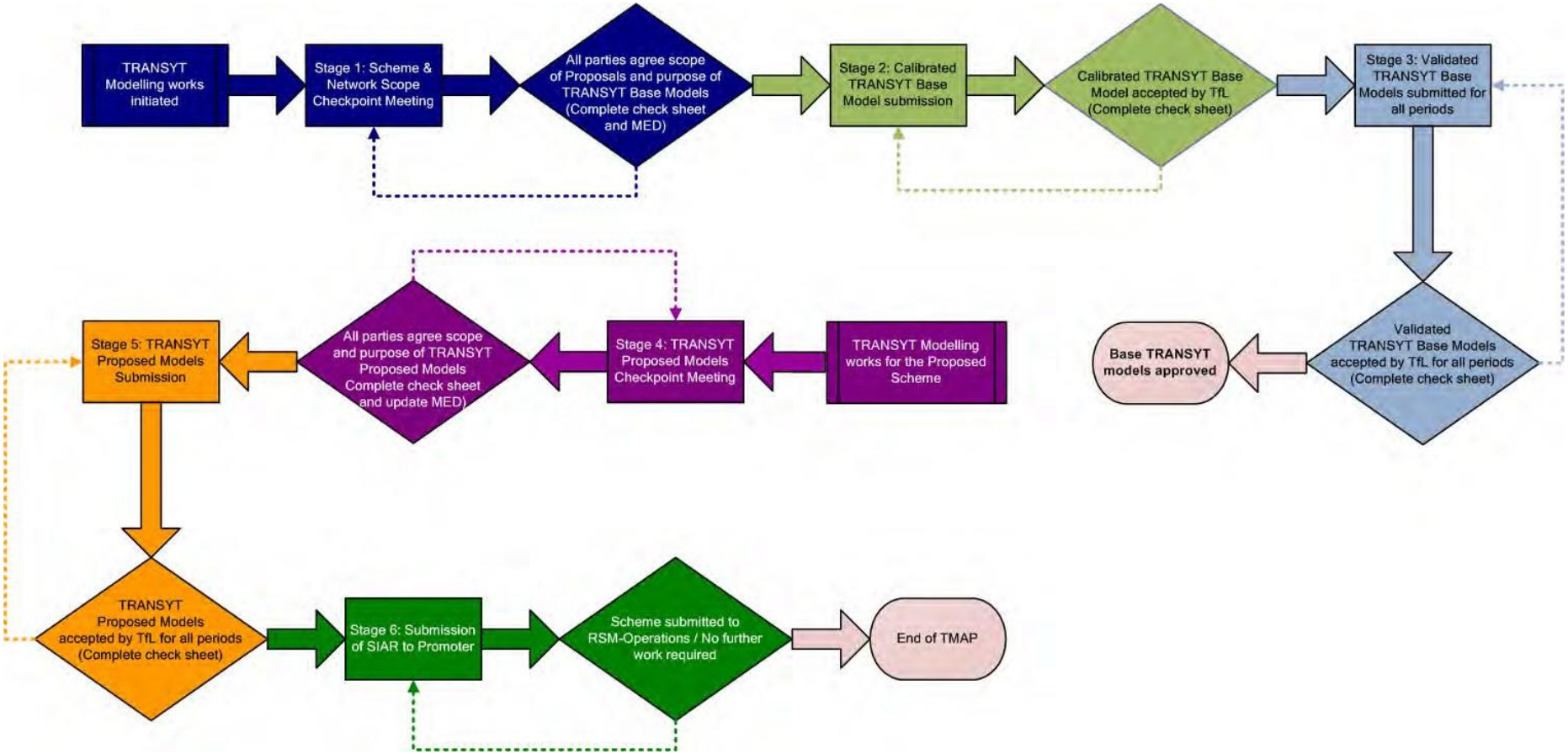


Figure 8: TfL TRANSYT Model Auditing Process (TMAP) Flow Chart.

Table I 2: TfL TRANSYT Model Auditing Process (TMAP) Summary Sheet - Stage 2.

TMAP Stage 2 - Calibrated TRANSYT Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits TRANSYT modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	I . Build Calibrated TRANSYT Base Model. 2. Complete the DE section of the TMAP stage 2 check sheet (SQA-0523) and provide to the CE. 3. Formally submit the Calibrated TRANSYT Base Model (with the DE & CE-signed TMAP Stage 2 check sheet) to the P/MAE. 4. Complete all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the TMAP Stage 2 check sheet.
	CE	I . Audit the Calibrated TRANSYT Base Model prior to submission by the DE. 2. Complete, sign and return the TMAP stage 2 check sheet (SQA-0523) to the DE. 3. Assess any further iterations of the model in the event of the submission being “Rejected” by the MAE.
TfL Representatives	SAE	None.
	MAE	I . Audit DE-submitted Calibrated TRANSYT Base Model. 2. Complete the MAE’s section of the TMAP stage 2 check sheet (SQA-0523). 3. Send completed check sheet to P/DE with an “Accepted” or “Rejected”. 4. Conduct further audits on a rejected model, proceed until you can return an accepted TMAP Stage 2 check sheet.
	NAE	None.

NB: The P has a limited amount of the MAE’s auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table I 3: TfL TRANSYT Model Auditing Process (TMAP) Summary Sheet - Stage 3

TMAP Stage 3 – Validated TRANSYT Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits TRANSYT modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Develop Validated TRANSYT Base Models for all time periods derived from the accepted TMAP Stage 2 Calibrated TRANSYT Base Model. 2. Complete the DE section of the TMAP Stage 3 check sheet (SQA-0524, one for each time period under consideration) and provide to the CE. 3. Formally submit the Validated TRANSYT Base Models (with the DE & CE-signed TMAP Stage 3 check sheet) to the P/ MAE. 4. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the TMAP Stage 3 check sheets.
	CE	1. Audit the Validated TRANSYT Base Model for each time period prior to submission by the DE. 2. Complete, sign and return the TMAP Stage 3 check sheet (SQA-0524) to the DE. 3. Assess any further iterations of the model in the event of the submission being “Rejected” by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Validated TRANSYT Base Model for each time period. 2. Complete the MAE section of the TMAP Stage 3 check sheet (SQA-0524). 3. Send completed check sheet to P/ DE with an “Accepted” or “Rejected”. 4. Conduct further audits on a rejected model, proceed until you can return an accepted TMAP Stage 3 check sheet. 5. Upload the approved base models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE’s auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table I 4: TfL TRANSYT Model Auditing Process (TMAP) Summary Sheet - Stage 4.

TMAP Stage 4 – TRANSYT Proposed Model Meeting		
Roles		Key Responsibilities
Promoter Representatives	P	Attend meeting to confirm the scope of the proposals as discussed during MAP Stage I . Confirm understanding that the MAE will not begin any audit until the SAE has completed a Signal Safety Audit of the proposals.
	DE	I . In conjunction with and agreement of the P/SAE/MAE, produce a statement detailing the scope for each of the TRANSYT Proposed Models. 2. In conjunction with and agreement of the P/SAE/MAE, supply a record of the work requiring completion prior to submission of the TRANSYT Proposed Models. 3. In conjunction and agreement with the P/SAE, agree when proposals will be submitted for SAE Signal Safety Audit. Confirm understanding that the MAE will not begin an audit until completion of the SAE Signal Safety Audit. 4. Formally submit the final 'Purpose Statement' derived from MAP Stage I and the agreed details of the scheme/modelling, as set out above, to P/SAE/MAE. 5. Complete the DE's section of the TMAP Stage 4 check sheet (SQA-8676).
	CE	None.
TfL Representatives	SAE	Obtain the DE-created submission dates for all junctions in the Baseline List agreed in MAP Stage I in order to conduct Signals Safety Audit.
	MAE	I . Obtain and agree the DE-created statement detailing the 'Purpose' for each of the TRANSYT Proposed Models. 2. Obtain and agree the DE-created record of the work required, prior to submission of the TRANSYT Proposed Models. 3. Confirm that the P/DE understand an audit will not begin until the SAE has completed a Signal Safety Audit of the proposals. 4. Review/update the MED. 5. Complete the MAE section of the TMAP Stage 4 check sheet (SQA-8676).
	NAE	Attend meeting to agree the scope of the proposals as previously discussed during MAP Stage I .

Table I 5: TfL TRANSYT Model Auditing Process (TMAP) Summary Sheet - Stage 5.

TMAP Stage 5 – TRANSYT Proposed Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits TRANSYT modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions.
	DE	I. Formally submit the proposed Method of Control changes to the P/SAE for auditing and approval, using the MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530). 2. Obtain the approved MAP Stage 5 SQA-0640 Compliance Check Sheet sheets from the SAE. 3. Develop TRANSYT Proposed Models for all periods based on "Accepted" TMAP Stage 3 Validated TRANSYT Base Models. 4. Complete the DE's section of the TMAP Stage 5 check sheet (SQA-0525, one for each time period under consideration) and provide to the CE. 5. Formally submit the DE & CE-signed TMAP Stage 5 check sheet to the P/MAE. 6. Complete modelling work as required by the MAE in the event of the submission being rejected until it is accepted, as documented in the TMAP Stage 5 check sheet.
	CE	I. Audit the TRANSYT Proposed Model for each time period prior to submission by the DE. 2. Complete, sign and return the TMAP Stage 5 check sheet (SQA-0525) to the DE. 3. Assess any further iterations of the model in the event of the submission being rejected by the MAE.
TfL Representatives	SAE	I. Audit SQA-0640 compliance for each method of control change within the scheme. 2. Complete, sign and return a MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each method of control change within the scheme to the DE/MAE. 3. Indicate to the MAE that the proposals are SQA-0640 compliant and submitted modelling may be audited within TMAP Stage 5.
	MAE	I. Obtain a SAE-signed MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each TRANSYT Proposed Models. 2. Complete the MAE section of the TMAP Stage 5 check sheet (SQA-0525, one for each time period under consideration). 3. Send completed TMAP Stage 5 check sheet to P/DE. 4. Conduct further audits on a rejected model, proceed until you can return an accepted TMAP Stage 5 check sheet. 5. Upload the approved proposed models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

7 Vissim MODEL AUDITING PROCESS (VMAP)

An overview of VMAP is given in Figure 9, identifying the seven VMAP stages and the intermediate sequence of events that occur during the auditing process. This includes when formal meetings between MAP parties should occur, when model submissions should be made and what criteria need to be met before proceeding to the next MAP stage.

The roles and responsibilities of all VMAP participants are summarised in Table I 6 to Table I 9.

Formal check sheets are submitted at the end of all MAP Stages. Stages I and 4 are considered complete when the P and DE have received a signed and dated check sheet from the MAE. Stages 2a, 2b, 3 and 5 are considered complete when the relevant check sheets are signed as "Accepted" by the MAE. The version of the model to which an "Accepted" sheet applies is the only one admissible as part of VMAP. If for any reason modelling for a particular stage has to be amended, it will have to be fully re-submitted at that stage of the process and a new check sheet signed as "Accepted".

Signed copies of the completed check sheets and the "MAP Stage 5 SQA-0640 Compliance Sheet(s)" (SQA-0530) will be scanned and archived by TfL for Quality Assurance (QA) purposes. This provides a reference for the MAE when auditing the signal control data in the DE's models.

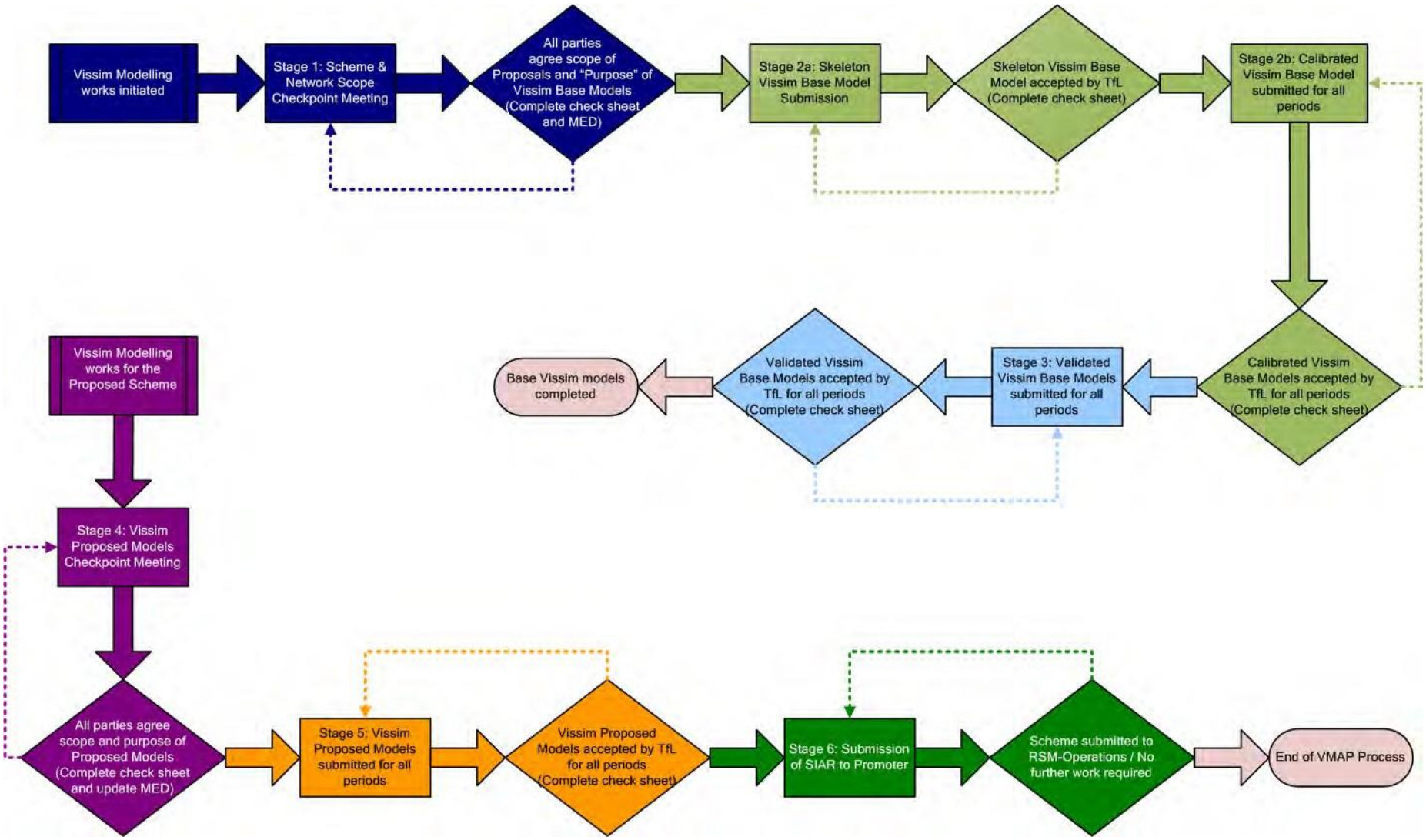


Figure 9: TfL Vissim Model Auditing Process (VMAP) Flow Chart.

Table I 6: TfL Vissim Model Auditing Process (VMAP) Summary Sheet - Stage 2a (Skeleton Model) & Stage 2b (Calibrated Model).

VMAP Stage 2a Skeleton & 2b Calibrated VISSM Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Vissim modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	2. Build Skeleton Vissim Base Model. 3. Complete the DE section of the VMAP Stage 2a check sheet (SQA-0526) and provide to the CE. 4. Formally submit the Skeleton Vissim Base Model (with the DE & CE-signed VMAP Stage 2a check sheet) to the P/MAE. 5. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the VMAP Stage 2a check sheet. 6. Develop Calibrated Vissim Base Models for all time periods based on the "Accepted" Skeleton Model. 7. Complete the DE section of the VMAP Stage 2b check sheet (SQA-0527, one for each time period under consideration) and provide to the CE. 8. Formally submit the Calibrated Vissim Base Models (with the DE & CE-signed VMAP Stage 2b check sheet) to the P/MAE. 9. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the VMAP Stage 2b check sheet.
	CE	1. Audit the Skeleton/Calibrated Vissim Base Models submitted by the DE. 2. Complete, sign and return the VMAP Stage 2a Skeleton (SQA-0526) or 2b Calibrated Vissim Base Model (SQA-0527) submission check sheets to the DE. 3. Audit any further models in the event of the original submissions being "Rejected" by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Skeleton and Calibrated Vissim Base Models. 2. Complete the MAE's part of the "VMAP Stage 2a (SQA-0526) and VMAP Stage 2b (SQA-0527) check sheets". 3. Send completed check sheet to P/DE with an "Accepted" or "Rejected". 4. Carry out any further auditing work in the event of a "Rejected" model, until you can return an "Accepted" Check Sheet.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table I 7: TfL Vissim Model Auditing Process (VMAP) Summary Sheet - Stage 3.

VMAP Stage 3 – Validated Vissim Base Model Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Vissim modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions to pass this stage. Resubmission will consume total time allocated for the audit.
	DE	1. Develop Validated Vissim Base Models for all time periods derived from the accepted VMAP Stage 2b Calibrated Vissim Base Model. 2. Complete the DE section of the VMAP Stage 3 check sheet (SQA-0528, one for each time period under consideration) and provide to the CE. 3. Formally submit the Validated Vissim Base Models (with the DE & CE-signed VMAP Stage 3 check sheet) to the P/ MAE. 4. Carry out all further work required by the MAE in the event of the submission being rejected until it is accepted, as documented in the VMAP Stage 3 check sheets.
	CE	1. Audit the Validated Vissim Base Model for each time period prior to submission by the DE. 2. Complete, sign and return the VMAP Stage 3 check sheet (SQA-0528) for the DE. 3. Assess any further iterations of the model in the event of the submission being “Rejected” by the MAE.
TfL Representatives	SAE	None.
	MAE	1. Audit DE-submitted Validated Vissim Base Model for each time period. 2. Complete the MAE section of the VMAP stage 3 check sheet (SQA-0528). 3. Send completed Check Sheet to P/ DE with an “Accepted” or “Rejected”. 4. Conduct further audits on a rejected model, proceed until you can return an accepted VMAP Stage 3 check sheet. 5. Upload the approved base models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE’s auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

Table I 8: TfL Vissim Model Auditing Process (VMAP) Summary Sheet - Stage 4.

VMAP Stage 4 – Vissim Proposed Model Meeting		
Roles		Key Responsibilities
Promoter Representatives	P	Attend meeting to confirm the scope of the proposals as discussed during MAP Stage I . Confirm understanding that the MAE will not begin any audit until the SAE has completed a Signal Safety Audit of the proposals.
	DE	I . In conjunction with and agreement of the P/SAE/MAE, produce a statement detailing the scope for each of the Vissim Proposed Models. 2. In conjunction with and agreement of the P/SAE/MAE, supply a record of the work requiring completion prior to submission of the Vissim Proposed Models. 3. In conjunction and agreement with the P/SAE, agree when proposals will be submitted for SAE Signal Safety Audit. Confirm understanding that the MAE will not begin an audit until completion of the SAE Signal Safety Audit. 4. Formally submit the final 'Purpose Statement' derived from MAP Stage I and the agreed details of the scheme/modelling, as set out above, to P/SAE/MAE. 5. Complete the DE's section of the VMAP Stage 4 check sheet (SQA-8677).
	CE	None.
TfL Representatives	SAE	Obtain the DE-created submission dates for all junctions in the Baseline List agreed in MAP Stage I in order to conduct Signals Safety Audit.
	MAE	I . Obtain and agree the DE-created statement detailing the 'Purpose' for each of the Vissim Proposed Models. 2. Obtain and agree the DE-created record of the work required, prior to submission of the Vissim Proposed Models. 3. Confirm that the P/DE understand an audit will not begin until the SAE has completed a Signal Safety Audit of the proposals. 4. Review/update the MED. 5. Complete the MAE section of the VMAP Stage 4 check sheet (SQA-8677).
	NAE	Attend meeting to agree the scope of the proposals as previously discussed during MAP Stage I .

Table I 9: TfL Vissim Model Auditing Process (VMAP) Summary Sheet - Stage 5.

VMAP Stage 5 – Vissim Proposed Models Submission		
Roles		Key Responsibilities
Promoter Representatives	P	When the DE submits Vissim modelling, confirm with the MAE that it is of an appropriate standard and will not require multiple re-submissions.
	DE	1. Formally submit the proposed Method of Control changes to the P/SAE for auditing and approval, using the MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530). 2. Obtain the approved MAP Stage 5 SQA-0640 Compliance Check Sheet sheets from the SAE. 3. Develop Vissim Proposed Models for all periods based on "Accepted" VMAP Stage 3 Validated Vissim Base Models. 4. Complete the DE's section of the VMAP Stage 5 check sheet (SQA-0529, one for each time period under consideration) and provide to CE. 5. Formally submit the DE & CE-signed VMAP Stage 5 check sheet to the P/MAE. 6. Complete modelling work as required by the MAE in the event of the submission being rejected until it is accepted, as documented in the VMAP Stage 5 check sheet.
	CE	1. Audit the Vissim Proposed Model for each time period prior to submission by the DE. 2. Complete, sign and return the VMAP Stage 5 check sheet (SQA-0529) to the DE. 3. Assess any further iterations of the model in the event of the submission being rejected by the MAE.
TfL Representatives	SAE	1. Audit SQA-0640 compliance for each method of control change within the scheme. 2. Complete, sign and return a MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each method of control change within the scheme to the DE/MAE. 3. Indicate to the MAE that the proposals are SQA-0640 compliant and submitted modelling may be audited within VMAP Stage 5.
	MAE	1. Obtain a SAE-signed MAP Stage 5 SQA-0640 Compliance Check Sheet (SQA-0530) for each scheme method of control change. 2. Audit DE-submitted Vissim Proposed Models. 3. Complete the MAE section of the VMAP Stage 5 check sheet (SQA-0529, one for each time period under consideration). 4. Send completed VMAP Stage 5 check sheet to P/DE. 5. Conduct further audits on a rejected model and proceed until you can return an accepted VMAP Stage 5 check sheet. 6. Upload the approved proposed models to the TfL Model Library.
	NAE	None.

NB: The P has a limited amount of the MAE's auditing time. The P should therefore check that modelling is of an appropriate standard and will not require multiple resubmissions to pass this stage.

8 Glossary

Aimsun	Micro, meso and macroscopic modelling software developed by TSS-Transport Simulation Systems
AMAP	Aimsun Model Auditing Process
CE	Checking Engineer, the engineer responsible for checking and signing off the Design Engineer's work as fit-for-purpose for the Promoter
DE	Design Engineer, the engineer responsible for creating the modelling for the Promoter
DoS	Degree of Saturation, measure of capacity utilisation at a stopline
LinSig	Modelling software, developed by JCT Consultancy Ltd, used for detailed junction design, assessment of scheme proposals and the creation of skeleton models for checking against junction Controller Specification
LMAP	LinSig Model Auditing Process
MAE	Model Auditing Engineer, the engineer responsible for auditing the modelling and assessing the network impact of the scheme on behalf of TfL
MAP	Model Auditing Process
MED	Modelling Expectations Document, document created by the MAE in MAP Stage 1 , and updated in MAP Stage 4, which summarises the agreed modelling requirements
NAE	Network Assurance Engineer, the RSM-Operations engineer responsible for assessment, then approval/rejection of the Promoter's proposal (under the TMA)
NMD	Network Management Duty, duty to manage roads under the TMA
RSM-Operations	Road Space Management Operations, team within TfL which ensures compliance with the TMA
SAE	Signals Auditing Engineer, the engineer responsible for checking and safety approving the Proposal on behalf of TfL
SIAR	Scheme Impact Assessment Report, formerly known as TSSR, a document which identifies the impact of implementing a scheme on the network to provide the Promoter and RSM-Operations with all of the required information to make an informed decision on the project

SRN	Strategic Road Network, road network in London where TfL has a strategic interest and must be consulted over any changes which impact it
TfL	Transport for London
TfL Traffic Modelling Guidelines	TfL's overarching framework, in conjunction with MAP, to deliver modelling quality and indicate recommended 'Best Practice' relating to the approach and methodology of model development
TfL Traffic Manager	TfL's representative responsible for meeting TfL's Network Management Duty under the TMA
TLRN	Transport for London Road Network, 580km of London's roads which are managed by TfL and for which TfL is the highway authority
TMA	The Traffic Management Act (2004), which places a duty on local traffic authorities to ensure the expeditious movement of traffic on their or adjacent road networks
TMAP	TRANSYT Model Auditing Process
TranEd	Software developed by JCT Consultancy Ltd to provide an improved graphical user interface for TRANSYT versions I 2 and earlier
TRANSYT	Modelling software, produced by TRL Ltd, used for modelling and optimising signalised networks for representative traffic conditions
TSSR	Traffic Signal Supplementary Report, has been replaced by the SIAR
Vissim	Micro-simulation software developed by PTV AG
VMAP	Vissim Model Auditing Process

9 Document Control

Issue	Date	Purpose	Author	Checker	Approver
3	Mar 11	For Issue	J Smith	V Vorotović	J Robinson
4	Mar 12	Annual review completed, no change required. Email from James Smith dated 12/3/12 refers. Metadata updated – up-issue to version 4	J Smith	V Vorotović	J Robinson
5	Dec 13	Reference to TD amended to RSM	R Pierson	J Fraser	J Fraser
6	Dec 14	Full review. Network Performance update to Outcome Delivery team	V Vorotović	R Pierson	J Robinson
7	Jun 16	Review completed no change required. Next review set for Mar 17 by owner	V Vorotović	J Robinson	J Robinson
8	Mar 17	Review completed. References to Aimsun and AMAP added. Also MAP Stage 4 check sheets and Modelling Expectations Document. References to RSM amended to TfL where possible.	S Bulmer	J Green	M Pooke

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

Level of Check:
Type of Site:

Site Parameters:

Pedestrians? | Cyclists (on carriageway)? | Cyclists (on crossings)? | Equestrians?

Highest Posted Speed Limit:

Scope of Works:

Approvals:

Signed (S1 Engineer): Date:
Signed (S2 Engineer): Date:

GEOMETRY AND LAYOUT

Item No.	Description	Stage 1 Traffic Signal Safety and Quality Check	S1 CHK	Stage 2 Traffic Signal Safety and Quality Check	S2 CHK	Stage 1 Response to Stage 2 (if Required)	S1 RES	S2 CHK
1	Will vertical and horizontal alignment of all signals be consistent with required visibility, including sight-lights unobstructed? Will backing boards be required? Will advance warning signs be required? If so, has this been included on the Engineering Supplementary Information form?							
2	Are all signal head arrangements consistent and suitable?							
3	Could any vehicular signal heads (including cycles) be visible to conflicting flows? If mitigated, what mitigation has been provided?							
4	Are lane widths and swept paths proposed to be adequate for all road users? (Use evidence from swept path analysis, if provided). Is there the potential for large vehicles to overrun pedestrian or cycle facilities? Are signals proposed to have adequate clearance?							

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:				
Site Visit Date:		Address:		Drawing No:				
				WBS Code:				
5	Are proposed road markings and lane designations correct?							
6	Is provision for right turning vehicles required? Are right turners provided for appropriately, considering the speed of the approach? Will right turn lanes be able to accommodate queuing traffic without blocking other traffic movements?							
7	Is any proposed signal infrastructure likely to impact on off-carriageway traffic movements or visibility?							
8	Will the site impact on any private accesses?							

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

PEDESTRIAN, CYCLE & EQUESTRIAN CROSSING FACILITIES

9	Will proposed crossing widths (stud to stud) be adequate to accommodate:- 1) Pedestrians? (Refer to pedestrian flows if provided) 2) Cyclists? (Refer to cycle flows if provided)								
10	Will there be sufficient footway width to accommodate:- 1) Waiting pedestrians (including those with pushchairs / wheelchairs?) 2) Cycles? 3) Equestrians?								
11	Will traffic, pedestrian and cycle refuge islands meet minimum standards? Will refuge islands have the capacity to accommodate:- 1) Waiting pedestrians? 2) Cycles?								

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

	Is the proposed design of crossing points appropriate for the road width (kerb to kerb)? i.e. Staggered, straight across...					
12	If staggered, is the offset suitable? If straight-across in two halves, is th transition between two halves adequate?					
	Could any crossing signal heads and/or associated PCaTS units be visible to conflicting flows? If so, what mitigation has been provided for the following:-					
13	1) Pedestrians? 2) Cycles? 3) Equestrians?					
	Are all push buttons proposed to be sited in accordance with standards?					
14	Will tactile cones be provided?					
	Will audibles be provided? If so, will these be time switched & during what time?					
	Is necessary off-carriageway provision for cyclists proposed?					
15	If so, are routes proposed to be clearly defined with tactile paving and signage?					
	Will tactile paving be to the correct standard?					
16	Will flush kerbs be to the correct standard?					

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:				
Site Visit Date:		Address:		Drawing No:				
				WBS Code:				

CYCLIST ON CARRIAGEWAY FACILITIES								
17	Will widths of all cycle lanes be adequate? (Refer to cycle flows if provided)							
19	Are two-stage right turn facilities proposed? If so, are the waiting areas clearly defined with adequate sight-lines for cyclists undertaking the manoeuvre?							
19	Are ASLs appropriate in this design? If so, will the depth of ASLs be adequate? (Refer to cycle flows if provided)							
20	Will blind spot safety mirrors be provided? If so, are they proposed with adequate clearance, an ASL and a permitted left turn?							
21	Could left hooking and / or right turning conflicts between vehicles and cycles be a safety issue or has any mitigation been provided?							

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:				
Site Visit Date:		Address:		Drawing No:				
				WBS Code:				
BUSES								
22	Will proposed / existing bus stop locations have any impact on the flow of vehicular traffic or has any mitigation been provided?							
23	Is iBus existing or proposed at this site? If existing, is a new iBus design required with the changes proposed in this design?							

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

SIGNAL OPERATION AND TIMINGS

	Will the method of control (MOC) be safe for all road users?						
24	Are any prohibited/alternative stage moves required? Why?						
	Will all stages be appropriate for use in all modes of operation?						
	For existing sites, Engineer must check live running timings in the controller if these are to be used for proposed design						
25	Does the Junction Traffic Signal Design Sheet (SQA-8448) / Proposed Pedestrian Timing Sheet (SQA-8696) comply with standards with no errors or omissions?						
	Is an early start proposed? If so, will the signal layout be appropriate?						
26	Is an early cut off proposed? If so, will it be safe given the speed of traffic?						
	Will any proposed phase delays cause an early cut off, early start or other unsafe signal sequence?						
27	At internal stop lines, has clearance been accounted for by using phase delays and / or leaving amber links?						
	Will Speed Assessment (SA) equipment be required according to current standards?						
28	Where SA is required, but cannot be provided, please record why. If so, have intergreens been proposed to be increased to provide additional clearance time?						
	Are any regulatory signs proposed?						

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

29	Are all Traffic Regulation Orders (TROs) in place? Are any new TROs required? (Detail these on Engineering Supplementary Information form)			

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

CONSTRUCTION, ACCEPTANCE TESTING, MAINTENANCE AND DECOMISSIONING

30	Is all traffic infrastructure proposed to be located to minimise risk to operational staff over lifetime of asset?							
31	Is Engineering required to attend a Factory Acceptance Test (FAT)?							
32	Are there any errors or omissions on the LAT Attendance Requirement Form (SQA-8695)?							
33	Is the LAT Check List for ATS Form (SQA-8704) appropriate for this design's LAT?							
34	Are there any errors or omissions on the Design Hazard Register (SQA-8700)?							
35	Are there any errors or omissions on the Design Risk Assessment (SQA-8701)?							
36	Are there any errors or omissions on the Engineering Supplementary Information Form (SQA-8702)?							

SQA-8189 Traffic Signal Safety and Quality Check List 1 and 2

Site Reference:		Stage 1 Engineer:		Unique ID:	
Site Visit Date:		Address:		Drawing No:	
				WBS Code:	

	ADDITIONAL COMMENTS AND OBSERVATIONS							
37	Are any special facilities proposed to be provided? If so, please detail how these will operate.							
38	Are there any other assets proposed to be attached to the traffic signals, or existing (ANPR, etc.)? If so, please detail design considerations, including power and networking.							
39	Are there any errors or omissions on the Authorised Drawing?							
40	Does the design propose deviation from legislation, standards or local guidance? If so, what legislation, standard or local guidance is being deviated from? Is it appropriate for Stage 2 Checker to authorise this deviation? If it is not appropriate, who has the deviation been escalated to (name & role) and has their authorisation been granted?							

Appendix 1/17

Temporary Traffic Management Requirements

1 Temporary Traffic Management Requirements are published on line at :-

http://content.tfl.gov.uk/temporary-traffic-management-handbook.pdf

A hard copy is reproduced on the following pages.

Notwithstanding the detail in section 2.4 of the handbook, temporary auxiliary ramps to enable disabled people and others to continue to use a service or route shall be of a modular interlocking design with a minimum width of 1200mm and unlimited maximum panel width. End panels of interlocking modular design shall provide side access and remove a potential trip hazard. Mechanical adjustment shall suit all kerb heights from 100mm to 150mm. Ramps shall have a non-slip finish with a minimum PTV value of 64. Ramps shall withstand 1000kg loading. Ramps modules shall weigh less than 20kg to facilitate manual handling requirements.

For the illustration on page 24 of the handbook substitute the following

2 The Contractor shall be responsible for the provision, maintenance and surveillance of all traffic management measures. In the case of Rolling Lane Closures, the Contractor shall be responsible for overall control of the closure.

Temporary Traffic Regulation Orders (TTROs)

3 Traffic Orders are required to give effect to many mandatory traffic controls, such as parking or turning movements and at times temporary Orders (TTRO's) are required to modify them to accommodate highway works. The *Contractor* shall prepare any TTROs required to enable

the works, which shall then be processed by the *Client*. Applications, together with all supporting documentation, shall be submitted by the *Contractor* to the *Client* with the appropriate notice. In emergencies Traffic Notices may be processed (failure to process an order in a timely manner does not constitute an emergency).

4 The following notice periods apply:

a) Amending or making TTROs - 10 weeks

b) Making Traffic Notices - 24 hours

Driver Information Signs

5 Advance Information Signs shall be laid out as per TSRGD diagram 7003.1. The top panels shall be varied to suit each Client. Works Information signs shall comply with TSRGD 7006.1 formatted as Figure 17/1.

Figure 17/1

6 Legends for Figure 17/1 shall be selected from the following:

a) Bridge repair

b) Cable laying

c) Drain repairs

d) Road marking

e) Road resurfacing

f) Road improvement

g) Safety barriers

h) Street lighting

i) Surveying

j) Tunnel Maintenance

Legends for signs within Roadwork Sites

a) No Work – Concrete Setting (or similar reason)

b) Repair to bridge below

c) Lane closed for safety

d) Tree pruning

e) Grass cutting

f) Road repair

g) Traffic accident

h) Police incident

i) Lighting repair

Temporary Traffic Management handbook

Keeping people safe at roadworks

MAYOR OF LONDON

TRANSPORT

About Transport for London (TfL)

Part of the Greater London Authority family led by Mayor of London Sadiq Khan, we are the integrated transport authority responsible for delivering the Mayor's aims for transport.

We have a key role in shaping what life is like in London, helping to realise the Mayor's vision for a 'City for All Londoners'. We are committed to creating a fairer, greener, healthier and more prosperous city. The Mayor's Transport Strategy sets a target for 80 per cent of all journeys to be made on foot, by cycle or using public transport by 2041. To make this a reality, we prioritise health and the quality of people's experience in everything we do.

We manage the city's red route strategic roads and, through collaboration with the London boroughs, can help shape the character of all London's streets. These are the places where Londoners travel, work, shop and socialise. Making them places for people to walk, cycle and spend time will reduce car dependency and improve air quality, revitalise town centres, boost businesses and connect communities.

We run most of London's public transport services, including the London Underground, London Buses, the Docklands Light Railway, London Overground, TfL Rail, London Trams, London River Services, London Dial-a- Ride, Victoria Coach Station, Santander Cycles and the Emirates Air Line. The quality and accessibility of these services is fundamental to Londoners' quality of life. By improving and expanding public transport, we can make people's lives easier and increase the appeal of sustainable travel over private car use.

We are moving ahead with many of London's most significant infrastructure projects, using transport to unlock growth. We are working with partners on major projects like Crossrail 2 and the Bakerloo line extension that will deliver the new homes and jobs London and the UK need. We are in the final phases of completing the Elizabeth line which, when it opens, will add 10 per cent to central London's rail capacity.

Supporting the delivery of high-density, mixed-use developments that are planned around active and sustainable travel will ensure that London's growth is good growth. We also use our own land to provide thousands of new affordable homes and our own supply chain creates tens of thousands of jobs and apprenticeships across the country.

We are committed to being an employer that is fully representative of the community we serve, where everyone can realise their potential. Our aim is to be a fully inclusive employer, valuing and celebrating the diversity of our workforce to improve services for all Londoners.

We are constantly working to improve the city for everyone. This means freezing TfL fares so everyone can afford to use public transport, using data and technology to make services intuitive and easy to use, and doing all we can to make streets and transport services accessible to all. We reinvest every penny of our income to continually improve transport networks for the people who use them every day.

None of this would be possible without the support of boroughs, communities and other partners who we work with to improve our services. We all need to pull together to deliver the Mayor's Transport Strategy; by doing so we can create a better city as London grows.

London's road network

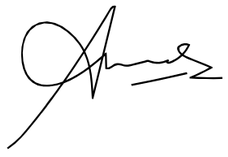
The London road network is shared between TfL, Highways England, 32 London boroughs and the City of London. TfL manages the Transport for London Road Network (TLRN), more widely recognised as the red routes and is responsible for the maintenance, management and operation of London's 6,000+ sets of traffic signals. The TLRN consists of 580km of road network, which represents just five per cent of London's roads, but it carries around a third of all London's traffic.

The Strategic Road Network (SRN) is made up of roads of significant importance, for which the London boroughs have highway responsibility, but TfL has oversight responsibility in terms of planned schemes and works that are likely to have a detrimental impact on highway performance.

TfL works 24 hours a day, 365 days a year managing the TLRN to make sure journeys are safe and reliable for all our customers. We have access to over 5,000 CCTV cameras that help monitor road network conditions for all road users.

Contents

Foreword



Will Norman

Walking and Cycling Commissioner

Roadworks are inevitable in a growing and prospering city like London. Utilities and highways infrastructure require maintaining and modernising; new housing and commercial developments need connections to services; and
the Mayor is investing record levels to transform London's streets to make them easier and safer to walk and cycle.

Poorly planned and designed roadworks can be a barrier to people travelling, resulting in delays, inconvenient diversions and, in some cases, unsafe conditions. People cycling are too
often asked to dismount or join narrow, congested traffic lanes, and people walking may be sent on extensive diversions, which are often unsuitable for those using a wheelchair or pushing a buggy.

Between 2005 and 2017, 99 people were killed or seriously injured in the vicinity of roadworks on the Transport for London Road Network (TLRN). While the works may not have been the direct cause of these tragedies, we know that unfamiliar road layouts, poorly signed diversions or a complete lack of cycling or footway provision heighten road risk.

No death or serious injury on London's roads is acceptable or inevitable, which is why the Mayor's Vision Zero
action plan aims to eradicate all deaths and serious injuries from our streets by 2041. While there is existing regulation and legislation setting standards for temporary traffic management,
we know more can be done to deliver safer provision.

This Temporary Traffic Management Handbook provides guidance for traffic management designers and work promoters on how to make roadworks safer. It will not only make our roads safer for vulnerable road users – people who walk, cycle and ride motorcycles
– but will also help to unlock the barriers to active travel faced by people who are visually impaired, or who use wheelchairs and other mobility aids.

The handbook has been produced by a working group of industry specialists and the TfL roadworks professionals who have been planning high-quality temporary traffic management arrangements and finding solutions to address the increased road risk caused by roadworks. I am delighted that it has been welcomed by the industry.

These guidelines apply directly to the TLRN and TfL will expect anyone planning works on these roads to follow this good practice. I also encourage these standards to be applied on
roads managed by boroughs and other authorities across London.

Well-designed, temporary traffic management plays a key part in making London's streets healthier, safer, and more attractive places to spend time, and contributes to putting London on the right path to becoming the world's most walkable city.

Walking Action Plan: Action 4 Launch the new Temporary Traffic Management Handbook in December 2018 to ensure that roadworks are
no longer a barrier to people walking and accessing London's streets.

Road network conditions

27m
journeys are made across London every day, from local walks to deliveries, cycle trips and the daily commute (2016)

16.8m (62%)
trips are made by sustainable modes (walking, cycling and public transport) (2016)

6.6m
walking trips (2016)

600,000
cycling trips (2016)

80%
Sustainable mode share by 2041

Killed and seriously injured in the vicinity of roadworks (2005-2017)

336
Total Londonwide for all road users

99
Total on the TLRN for all road users

167 (50%)
Number of killed and seriously injured vulnerable road users in London

41 (41%)
Killed and seriously injured on the TLRN were vulnerable road users

28 (8%)
Total fatalities Londonwide for all road users

8 (8%)
Total fatalities on the TLRN for all road users

78%
of people killed and seriously injured on the TLRN were vulnerable road users in 2017

59/41%
Split between pedestrians and cyclists killed and seriously injured on the TLRN in 2017

Roadworks activity

355,000
roadworks in London – 2017/18

34,000
roadworks on the TLRN – 2017/18

70,000
applications for permits to undertake roadworks on the TLRN – 2017/18

20,000
roadworks reports on the TLRN from other TfL on-street staff – 2017/18

7,700
reports on the TLRN received from members of public – 2017/18

13,500
fixed penalty notices issued for contravening roadworks regulations on the TLRN since 2010

130
roadworks-related offences prosecuted through the magistrates' courts on the TLRN since 2010

40,000
roadworks inspections on the TLRN – 2017/18

19%
the average work promoter's non-compliance rate for works in progress on the TLRN*

* measured as an average over six preceding periods in Q2 2018

Chapter 1 – About this guidance

1.1 Introduction

This handbook is provided for all those involved with every aspect of the planning, implementation and inspection of temporary traffic management associated with roadworks and construction activities taking place on the Transport for London Road Network (TLRN). The purpose of this guidance is to ensure that temporary traffic management does not create inconvenient or unsafe conditions for people travelling in London. There is a specific focus on people walking or cycling around works sites, in order to ensure those who wish to walk and cycle are not deterred by poor temporary traffic management.

Safety is at the forefront of this guidance; even where temporary traffic management is designed and set up to be safe, if it causes extensive diversions or significant inconvenience, it may drive unsafe decision-making by people travelling around the works. This handbook supplements existing legislative requirements and guidance that industry professionals will be familiar with:

- The Safety at Street Works and Roadworks: A Code of Practice (the Safety Code)[1]
- Chapter 8 of the Traffic Signs Manual (Chapter 8)[2]
- The Traffic Signs Regulations and General Directions (TSRGD)[3]

For works on the TLRN, TfL expects this guidance to be followed. Designers and works promoters should check with other highway authorities elsewhere in London to see if they approve the use of this handbook as good practice.

Our aim is to provide those using our streets with a safe, comfortable, intuitive, and consistent passage around roadworks and other construction sites.

This means ensuring that temporary traffic management is of the highest standard. By doing so, it will ensure streets and public spaces attract people from all walks of life and remain places where people choose to walk, cycle or use public transport, even where less space is available than before. Where it is necessary for road users to temporarily deviate away from a more familiar daily landscape, it is important they clearly understand what is expected of them.

Our vision is for organisations working on the road network to accomplish a zero-risk standard for roadworks operations by 2025.

Roadworks should not deter people from walking or cycling

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/321056/safety-at-streetworks.pdf

2 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/203669/traffic-signs-manual-chapter-08-part-01.pdf

3 http://www.legislation.gov.uk/uksi/2016/362/pdfs/uksi_20160362_en.pdf

1.2 The general principle

Anyone involved with roadworks must always ask themselves these two fundamental questions:

> 'Will someone using the road or footway from any direction understand exactly what is happening and what is expected of them?'
>
> 'Have I made the site safe to work in and for the general public?'

When works are necessary on the road network, we expect the commitment to Healthy Streets to be maintained. Walking and cycling should still be positive, attractive choices for people. It is our policy to prioritise walking, cycling and public transport. This handbook will help ensure this approach is incorporated into the traffic management design process, and provide a level of service that is as close as reasonably practicable to the permanent arrangement. This forms part of our commitment to Healthy Streets and our encouragement of active travel under all conditions.

To help meet Healthy Streets objectives, TfL expects traffic management on the TLRN to be:

- Safe - minimising collision risk with a sensible balance between practicality and risk mitigation, and feeling comfortable to use at all times of day
- Inclusive - allowing comfortable passage for people of all abilities and prioritising those for whom a barrier or diversion could compel them to take uncomfortable, risky or significantly more physically demanding alternatives
- Practical - providing realistic ways of enabling movement that minimise disruption for people
- Legible - being easily understood and unambiguous for all users

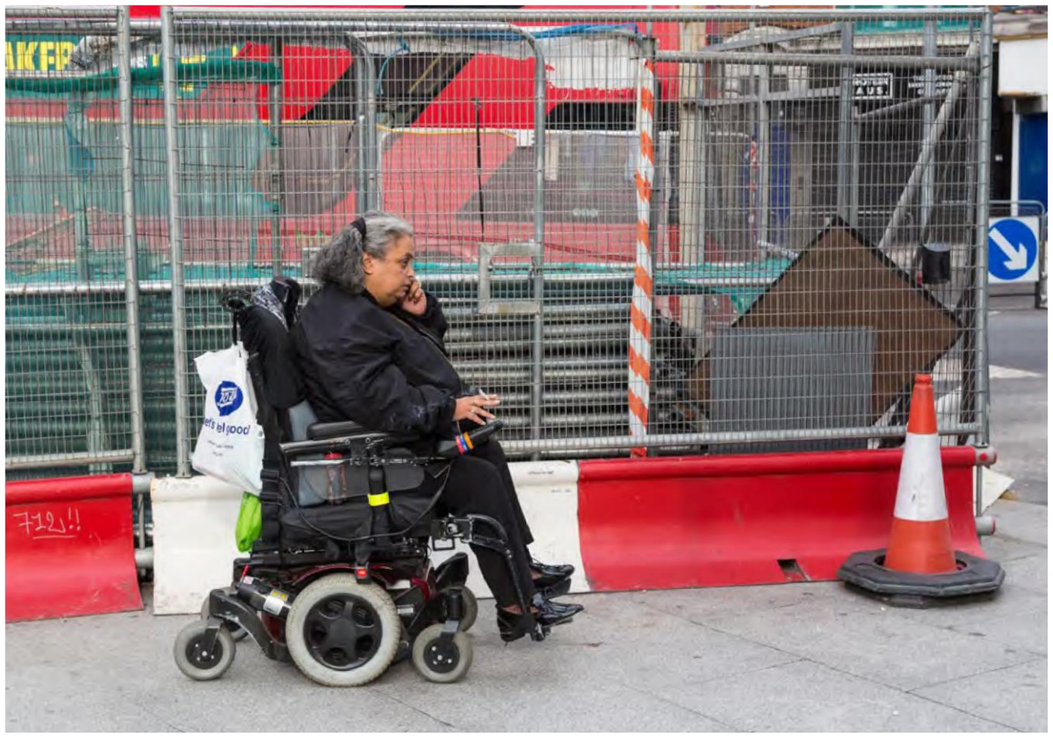
Designers and contractors should seek to re-provide facilities such as walkways or dedicated cycling facilities during roadworks to maintain routes with minimal disruption. They should also ensure those routes offer maximum comfort and comply with the Safety Code and Chapter 8.

It is essential that each proposal to undertake roadworks is given a specific assessment of risk by taking into account the existing road layout, and dedicated road user facilities and demand. Simply implementing a design that complies with the Safety Code is not always acceptable if the prevailing road network conditions are inappropriate for the selected solution.

For example, implementing a footway closure and a lengthy pedestrian diversion where there is a high footfall would not be desirable. This may result in pedestrians choosing to walk unrestricted in a live carriageway to navigate around the works, rather than follow an inconvenient and time- consuming diversion to cross the road.

Works promoters must be mindful they do not encourage unsafe road user behaviour such as pedestrians stepping into the carriageway, or cyclists accessing a works site by riding through cones, or deviating from a segregated cycle lane onto a busy footway.

The impact of works should primarily be mitigated through minimising the area of works while maintaining safety zones, and then seeking to provide the most convenient routes past or through the works areas. If a direct route cannot reasonably be maintained then robust measures should be put in place to segregate and guide road users as appropriate.



Routes past works sites must be suitable for all road users

1.3 Designer's responsibilities

The recently released Chapter 8 (Part 3 U2.6) clarifies the roles, responsibilities and resulting risk-sharing of designers and authorities in planning works. It is for the designer to assess the site and produce designs to meet the requirements of Chapter 8 and the Safety Code, this guide and other nationally recognised industry publications.

TfL, under the New Roads and Street Works Act,[7] has a duty to co-ordinate and manage the impact of works on the TLRN and may request conditions relating to the works without taking on a designer's role before a permit is granted.

Each roadworks site will have variable characteristics to take into account, such as the geometry of the road network, hazards, and street furniture. It is essential that works promoters meticulously examine the nature of each site and do not just apply standard layouts that are not fit for purpose. Each option should be carefully considered and risk assessed.

Safe working methodologies and the design of the traffic management should, wherever possible, meet the needs of all road users, particularly the most vulnerable. If it is determined this is not viable, please contact the relevant TfL Assessor to look at alternative solutions.

Designers should be mindful that people may attempt to walk or cycle along routes with which they are familiar, even if their intended passage is made more difficult. This often applies when footways and crossing facilities are closed, but there remains a high demand from pedestrians; or when requiring cyclists to dismount when they could continue in the carriageway.

Signing should deliver information about the temporary conditions and should not solely be relied upon to direct behaviour. Consideration should be given to road users who are unable to read signs or comprehend English.

In addition to this handbook, stakeholders should also consider the following legislation:

- The Health and Safety at Work Act 1974, which ensures the safety of the public and employees at roadworks sites[4]
- Construction (Design and Management) Regulations 2015, which places legal duties on clients, principal designers and contractors to plan, co-ordinate and manage health and safety throughout all stages of a project[5]
- Management of Health and Safety at Work Regulations 1999, which establishes the need for work to be managed in a way that prevents accidents and ill health[6]

4 https://www.legislation.gov.uk/ukpga/1974/37
5 http://www.hse.gov.uk/construction/cdm/2015/index.htm
6 http://www.legislation.gov.uk/uksi/1999/3242/contents/made
7 http://www.legislation.gov.uk/ukpga/1991/22/contents

Chapter 2 – Pedestrians at roadworks

2.1 Walking in London

A new Walking action plan[8] will encourage more Londoners to explore the city by foot. The plan, launched by London's Walking and Cycling Commissioner in July 2018, sets out how London will become a city where walking, for those that can, is the most obvious, enjoyable and attractive means of travel for all short trips. This forms parts of the Mayor's Transport Strategy, which applies a Heathy Streets Approach to the whole of London for the first time.

Research shows many people are put off walking due to concerns about road danger. The purpose of this guidance is to ensure that roadworks are not considered as one of the deterrents to walking. Roadworks, and the temporary access arrangements around them, must therefore be carefully managed and designed to ensure alternative routes are clear, safe, and convenient.

London has higher flows of pedestrians than would typically be found in many UK urban centres. Many pedestrians are visitors and tourists from overseas who are unfamiliar with UK highways, traffic behaviour and signing. Works promoters need to be mindful of the risks this can generate and develop a safe system of work through a robust risk assessment.

2.2 Design principles

TfL applies seven key principles when designing for pedestrians, which jointly promote improved road safety and support a more attractive and better quality walking experience. These principles can be equally applied to temporary situations, and traffic management designers should give each principle due consideration when formulating a pedestrian strategy at works sites.

Seven key principles when designing for pedestrians

Principle	Indicator	How it applies to traffic management
Safety	Walking environments should be safe to use and feel safe to spend time in	Ensuring routes are clearly communicated by design or signing; appropriate for wheelchair users and people who are visually impaired; safe from works and traffic hazards
Comfort	Walking environments should allow unhindered movement for all pedestrians and meet demand	Ensuring routes have good surfaces; are well-lit and 'open' to avoid ambush points and a fear of personal security
Inclusivity	Walking environments should support all types of pedestrians to improve accessibility by creating inclusive streets and places	Ensuring barriers meet chapter 8 requirements: correctly erected; free from trip hazards; ramps should be stable and with shallow gradients; where crossings are closed alternative controlled crossings are supplied to enable pedestrians to cross safely with adequate time
Directness	Walking environments should not be obstructive, allowing easy and convenient routes to create accessible and connected places for all pedestrians	Diversion routes should be convenient and as close to desire lines as possible. Designers should design to expected behaviours, not intended behaviours
Legibility	Walking environments should be legible for all pedestrians to know intuitively what places are for and who has priority at any given time	Pedestrians using the road should be able to understand exactly what is happening and what is expected of them. Signs should be carefully selected to avoid clutter but benefit the road user. Navigation should be initiated by the design layout as far as possible and supplemented by signs where needed
Attractiveness	Walking environments should be inviting for pedestrians to go through or spend time in	Segregation of traffic from pedestrian routes, reducing vehicle speeds, keeping the site and its surrounds clean and tidy. Plant and materials should be stored safely and in an organised fashion. Barriers, signs and cones should be well maintained and kept orderly. Barriers should be continuous and consistent and all equipment washed and repaired or replaced if damaged
Connectivity	Walking environments should support key walking routes to meet pedestrian desire lines. Street quality should be consistent to ensure attractiveness is not in isolated areas to support the permeability of places	Ensuring routes and signing cater for expected pedestrian traffic including commuters, tourists and surges in demand from nearby special events

8 http://content.tfl.gov.uk/mts-walking-action-plan.pdf

2.3 Inclusive access

The Safety Code states:
'You must take into account the needs of children, older people and disabled people, having particular regard for visually impaired people'

and you must provide:
'a safe route suitable for people using wheelchairs, mobility scooters, prams or pushchairs'

Temporary situations without proper planning and robust risk assessments can result in reduced comfort to the public and place people at risk. Disabled pedestrians and blind or partially sighted people are particularly vulnerable.

Unlike drivers of motorised vehicles who are trained and tested to use a vehicle on the highway, in many cases pedestrians will not have the same knowledge of traffic signs. They are also permitted to use all areas of a highway. Their unawareness must be considered to ensure design proposals are as naturally intuitive as possible.

In circumstances where pedestrian flows are high or space is constrained, sign placement needs very careful consideration to avoid creating footway pinch-points or obstacles.

It is also important to ensure that signs are not obscured by the volume of pedestrians using the highway, and that traffic management proposals clearly demonstrate how this will be achieved.

In practice, this means that an inclusive design approach must be used for temporary arrangements and that reasonable adjustments must be made to help disabled pedestrians travel easily.

Every pedestrian should be able to use the street independently and with confidence at any time of day. Reference is made again to the two fundamental statements from the Safety Code that must always be kept in mind:

'Will someone using the road or footway from any direction understand exactly what is happening and what is expected of them?'

'Have I made the site safe to work in and for the general public?'

Chapter 8 (Part 3 U1.4.2) also states:
'Underlying the design of temporary traffic management arrangements should be the aim to achieve a level of safety and road user comprehension no worse than the rate for non-works conditions…'

Site-specific risk assessments must also consider the needs of visually impaired and disabled people

High pedestrian flows need careful consideration when planning signing strategies

Pedestrian comfort should be maintained in relation to predicted flows. TfL's Pedestrian Comfort Guidance[9] highlights the need to devise suitable space and recommends a two-metre- wide footway to allow two wheelchairs to pass each other if space permits.
The Pedestrian Comfort Guidance ideal minimum width in low-use areas is 1.5 metres. However, this will depend on the length of the works. With longer work areas, provision for a waiting space may be required.

To assist designers in allocating space for walking, the Pedestrian Comfort Guidance defines a scale ranging from A-E (comfortable to uncomfortable) for footway comfort levels. Where it is achievable the benchmark for comfort is ideally class B+, but no less than B-.

As the Safety Code clarifies, traffic management must take into account the needs of children, older people and people with disabilities, particularly those with sight impairments. It
must provide a safe route that is also suitable for people with small children, pushchairs, wheelchairs and mobility scooters. These issues must also be considered in the context of the Equality Act 2010,[10] which places a legal obligation on public bodies to have due regard to the need to advance equality of opportunity between persons who share a relevant protected characteristic and persons who do not share it.

9 http://content.tfl.gov.uk/pedestrian-comfort-guidance-technical-guide.pdf

10 https://www.gov.uk/guidance/equality-act-2010-guidance

Pedestrian comfort levels (PCL) for different localities

Scale	High street		Office and retail		Residential		Tourist attraction		Transport interchange	
	Peak	Ave of max	Peak	Ave of max	Peak	Ave of max	Peak	Ave of max	Peak	Ave of max
A B+	Comfortable		Comfortable		Comfortable		Comfortable		Comfortable	
B	Acceptable				Acceptable		Acceptable			
B-	At risk		Acceptable				At risk		Acceptable	
C+ C-	Unacceptable / Uncomfortable		At risk		At risk		Unacceptable / Uncomfortable		At risk	
D E					Unacceptable / Uncomfortable					
	Peak and Average of maximum activity levels have similar guidance as people visiting retail areas stated they were particularly sensitive to crowding		The 'at risk' level is set at a lower PCL during the Average of maximum activity than peak flows. This is because of the greater number of single travellers and the short duration of maximum activity		The 'at risk' level is set at a lower PCL than peak flows in Residential Areas to reflect the short time this is likely to occur. A site visit to Residential sites is particularly important to check if there is school activity or a bus stand in the area		Peak and Average of maximum activity levels have similar guidance as people visiting tourist areas are likely to be particularly sensitive to crowding		The 'at risk' level is set at a lower PCL during the Average of maximum activity than peak flows. This because of the greater number of single travellers and the short duration of maximum activity	

2.4 Footway ramps and boards

The Safety Code gives advice on footway ramps and boards, however, in February 2018 the Highway Authority and Utilities Committee produced Advice Note (No. 2018/01), Specification and Operational Requirements for Footway Boards, Driveway Boards, Footway Ramps and Road Plates.[11]

This is a standard that facilitates wheelchairs and mobility scooters to transition over a kerb from footway to carriageway in temporary situations.
The advice note gives supplementary guidance to the Safety Code, although it is acknowledged there are some variations when compared to the advice contained within the Safety Code.
For clarity, TfL recognises and accepts the Highway Authority and Utilities Committee advice note (2018/01).
Contractors are expected to demonstrate they are operating to this latest advice and the changes in standards to support site-based risk assessments by being less prescriptive to enable better design. They should not be seen as a lowering of standards.

Under the Equality Act 2010, works promoters are required to provide auxiliary aids or services to enable disabled people to continue to use a service or route, and to overcome physical features. It is not only people who are disabled who can find temporary situations more difficult to navigate - children, older people or those with injuries or luggage will also benefit.

When installing footway ramps to make kerbs accessible, special attention should be paid to ensuring the gradient is not too steep for wheelchair users to safely use. The gradient will be greatly influenced by the kerb height and it cannot be assumed that standard off-the-shelf products will meet the specification in all circumstances.
Standard kerb heights range from 100mm to 140mm and specialised bus stop kerbs can be 220mm high.

The Department for Transport's (DfT) advice note on Inclusive Mobility[12] advises that ramps should ideally be 1:20 with a maximum length of 10 metres. Steeper ramps with a 1:12 gradient are acceptable at lengths less than two metres, and at 1:10 if no longer than 600mm.

11 http://hauc-uk.org.uk/publication/69/

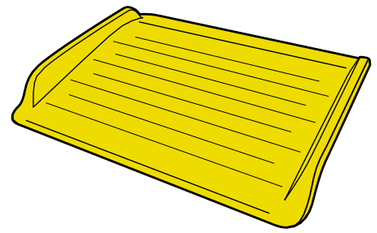
12 https://www.gov.uk/government/publications/inclusive-mobility

Temporary plastic footway ramp

Designers will need to assess the height of the obstacle and therefore length of ramp to ascend/descend and the resulting carriageway intrusion/impact with turning space when required. Where a ramp protrudes into a live traffic lane, it is paramount the hazard to cyclists and motorists is clearly signed and guarded.

Duration of works and site attendance will also be fundamental to the design solution. For off-peak working and fully attended sites, a steeper ramp may be tolerable. However, for unattended works sites of extended duration, designers should ensure ramps are feasibly shallow.

Typical footway ramp



Kerb ramps help maintain accessibility for people who are disabled, or pushchair users

2.5 Safe routing

The Safety Code has a hierarchy for providing safe routes for pedestrians when works obstruct a footway, either in part or wholly, and makes it clear that a temporary walkway should only be provided in the carriageway if it is not possible to provide a safe pedestrian access on the footway.

However, when this process is applied to footways with high or very high pedestrian flows, which is typical of many central urban areas, designers will need to risk assess the impact of a total closure (or substantially restrictive partial closure) and the suitability of rerouting the pedestrian demand.

If crossings become overly congested, or the detour is significantly different to the pedestrian desire line, it is probable that a number of pedestrians may opt to ignore the signed instructions and walk outside barriers into the live carriageway adjacent to the closed footway. Mitigation will be required, by advanced planning (checking schedules of music/sporting events), modifying the traffic management at peak flows or supplying marshals.

It is a requirement of the Safety Code that someone on a footway approaching from any direction will understand exactly what is happening and what is expected of them. A pedestrian route should be intuitive through design and layout and not be confusing. Signing, which could include non-traffic signs, may assist with destination routing and reduce confusion.

A robust traffic management design should cater for expected public behaviour and not expect road users to behave as desired in a theoretical circumstance. Therefore it will frequently be the case in these situations that the safest solution to manage pedestrians is to provide a walkway of sufficient width in the carriageway. This will often retain pedestrians closest to their original desire line.

At temporary works, where there is a risk of pedestrians not understanding or disregarding signing to cross the road at the designated crossing points, pedestrian barriers should be considered to prevent crossing at less safe locations.

Some locations are subject to crowding, such as outside stadiums, concert venues and major transport hubs. The type of barrier used in these situations should be suitable for crowd management and safe for emergency evacuations of adjacent premises and facilities.

Supplementary non-traffic destination signs

Poor sign usage and clutter

2.6 Footway closures

In the majority of cases, a legal notice under the Highways Act is not required to formally close a footway if an adjacent pedestrian route is maintained, or an alternative pedestrian route
is provided for the same section of highway. However, a legal notice will be required for that section of footway if:

- A pedestrian route cannot be maintained
- A subway is to be closed
- A footbridge is to be closed

This Highways Act notice is separate to any permit approvals that may be required for the works. In all situations, an alternative diversion route needs to be identified. The route must be as close to the original desire line as possible, accessible and considered reasonable for pedestrians with mobility impairments. By reasonable, it means the route has been successfully scrutinised with due regard to the footway surface condition and that it is free from slip and trip hazards.

Where the route is over a verge then it should be surfaced with a temporary covering or compacted granular material so that it is suitable for all pedestrians with special consideration for wheelchair users, visually impaired people and those with restricted mobility. Access to all affected properties must be maintained and assistance provided, where necessary, for pedestrians who may require it.

If a footway closure is necessary despite the likelihood of causing significant impact, marshals should be available in key locations to guide and assist pedestrians. Significant impact could be determined by a number of factors, including:

- High pedestrian flows
- Lengthy diversions likely to cause hardship to pedestrians with restricted mobility
- More complex diversions likely to cause confusion to visually impaired people

Further mitigation measures should be considered to lessen the impact of footway closures. Temporary pedestrian crossing systems such as portable traffic signals can avoid lengthy diversions
and provide a significant local benefit, particularly in areas frequented by shoppers, commuters, tourists
and schoolchildren.

When pedestrians are diverted in close proximity to cycle tracks and lanes, extra steps may need to be taken to avoid conflict between cyclists and pedestrians. Examples include longitudinal barriers which can prevent pedestrians walking in to the carriageway, signs warning pedestrians to look in the correct direction, and monitoring pedestrian activity once the site has been installed to see if expected behaviour matches actual behaviour.

Closed footway with temporary walkway in carriageway

Marshals can help maintain a safe system of work and assist pedestrians

2.7 Personal safety and security

Section 17 of the Crime and Disorder Act 1998[13] places an obligation on local authorities and the Mayor to do all they reasonably can to prevent crime, disorder and behaviour affecting the local environment.

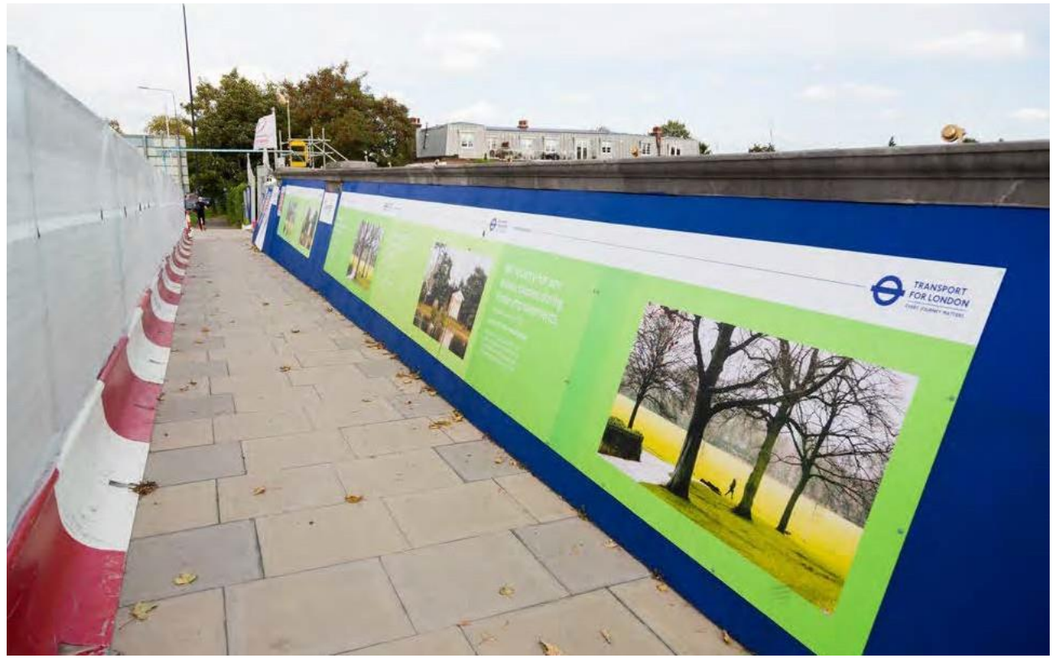
Pedestrian provision should feel safe and avoid creating environments that could lead to crime or antisocial behaviour.
TfL has a duty to give due regard to crime and disorder and be satisfied that traffic management proposals have been assessed for security and personal safety, as well as the basic amenity required by the Safety Code.
Consequently, designers should consider potential ambush points caused by hoarding, fencing, hidden corners or where a diversion route is implemented away from the public highway.

When rerouting pedestrians with high barriers or hoarding, street lighting needs to be sufficient to illuminate the footway surface to prevent slips and trips and, critically, to avoid casting shadows and dark ambush points which may facilitate crime. Barriers and hoarding should be chamfered, splayed and/or angled where necessary to prevent hiding places, which may encourage antisocial conduct.

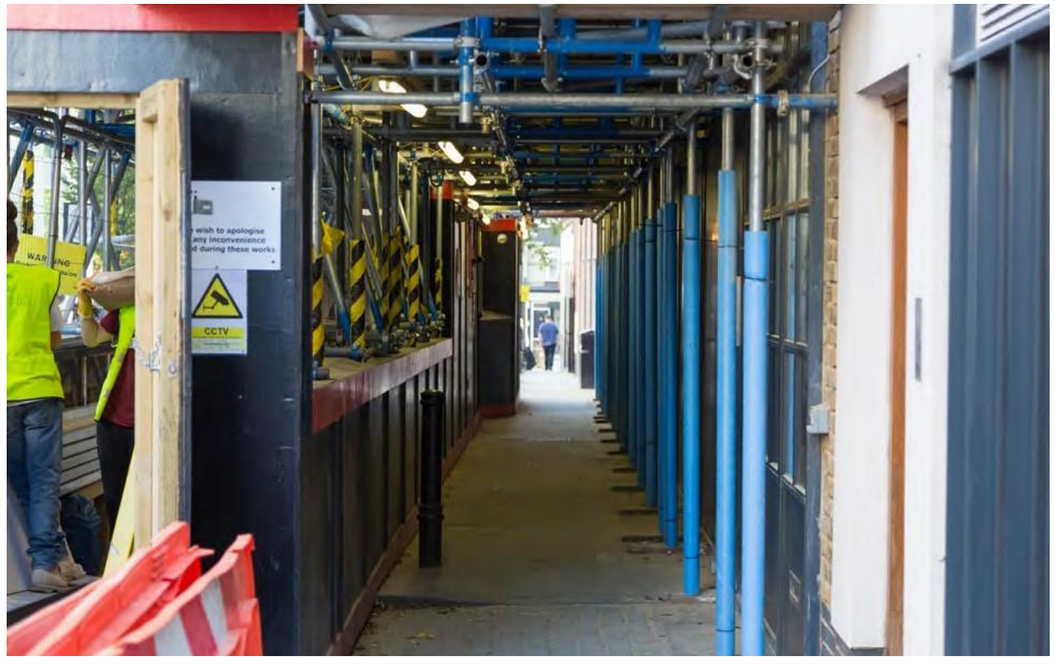
Regular site inspections for general traffic management maintenance should also include inspecting areas where suspect packages could be concealed.
All contractors and members of the public are reminded to remain alert to the danger of terrorism and report any suspicious activity to the police immediately on 999 or the anti-terrorist hotline: 0800 789 321.

Standard maintenance of works sites should also include regular inspections to ensure tidiness, with any accumulating litter properly disposed of within the confines. Public-facing boundaries of the site barriers in situ for prolonged periods can often trap litter, which is both unsightly and potentially an obstacle to pedestrians.

13 https://www.legislation.gov.uk/ukpga/1998/37/contents



Good example of site hoarding



Poor hoarding creating dark and foreboding footway

2.8 Pedestrian barrier selection

All pedestrian barrier systems should comply with the following standards:

- BS 8442:2015
  Miscellaneous road traffic signs and devices
- BSEN12899-1:2007
  Fixed, vertical road traffic signs
- The Safety Code
- Chapter 8
- TSRGD

Deviations from the above standards should only be in exceptional circumstances following a site-specific risk assessment that identifies there is a safer and appropriate alternative. Works promoters, designers and contractors must be aware that metal crowd control barriers or similar products are unlikely to be suitable as they do not comply with the national standards above.

Works promoters should be mindful of the differences between traffic and pedestrian barriers as the products often appear very similar.

Where footways are subject to high pedestrian flows/crowding, or where high winds could be prevalent, barrier systems should be reinforced with ballast in accordance with manufacturers' guidelines.

Alternatively, more suitably robust and heavy duty barriers should be provided to ensure stability under extraordinary conditions.

In exceptional or special circumstances a viable pedestrian route may be necessary on a dual carriageway or high-speed road. In these circumstances, consideration should be given to providing protection with a tested and approved vehicle restraint system. For all times of the day the design of the walkway must consider disabled pedestrians, particularly those with visual impairments.

It is not acceptable to use tape such as barrier or hazard warning tape, at the perimeter of a works site, or a rope/ chain in place of an approved barrier system as it does not comply with the national standard.

Low-trip hazard barrier feet are recommended to better facilitate pedestrians with disabilities as they remove trip hazards and give greater visual awareness of potential trip hazards and add more space for comfort.

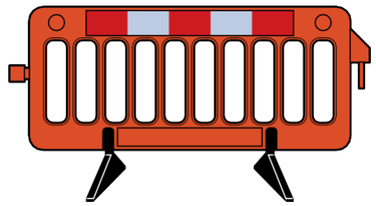
A designer must consider the site from a child's perspective. Children do not perceive danger in the same way as adults and they can often see works sites as fun places to enter out of curiosity. Where children can be reasonably expected to use the footway, it is unlikely that modular post- and plank- style barriers, as shown in the image on the right, will offer a sufficient barrier to children who could easily climb through the large gaps.

This is especially important for works near schools, parks, residential estates and similar environments where children may be unsupervised by adults.

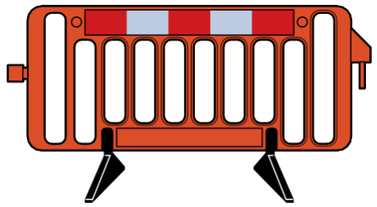
Unless a site-specific risk assessment shows otherwise, typical mesh site fencing, which is not compliant with the standards, should not ordinarily be used to secure site boundaries on the footway in place of pedestrian barrier systems compliant with Chapter 8 and the Safety Code. There are proprietary barriers systems on the market that afford the security of these fencing systems and that also comply with the requirements defined above.

Barrier systems with large gaps can easily be breached by children

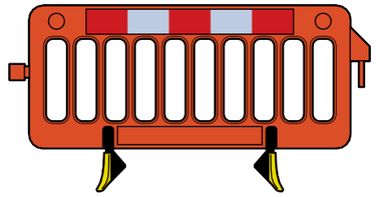
Traffic and pedestrian barriers



Pedestrian barrier has a tapping rail at its base for visually impaired people to follow with a walking cane



Traffic barrier without a tapping rail can be deployed in areas away from pedestrian routes



Pedestrian barrier with low-profile feet can reduce obstructive widths and tripping hazards

Example of supplementary information signs for pedestrians

2.9 Temporary pedestrian signing and information

Temporary pedestrian traffic signs that are not already prescribed should be white on red in accordance with the specifications detailed in Schedule 13 Part 9 of the TSRGD.

Where pedestrians are required to be redirected and diverted around the works area, the alternative route should be sensibly apparent to all pedestrians, especially those who are visually impaired – this means providing a continuous tapping rail. Therefore, signs alone must not be relied upon.

However, if a pedestrian route is visually less obvious, temporary pedestrian traffic signs can help provide an improved understanding of where to go. These traffic signs can be complemented by others such as Legible London wayfinding and map-based signs, which help pedestrians orientate themselves to their intended route or destination. Throughout, pedestrian behaviour should be regularly monitored by those undertaking the works, with assistance offered to people who need it.

If the shortest and most direct route is not always accessible to visually impaired pedestrians, an alternative route should also be provided. The constraints of the shorter route should be made clear to pedestrians: for example, if it is not suitable for wheelchair users.

Bad practice: confusing and non-compliant signs, with non-standard wording and sign clutter

Good practice: pedestrian sign communicating access to businesses is maintained

2.10 Working adjacent to or at permanent crossings

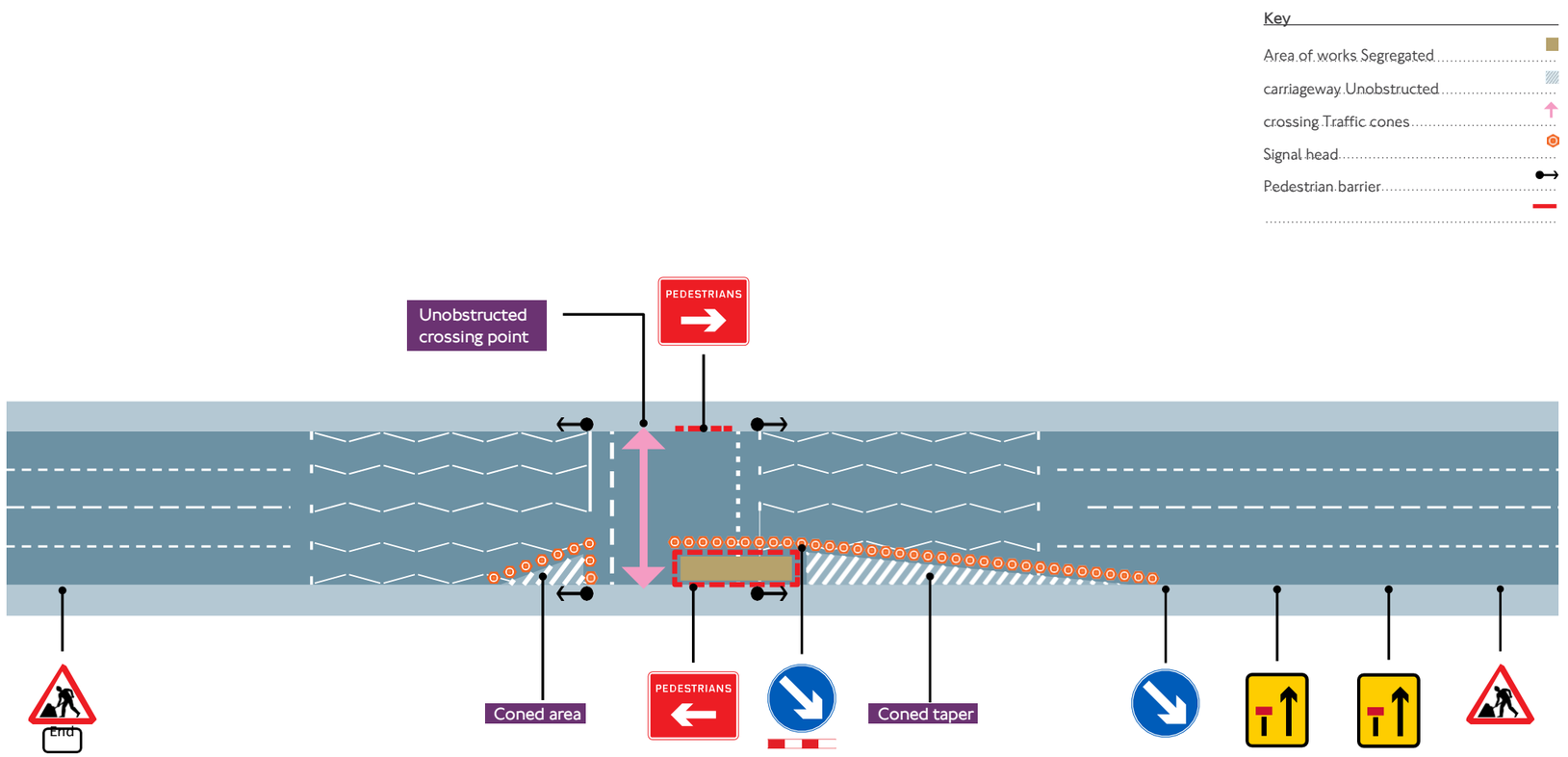
Where works encroach onto a crossing area or restrict a crossing point on the footway, but the crossing has space to remain open, barriers must be used to guide pedestrians and prevent the overall route length from being increased to more than the permanent arrangement. This will ensure traffic signal timings remain unaffected. If the overall crossing distance at a signalised crossing changes, TfL must be informed in order to alter signal timings to ensure they are safe.

2.11 Portable crossing facilities

To minimise congestion and pollution from traffic, the setting for pedestrian crossing phases should be carefully considered and subsequently monitored. Manual control by operatives may be required for an 'all red' phase for vehicles when there are high numbers of pedestrians at peak times or on event days if the site is near an entertainment or sporting venue.

Where permanent signalised crossing facilities are required to be switched out to facilitate works, the designer should provide a safe temporary crossing for pedestrians. TfL expects temporary crossing facilities to meet pedestrian desire lines. If this is not practical, a risk assessment needs to identify alternative provision.

Partially obscured crossing



Chapter 3 – Cyclists at roadworks

3.1 Designing for cyclists at roadworks

London's road network landscape is changing, with the introduction of more dedicated facilities to serve the increased number of cyclists. This has resulted in different types of cycles using the network, including those used as mobility aids and those for transporting goods or people. Current national guidance does not sufficiently cover recent developments in road user provisions such as segregated cycle lanes. This chapter expands on the currently published national guidance by setting out other considerations that should also be given to the needs of cyclists.

The Safety Code highlights the requirement for traffic management to take into account the needs of disabled and older people in the planning and execution of works.
Not all cyclists can easily dismount, particularly when the cycle is used as a mobility aid. Some types of cycle are wider and longer than others (such as cargo/child-carrying cycles and tricycles), and some users are particularly sensitive to poor surface conditions.

In addition to national standards, this chapter should also be read in conjunction with the following documents to provide a framework for considering temporary traffic management for cyclists during street works and roadworks.

- Traffic Advisory Leaflet 15/99 Cyclists at Roadworks[14]
- The London Cycle Design Standards[15] The London Cycle Design Standards provides useful information such as defining flow categories for cyclists.

Peak hour flow categories for cyclists

Peak hour flow category	One-way lane/track	Two-way track
Very low	<100	<100
Low	100-200	100-300
Medium	200-800	300-1,000
High	800-1,200	1,000-1,500
Very high	1,200+	1,500+

14 http://www.ukroads.org/webfiles/tal 15-99 cyclists at roadworks.pdf
15 https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit#on-this-page-2

3.2 General principles

The Safety Code states 'You should consider whether access on the carriageway can be preserved for cyclists, even if it needs to be closed to motor vehicles'.

Traffic management designs should retain or re-provide cycle facilities unless there are insurmountable barriers to doing so. This includes:

- Looking to preserve cycle access, even when the carriageway is closed to motor vehicles
- Preserving or introducing exemptions, contraflows and cycle gaps to maintain cycle accessibility during works
- Creating temporary dedicated cycle facilities where necessary

For designated cycle routes or streets with high cycle flows, a level of service reasonably equivalent to the permanent arrangement should be maintained.
Where all or part of the highway is closed on such streets, alternative suitable quality provision should be found for cyclists.

Where shared cycle facilities are temporarily closed, re-providing a similar standard facility may be challenging, but temporary facilities should be designed to work for all road users. Alternative cyclist provisions may be re-established by sharing general traffic lanes as part of temporary traffic management, but only where suitable lane widths exist, and only where speeds are appropriate for the purposes of sharing.

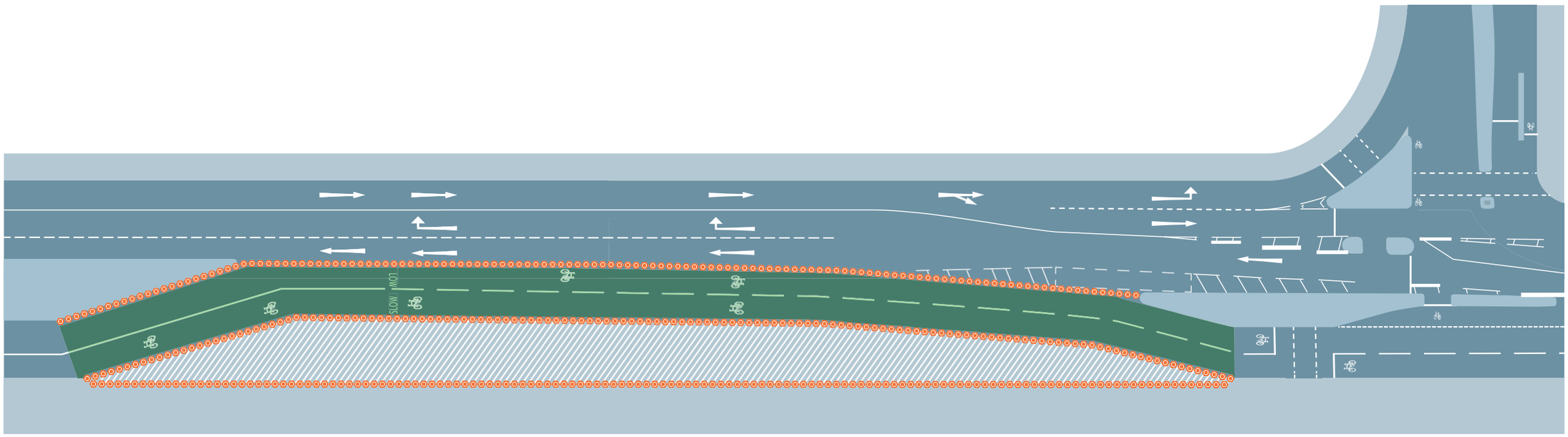
Footways may only reasonably be shared between pedestrians and cyclists if sufficient width is available and if traffic management has been designed to encourage courteous and responsible behaviour towards more vulnerable pedestrians.

Road closures impacting cyclists need careful consideration. Diverting cyclists onto other roads should only be necessary where it is not reasonably practicable to preserve cycle access. Diversions, if required, must not be unnecessarily long and should avoid mixing cyclists with heavy goods vehicles.

Rerouting segregated cycle lane to maintain a dedicated cycle facility

Key

- Temporarily rerouted cycle lane Works area
- Traffic cones



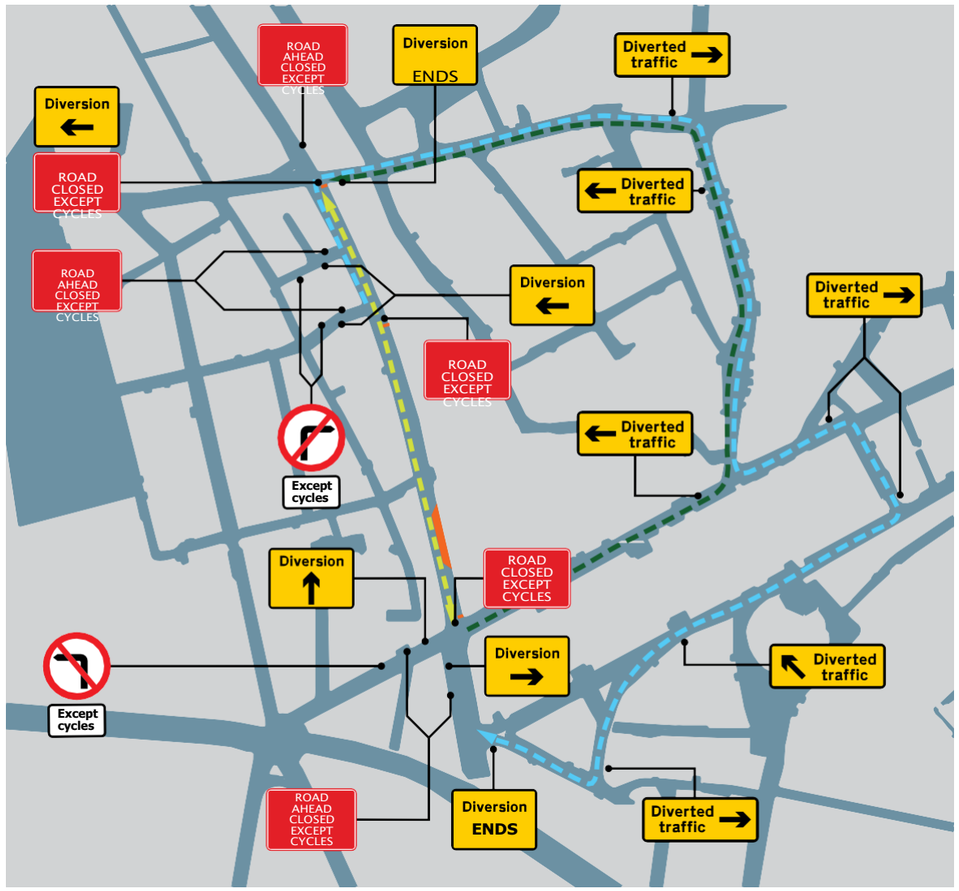
3.3 Maintaining access for cycling

Construction activities and temporary works impact all road users, but it is vital the needs of cyclists should be given appropriate consideration, particularly when considering lane widths and diversion routes.

Where it may be necessary to close the road for motor vehicles, wherever possible diversions should be avoided and access maintained for cyclists in both directions throughout the period of roadworks. Cyclists are unlikely to accept lengthy detours or long delays. In such conditions, some cyclists may attempt to access a road lane used by
traffic travelling in the opposite direction or mount footways.

Asking cyclists to dismount should be avoided if access can be maintained

Maintaining cycle provisions through a road closed to motor vehicles



Key

Area of works

Cycle route Car route

Options for maintaining cycling provision

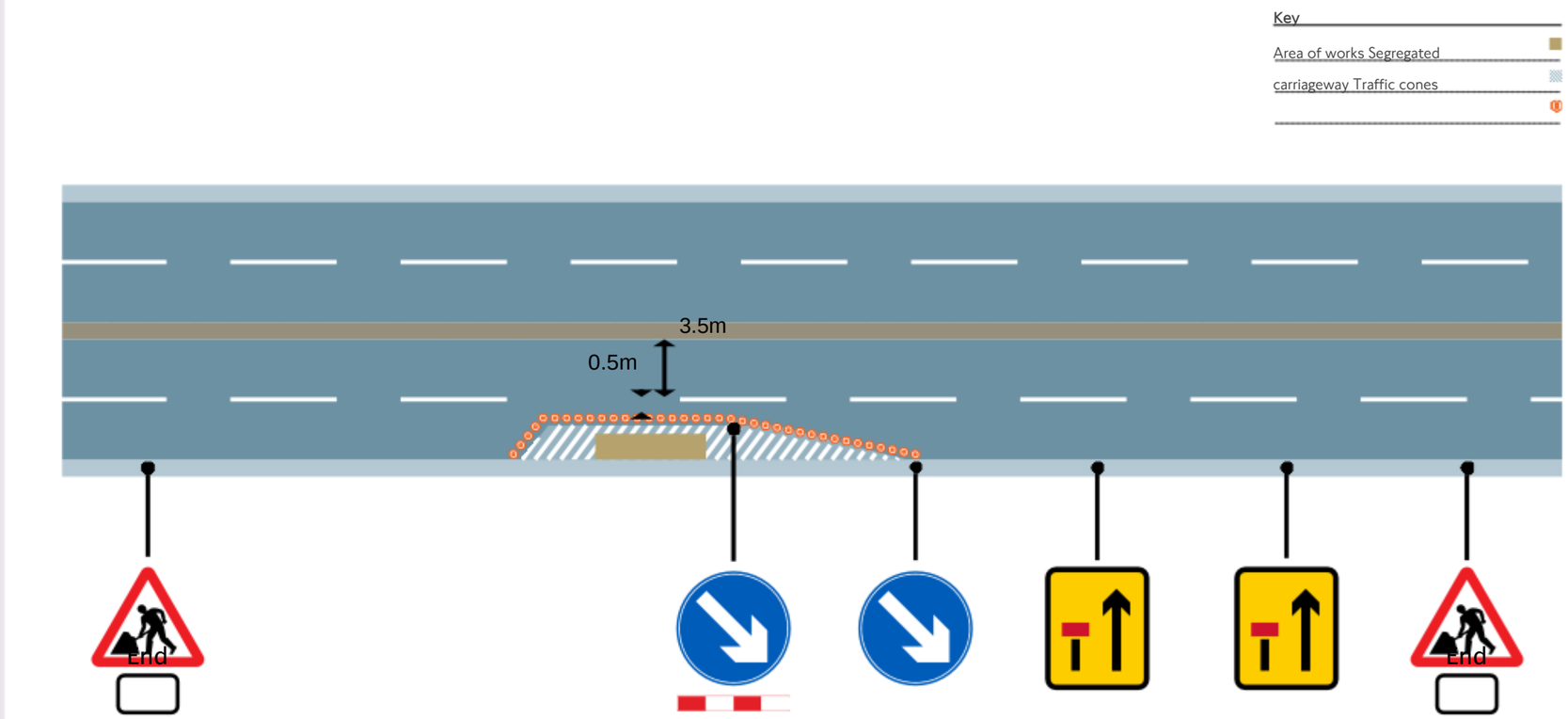
Alternatively, closures can be avoided by providing a temporary segregated contraflow cycle lane, shared path or route away from the carriageway. This kind of provision will be particularly desirable to avoid sending cycles onto a diversion that includes dual carriageways. Please see page 62 (3.6 Road closures and the impact on cycling) for further guidance.

Cyclists are generally more at risk through roadworks because of risks associated with obscured sight lines, merging with mainstream traffic, and pinch-points. In such scenarios, limiting the length of the site should be considered. For example, if a scheme is to be constructed over a length of 100 metres and a dedicated cycle facility or traffic lanes wider than 4 metres cannot be provided, then the traffic management should be restricted to shorter sections to reduce the exposure of cyclists travelling through more vulnerable road conditions over a greater distance. Where there is significant cycle demand and the length of the works site cannot be adapted, alternative measures should be considered, such as provision of an off-road cycling facility, or a general vehicular traffic diversion while retaining dedicated cycle facilities through the works site.

Possible cycle routing options to avoid dual carriageway diversions

Where site conditions allow, the cone line or outer edge of a full lane closure can often be narrowed/pulled back from the carriageway lane markings to create the preferred width to accommodate cycling. This approach is especially important for sites immediately on the approach to signalised junctions, where cyclists often filter through queuing vehicles in order to reach the stop/give way line.

Minimising the width of a full lane closure to allow space for cyclists



There are a number of potential hazards or impacts that must be considered when designing 'cycle friendly' temporary traffic management on the carriageway, including:

Impact

How will the traffic be managed where a cycle lane is removed or rerouted?

Has consideration been given to cycle-specific diversion routes separate to the motor vehicle diversion routes?

Can cycles enter the works site through widely spaced cones or other permeable traffic management segregation measures?

Is the traffic management for a full road closure without cyclist exemption robust enough to prevent cyclists breaching the blockade?

How will cyclists who are less able to walk manage on foot if required to dismount?

Can a cycle contraflow be maintained where a directional closure without cyclist exemption is proposed?

Will a cycling dismount area be safe and clear of flowing traffic?

Signing and guarding

Is it necessary to use 'cyclists dismount' signs if an alternative route is available, eg in the carriageway?

What measures have been considered to avoid conflicts between cyclists and pedestrians (including short, temporary route alterations or sharing space)?

Are existing and temporary cycle lanes free from obstructions, including roadworks signing?

Geometry

Will the traffic management proposals obstruct cyclist sight lines?

Have pinch-points been identified that may 'squeeze' cyclists?

Where there is a single lane, will a challenging steep incline of the road cause cyclists to unreasonably compromise vehicle movement?

Surface condition

Has the condition of the road surface been assessed to address any imperfections such as raised ironwork, potholes and surface debris that might cause skidding?

Are all proposed temporary measures safe for cyclists, including raised cable protectors, hoses or road plates?

3.4 Temporary signing for cyclists

All temporary signs at roadworks must meet the requirements of the TSRGD. Further guidance is supplied in the DfT Traffic Advisory Leaflet 01/14[16] (Temporary white on red signs at roadworks).

Designers must use prescribed signs where they exist before they design other temporary signs that are covered in Schedule 13 Part 9 of the TSRGD 2016. Where designers need to create temporary signs for cyclists under this provision they must be white text on a red background. If the sign contains a more general message then it will be black text on a yellow background.

As Schedule 13 Part 9 provision of the TSRGD allows designers a more flexible approach to producing signs, there is scope to use different terminology to describe a cycle facility, ie, cycle lane, cycle track, cycle route and cycle path. These terms do not mean the same thing, and are frequently misused. This inconsistent messaging creates road user confusion, especially when passing through multiple works areas.

In order to promote consistency in terminology when designing signing the following table should be used to define cycle provisions:

Cycle lane	Part of a carriageway marked with a formal lane marking and allocated for use by cyclists. Cycle lanes can either be advisory ('dashed') or mandatory ('solid') 
Cycle track	A right of way for pedal cycles with or without right of way on foot. It can either be: • Part of a public highway adjacent to a carriageway, or • A separate highway in its own right Pedestrians and cyclists may be separated by physical barriers, by level, or by markings only
Cycle route	A continuous, linear series of links and junctions, signed and/or branded as a coherent facility from A to B; usually planned and delivered as a single facility or in identified phases. For roadworks that are local in nature, signing should make reference to cycle lanes or tracks as appropriate. Only when a substantial section of a defined route is diverted on to an alternative road would reference be made to a route
Cycle path	A non-specific term and should not be used on road traffic signs

16 https://www.gov.uk/government/publications/temporary-white-on-red-signs-at-road-works

Bad practice: designers must ensure they use the right signs and choose the right colours to ensure traffic management is compliant and consistent

Good practice: when signs are correct and appropriately used road users are more likely to comply with the instructions

Temporary routes and other facilities for the exclusive use of cyclists should be clearly signed well in advance of the roadworks.

Only when all other reasonable possibilities have been exhausted is it acceptable for a works promoter to utilise 'Cyclists dismount and use footway' signs. In the vast majority of cases, the network can be reconfigured to retain space for cycling and the use of this sign is very much a last resort option.

Where the 'dismount' signs are unavoidable, works promoters should consider the impact of cyclists who wilfully ignore the signed instruction and potentially compromise pedestrian safety. They should equally be mindful that not all cyclists can easily dismount and proceed on foot, especially those using cycles as mobility aids.

Forcing people with disabilities to proceed on foot or assisting them to dismount could cause accidental injury to either party. In these scenarios, the provision of marshals on site can assist disabled cyclists to find the best possible solution to navigate around the works without having to dismount. It is recommended marshals receive disability equality training to assist in these situations.

Alternative sign mounting reduces trip hazard and sign maintenance

Where a cycle lane is closed within the carriageway and cycles are directed to join the traffic by blue and white arrows and cone tapers, there is no requirement for additional 'cycle lane closed' or 'cycle lane closed ahead' signs. However, if the works necessitate the closure of a cycle lane and motor vehicles are necessarily directed to use the lane, then the signs would be expected to notify all road users that motor vehicles will need to enter the cycle lane. When signing is required to give instructions or information to cyclists (eg 'Cycle lane closed'), designers must consider the need for advance signing (eg 'Cycle land ahead closed'), so that cyclists may alter their road position in good time. This is especially important on declines and sections of road with high cycle demand.

Where cyclists are required to merge back in with motor vehicle traffic because a cycle lane or cycle track is closed ahead, it would not be necessary to sign a cyclist diversion route. It should be clear to cyclists approaching from either direction where the facility is closed, where they can safely join the carriageway and where the facility is re-opened. Excessive signing contributes to clutter and creates potential obstructions and maintenance issues.

For longer duration works, semi-permanent sign installation may be preferable to conventional temporary A frame signs. These reduce trip hazards and maintenance and ensure the signs remain visible and effective at all times.

Cycle lane closure signs

3.5 Shared-use footways

Providing a temporary shared footway between cycles and pedestrians is not generally desirable when determining traffic management solutions for roadworks. Efforts should be made to accommodate cycles safely on the track or carriageway. Where it is deemed necessary, an assessment of the cycle and pedestrian flows will need to be made to ensure the design is robust and viable for the anticipated demand. Local Transport Note LTN 1/12[17] 'Shared use routes for pedestrians and cyclists' is a useful reference guide, as is the London Cycling Design Standards,[18] which gives indicative pedestrian and cycle flow ranges for shared facilities.

The characteristics of shared-use footways can vary significantly and will influence the optimum traffic management design solution. A local risk assessment must therefore be undertaken to understand:

- The locality of street furniture
- Access to properties
- Flows of cycles and pedestrians when the works are taking place
- Whether the route has any form of segregation
- The length of works
- The nature of the adjacent carriageway and available space

On partially separated (ie where the separation is not continuous along the route) and shared routes, cycle flow must be considered relative to pedestrian flow – the categories in the table at the bottom are specified in the London Cycle Design Standards.

A width of 3 metres is the desirable minimum for a shared path with two- way cycling, but this is dependent on user flows. On low-usage footways with a short works length and duration this may be reduced to an absolute minimum of 2.2 metres. On shared-use routes
with single-direction cycle routes, the desirable minimum width is 2.5 metres. However, with low-usage footways, this may be reduced to an absolute minimum of 1.5 metres if the works are of a short length and duration.

Designers proposing shared-use facilities will need to also factor in the requirement for a Temporary Suspension Request to authorise the shared use and a detailed traffic management assessment.

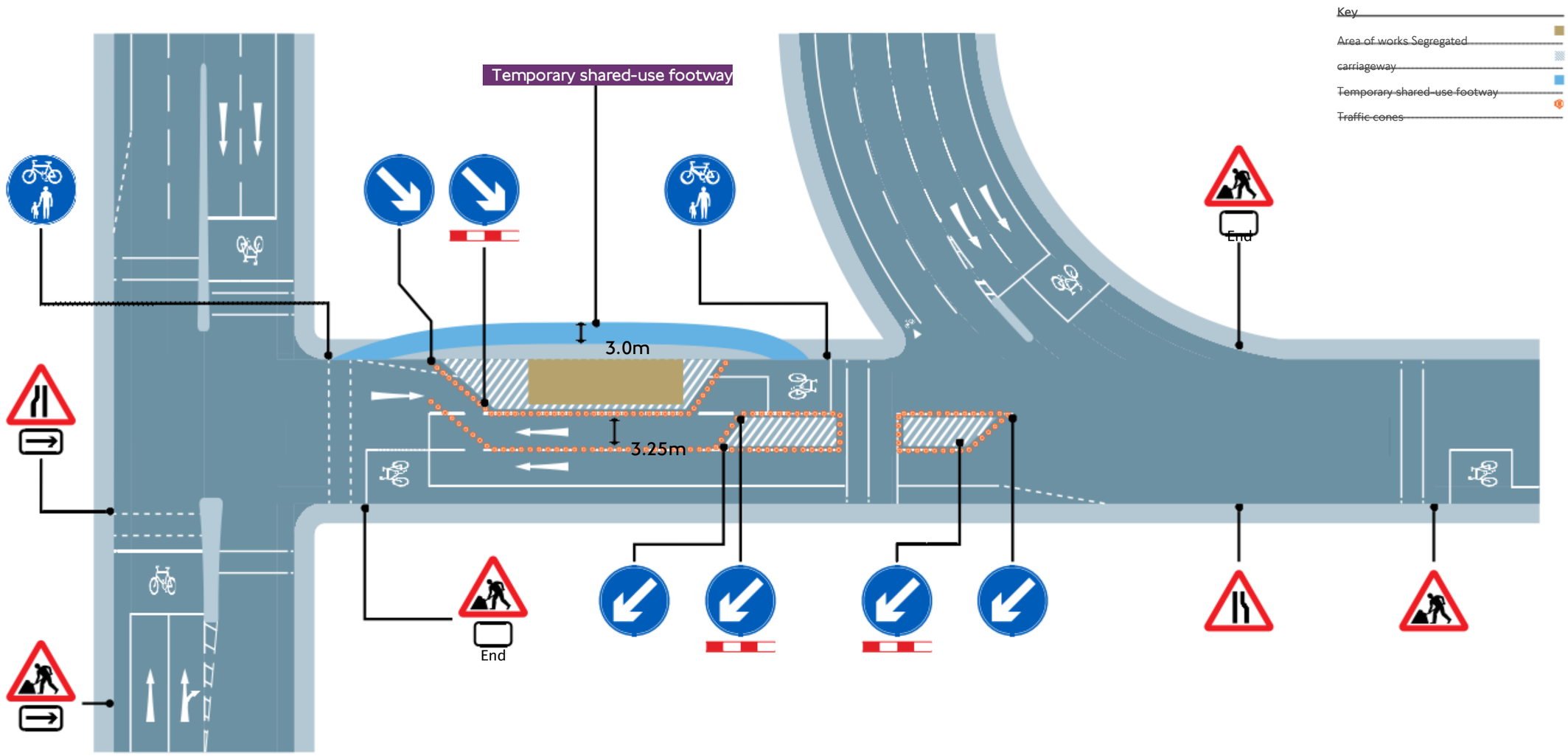
17 https://www.gov.uk/government/publications/shared-use

18 https://tfl.gov.uk/corporate/publications-and-reports/streets-toolkit#on-this-page-2

Flow categories for partially separated and shared routes

Peak hour flow category	Pedestrians per hour	Cyclists per hour
Very low	0-120	0-60
Low	120-200	60-150
Medium	200-450	150-300
High	450-900	300-450
Very high	900+	450+

Example road layout of a temporary shared-use footway to enable cycles to safely transition past a works site segregated from traffic



3.6 Road closures and the impact on cycling

Full road closures can present unique issues for cyclists, which may be particularly important on routes with high cycle flows.

This will be especially necessary where a diversion route fulfils one or more of these conditions:

- Involves significantly greater effort to the diverted cyclists owing to new, unreasonably extensive distances and gradients
- If it is a heavily used cycle commuter route and the intention is to close the road during peak hours
- Put cyclists at greater risk due to the road layout and traffic conditions on the diversion route
- The temporary works will be required for a prolonged period

Diversion routes must be assessed for their suitability for cycling as well as motor vehicles because, from a cyclist's perspective, they may appear to be overly long or arduous. If some cyclists find an apparently shorter route more attractive, this may result in unsafe movements through junctions and prohibited or illegal footway riding.

Bad practice: designers should avoid the need to request cyclists to dismount if they can safely continue in the carriageway

In the first instance, the site should be assessed with the aim of maintaining a safe route for cyclists past the works. While a closure to motor traffic may be necessary, exceptions can often be made for cycles, which can use relatively narrow widths (but ideally no less than 1.5 metres). The London Cycle Design Standards gives useful guidance on defining effective widths.

Where a road is fully closed to motor vehicles in both directions, yet a route is

closed except cycles' or 'Road closed except for access and cycles' should be used. Where a road is partially closed ie closed in a given direction to motor vehicles only, with cycles permitted through a closure point, then it may be preferable to use a 'No entry' sign with an 'Except cycles' sub-plate.

Care must be taken to ensure the design makes it clear to all road users, especially pedestrians, that cycles are permitted through a closure point. Where cycles pass through a closure point that prohibits motor traffic or in contraflow situations, it should be clear to pedestrians to expect cycles, particularly at crossings. Barriers and other methods of separation may well be required to mitigate any risk and designers should consider sight lines.

Cycle signs used at road closures

No entry sign except cycles

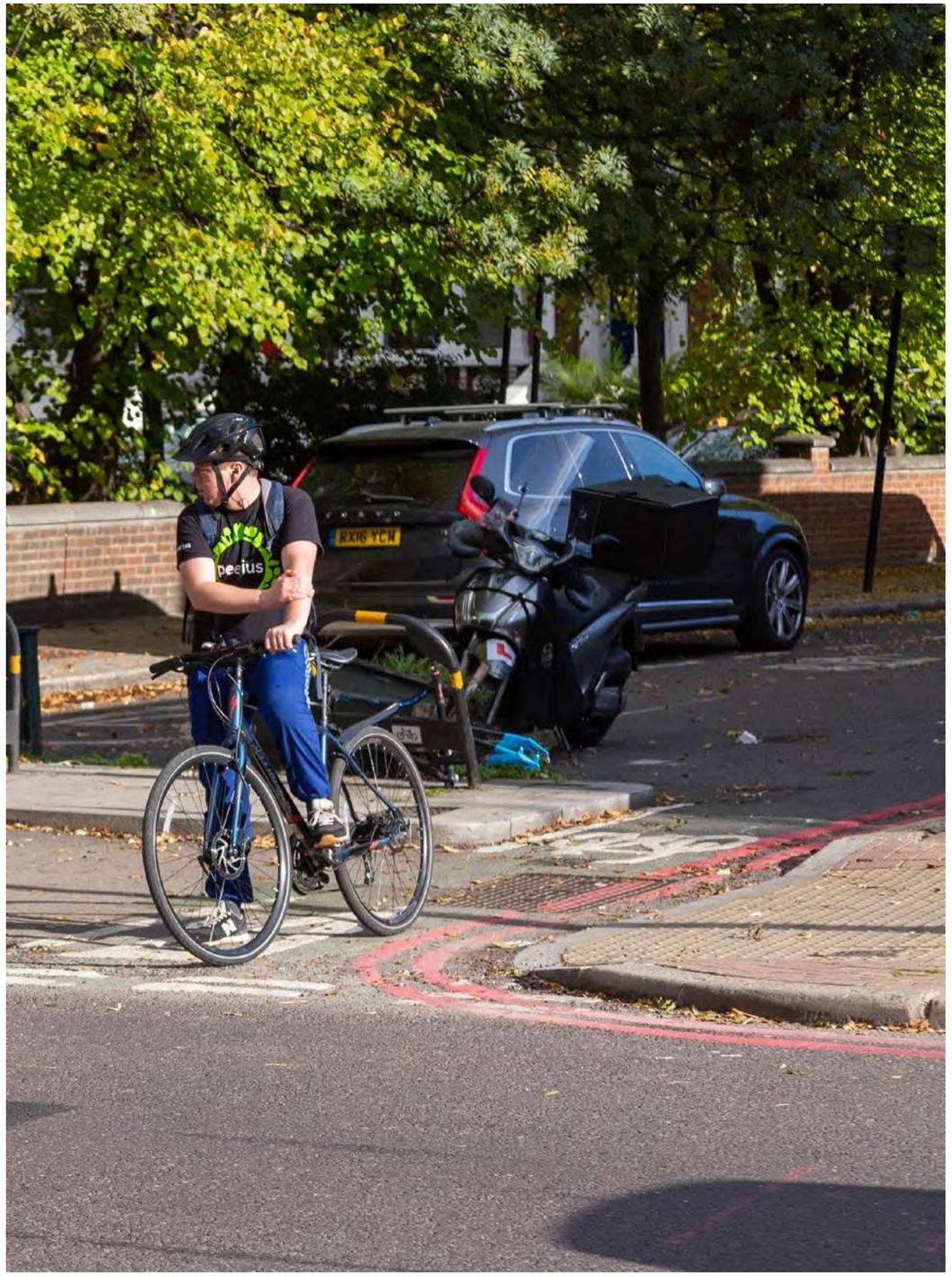
Diverted cyclists sign

Contraflow cycle lanes or tracks should be a recommended minimum of 1.5 metres, or an absolute minimum of
1.2 metres wide where providing the desirable width would compromise facilities for other road users. A site- based risk assessment may identify that physical segregation from opposing traffic may be required. Opposing traffic must have sufficient lane width not to encroach in this facility.

Contraflows of any vehicles can be confusing to pedestrians who may instinctively not notice approaching traffic if they are not expecting it.
Pedestrian barriers should be considered along the length of the contraflow
to prevent pedestrian encroachment other than at crossing points. Further mitigation measures should be considered to warn people crossing the contraflow cycle lane to look out for cycles in both directions and also cycles approaching in the temporary contraflow lane. Designers should acknowledge
that some cyclists may decide to remain on the carriageway if the diversion is too long.

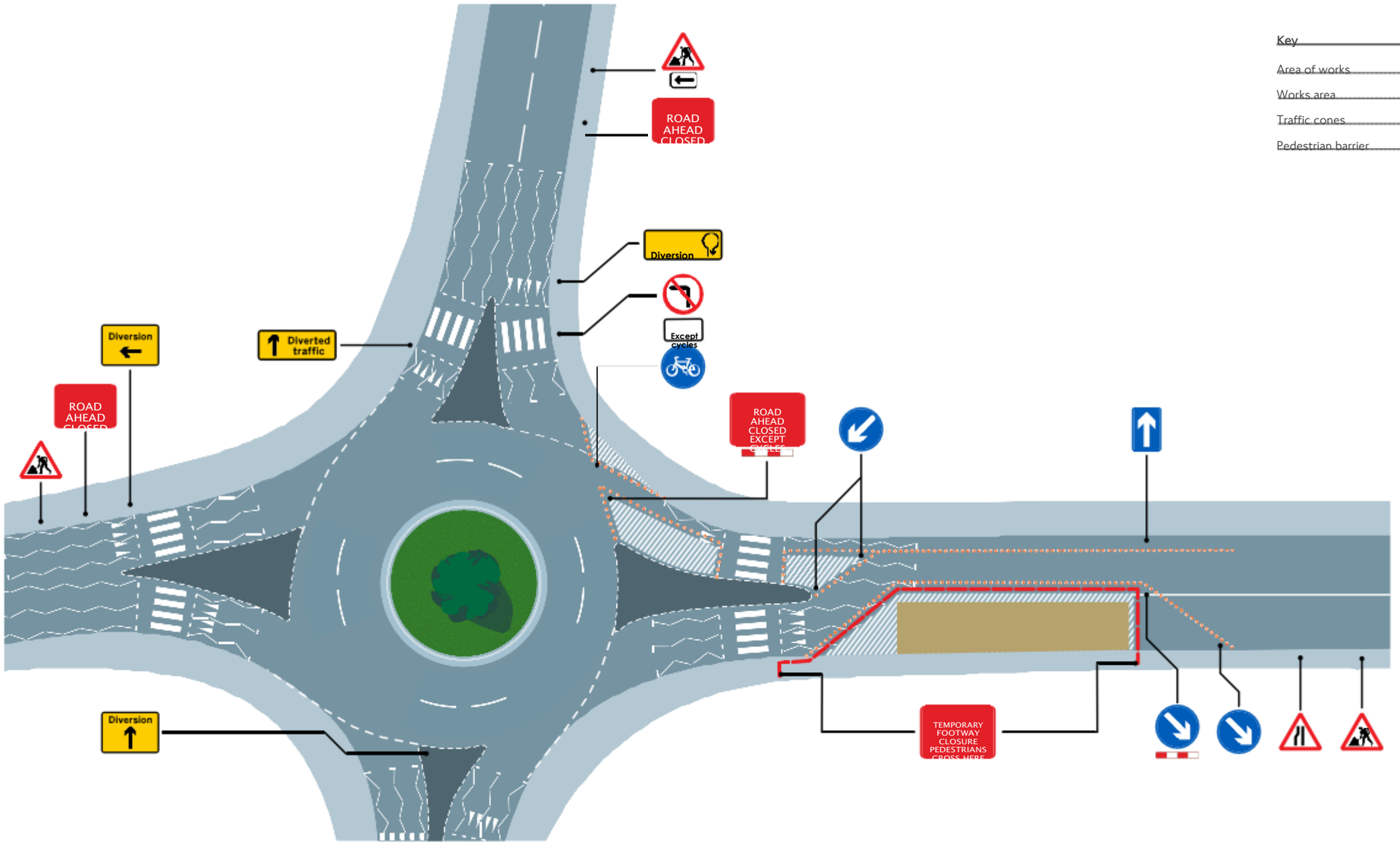
If it is not possible to retain space for cycling on a road closed to motor vehicles and the primary diversion route is likely to be too arduous or hazardous for cyclists to use, a cycle-specific alternative route should be considered, which could be shorter, on quieter roads and signed accordingly.

Where cycle diversion routes are necessary they must be as short as practicable to desire lines and clearly signed, preferably using routes with light traffic flows. Often cycles can legally pass through routes prohibited to motor vehicles such as roads with filtered permeability, eg bollard-protected cul-de-sacs.



Cycle diversion routes should make use of roads with filtered permeability

Cycle contraflow system



Cycle safety at roadworks

Sign warning of narrow lanes affecting cyclist safety

Sign face dimensions

3.7 Lane widths and temporary speed limit reduction

The TLRN comprises London's major roads and carries around a third of all the city's traffic. Therefore, it is used by large goods vehicles, buses and cars, along with large numbers of pedestrians and cyclists.

The first priority of any traffic management designer is to design out risk and remove the hazard and consequential need for additional signing. Retaining or re-providing facilities for cycles that are equivalent to the pre-existing level of service are the preferred options. However, it is acknowledged that maintaining the same level of service may not always be feasible due to the physical constraints of the highway. This is especially the case where cycles are accommodated on-carriageway. Where cycles are required to share space with motor vehicles as they pass the works site, it is essential to ensure adequate lane widths can be provided.

Warning sign should not be black and yellow

Correct warning sign

Running lane widths must be suitable to cater for all vehicle types likely to be using the lane, which could mean that certain widths are hazardous to cycles sharing space with motor vehicles. In these circumstances, TfL expects the risk to be mitigated with signing if the hazard cannot reasonably be designed out.

To minimise the risk arising from cyclists being overtaken too closely in a narrow lane and to promote increased comfort levels for cyclists, the 'Narrow lane do not overtake cyclists' sign should be used.

The sign must be manufactured in accordance with the specification above.

Straightforward narrow lanes may not be the only reason why a sign to instruct drivers not to overtake cyclists might be required. Greater risk at bends, pinch-points and corners may also justify a 'do not overtake' sign.

The sign should be placed on all approaches to the narrow lane, normally after the road narrows sign or lane closure (wicket board) signs and prior to the first cone, and only be used where all of the conditions apply:

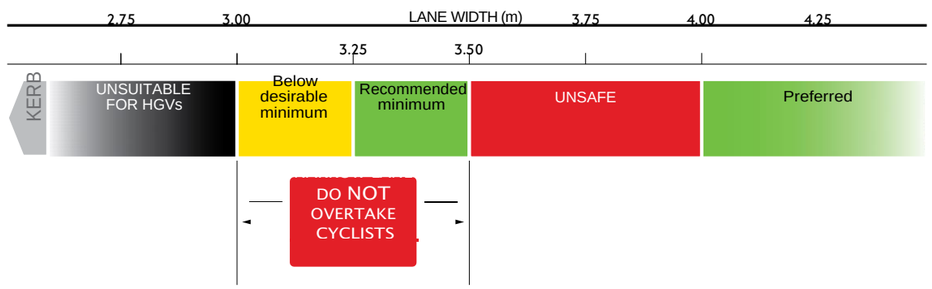
- Where cycles are required to share a lane with motor vehicles as no suitable alternative facility is achievable
- Where the carriageway is either a single carriageway of any speed limit or a dual carriageway where the permanent road speed limit is 30mph or less
- Where there is only a single lane available for traffic in the given direction
- Where the available lane width is 3 metres to 3.5 metres

The sign should not be deployed in other situations as inappropriate use dilutes the message and its effectiveness in scenarios where it would be appropriate and required.

Lane widths of four metres or more enable cars and wider vehicles to overtake cyclists safely. Therefore, where possible, designers should look to maintain or create lane widths of at least 4 metres on carriageways where high cycle flows exist.

If a 4-metre-wide lane is not achievable, then the straight narrow lanes design objective must be to deter overtaking cyclists because it cannot be achieved with safe clearance. Therefore, the lane width should be reduced to a maximum of 3.5 metres because lane widths greater than 3.5 metres and less than 4 metres must be avoided to discourage wider vehicles attempting to overtake cyclists when there is insufficient space to do so.

Lane width guidance for cycles in carriageway



Widths between 3.25 metres and 3.5 metres will allow buses and HGVs to use the lane but it will not be possible for them to overtake cycles.

The desirable minimum lane width in temporary situations for buses and HGVs is 3.25 metres, but in exceptional circumstances the lane width may be reduced to an absolute minimum of 3 metres as per the Safety Code. If this narrow lane is on a bus route you will need to liaise with the TfL Bus Operations team to discuss the restrictions and possible impact on the bus services.

The lane widths specified above are based on straight or near-straight traffic management layouts. For traffic management layouts incorporating bends or geometry that are not linear in nature, the designer should consider undertaking swept path analysis to establish if vehicle tracking is viable to pass the works and alter the lane widths as necessary.

Where HGVs and buses are on diversion, lane widths can be reduced to an absolute minimum of 2.5 metres.

However, research shows that traffic lane widths between 3.2 and 3.9 metres where there is no dedicated cycle lane are an inherent risk to cyclists as they can lead to uncomfortably close passes of cyclists because drivers are left uncertain about whether it is safe to overtake.

Reducing speed limits must be considered in situations where lane widths are less than 3.5 metres and motor vehicles are unable to pass cyclists safely. These reductions can be either in an advisory form or regulatory depending on the circumstances, such as the duration of the traffic management phase. Speed camera enforcement should also be considered where deemed appropriate, which should be discussed with the traffic management assessment team.

Where possible, the available lane width will encompass the normal running lane but it may also include hatched areas where traffic is permitted to enter for short duration works.
For longer duration works or where the road layout may lead to road user confusion, it may be necessary to modify the existing markings.

Two-way working on single carriageways with available remaining carriageway width of 6.75 metres or above will not necessarily require physical segregation between opposing lanes.

Site-specific risk assessments will determine the need for segregation and will be based on factors such as the duration of works, traffic flows – particularly the number of cycles and HGVs – and road geometry and features.

3.8 Barriers and cyclists

When selecting barrier products for longitudinal runs along which cyclists may pass, designers must ensure the feet or bases of the barrier do not introduce a hazard to pedals of the bicycles.

3.9 Surface quality

Designers should be mindful of the particular vulnerabilities that cyclists encounter such as uneven, slippery or excessively rough surfaces. Risk assessments should be undertaken to ensure that cyclists are not being guided into hazardous surfaces and raised ironwork.

If cyclists are to be signed via a diversion route, then the surfacing on this alternative alignment should be assessed and made safe if necessary before the diversion is deemed adequate.

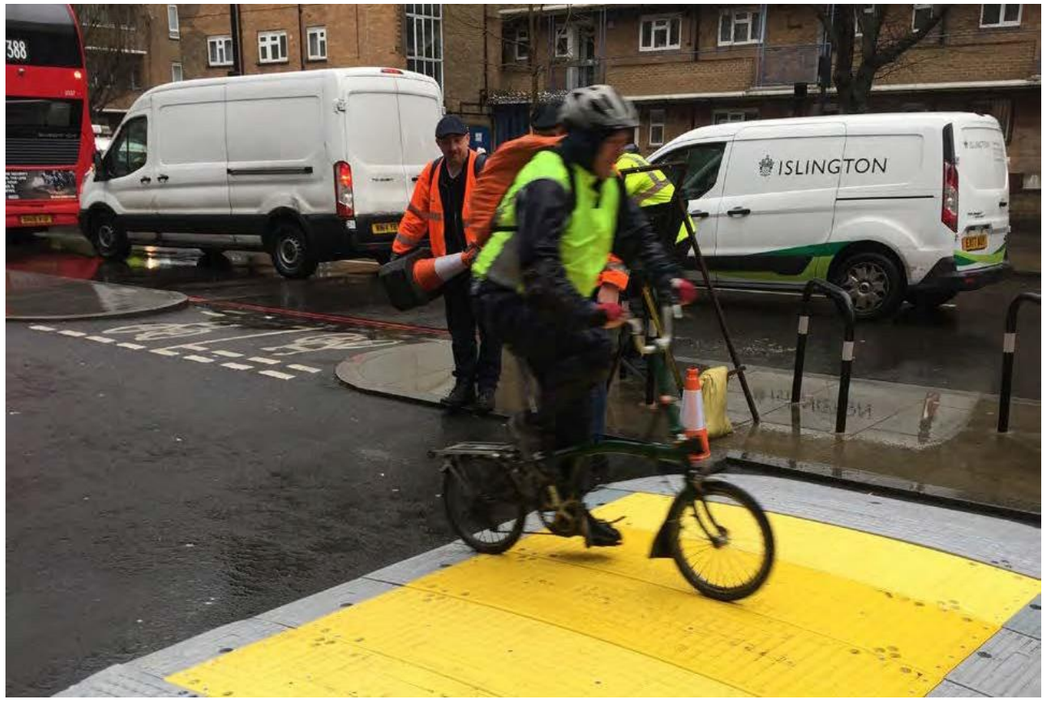
Barriers are often the best product to guide cyclists

3.10 Cycle track ramps and boards

London has a variety of cycle tracks with different characteristics that require assessing before deciding on the correct type of temporary ramps or boards to install. In most circumstances where cycle tracks are on footways, either shared-use or segregated, conventional footway boards will be sufficient.

Segregated cycle tracks, however, do have vehicular crossings and transitions. In these locations, a higher-specification road plate may be required. Emergency vehicles sometimes access segregated tracks so works promoters should ensure any temporary covers are adequately signed and visibly stand out.

Boards, humps or ramp approaches that are greater than 50mm high should be sinusoidal in profile to minimise rider vibration and avoid deterring cyclists from using the route (see Road hump profiles diagram on page 75). If a sinusoidal ramp is not achievable, leading edges of ramps should be clearly highlighted or clearly marked so they can more easily be anticipated by cyclists.



Cycle track road plating system

The London Cycling Design Standards advise that maximum linear ramp gradients should normally be between 1:10 and 1:20. It is recommended that the new surface of the hump is continued 500mm beyond the ramp into the existing carriageway surface to produce a smoother profile.

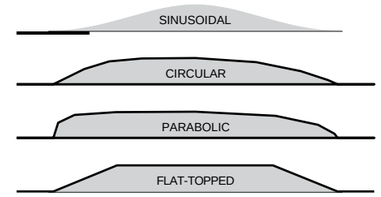
In instances where extended or multiple ramps are needed, they should preferably avoid 'L' and 'T' shape configurations, or run parallel with the general direction of cycle travel.
Turning circles of larger cycles and of mobility scooters should also be taken into account when considering the use of ramps and landing areas.

Leading or tail edges of ramps should be installed avoiding acute angles so that the edges are as far as practicable to be perpendicular to the approach/exit route of cycles.

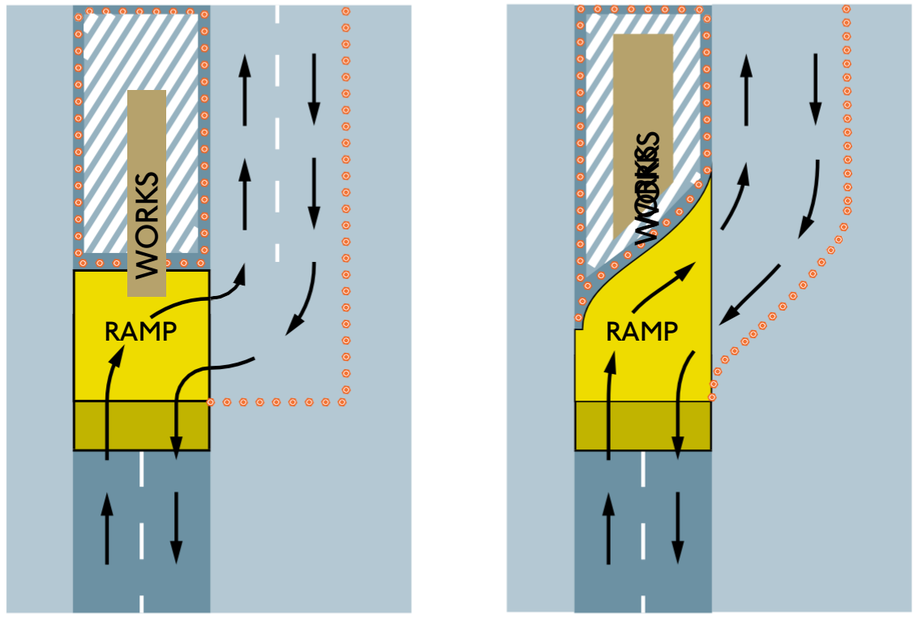
Temporary ramps should have high friction surfaces and should avoid adverse cambers as certain cycles are more prone to tipping over, such as disability cycles, tricycles and cargo cycles.

All temporary ramps should be signed with 'Ramp' signs to highlight the hazard. Where advanced visibility is fully or partially obscured or it could reasonably be expected to be obscured during high cycle flows, a supplementary 'Ramp ahead' sign is advisable.

Road hump profiles



Cycle ramps must take into account turning circles of various types of cycles



Ramp with 90° bend

Ramp without 90°bend

3.11 Tempo rary traffic signals

Temporary traffic signals should give cyclists sufficient opportunity to pass safely through roadworks with the appropriate intergreen times used to prevent collisions or unsafe passing with oncoming motor vehicles in a shuttle lane. When specifying the most appropriate arrangements, consideration should be given to clearance times for cyclists, particularly on steep hills.

When a traffic management drawing is submitted with portable traffic signals, the drawing and location will be assessed and signal timings may be supplied by TfL to the designer for implementation. Otherwise, the contractor will be expected to operate them as agreed or
in line with the recommendations of the DfT 'An Introduction to the use of Portable Vehicular Signals'[19] booklet, which is also known as the 'Pink Book'.

19 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/509198/introduction-use-portable-vehicular-signals.pdf

3.12 Works on the carriageway without cycle lanes

Where works occupy an area in the carriageway where there is no permanent provision for cycles (this may include bus lanes), either at the location or in close proximity to the approaches to the site, it is not normally expected that a temporary cycle lane would be required for the works. This is unless the road layout and/or workspace requirements place cyclists into a significantly more vulnerable position as identified in a risk assessment.

Where there is an identifiable increased risk to cyclists, consideration should be given to providing a facility through temporary carriageway markings or physical segregation. Risks may include heavy traffic flows, poor surface quality, construction traffic movements, or just the high volume of cyclists. A key consideration in addition to the risk will be the available space on the carriageway and the resulting lane widths available. For further information please see 3.7 regarding lane widths.

This scenario is more likely to be identified in outer London boroughs, where the mix of cycles in relation to motor traffic is lower when compared to inner London. However, sections of the road network exist in many locations where no extra provision is required provided lane widths are generous and hazards are low.

In these circumstances the traffic management may look typically generic with no extra measures for cyclists, except for signing to warn of narrow lanes when the width is 3.5 metres or less.

The works site length should be kept to a minimum to reduce the impact on general traffic and discomfort for cyclists. Long stretches of traffic management can become intimidating for cyclists and frustrating for motorists. When considering the length of traffic management arrangements, designers will also need to be mindful of the likely speeds of cyclists passing through the works as their speed may be adversely affected by gradients. Consideration should be given to phasing the works for reduced lengths of road space occupation, and storing materials and plant away from cycle routes with a high demand.

Cycling in works without cycle lanes

3.13 Works on the carriageway with cycle lanes

Where there is a cycle lane within the carriageway that will become obstructed by the safety zones or working area, then it will be expected that the facility will be re-provided past the temporary works, unless the risk to cyclists has been deemed acceptably low.

Where the temporary segregation terminates, care needs to be taken to ensure cyclists re-join the carriageway in a safe manner and location. Both drivers and cyclists need good visibility of each other and the alignment of their respective approaches so as to ensure a smooth transition.

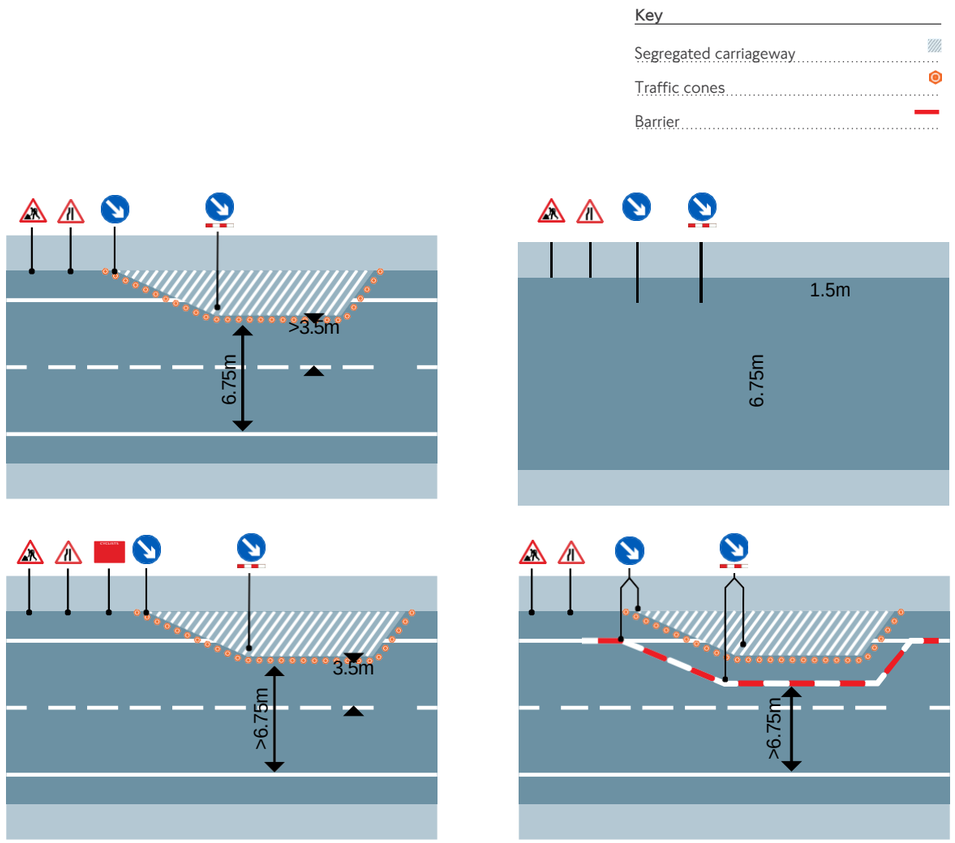
If it is not viable to provide delineation or segregation, it would be expected designers consider risk mitigation using other measures, such as using hazard warning signing, separation of road users by diverting motor vehicles, or cyclists via different routes, or speed reduction.

Designers need to be mindful of cyclist behaviours and the possibility of cyclists entering and exiting the facility between cylinders. Where it is desirable to retain cyclists in a lane or prevent access/egress along the lane, then continuous barriers are advised.

3.14 Cycle lane closure

Cycle lanes are classed as being in the carriageway and therefore subject to Lane Rental charges in accordance with the charges for the adjacent running lanes. Cycle tracks are specifically covered by Lane Rental charges but shared-use paths may not be chargeable if an alternative route is provided. TfL's Assessment team should be contacted if clarification is required.

Alternative examples for works in or adjacent to cycle lanes



3.15 Works on cycle tracks

Segregated cycle facilities feature on many sections of the TLRN and provide a vital network for cyclists on key routes.

Segregated cycle tracks, particularly bi-directional tracks, present challenging issues for traffic management designers as considerations need to be given to managing the passage of pedestrians, cycles and motor vehicles, all with separate facilities that will frequently intersect. Signalised junctions will need detailed consideration, and consultation with TfL will be required to ensure traffic management designs can be operable and safe in conjunction with the phasing of the lights.

Where partial obstruction of the segregated cycle tracks is required for works, the same sign sequence and signing principles apply to cycle traffic in the track as to general vehicular traffic in the carriageway.

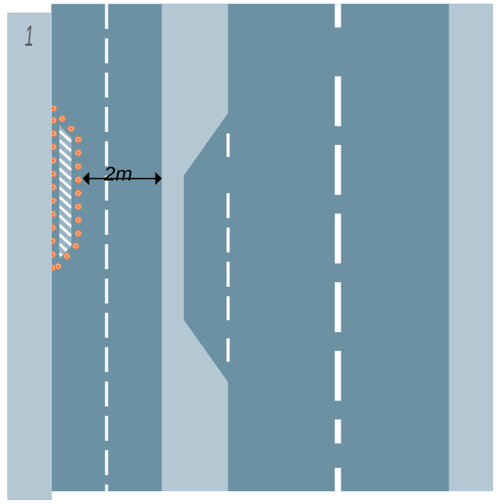
The necessary space remaining open to cycling will be dependent on several factors, including the predicted cycle flows, the day and time of works, and the duration of works. TfL expect track widths to adhere to the following:

- Bi-directional tracks: 2 metres desirable minimum total track width
- Single direction tracks: 1.5 metres desirable minimum total track width

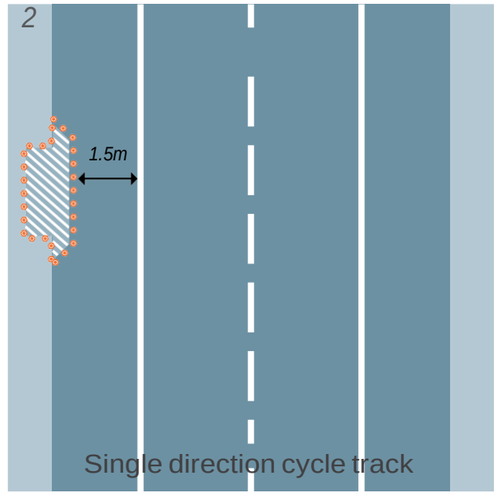
It is paramount that cones or barriers marking the segregation boundary are in good order and well maintained.
Barriers with protruding feet should be avoided as there is an increased risk to cycilists, who may snag pedals.

Where works require the total obstruction of the cycle facility, it will be incumbent upon the designer to seek, in the first instance, to re- provide a segregated facility of similar level of service past the works. This will most likely require routing the cycle track into the carriageway, but if this is not possible, cycles could potentially be directed onto the footway by the creation of a shared-use footway to enable cycles to continue without dismounting. If neither of these options is possible, cyclists should be redirected to join the carriageway at a safe location.

Desirable minimum cycle track and cycle lane widths



Bi-directional cycle track



Single direction cycle track

Chapter 4 – Other road users at roadworks

4.1 Introduction

Although safety at roadworks is a top priority, it is also important that we continue to deliver a good transport experience for all of our customers.

London buses transport more people than any other public transport mode. They can move 70 people in the same amount of road space occupied by three cars. People using public transport typically do between eight and 15 minutes of active travel per day, which supports the Mayor's Healthy Streets Approach.

In 2018, lorries and vans account for around one fifth of road traffic in London. As London grows the volume of freight and servicing trips is forecast to grow – delivering economic and commercial benefits to London.

Therefore, it is important that disruption caused by roadworks to motorised vehicles is minimised, and that these road users have confidence in the reliability of their journey choice.

Advising powered two-wheelers of uneven road surface

4.2 Powered two-wheelers and mobility scooters

The safety of motorcycle and mobility scooter users also needs to be considered when designing traffic management. Maintaining clear sight- lines and smooth road and footway surfaces to minimise incidents is paramount. On-site wheel cleaning and road sweepers should be available to restrict muck transferring to the road space outside the site area.

4.3 Bus passengers

Sustaining bus services while roadworks are being undertaken is a key priority for TfL, given the high number of passengers that can be transported
by this service. Therefore, every effort must be made to ensure services remain unaffected. Where that is not possible, temporary measures should be considered, including:

- Planning traffic management phases to avoid bus stop closures. Temporary bus stop facilities should be provided where this is not possible

- Continuation of a dedicated bus lane. Where there are a high number of bus services, consideration should be given to retaining a dedicated facility for buses only and placing other motorised vehicles on diversion.

- Keeping diversion routes to an absolute minimum

- Supplying an alternative shuttle bus service. This may be using a smaller-sized mini-bus that is able to navigate around the roadworks
site, or a smaller bus on a short local diversion away from the works

Developers and contractors will need to understand the impacts to both journey times and the cost implications to the operators when designing proposals.
TfL assessors are able to provide information on the predicted number of bus passengers who may be impacted by restricting bus journeys. Access to the site during construction may also be a cause of delay to London's bus passengers, whether along the route or by suspending bus stops and bus lanes.

Separate approvals are required for suspending bus stops and bus lanes. Bus lanes can be suspended by a temporary suspension request – see
Chapter 2 (page 16). Requests for bus stop suspensions are made through the Bus Operations (see 4.4 Timescales for bus service changes).

All vehicle types should be able to negotiate a site layout. TfL may require swept paths to prove this is possible, especially where long wheel-based rigid and articulated vehicles are involved. As with cycles, there are minimum widths set in place so buses can negotiate traffic management layouts. A minimum width of 3.5 metres is required.

4.4 Timescales for bus service changes

The table below sets out typical notice periods where changes to bus services are required:

Service	Notice period
Bus stop suspensions	2-3 weeks
Bus diversions	6-8 weeks
Temporary stops	7-10 days
Publicity / communications	4-6 weeks
Countdown / iBus (changes to routes)	2 weeks
Bus shelter relocation	16-18 weeks

Contact details for Buses can be found at the end of this document.

4.5 Freight

TfL is committed to improving road safety. London's continued growth and associated construction activity means that vulnerable road users, such as pedestrians and cyclists, together with construction traffic, are sharing roads more than ever, and therefore increasing the risk of collisions.

Between 2008 and 2013, HGVs were involved in 55 per cent of all cycling fatalities in London. Analysis of these figures found that construction- related HGVs, such as tippers, were overrepresented within these figures. In 2011, seven of the nine HGVs involved in cyclist fatalities were construction- related vehicles.

Developers and construction clients have a responsibility to manage the impact of their activities on road users and the wider community. The construction industry can take positive steps to take ownership of road safety and reduce the risk of collisions in their supply chain.

The Construction Logistics and Cyclist Safety (CLOCS) programme is a construction industry-led initiative which aims to achieve a visionary change in the way the construction industry manages work-related road safety.

As part of CLOCS, a document has been developed called CLOCS Standard for construction logistics: managing work related road risk.[20] This is a common national standard for use by the construction logistics industry. Implemented by construction clients through contracts and adhered to by vehicle operators, it contains 16 requirements around the safety of fleet operations, vehicles, drivers and the management of construction sites.

Each requirement has been developed with the aim of reducing the risk of a collision between HGVs and vulnerable road users such as cyclists and pedestrians. Responsibility for application of the standard lies with both clients and vehicle operators.

TfL encourages developers and construction companies who have not already done so to implement and ensure compliance with the CLOCS standard.

4.6 Working near TfL tram infrastructure

When works are in the vicinity of trams or other guided transit systems, the designer will need to consult with operators in the planning phase. This is to ensure their requirements are fully met and ensure risks are as low as reasonably practicable to the operation of trams or road users. Any agreed requirements must be effectively communicated to the designers, the commercial team and the contractors or principal contractors who will be delivering these works.

Further information on TfL trams can be found here.[21]

20 https://www.clocs.org.uk/page/clocs-standard

21 https://tfl.gov.uk/modes/trams/