TRANSPORT SCOTLAND (AGENCY OF THE SCOTTISH GOVERNMENT)
TRUNK ROADS & BUS OPERATIONS (TRBO)

TS INTERIM AMENDMENT No 38:
TEMPORARY BARRIER DECISION TOOL (TBDT)

SUMMARY
This TS IA sets out a risk based approach to guide the selection of temporary barriers for use at short term road works (greater than 2 and less than 28 days duration).

Contents

1 INTRODUCTION

Background

1.1 Road workers are required to operate in a potentially hazardous workplace. Temporary vehicle restraint systems may be used to protect road workers from errant vehicles as an alternative to the normal practice of work site delineation with traffic cones. Temporary vehicle restraint systems may also be used to protect road users and third parties[1] from hazards introduced as a result of road works or road worker activities.

1.2 This interim amendment describes a Temporary Barrier Decision Tool (TBDT) that is intended to support the decision making process associated with the use of temporary barrier systems. The Tool is to balance the risk of installation of temporary barrier against the risk to road workers, and the travelling public should a temporary barrier not be in place. All of the factors included in the Tool should be considered as options that can be altered in order to reduce the level of risk to road workers, those installing barriers, road users and third parties. The TBDT does not replace any requirements given in other Transport Scotland and DMRB standards and guidance. It focuses only on the decision to provide a temporary barrier at road works where other road or road side features (temporary, under construction or permanent) do not require provision of a temporary barrier.

1.3 The tool is for use on those parts of the trunk road network operated and maintained by Transport Scotland (TS). The tool and guidance given in this document is based on principles compatible with temporary barriers specified in accordance with TS requirements.

1.4 The Tool is applicable to road works on the TS trunk road network where the speed of the road is 50mph or greater. This does not preclude the tool from being utilised on roads of less than 50mph but risk scoring for those roads may differ and the tool may not be the most appropriate choice for deciding temporary barrier needs in such cases.

1.5 The Tool has been calibrated to guide users to consider choices made about the design of road works and use of temporary barriers that ensure that risks to road workers, barrier installers, road users and third parties are As Low As is Reasonably Practicable (ALARP).

1.6 The Tool is based on installation and removal of temporary traffic management being in accordance with the guidance offered in the documents Chapter 8 of The Traffic Signs Manual[2] and Guidance for Safer Temporary Traffic Management[3] and other associated guidance documents.

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[1] Within the context of this document the term 'third parties' defines those persons who might be exposed to safety risk as a result of the road works, but who are not road workers, or road users. This might include persons using a local authority road or railway line adjacent to the trunk road network, or persons living or working on a private development adjacent to the trunk road.

[2] Chapter 8 of the Traffic Signs Manual - Traffic Safety Measures and Signs for Road Works and Temporary Situations, Part 1: Design, 2009. Available on the Department for Transport website: http://www.dft.gov.uk/pgr/roads/tss/tsmanual/tsmchap8part1.pdf

[3] Guidance for Safer Temporary Traffic Management. Available on the Highways Agency website: http://www.highways.gov.uk/aboutus/701.aspx

Use of this document

1.7 Although this TS IA is intended to form part of a future standard, at present, it is issued as guidance only. Transport Scotland wishes it to be adopted and used in order to:

(a) assess its potential influence on roadwork schemes and
(b) The TBDT is issued as guidance; it must not be used to replace common sense or experienced judgement, or assumed to represent strict instructions for when to install temporary barriers.
In order to inform future development of the tool, feedback is requested to be submitted to Transport Scotland Unit Bridge Managers (UBMs) or Transport Scotland Area Managers. This should include copies of completed assessments, together with the corresponding supplementary information requested on the form shown in Annex B.

1.8 This document outlines a risk based approach to:

(i) determining whether or not a temporary barrier is needed and then if it is,
(ii) selecting the most appropriate temporary barrier for a given situation.

To date it has been reviewed by representatives from the Highways Agency (HA), Transport Scotland (TS), Health and Safety Executive (HSE) and individuals from industry. To allow all of industry to have early visibility, Transport Scotland has decided to issue this document for use in parallel to seeking wider feedback.

1.9 The interim amendment contains four chapters and two supporting appendices:

Chapter 1 – Introduction to the TS IA and TBDT
Chapter 2 – Terminology and definitions used within the TS IA and TBDT
Chapter 3 – Assumptions and general guidance on using the tool
Chapter 4 – Detailed tool notes, providing detailed guidance on each of the factors within the tool
Annex A – Temporary Barrier Decision Tool (TBDT)
Annex B – Additional feedback information

The main purpose of the TS |A is to enable the use of Annex A (the TBDT); the rest of the interim amendment provides supporting information and guidance.

The ALARP Principle

1.10 Reference is made throughout this TS IA to the ALARP principle. This is a concept that underpins the tolerability of risk associated with work activities (such as road works) within the UK. The ALARP principle is explained figure 1.1.

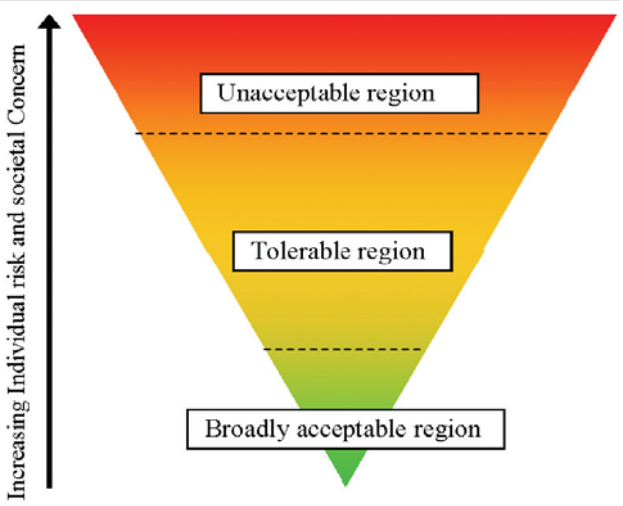


Figure 1.1: ALARP Principle

It is a requirement that activities falling into the 'unacceptable' region must be either terminated or managed to reduce risk to at least 'tolerable' levels, irrespective of cost.

1.11 Risks falling into the 'tolerable' region are those that people can normally accept in order to secure some personal benefit, such as employment or travel. However, reasonable efforts must still be made to reduce risks. Once the point is reached where the resources needed to make further risk reduction is grossly disproportionate to the risk reduction, then risks are As Low As Reasonably Practicable (ALARP).

1.12 Risks falling into the 'Broadly Acceptable' region generally require no further control, apart from ensuring that existing established good practice is followed.

Mandatory Requirements

1.13	Whilst the outputs from the tool are to be used as guidance only, where it is applied, the steps and scores set out in the tool are mandatory and must be followed in full.

2 TERMINOLOGY AND DEFINITIONS

Safety Clearances

2.1 The safety clearance definitions are as given in Figure 2.1 below. Chapter 8 deals fully with safety clearances; however for the purposes of this document, for all roads with a permanent speed limit of 50mph or more, the lateral clearance between the edge of the working space and that part of the carriageway being used by traffic should be not less than 1.2 m. On single carriageways if the nature of the road is such that a lateral safety clearance of 1.2m cannot be achieved, then the lateral safety clearance should be as wide as practicable with an absolute minimum of 0.5m.

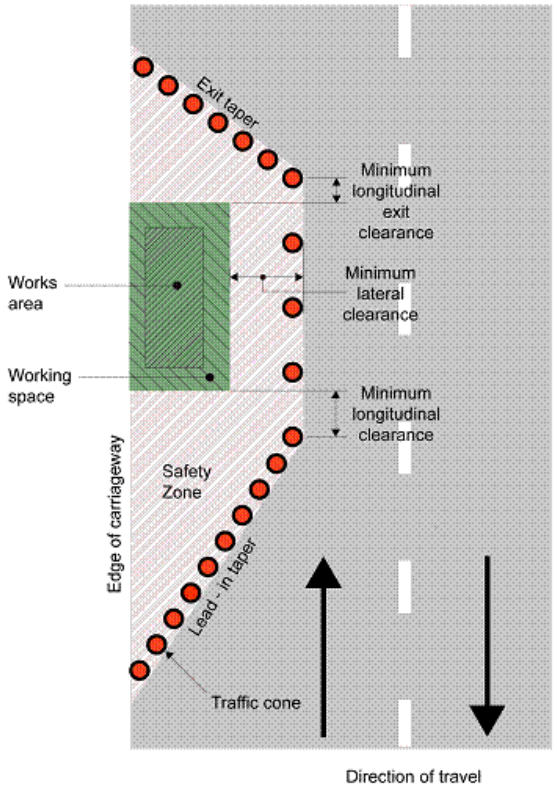


Figure 2.1: Clearances around working space

Where it is reasonably practicable to provide additional clearance this should be done. In reaching a decision on what additional space, if any, may be provided, due regard should be paid to any possible consequences for the safety of road users and also to possible additional costs, including extra delay to road users. The latter will arise if there is insufficient capacity in the road space left available to traffic. The minimal longitudinal clearance must be long enough such that there is minimal possibility of an errant vehicle entering the works and colliding straight into the works area. Set-back is the lateral distance between the traffic face of a safety barrier and the edge of the running lane - refer to TD 19, paragraph 8.19.

Working Space

2.2 Working space is the space around the works needed for the safe movement of workers and equipment. See “Safety Clearances”.

Works Area

2.3 The works area is the area occupied by the works. See “Safety Clearances”.

Bridge

2.4 For the purposes of the document a bridge is any trunk road structure supporting a trunk road where barrier weight or fixing issues may need to be considered (guidance on these issues should be sought from those responsible for the management and maintenance of the bridge and barrier manufacturers or promoters) or where works may take place below, on or beside.

Length of Barrier

2.5 The risk scoring methodology within the Tool assumes that the length of barriers installed will be at least 100 metres. However when estimating the actual length of barrier for the purpose of applying the Tool, the following should be considered:

- Minimum length recommended by the manufacturer/promoter to fully achieve the containment level required,
- A minimum start longitudinal clearance before the work space of at least 30metres for N2, H1 and H2 barriers or 45metres for H4a barriers. These lengths may be increased dependant upon site conditions, for example works on a bend where there is an increased risk of an errant vehicle entering the works area; and
- A minimum end longitudinal clearance after the work space of at least 7.5metres for N2 barriers, 10.5 metres for H1 and H2 barriers, and 18 metres for H4a barriers. These lengths may be increased dependant upon site conditions, for example the need to achieve an acceleration lane for site traffic, allowing easier integration with traffic flows. See TD 19 Table 3.1 for confirmation of start and end clearances.

Road Works / Works

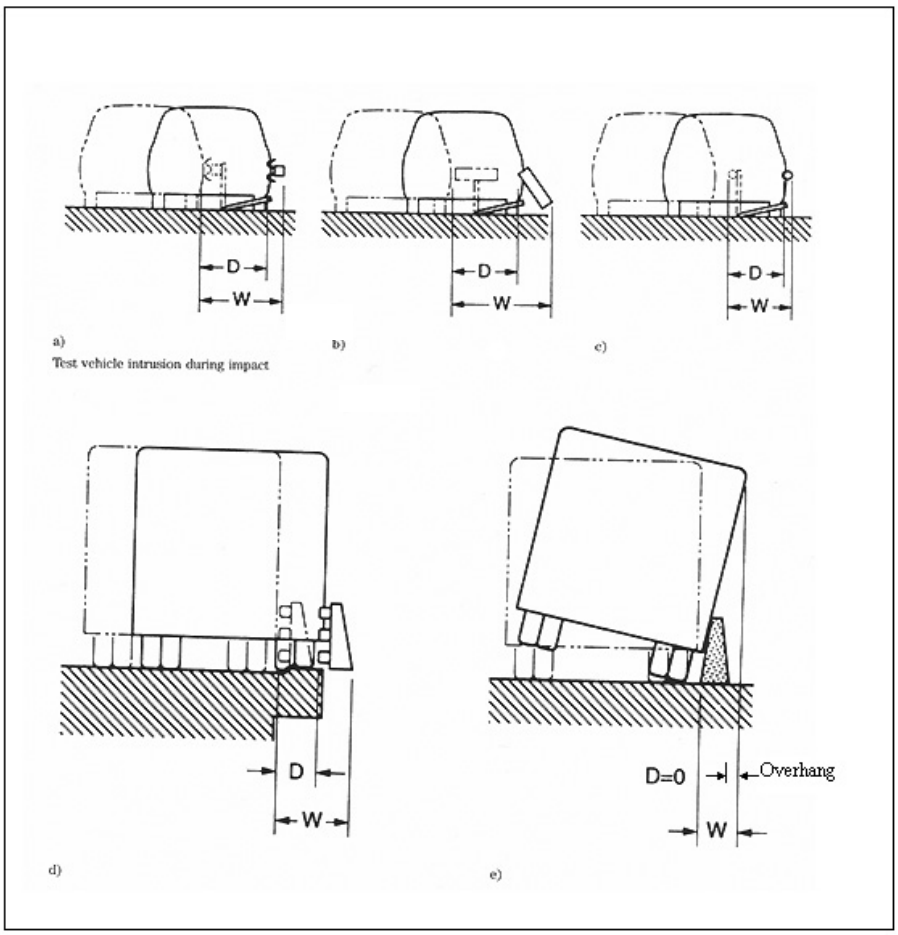
2.6 In this document “road works” are defined as any works or temporary restrictions which cause partial or total obstruction of any road or trunk road, whether on the verge, hard shoulder, footway, cycleway, bridleway or carriageway. Examples may include trunk road improvement schemes, excavations, structural or maintenance works of any kind, street works or any other work executed on or near the trunk road together with the necessary working space, safety zones, space required for the storage of any materials or accommodation for staff, the construction of any temporary structures and the operation of any constructional plant required for the execution of such work, including associated surveys and inspections.

SSD – Stopping Sight Distance

2.7 “Stopping sight distance” is the distance required for a vehicle to come to a stop, taking into account the time taken to perceive, react, brake and stop safely. For full details see TD 9 – Table 3

Barrier Working Width

2.8 Is defined as the distance between the traffic side of the barrier *before impact* and the maximum dynamic lateral position of the system *after* impact plus any vehicle overhang that occurs. See Fig 2.2. Barrier performance is declared in accordance with the working width classes given in table 2.1.



Key

- - - -
Normal road position

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Position after impact

D = Deflection
W = Working Width

Figure 2.2: Dynamic Deflection and Working Width (TD 19 Figure 1.1)

Barrier Working Width Class	Levels of Barrier Working Width (m)
W1	≤ 0.6
W2	≤ 0.8
W3	≤ 1
W4	≤ 1.3
W5	≤ 1.7
W6	≤ 2.1
W7	≤ 2.5
W8	≤ 3.5

Table 2.1: Barrier Working Width Classes

Setback

2.9 For permanent barriers the set-back is the lateral distance between the traffic face of a safety barrier and as appropriate:

i. Nearside: the back of the nearside hardstrip or hardshoulder
ii. Nearside: the kerb face for roads without a nearside hardstrip or hardshoulder
iii. Offside: the trafficked edge of the edge line or the kerb face where there is no edge line

For most road works with temporary barriers set back will be taken from temporary marking or studs - see Traffic Signs Manual (TSM) Chapter 8 Appendix A1 details, E1, E2, F1, F2.

Containment Level

2.10 Barriers are tested in accordance with the performance requirements set out in BS EN 1317 for a specific containment level. For guidance Table 2.2 gives the correlation of containment levels normally used on the TS network.

	Containment Level
Normal Containment	N1 / N2
Higher Containment	H1 / H2 / H3
Very High Containment	H4a / H4b

Table 2.2: Containment Levels

For a full description of the acceptance tests please see BS EN 1317 for guidance.

Delineator

2.11 Equipment or markings used to mark out the route which the traffic must use to pass an obstruction due to road works.

Cone

2.12 A delineator that meets the requirements of diagram 7101.1 of the TSRGD (Traffic Signs Regulations and General Directions).

Install / Installation

2.13 For the purposes of this document when the words ‘install’ or ‘installation’ are used, this is taken to mean all phases of providing a temporary barrier system and the relocation of temporary barriers (if applicable).

Temporary Barriers

2.14 Non permanent Vehicle Restraint Systems used to protect the workforce or infrastructure and to protect road users from the potential hazards associated with road works.

Road Side Hazard

2.15 Road Side Hazards are features adjacent to the carriageway that could result in a fatality or serious injury if they were hit by an errant vehicle. Examples include deep excavations, large plant and equipment within the works, Traffic Management (TM) vehicles, permanent structures such as bridge piers or abutments that are normally protected by a permanent barrier that has been temporarily removed for the purpose of the works and temporary structures such as scaffolding.

3 PRINCIPLES & GUIDANCE ON USING THE TOOL

Principles

3.1 Those intending to use this interim amendment and the Tool must be competent to undertake the risk based assessment.

3.2 Cost benefit analysis to support the choice of temporary barrier system selected is implicit in the tool: no further cost benefit calculations should be required.

3.3 Barriers identified as a result of applying this tool are specified in accordance with Transport Scotland requirements.

3.4 The risk scoring methodology within the Tool assumes that the length of barriers will be at least 100 metres. In practice, the length of barrier could be less than 100 metres in some instances, see definitions 'Length of Barrier'.

Using the Tool

3.5 The tool basically comprises two sections; one to consider the need for barriers to protect road workers and the other to consider the need for barriers to protect road users and 3rd parties.

3.6 The following figures show the process of applying the tool:

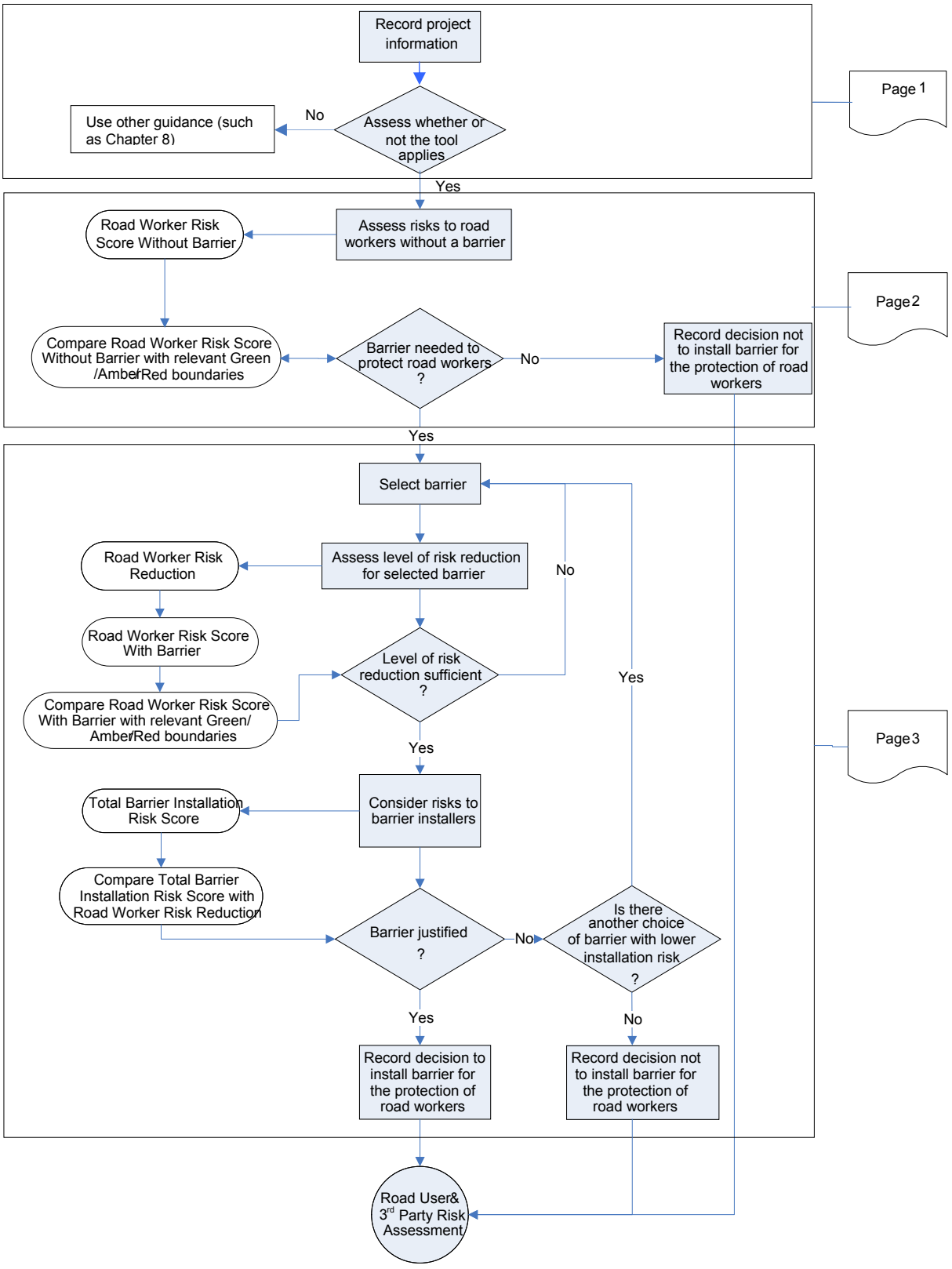

Figure 3.1: Using the Tool Part 1

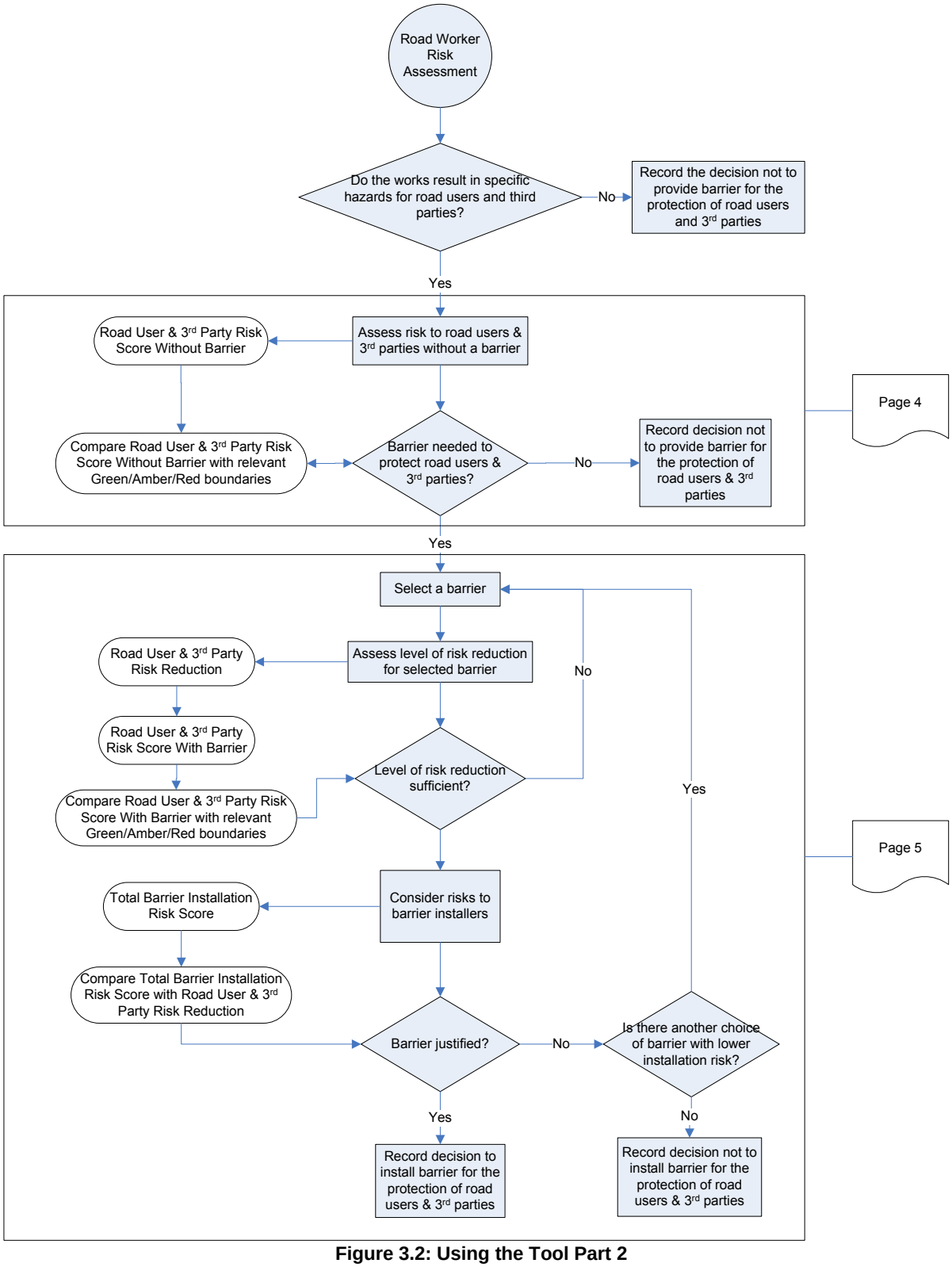

Figure 3.2: Using the Tool Part 2

Page 1 of the Tool (Annex A) is used to record all the relevant project information. This page is also used to decide whether or not the Tool is applicable for the proposed works. If one of the answers to the questions at the bottom of Page 1 (Annex A) is 'yes' then the tool may not be applicable and therefore the use of other guidance (such as Chapter 8) may be more appropriate.

Page 2 (Annex A) is used to assess the risk to road workers without a barrier in place and to decide if this justifies the provision of some sort of barrier.

Page 3 (Annex A) is *only* used if Page 2 indicates that installation of a barrier for the mitigation of road worker risk may be/is required. It assesses the risk to road workers with a barrier in place to see if the risk has been reduced sufficiently or whether a higher containment barrier is needed. It also assesses the risk to barrier installers and requires a check to ensure this is justified when compared with the level of road worker risk reduction.

Pages 4 and 5 (Annex A) deal with risks to road users and third parties. These pages only need to be completed if the works result in specific road side hazards that could result in a fatality or serious injury if they were hit by an errant vehicle. Examples include deep excavations, roadside hazards normally protected by a permanent barrier that has been temporarily removed for the purpose of the works, roadside structures that will be temporarily weakened as a result of the works, temporary structures (e.g. scaffolding) and plant associated with the works.

The Tool makes extensive use of 'tick boxes'. These all use the following format:

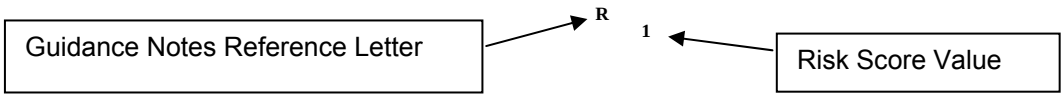

Figure 3.3: Tool Tick Box Format

The reference letter is a letter from A to AE which is in front of each title in Section 4 of this TS IA. This helps users find the appropriate part of this interim amendment that explains the background to each of the factors included in the Tool – why it is included and what the score is intended to reflect. In addition the Tool may refer to notes in Annex A that give further clarification.

A tick is placed in each box that represents the most appropriate answer to a particular question asked by the Tool. The risk score value of this box is then written in the Risk Score column at the end of that line.

Below is an example of one of the questions in the Tool. If, for example, the percentage of HGVs is between 8 and 15%, a tick should be placed in the '8-15' box. The associated risk score value is 3; a 3 is therefore written in the 'Risk Score' box at the end of the line.

							Risk Score
What is the percentage of HGVs (unladen weight >3.5tonnes)?	<8	1	8-15	✔ 3	>15	5	**3**

Figure 3.4: Example Completion of a Tool Question

Each page of the Tool is broken down into a series of sections. 'Total' risk scores for each of these sections are determined by summing all the risk scores within the section. Sections also define a range of risk 'factors' to be used by the Tool. The 'Total' risk scores and risk 'factors' are then input to defined formulae to determine the final risk scores.

Below is an example of a risk score formula:

ROAD WORKER RISK SCORE WITHOUT BARRIER	=	(Total Road Type Score + Total Local Factors Score + Total Road Characteristics Score + Total Design of Works Score) / (Lateral Separation Factor x Temporary Speed Limit Factor)

Figure 3.5: Example Risk Score Formula from the Tool

This particular formula takes the Total risk scores for 'Road Type', 'Local Factors', 'Road Characteristics with Works in Place', 'Design of Works' and the 'Lateral Separation and Temporary Speed Limit' factors to calculate the 'Road Worker Risk Score Without a Barrier'. For example, for the following total risk scores and factors:

Score/Factor	Value
Total Road Type Score	42
Total Local Factors Score	2
Total Road Characteristics with Works in Place Score	10
Total Design of Works Score	20
Lateral Separation Factor	2
Temporary Speed Limit Factor	1

Figure 3.6: Example Risk Factor Scores

Then the 'Road Worker Risk Score Without Barrier' score would be:

(42 + 2 + 10 + 20) / (2 x 1) = 37

This would be recorded on the scoring sheet as:

ROAD WORKER RISK SCORE WITHOUT BARRIER **(Total Road Type Score + Total Local Factors Score + Total Road Characteristics Score + Total Design of Works Score) / (Lateral Separation Factor x Temporary Speed Limit Factor)**	**37**

Figure 3.7: Example Record of a Risk Score

The corresponding risk level is identified as either broadly acceptable, tolerable or intolerable by using the appropriate version of the following table:

ROAD WORKER RISK WITHOUT BARRIER	Tick if score is less than 35 - A barrier is not required	GREEN Note 1		Barrier required?
	Tick if score between 35 and 65 - A barrier may be required	AMBER Note 1		
	Tick if score is more than 65 - A barrier is required	RED Note 1		

Figure 3.8: Example Table from tool for Assigning Road Worker Risk Without Barrier

Different versions of this table are given within the Tool for the following situations:

- Road worker risk without a barrier
- Road user & 3rd party risk without a barrier

The resulting colours for risks **without** a barrier have the following meanings:

Green – The risk is broadly acceptable. Therefore cones and/or delineators in line with Chapter 8 of the TSM will be sufficient.

Amber – Risk is tolerable but consideration should be given to reducing risk further, to the point where risks are managed as low as reasonably practicable (ALARP). This can be achieved either by changing the design of the road works or by installing a barrier of N2 containment. If changing the design of the road works is used to mitigate risk, then the Tool should be used again to confirm that the associated risk for the new design is lower and remains at least amber, or has been improved to green.

Red – The risk is intolerable and must be reduced. Either change the design of the road works or install a barrier of at least N2 containment. The Tool should then be used again to confirm that risk with the new design or N2 barrier has been improved to at least amber, if not green.

If it is decided to install a barrier, then the "Constraints on Barrier Choice" and "impact of Barrier on Road Worker Risk Score" and "impact of Barrier on Road User & 3rd Party Risk Score" sections (as appropriate) should be completed. These sections help guide the choice of barrier and assess the level of risk reduction provided by the proposed barrier type. The resultant risk level with a barrier in place is then assessed as broadly acceptable, tolerable or intolerable by using the appropriate version of the following table:

ROAD WORKER RISK WITH BARRIER	Tick if score is less than 35 – The barrier gives enough protection	GREEN Note 4		Barrier sufficient?
	Tick if score between 35 and 65 - Consider a barrier with better containment	AMBER Note 4		
	Tick if score is more than 65 - A barrier with better containment is required	RED Note 4		

Figure 3.9: Example Table from Tool for Assigning Road Worker Risk With Barrier

Different versions of this table are given within the Tool for the following situations:

- Road worker risk with a barrier
- Road user & 3rd party risk with a barrier

The resulting colours for risk **with** a barrier have the following meanings:

Green – The risk with the proposed barrier type in place is broadly acceptable.

Amber – Risk is tolerable but consideration should be given to reducing risk further, to the point where risks are managed as low as reasonably practicable (ALARP). This can be achieved either by changing the design of the road works to reduce the risk associated with the current barrier choice, or use judgment to decide if a barrier with higher containment should be installed. If changing the design of the road works is used to mitigate risk, then the Tool should be used again to confirm that the associated risk for the new design is lower and remains at least amber, or has been improved to green.

Red – The risk is intolerable and must be reduced. Either change the design of the road works or install a higher containment barrier. The Tool should then be used again to confirm that risk with the new design or higher containment barrier has been improved to at least amber, if not green.

The final part of the tool is the "Barrier Installation Risk Score". In this section the scores for the first two questions must be multiplied by a 'length' factor which is related to the length of the barrier. If, for example, a temporary barrier of 300m is to be installed then, (from the table under note 5 of the notes section), the Length Factor is 3. This is reflected in the Tool as follows:

Multiply Y and Z by length factor (values found in note 5) to calculate risk score							Length Factor Note 5		
Man hours to install temporary barrier per 100m (see Note 6)	<2	Y 1	2-5	✔ 2	>5	Y 3	3	Risk Score	2x3= 6
No. of metres of barrier per delivery truck?	<100m	Z 1	100-30m	Z 3	<30m	✔ 5	3		5x3=15
Number of additional vehicles required for installation e.g. forklifts	0	AA 1	1-2	AA 3	>2	✔ 5			5

Figure 3.10: Example Calculation of Barrier Installation Risk Scores

The Tool tries to ensure that the Total Barrier Installation Risk Score is not greater than the Road Worker or Road User & 3rd Party Risk Reduction. This will usually ensure that the benefits of installing a barrier are not outweighed by the risks.

The decision to provide a barrier or not is recorded. If no barrier is required, a statement to this effect, plus a brief summary of the justification is entered at the bottom of the Tool. If a barrier is to be provided the chosen barrier system and its containment level are entered at the bottom of the Tool, and a brief justification is entered. The tool is then signed.

The same basic process is followed for road workers, then for road users & 3rd parties.

4 DETAILED TOOL NOTES

The bold letters at the beginning of the paragraphs in this section correspond to identification letters within cells of the Temporary Barrier Decision Tool. The text in each paragraph gives advice on how to fill in and respond to the corresponding cell in the Temporary Barrier Decision Tool. The paragraphs are grouped under headings corresponding to sections of the Tool and follow the flow of completing the form.

Whether to use the Tool

4.1 **A** - Are the planned works less than 2 days in duration?
If the answer to this question is 'Yes' then the Tool is not applicable as deployment of a temporary barrier system will disproportionately extend the duration of the scheme. Follow Chapter 8 and/or Hard Shoulder Working Guide (where applicable)

4.2 **B** - Are the works **greater** than 28 days in duration?

If the answer is 'Yes' then carry out a risk assessment in line with your company policy for long term road works. The Tool is designed to look at the risk at a particular point on the network; if the barriers are to be relocated, a new assessment should be carried out.
N.B. The 28 days refers to the period that barriers would be fixed in one location and not necessarily the total duration of the works or scheme.

4.3 **C** - Will the road be closed?

If it is feasible to close the road and is cost effective to do so, utilising a road closure would reduce the risk to the road workers. However the following issues will need to be considered:

- The diversion route should not increase potential risk to the road user either using the diversion or affected by it;
- Using a road closure should not increase the risk to the road worker, for example when deploying and removing the necessary temporary traffic management, relative to the alternative risks of working adjacent to live traffic;
- Provision of a diversion should be cost effective when considering likely delays, Temporary Traffic Management (TTM) requirements etc.;
- The diversion route must be practicable for the diverted vehicles; and
- The diversion route should not have an impact on emergency vehicle access or response times.

Diversions are dealt with in Chapter 8, Section D3.15

HA Road Definition

4.4 **E** - What is the road type?

Roads are categorised into the following types within the Tool:

- All purpose single carriageway road (50mph or 60mph);
- All purpose dual carriageway roads (D2AP or D3AP); and
- Motorways (D2M, D3M or D4M).

This Road Type classification is required in order to correctly attribute the AADT risk score (see 4.7).

Environmental Risks – Road Type

4.5 **F** - What is the permanent speed limit of the road?

In line with Chapter 8, roads are given a risk score based upon the following permanent speed limits:

- 50mph
- 60mph
- 70mph

4.6 **G** - What is the two-way AADT traffic flow on this section of road?

Annual Average Daily Traffic (AADT) is the total volume of vehicle traffic in both directions of a road per 24 hour day. This information can be obtained by emailing Stuart.Hay@transportscotland.gsi.gov.uk

The risk of an errant vehicle entering the works area increases in line with the AADT traffic flow. In the Tool, the AADT is classified into 'Low', 'Medium' or 'High' dependant upon road type and is as shown in the following table:

	AADT flow range					
	Single carriageway	**Dual-carriageway**		**Motorway**		
	S2 or WS2	**D2AP**	**D3AP**	**D2M**	**D3M**	**D4M**
LOW	<15.000	<30,000	<45,000	<30,000	<45,000	>60,000
MEDIUM	15,000-30,000	30,000 to 60,000	45,000 to 90,000	30,000 to 60,000	45,000 to 90,000	60,000 to 120,000
HIGH	30,000	> 60,000	>90,000	> 60,000	>90,000	>120,000

Table 4.1: Classification of Traffic Flow Based on AADT

When assessing risks on routes subject to significant seasonal variation in traffic levels e.g. major tourist routes, then the flow range that best reflects the traffic levels at the time of the works should be used.

When assessing risks during night time hours, traffic flow scores are reduced by a factor of 10. This takes account of the lower traffic flows at night and ensures that risks are not over stated.

4.7 **I** - What is the percentage of HGVs (unladen weight >3.5tonnes)?

The higher the percentage of HGVs through the road works, the more likely an errant vehicle is to breach a temporary barrier system, unless a high containment barrier system is used.

The percentage of HGVs can be obtained from the AADT traffic flow data.

Environmental Risks - Local Factors

4.8 **J** – Is the works area close to a lay-by, bus stop, roundabout, slip road, other junction type, public access, air or sea port?

The presence of a slip road, bus stop, roundabout, other junction type, lay-by or public access close to the works may increase the likelihood of an errant vehicle entering the works area.

Location is also to be considered as the likelihood of an errant vehicle entering the works area may increase in the vicinity of an international port or airport, where drivers may be unaccustomed to driving on the left.

Environmental Risks - Road Characteristics with the Works in Place

4.9 **K** - Does the alignment comply with current standards?

The physical road layout in the works vicinity will have an impact upon the likelihood of an errant vehicle entering the works area. When looking at alignment, consider the worst case; this includes taking account of the alignment resulting from the planned layout of works.

Where no records exist and the alignment is considered not to comply with current standards, then a higher risk score should be used.

4.10 **L** - Is there more than one lane adjacent to the works area?

This is intended to address situations such as where lane 1 is the work area and lanes 2 and 3 are the running lanes. Lane changing adjacent to the works area increases the likelihood of an errant vehicle entering the works area due to an incident involving 'loss of control' whilst a vehicle is changing lanes.

4.11 **M** - Is the road section prone to adverse weather conditions?

If the works are to be carried out at a time of year in which fog may be present, this could have a detrimental effect on the road users ability to see signage etc. If the road travels east (or west) and especially if the works are being carried out in the winter months, there may be an increased risk from glare from the sun to the road user (or the road worker).

4.12 **N** - Is there a likelihood of driver fatigue?

Driver behaviour should be considered as part of the risk to the road worker.

1. Some long straight sections of road may be monotonous to drive along and increase the likelihood of an errant vehicle entering the works area;
2. Relaxation works (as defined in Chapter 8 of the Traffic Signs Manual) and very long works with average speed cameras may increase the risk of driver fatigue; and
3. Long stretches of road that are devoid of service areas may increase the risk of accidents due to driver fatigue.

The likelihood of driver fatigue is therefore grouped into the following categories:

	Sleep-Related Vehicle Accidents	Risk score
	No obvious risk factor	1
Factor 1	Site on featureless rural road with the minimal services and/or minimal distractions for drivers at the side of the road	3
Factor 2	Relaxation works or very long works with average speed cameras	3
Factor 2	Site on sweeping right hand bend, sweeping left hand bend with no central reserve safety barriers or a site at the end of a long route (e.g. eastbound of eastern end of M20 or southbound of southern end of M3 etc.)	5
	Combination of any of the above factors	9

Table 4.2: Assigning Driver Fatigue Score

Environmental Risks – Design of Works

4.13 **O** - What is the duration of the works?

The length of time the road works are in place increases the risk of an incident.

4.14 **P** - What is the maximum expected number of workers per 100m in the works area?

The more staff that are present, the higher the potential risk of a worker being struck in the event of an errant vehicle entering the works area. This however may vary as the works progress, therefore in obtaining the risk score, use the maximum number of road workers who may be present on site at any one time.

When looking at the maximum number of road workers area where they might congregate for briefings, start of shift etc. should also be included.

Works length is dealt with in Section D3.5 of Chapter 8.

4.15 **Q** - How many man hours are required to complete the works?

The longer the workers are on the site, the higher the potential risk of a worker being struck in the event of an errant vehicle entering the works area.

4.16 **S** - Is the works area in a confined space?

In a confined space such as under a bridge, it will be more difficult for workers or road users to escape or avoid an incident in the event of an errant vehicle entering the works area.

4.17 **T** - Are the works lit?

Works that are lit may have a reduced likelihood of an errant vehicle entering the works area.

Select N/A if the works are being carried out during daylight hours.

Worker Exposure and Temporary Speed Limit Factors

4.18 **R** - How far are the workers/road users from the traffic/roadside hazard?

Guidance given in Chapter 8 should be followed and safety clearances are dealt with in Sections D3.2 and O3.2. This states that the lateral clearance between the edge of the working space and that part of the carriageway should not be less than 1.2m. Increased lateral clearance would provide a further risk reduction.

Increasing the distance from moving traffic increases the reaction time for both the road user and the road worker. A clearance of 3m approximately halves the likelihood of an errant vehicle reaching a road worker or roadside hazard. Closing an extra lane is therefore desirable from the point of view of safety (closing a lane may cause congestion and increase the risk of accidents amongst road users approaching the works, however this is thought to be largely offset by a reduced risk accidents whilst road users are within works).

4.19 **H** - Is there a temporary speed limit?

Reducing the speed of traffic through road works will reduce the risk to the road workers. This may be achieved either by imposing a temporary speed restriction or by taking traffic through the road works in a low speed convoy system (typically at 20 mph). If a low speed convoy system is adopted, a temporary barrier is unlikely to be required; the scoring of the Tool is weighted towards this conclusion. If risks do need to be further reduced when a convoy system is used then mitigation measures other than temporary barriers should be considered first.

If a temporary speed restriction is likely to be poorly observed or cannot be relied upon, such as in the absence of speed cameras or average speed cameras, then it may not be appropriate to take full credit for the speed restriction; in these circumstances the Temporary Speed Limit Factor should be reduced from 2 to 1.5.

Constraints on Barrier Choice

Whilst a risk score cannot be directly attributed to the constraints in this section they do need to be recorded as they direct possible temporary barrier system choice. These factors are detailed below:

4.20 **U** - Is the percentage of HGVs on the road greater than 15%?

Where a high percentage of HGVs pass through the works area, a temporary barrier system of greater than N2 should be considered to mitigate the risk as much as possible.

4.21 **V** – Are the works on a bridge parapet or a barrier protecting a bridge parapet?

Where the planned works are to replace a bridge parapet then the works area should be protected by a temporary barrier system equal to or greater than the parapet being repaired or replaced.

4.22 **W** - Is weight an issue (works on bridges)?

A lighter barrier may be required where the work zone is situated in an area with a weight limit, such as on a bridge. Contractors should contact manufacturers or promoters to determine the suitability and selection of safety barriers for particular locations, such as bridges, where weight is an issue.

4.23 **X** – Based on the width of the road and available space for installation, can all systems be considered?

The risk to road workers will be reduced if additional lanes can be closed off during the installation of a temporary barrier system.

During installation some barrier types require additional space to enable plant, for example fork lifts, to achieve 90 degree access to the line of the barrier. The width required can vary for different barrier types from 0.5m to greater than 8m depending on the temporary barrier system selected and any special lifting requirements. In some instances where a temporary barrier system with a high containment value may be selected, the need to close a large portion of the road may not be achievable (single lane roads) or even acceptable if it increases risk to the road users from extensive lane closures.

Impact of Barrier on Road Worker Risk Score

4.24 **AC** - What is the chosen containment level?

Barriers are tested in accordance with BS EN 1317. Tests are carried out to determine compliance with a chosen containment level. Higher containment barriers provide a lower risk to the road worker, therefore in principle, the higher the containment of the barrier system chosen, the better. This of course, must be balanced against the other barrier associated risk factors, such as installation time and Working Width.

Note that TD19[4] states that the minimum requirement for speed limits of 50mph or above is N2.

4.25 **AB** – What is the Working Width of the Barrier?

Section 2.8 provides details of barrier Working Width classes and the associated levels of barrier Working Width (in metres)

The barrier working width is an essential consideration in choosing the barrier system but must be considered in line with other properties of the barrier system, such as weight, speed of installation etc. Where the width of the road works is limited, for example because lanes cannot be closed, then using a barrier with a lower working width decreases the risk from a barrier deforming into the works area.

Wherever possible, space must be available for the proposed barrier to achieve its full working width. However in some high risk situations the use of any sort of temporary barrier system, with a containment level of at least N2 would still be

[4] TD 19 “Requirement for road restraint systems” (Design Manual for Roads and Bridges (DMRB 2.2.8), The Stationery Office Ltd, 2006

beneficial compared to cones alone and therefore a reduced space compared to the barrier working width may be considered when other methods to mitigate the risks have been exhausted. Departures from standards are required where the working width of the proposed barrier will be greater than the available space.

Shielding Factor

4.26 The 'shielding factor' is a factor **with a maximum permitted value of 1.0** that reflects the proportion of the works area that is protected by the proposed barrier. It is theoretically possible for this factor to have a value of greater than 1.0, but where this is the case, a maximum value of 1.0 should be used within the subsequent risk score calculations.

Barrier Installation Risk

4.27 **Y** - Operative hours to install temporary barrier per 100m (additional to those required for other traffic management)?

The longer the barrier takes to install combined with the number of staff required, increases the risk of an incident. A barrier with a minimum installation time, requiring a minimum number of installers would be the ideal as this mitigates the risk as much as possible. However, this must be weighed against the other barrier performance factors, such as working width and containment level. The number of operative hours to install a barrier should be based on an assessment of site constraints that may influence installation and details of operative hours to install temporary barrier for systems sought from the relevant system manufacturers or promoters.

4.28 **Z** - Number of metres of barrier per delivery truck?

The higher the number of vehicles required to deliver the barrier, the greater the risk.

Details of the number of metres of barrier per delivery truck for systems should be sought from the relevant system manufacturers or promoters.

4.29 **AA** - Number of additional vehicles required for installation?

The higher the number of additional delivery vehicles on site, the greater the risk to the road workers.

Conclusion

AD - Space to record the chosen barrier type.

AE – Space to record the justification for the choice of barrier, including the justification for not providing a barrier, if this is the case.

Where the space provided within Annex A to record details of the assessment are insufficient, it is recommended that users attach further details of the background and assumptions associated with the application of the TBDT. This is to ensure adequate and sufficient audit trail for the future.

Third Party and Road User Risks

4.30 **AF** – What fraction of total length of the road works is occupied by specific roadside hazards to third parties or road users?

This enables the tool to take account of the chance of specific roadside hazards being hit by errant vehicles during road works and causing injury to road users or third parties. Examples of such specific roadside hazards include bridge piers temporarily unprotected due to construction work, deep excavations, temporarily dismantled central reserve barriers, TM vehicles and plant. Note that barriers themselves present a degree of risk to road users but designers should ensure that this is less than that of the specific roadside hazard they are protecting. When calculating the fraction of total length of the road works occupied by specific roadside hazards the length of any temporary barrier should not be used in the calculation.

The factor considers likelihood of the specific roadside hazard being hit, taking account of its size. For example:

- 250m long excavation within 500m length of works = 250 / 500 = 50%
- 950m long section of dismantled central reserve barrier within 1000m length of works = 950 / 1000 = 95%
- 20 TM vehicles 5m long parked anywhere within 1000m length of works = (20 x 5) / 1000 = 10%
- 2 Plant items 10m long moving around anywhere within a 500m length of works = (2 x 10) / 500 = 4%

4.31 **AG** Are the roadside hazards mobile (e.g. TM vehicles or plant)?

This factor further defines the likelihood of a roadside hazard being hit, taking account of whether the hazard is mobile (as opposed to static i.e. in a fixed location) during the works period. At any one time, the hazard(s) may only be occupying a relatively small part of the works area (e.g. a 10m vehicle within a 500m length of works), but if the hazard(s) can move around during the day, or on a daily basis, then potentially the whole length of the works area may need protecting.

4.32 **AH** - Are there any factors that could significantly increase the likelihood of a roadside hazard being hit, or the consequences for road users or third parties?

This reflects other factors that may significantly increase the likelihood of a roadside hazard being hit, or the severity of the consequences for road users or third parties. Examples include:

- If a hazard could be hit by traffic from either carriageway. An example would be an unprotected deep excavation within the central reserve. This is particularly significant during daytime hours, when traffic flows are significantly higher (than at night).
- If the works involve the removal of an existing central reserve barrier such that an errant vehicle could crossover onto an opposing carriageway **during peak flow or daytime hours**.
- If the works involve the removal of an existing barrier such that an errant vehicle could get onto an adjacent railway line or other road

- If the roadside hazard is a substandard/temporarily weakened bridge or other large structure that could realistically be expected to fail (either partial or complete collapse) if it was hit by an errant vehicle.
- Third party risks to schools, hospitals, chemical works - refer to TD 19, 3.12 (i) to (iv).

Other Considerations

The following paragraphs outline a number of other considerations which designers should take into account when considering the use of temporary barriers. These are not covered by the Tool, but may be relevant in certain specific circumstances.

Works on bridges

4.33 On a bridge, the anchorage requirements of some barrier systems may prevent their use due to the need to avoid drilling into the bridge structures. Contractors and designers should consult relevant barrier manufacturers and promoters to determine the suitability of specific barrier systems for use on a specific bridge deck.

What are the logistics of barrier installation?

Some of the logistical considerations for the barrier are:

- Number of vehicles required to transport the barrier;
- What routes the vehicles and installers will take to get to the site; and
- Whether additional vehicles are required for installation (e.g. forklifts)?

Height of the barrier

4.34 A higher barrier looks more intimidating (e.g. high concrete barriers) and so drivers may shy away from it and/or drive more slowly thus reducing the risk to the road worker. However, the effect of the barrier height on sightlines must be considered.

Therefore barrier height in relation to an overall risk assessment of the barrier installation should be considered alongside the other barrier properties when choosing a barrier system. Consult barrier manufacturers and promoters for height details of specific barrier systems.

Mitigation Measures for Taper/Entry to Works Area

Whilst the Tool addresses the need for temporary barrier systems in a longitudinal role, there still exists a risk to the road worker from an errant vehicle penetrating the works area via the taper. The following paragraphs identify issues associated with tapers and entries to works; these are not assessed by the Tool and authoritative guidance should be sought on how to resolve the issues once a decision has been made to install a temporary barrier.

It is normal practice that any cone taper is designed in line with Chapter 8 and therefore an errant vehicle would have to pass through at least 200m of taper cones, signage, as well as a “lead in” zone before coming into the work area but the risk is still there and therefore possible ways of improving safety at the start of the works are described below.

A vehicle fitted with a Lorry Mounted Crash Cushion (LMCC)

4.35 This is only recommended for short duration works as risks to drivers of crash cushion vehicles used in one period for long periods are high.

Crash cushions fixed to plates and then pinned

4.36 The use of a static crash cushion fitted to a steel plate at the start of the working area is a possibility for longer term works. These plated devices must be installed by suitably qualified personnel in accordance with approved manufacturer's instructions in order for them to provide the maximum protection.

Slight taper and ramped ends

4.37 It is normal practice to taper the barriers back away from the trafficked carriageway by about 1m at the beginning and to ramp down the end, in accordance with manufacturer's requirements.

4.38 Options to be avoided include:

- Rigid stopping devices
  Any rigid stopping devices which have limited absorption characteristics should be avoided as this increases the severity of an impact to the occupants of the errant vehicle.

- Parking works vehicles
  Parking works vehicles at the end of the work site in order to provide protection should also be avoided as this would increase the risk to the occupants of an errant vehicle.

- Solid barriers at 90° to the road user
  These barriers would increase the risk to the road user and not provide optimum protection to the road worker as barriers are not tested for impacts at 90°.

ANNEX A – TEMPORARY BARRIER DECISION TOOL (TBDT)

This is the Temporary Barrier Decision Tool. Guidance and notes on the application of this tool are provided in TS IA 38 Also note that references to temporary barriers can be found in TD 19 and the Road Restraint Risk Assessment Process (RRRAP).

Within this and any associated documents, the term 'works' refers to either the whole works or to an element of the works lasting 28 days or less.

Project (including PIN)	

Phase (if applicable)	

Designer & Company Name		***Date***	

Brief description of planned works	

	NO	**YES**
Are the planned works <u>less than</u> 2 days in duration?	A	Follow Chapter 8 of the Traffic Signs Manual (TSM) for guidance.
Are the works <u>greater</u> than 28 days in duration?	B	Follow Chapter 8 of the TSM for guidance.
Will the road be closed?	C	Follow Chapter 8 of the TSM (see also handbook for additional considerations)

<u>Use the Tool if all answers are NO.</u>

TS ROAD DEFINITION

What is the road type?	Single	E	D2AP	E	D3AP	E
	D2M	E	D3M	E	D4M	E

ROAD WORKER RISK

Road Type (tick appropriate boxes and enter score)

What is the permanent speed limit?	50mph	F 1	60mph	F 3	70mph	F 5	Risk Score	
What is the two-way AADT traffic flow on this section of road? Reduce scores to a tenth of values shown if work is done just at night.	LOW	G 20	MEDIUM	G 40	HIGH	G 60		
What is the percentage of HGVs (unladen weight >3.5 tonnes)?	<8%	I 1	8%-15%	I 3	>15%	I 5		
							Total Road Type Score	

Local Factors

	YES			
Is the works area close to a lay-by, a bus stop, roundabout, slip road, other junction type, public access, air or sea port?	J 1	Score 1 per Risk Factor	Total Local Factors Score	

Local Factors:

Road Characteristics with Works in Place

Does the alignment comply with current standards?	Full standards met	K 1	Full SSD, curve or undulation present	K 3	Non-compliant SSD or alignment	K 7	Risk Score	
Is there more than one lane adjacent to the works area?	No	L 1	Yes	L 5				
Is the road section prone to weather problems (fog, snow, low sun etc)?	No	M 1	Yes	M 5				
Is there a likelihood of driver fatigue?	No Obvious Factor	N 1	Featureless Road or Works, Factors 1 or 2	N 3	Long Sweeping Factor 2	N 5	Comb-ination N 9	
							Total Road Characteristics Score	

Design of Works

What is the duration of works?	<7 days	O 1	8 to 14 days	O 3	15 to 28 days	O 7	Risk Score	
What is the maximum expected number of workers per 100m in the works area?	1 – 4	P 1	5-10	P 3	>10	P 7		
How many man-hours are required to complete the works?	<70	Q 1	70-300	Q 3	>300	Q 7		
Is works area in a confined space (e.g. under a bridge)?	No	S 1	Yes	S 3				
Are the works lit?	N/A or Yes – street lights	T 1	Yes – temporary lights	T 2	No	T 3		
							Total Design of Works Score	

Lateral Separation and Temporary Speed Limit Factors

How far are the workers from the traffic?	>3m	R 2	1.2 to 3m	R 1			Lateral Separation Factor	
Is there a temporary speed limit?	No	H 1	Yes, at least 10 mph reduction	H 2	Yes, convoy system	H 5	Temporary Speed Limit Factor	
ROAD WORKER RISK SCORE WITHOUT BARRIER = (Total Road Type Score + Total Local Factors Score + Total Road Characteristics Score + Total Design of Works Score)/(Lateral Separation Factor x Temporary Speed Limit Factor)								

ROAD WORKER RISK WITHOUT BARRIER	Tick if score is less than 35 – A barrier is not required	GREEN Note 1		Barrier required?
	Tick if score between 35 and 65 - A barrier may be required	AMBER Note 1		
	Tick if score is more than 65 - A barrier is required	RED Note 1		

Follow this section if a barrier may be/is required to protect road workers

3

CONSTRAINTS ON BARRIER CHOICE

Is the percentage of HGVs on the road greater than 15%? (previously noted in box I)	**Yes – Consider using >N2 system if possible**	U	**No – Choose N2 system as a minimum**	U
Are the works on a bridge parapet or a barrier protecting a bridge parapet?	**Yes – select a barrier of containment equal to the original parapet/barrier**	V	**No**	V
Is weight an issue? (works on bridges)	**Yes – Consider the need to select a lighter barrier**	W	**No**	W
Based on the width of the road and available space for installation, can all systems be considered?	**Yes**	X	**No – select a barrier which requires low width for installation**	X

IMPACT OF BARRIER ON ROAD WORKER RISK SCORE

Chosen barrier:

Containment level	**N2**	AC 55	**H1 (or H2, H3)**	AC 75	**H4a (or H4b)**	AC 90	**Containment Level Score**	
Working Width	**W Class**	AB	**Metres**	AB				
Shielding Factor	*Shielding Factor = ((3 x Lateral Separation Factor) – Working Width in Metres)/2)* $= \left(\frac{(3 \times \_\_\_\_) - \_\_\_\_}{2}\right) = \_\_\_\_\_$						**Shielding Factor (Maximum permitted value is 1.0)**	

***ROAD WORKER RISK REDUCTION = ROAD WORKER RISK SCORE WITHOUT BARRIER x* (Containment Level Score/100) x**

(Shielding Factor) $= \_\_\_\_ \times \left(\frac{\_\_\_\_}{100}\right) \times (\_\_\_\_\_) = \_\_\_\_\_$ **See Note 11 re night working**

ROAD WORKER RISK SCORE WITH BARRIER =ROAD WORKER RISK SCORE WITHOUT BARRIER – ROAD WORKER RISK REDUCTION

ROAD WORKER RISK WITH BARRIER	**Tick if score is less than 35 - The barrier gives enough protection**	**GREEN Note 4**		**Barrier sufficient?**
	Tick if score between 35 and 65 - Consider a barrier with better containment	**AMBER Note 4**		
	Tick if score is more than 65 - A barrier with better containment is required	**RED Note 4**		

BARRIER INSTALLATION RISK SCORE

Multiply Y and Z by length factor (values found in note 5) to calculate risk score

							Length Factor Note 5		
Operative hours to install temporary barrier per 100m? (See Note 6)	**<2 man/hrs per 100m**	Y 1	**2-5 man/hrs per 100m**	Y 2	**>5 man/hrs per 100m**	Y 3		**Risk Score**	
No. of metres of barrier per delivery truck?	**>100m**	Z 1	**100-30m**	Z 3	**<30m**	Z 5			
Number of additional vehicles required for installation e.g. forklifts?	**0**	AA 1	**1-2**	AA 3	**>2**	AA 5			

Total Barrier Installation Risk Score (Divide score by 8 if installation takes place overnight) Note 10

If the Total Barrier Installation Risk Score is greater than the Road Worker Risk Reduction, then the installation of a barrier may not be justified.

CONCLUSION

Barrier Required?	**Chosen barrier type:** AD
Justification for no barrier	**Justification for chosen barrier type:** AE

Assessed by		**Signed**	

Complete this assessment only if specific hazards are present for road users and 3rd parties (see Note 7)

TS ROAD DEFINITION

What is the road type?	Single	E	D2AP	E	D3AP	E
	D2M	E	D3M	E	D4M	E

ROAD USER & THIRD PARTY RISKS

Specific Hazards:

Road Type (tick appropriate boxes and enter score)

What is the permanent speed limit?	50mph	F 1	60mph	F 3	70mph	F 5	Risk Score	
What is the two-way AADT traffic flow on this section of road?	LOW	G 20	MEDIUM	G 40	HIGH	G 60		
What is the percentage of HGVs (unladen weight >3.5 tonnes)?	<8%	I 1	8%-15%	I 3	>15%	I 5		

Total Road Type Score	

Local Factors in proximity of Specific Hazards

	YES			
Is the works area close to a lay-by, a bus stop, roundabout, slip road, other junction type, public access, air or sea port?	J 1	Score 1 per Risk Factor	Total Local Factors Score	

Local Factors:

Road Characteristics in proximity of Specific Hazards with Works in Place

Does the alignment comply with current standards?	Full standards met	K 1	Full SSD, curve or undulation present	K 3	Non-compliant SSD or alignment	K 7			Risk Score	
Is there more than one lane adjacent to the works area?	No	L 1	Yes	L 5						
Is the road section prone to weather problems (fog, snow, low sun etc)?	No	M 1	Yes	M 5						
Is there a likelihood of driver fatigue?	No Obvious Factor	N 1	Featureless Road or Works, Factors 1 or 2	N 3	Long Sweeping Factor 2	N 5	Comb-ination	N 9		

Total Road Characteristics Score	

Design of Works in proximity of Specific Hazards

What is the duration of works?	<7 days	O 1	8 to 14 days	O 3	15 to 28 days	O 7	Risk Score	
Is works area in a confined space (e.g. under a bridge)?	No	S 1	Yes	S 3				
Are the works lit?	N/A or Yes – street lights	T 1	Yes – temporary lights	T 2	No	T 3		
What fraction of total length of the road works is occupied by specific hazards to road users or third parties?	<10%	AF 2	10%-90%	AF 6	>90%	AF 14		

Total Design of Works Score	

Road User & Third Party Lateral Separation, Severity, Mobility and Temporary Speed Limit Factors

How far are road users from the roadside hazard?	>3m	R 2	1.2 to 3m	R 1			Lateral Separation Factor	
Are the roadside hazards mobile (eg TM vehicles or plant)?	No	AG 1	Yes	AG 2			Hazard Mobility Factor	
Are there any factors that could significantly increase the likelihood of a roadside hazard being hit, or the consequences for road users or third parties?			One or more Yes	AH 0.5	All No	AH 1	Severity Factor	
Is there a temporary speed limit?	No	H 1	Yes, at least 10 mph reduction	H 2	Yes, convoy system	H 5	Temporary Speed Limit Factor	

ROAD USER & THIRD PARTY RISK SCORE WITHOUT BARRIER = (Total Road Type Score + Total Local Factors Score + Total Road Characteristics Score + Total Design of Works Score)/(Lateral Separation x *Hazard Mobility* x *Severity* x *Temporary Speed Limit Factors)*	

ROAD USER & 3RD PARTY RISK WITHOUT BARRIER				Barrier required?
	Tick if score is less than 40 – A barrier is not required	GREEN Note 8		
	Tick if score between 40 and 65 - A barrier may be required	AMBER Note 8		
	Tick if score is more than 65 - A barrier is required	RED Note 8		

Follow this section if a barrier is selected to protect road users or third parties

CONSTRAINTS ON BARRIER CHOICE

5

Is the percentage of HGVs on the road greater than 15%? (previously noted in box I)	**Yes – Choose >N2 system if possible**	U	**No – Choose N2 system as a minimum**	U
Are the works on a bridge parapet or a barrier protecting a bridge parapet?	**Yes – select a barrier of containment equal to the original parapet/barrier**	V	**No**	V
Is weight an issue? (works on bridges)	**Yes - Consider the need to select a lighter barrier**	W	**No**	W
Based on the width of the road and available space for installation, can all systems be considered?	**Yes**	X	**No – select a barrier which requires low width for installation**	X

IMPACT OF BARRIER ON ROAD USER & 3rd PARTY RISK SCORE

Chosen barrier:

Containment level	**N2**	AC 55	**H1 (or H2, H3)**	AC 75	**H4a (or H4b)**	AC 90	**Containment Level Score**	
Working Width	**W Class**	AB	**Metres**	AB				
Shielding Factor	Shielding Factor = ((3 x Lateral Separation Factor) – Working Width in Metres)/2) $= \left(\frac{(3 \times \_\_\_\_) - \_\_\_\_}{2}\right) = \_\_\_\_\_$						**Shielding Factor (Maximum permitted value is 1.0)**	

ROAD USER & THIRD PARTY RISK REDUCTION = ROAD USER & THIRD PARTY RISK SCORE WITHOUT BARRIER x

(Containment Level Score/100) x (Shielding Factor) = $\_\_\_\_ \times \left(\frac{\_\_\_\_}{100}\right) \times (\_\_\_\_\_) = \_\_\_\_\_$ **See Note 11 re night working**

ROAD USER & THIRD PARTY RISK SCORE WITH BARRIER = ROAD USER & THIRD PARTY TOTAL RISK SCORE WITHOUT BARRIER – ROAD USER & THIRD PARTY RISK REDUCTION

				Barrier sufficient?
ROAD USER & 3RD PARTY RISK WITH BARRIER	**Tick if score is less than 40 - The barrier gives enough protection**	**GREEN Note 9**		
	Tick if score between 40 and 65 - Consider a barrier with better containment	**AMBER Note 9**		
	Tick if score is more than 65 - A barrier with better containment is required	**RED Note 9**		

BARRIER INSTALLATION RISK

Multiply Y and Z by length factor (values found in note 5) to calculate risk score

							Length Factor Note 5		
Operative hours to install temporary barrier per 100m? (See Note 6)	**<2 man/hrs per 100m**	Y 1	**2-5 man/hrs per 100m**	Y 2	**>5 man/hrs per 100m**	Y 3		**Risk Score**	
No. of metres of barrier per delivery truck?	**>100m**	Z 1	**100-30m**	Z 3	**<30m**	Z 5			
Number of additional vehicles required for installation e.g. forklifts?	**0**	AA 1	**1-2**	AA 3	**>2**	AA 5			

Total Barrier Installation Risk Score (Divide score by 8 if installation takes place off peak overnight) Note 10	

If the Total Barrier Installation Risk Score is greater than the Road User & Third Party Risk Reduction, then the installation of a barrier may not be justified).

CONCLUSION

Barrier Required?	**Chosen barrier type:** AD
Justification for no barrier	**Justification for chosen barrier type:** AE

Assessed by		**Signed**	

MITIGATION MEASURES FOR TAPER/ENTRY TO WORKS AREA

The Tool is designed to look at the use of a temporary barrier to mitigate risk to road workers, road users and 3rd parties involved in road works of greater than 2 days but less than 28 days duration and for barrier placement in a single location. With this in mind, and where applicable, when a taper is utilised consideration should be given to mitigating risk from errant vehicles in this area, especially if the Total Score without a barrier is RED or AMBER. See earlier notes on taper design.

NOTES - ***Note 1***

Green	**Unless experience indicates that the tool has not taken account of a specific, significant danger**, the risk to road workers from an errant vehicle entering the works area from an adjacent lane is broadly acceptable. Therefore cones and/or delineators in line with Chapter 8 of the TSM may be used.
Amber	Risks are tolerable but must be managed ALARP. Either: • Change the design of the works so that the "Road Worker Risk Without Barrier" is reduced when you re-evaluate it. This can include closing a lane to increase lateral separation or working at night off-peak. • Use judgement to decide if a temporary barrier of N2 containment should be installed. Factors to take account of include: o situations where temporary barriers have been used in the past, o how close the "Road Worker Risk Without Barrier" score is to the boundary of the red zone. The nearer it is to the boundary, the more likely that installing a barrier is justified, o the cost of hiring and installing the barrier, o any disruption associated with the use of the barrier, o the size of "Road Worker Risk Reduction" score compared to the "Total Barrier Installation Risk" score. If the barrier installation risk would be higher than the road worker risk reduction, then installing a barrier is unlikely to be justified. See also note 6 for limits on the time for installing and removing barriers relative to the duration of the works. Risks can be considered ALARP once it can be demonstrated that further measures to reduce risk would be grossly disproportionate to the benefit gained.
Red	The risk is intolerable and risk reduction must be achieved irrespective of the cost. Either: • Change the design of the works so that the "Road Worker Risk Without Barrier" becomes amber or green when you re-evaluate it. This can include closing a lane to increase lateral separation, • Install a barrier of at least N2 containment. Higher containment barriers are likely to be justified if the road worker risk score exceeds 90.

Table C.1: Required Response to Road Worker Risk without Barrier Score/Colour

Notes 2 and 3 are intentionally omitted.

Note 4

Green	**Unless experience indicates that the tool has not taken account of a specific, significant danger**, the risk to road workers from an errant vehicle entering the works area from an adjacent lane is broadly acceptable. Therefore cones and/or delineators in line with Chapter 8 of the TSM may be used.
Amber	Risks are tolerable but must be managed ALARP. Either: • Change the design of the works so that the "Road Worker Risk With Barrier" is reduced when you re-evaluate it. This can include closing a lane to increase lateral separation or working at night off-peak. • Use judgement to decide if a higher containment barrier should be installed. Factors to take account of include: o situations where higher containment temporary barriers have been used in the past, o how close the "Road Worker Risk With Barrier" score is to the boundary of the red zone. The nearer it is to the boundary, the more likely that installing a higher containment barrier is justified, o the cost of hiring and installing the barrier, o any disruption associated with the use of the barrier, o the size of the "Road Worker Risk Reduction" score and compared to the "Total Barrier Installation Risk" score for the higher containment barrier. If the barrier installation risk would be higher than the road worker risk reduction, then installing a higher containment barrier is unlikely to be justified. See also note 6 for limits on the time for installing and removing barriers relative to the duration of the works. Risks can be considered ALARP once it can be demonstrated that further measures to reduce risk would be grossly disproportionate to the benefit gained.
Red	The risk is intolerable and risk reduction must be achieved irrespective of the cost. Either: • Change the design of the works so that the "Road Worker Risk With Barrier" becomes amber or green when you re-evaluate it. This can include closing a lane to increase lateral separation, • Install a higher containment barrier so that the "Road Worker Risk With Barrier" becomes amber or green when you re-evaluate it.

Table C.2: Required Response to Road Worker Risk with Barrier Score/Colour

Note 5
The table below is used to take account of the length of the barrier being installing when scoring the barrier installation risk.

Length of Barrier	Length Factor
≤100m	1
101-200m	2
201-300m	3
301-400m	4
401-500m etc	5

Table C.3: Barrier Length Factor

When considering barrier lengths greater than 500 metres it may be necessary to carry out a further risk assessment, especially if the barrier is to continue past a junction or constitute a change of alignment such as a bend. Designers should also consider access for works vehicles, emergency vehicle access and risk to road users faced with a continuous length of unbroken temporary barrier with no refuge.

Note 6
Check that the time required for the installation and removal of the barrier is less than the time to carry out the work itself.

Note 7
This assessment needs to be completed if there are unprotected roadside hazards associated with the road works that are capable of causing a fatality or serious injury to road users or third parties if an errant vehicle were to hit them. Examples of such hazards are bridge piers, deep excavations, temporarily dismantled central reserve barriers, TM vehicles or plant.

Note 8

Green	**Unless experience indicates that the tool has not taken account of a specific, significant danger**, the risk to road users and 3rd parties is broadly acceptable. Therefore cones and/or delineators in line with Chapter 8 of the TSM may be used.
Amber	Risks are tolerable but must be managed ALARP. Either: • Change the design of the works so that the "Road User & Third Party Risk Without Barrier" is reduced when you re-evaluate it. This can include closing a lane to increase lateral separation or working at night off-peak. • Use judgement to decide if a barrier of temporary N2 containment should be installed. Factors to take account of include: o situations where temporary barriers have been used in the past, o how close the "Road User & Third Party Risk Without Barrier" score is to the boundary of the red zone. The nearer it is to the boundary, the more likely that installing a barrier is justified, o the cost of hiring and installing the barrier, o any disruption associated with the use of the barrier, o whether temporary speed restrictions have reduced the speed limit to 40 mph or below, where there is not normally a requirement for permanent barriers, o the size of "Road User & Third Party Risk Reduction" score compared to the "Total Barrier Installation Risk" score. If the barrier installation risk would be higher than the road user & third party risk reduction, then installing a barrier is unlikely to be justified. See also note 6 for limits on the time for installing and removing barriers relative to the duration of the works. Risks can be considered ALARP once it can be demonstrated that further measures to reduce risk would be grossly disproportionate to the benefit gained.
Red	The risk is intolerable and risk reduction must be achieved irrespective of the cost. Either: • Change the design of the works so that the "Road User & Third Party Risk Without Barrier" becomes amber or green when you re-evaluate it. This can include closing a lane to increase lateral separation, • Install a barrier of at least N2 containment. Higher containment barriers are likely to be justified if the road worker risk score exceeds 90.

Table C.4: Required Response to Road User & 3rd Party Risk without Barrier Score/Colour

Note 9

Green	**Unless experience indicates that the tool has not taken account of a specific, significant danger**, the risk to road users and 3rd parties is broadly acceptable. Therefore cones and/or delineators in line with Chapter 8 of the TSM may be used.
Amber	Risks are tolerable but must be managed ALARP. Either: • Change the design of the works so that the "Road User & Third Party Risk With Barrier" is reduced when you re-evaluate it. This can include closing a lane to increase lateral separation or working at night off-peak. • Use judgement to decide if a higher containment should be installed. Factors to take account of include: o situations where higher containment temporary barriers have been used in the past, o how close the "Road User & Third Party Risk With Barrier" score is to the boundary of the red zone. The nearer it is to the boundary, the more likely that installing a higher containment barrier is justified, o the cost of hiring and installing the barrier, o any disruption associated with the use of the barrier o whether temporary speed restrictions have reduced the speed limit to 40 mph or below, where there is not normally a requirement for permanent barriers o The size of the "Road User & Third Party Risk Reduction" score compared to the "Total Barrier Installation Risk" score for the higher containment barrier. If the barrier installation risk would be higher than the road user & third party risk reduction, then installing a higher containment barrier is unlikely to be justified. See also note 6 for limits on the time for installing and removing barriers relative to the duration of the works. Risks can be considered ALARP once it can be demonstrated that further measures to reduce risk would be grossly disproportionate to the benefit gained.
Red	The risk is intolerable and risk reduction must be achieved irrespective of the cost. Either: • Change the design of the works so that the "Road User & Third Party Risk With Barrier" becomes amber or green when you re-evaluate it. This can include closing a lane to increase lateral separation, • Install a higher containment barrier so that the "Road User & Third Party Risk With Barrier" becomes amber or green when you re-evaluate it.

Table C.5: Required Response to Road User & 3rd Party Risk with Barrier Score/Colour

Note 10

Traffic flow off peak at night is significantly lower at than during the day. If the barrier installation will be done only off peak overnight, then the Total Barrier Installation Risk Score obtained by adding up the score for the individual elements, need to be divided by 8 to take this into account. This ensures that the risks are not over stated. Bear in mind that during winter, the morning and evening peak flows can occur during hours of darkness.

Note 11

Traffic flow at night has a significantly higher proportion of HGVs than during the day. If N2, H1, H2 or H3 barriers are being used to achieve the risk reduction and the road work is only being done at night, then the calculated Road Worker Risk Reduction score must be reduced by a factor of 2. This is to avoid overstating the risk reduction that will be achieved and reflect the limited ability of the barriers listed to prevent HGVs ingressing into road works.

ANNEX B – ADDITIONAL INFORMATION TO BE SUBMITTED WHEN GIVING FEEDBACK ON THE TOOL

It should be completed and submitted to the creator of the handbook, along with the corresponding completed assessments using the forms in Annex A when giving feedback on the tool. This will enable the calibration of the tool to be checked.

Parameter	Details	Units
AADT		
% HGVs		%
Length of working area over which road workers would be distributed (eg if they work on a 200m long strip that progresses along a 2km road works, this distance is 200m)		M
Width of working area over which road workers would be distributed		M
Lateral separation of road workers from traffic		M
Average number of road workers in the working area		
Planned duration of road works at the location being assessed for barriers		Days
Will works be done during the day or night (or both)?		
Number of road side hazards to road users		
Will road users be exposed to hazards during day and night, just during the day or just during the night?		
Type of road side hazards		
Factors that could significantly increase the likelihood of a roadside hazard being hit, or the consequences for road users or third parties.		
Dimension of road side hazards normal to flow of traffic		M
Lateral separation distance between traffic and roadside hazards		M
Total cost of Temporary Barrier to protect road workers from traffic (including design/survey, installation and hire or purchase costs)		£
Total cost of Temporary Barrier to protect road users from roadside hazards (including design/survey, installation and hire or purchase costs). Only include costs for sections of barrier specifically protecting against road side hazards		£
Barrier Type		
Barrier Working Width		M
Set back		M
Total length of barrier		M
Length of working area over which barrier installers would be distributed (eg if they install a 3km barrier in 100m sections, this distance id 100m)		M
Width of working area over which barrier installers would be distributed. Probably the same as the installation width		M
Lateral separation of barrier installers from traffic		M
Average number of barrier installers in working area		
Planned duration of Barrier Installation to protect Road Workers		Days
Planned duration of Barrier Installation to protect Road users. Only include time for sections of barrier specifically protecting against road side hazards		Days
Is all of Barrier Installation to be done at night?		