

Road Safety Audit

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Summary :

This Standard covers the requirements for Road Safety Audit on National Road Schemes. It describes the stages at which the audits shall be carried out, the procedures to be followed and the monitoring of schemes after opening.

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**VOLUME 5 ASSESSMENT AND
PREPARATION OF ROAD
SCHEMES**

**SECTION 2 PREPARATION AND
IMPLEMENTATION**

PART 2

NRA HD 19/07

ROAD SAFETY AUDIT

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1. INTRODUCTION

General

1.1 The objective of this Standard is to ensure that the road safety implications of all schemes are fully considered for all users of the road and others affected by the scheme.

Revisions since HD 19/04 and HA 42/04

1.2 This Standard supersedes NRA HD 19/04, Road Safety Audits, and NRA HA 42/04, Road Safety Audit Guidelines. The two documents have been combined and minor revisions have been made throughout. The principal changes are as follows:

- The definitions of Road Scheme and Exception Report have been clarified (Paragraphs 1.7 and 1.15);
- The concept of Confined Road Safety Audits has been introduced (Paragraph 2.6);
- The recommended audit stages for the different scheme types have been revised (Table 2/1);
- The team approval procedure has been clarified and qualification and experience requirements amended (Paragraphs 3.5 to 3.14);
- The requirements for site visits have been revised (Paragraph 3.17);
- The procedures for producing audit report, designer response and exception report have all been clarified (Paragraphs 3.28 to 3.56);
- The requirements for accident monitoring have been revised (Paragraph 3.58); and
- The discussions on development schemes, costs and risk assessment have been revised (Chapter 6).

1.3 Mandatory sections of this document are contained in boxes. The Design Office must comply with these sections or obtain agreement to a Departure from Standard from the Overseeing Organisation. The remainder of the document contains advice and explanation, which is commended to users for consideration.

Scope

1.4 This Standard sets out the procedures required to implement Road Safety Audits on national road schemes. It defines the relevant schemes and stages in the design and construction at which audits shall be undertaken and sets out the requirements for post-implementation accident monitoring.

1.5 The Standard is commended to other Road Authorities for use in the preparation of their own road schemes on non-national roads.

Definitions

1.6 *Road Safety Audit:* The evaluation of road schemes during design and construction, before the scheme is opened to traffic, to identify potential safety hazards which may affect any type of road user and to suggest measures to eliminate or mitigate those problems.

1.7 *Road Schemes:* All works that involve new road construction or permanent change to the existing road layout. This includes any change to kerb or road edge, signs, road markings, lighting, signalling, drainage, landscaping and installation of roadside equipment.

1.8 *Design Office:* The organisation managing the various phases of scheme preparation and supervision of construction.

1.9 *Design Team:* The group undertaking the various phases of scheme preparation and supervision of construction on behalf of the Design Office. This may be a team within the Design Office or a separate consultant.

1.10 *Audit Team:* A team of a minimum of two persons, independent of the Design Team and approved by the Overseeing Organisation. The Audit Team shall comprise staff with appropriate levels of training and experience in road safety engineering, accident investigation and road safety audit, as set out in memoranda produced from time to time by the Overseeing Organisation. Each member of the Audit Team shall consider

the scheme design at specific stages to identify road safety problems. In the case of Design and Build schemes, the Audit Team shall be from a completely separate organisation to the Design Team.

1.11 *Audit Team Leader (ATL)*: The person nominated and approved as Audit Team Leader in accordance with the memoranda referred to in the preceding paragraph.

1.12 *Director*: The Head of Engineering in the Overseeing Organisation.

1.13 *Scheme Project Manager (SPM)*: The person within the Design Office responsible for ensuring the progression of a scheme in accordance with policy and procedures.

1.14 *Design Team Leader (DTL)*: The person within the Design Team responsible for managing the scheme design.

1.15 *Exception Report*: A report prepared by the Scheme Project Manager on each item in the Audit Report where Design Team and Audit Team cannot agree appropriate means of addressing an underlying safety problem identified by the Audit.

1.16 *Overseeing Organisation*: For National Road Schemes the Overseeing Organisation is the National Roads Authority (NRA). Where the scheme is not on a national road, then the appropriate Overseeing Organisation shall be substituted for the NRA.

2. ROAD SAFETY AUDIT

Schemes to be Audited

2.1 Except as noted at Paragraph 2.3 this Standard shall apply to all road schemes on national roads including motorways. This includes work carried out under agreement with the Overseeing Organisation resulting from developments alongside or affecting the national roads.

Application to Major Temporary Traffic Management Schemes

2.2 Application of this Standard to major temporary traffic management schemes is at the discretion of the SPM in consultation with the Overseeing Organisation.

Exemption

2.3 Schemes may be given exemption from auditing requirements by the Director where specialist consideration has already been given to safety issues and a formal audit would merely duplicate that work.

Scope of the Audit

2.4 The Road Safety Audit shall only consider matters that have an adverse bearing on road safety. It shall consider safety under all operating conditions.

2.5 The primary purpose of a Road Safety Audit is to identify potential safety hazards within the scheme design or construction as they could affect road users. A road safety audit is not a check of compliance with design standards. The audit shall not be concerned with structural safety.

2.6 For certain categories of scheme it may be necessary to confine the scope of the audit so that only particular pre-defined elements of the road layout are assessed. For example a scheme to replace direction signs over a length of road; in this

case the road safety audit would be confined to examining only the signage element of the road layout. Specification of these "Confined Road Safety Audits" is at the discretion of the SPM in consultation with and with the approval of the Overseeing Organisation.

2.7 These guidelines also apply to arrangements between developers and Road Authorities regarding road safety audits of the road and traffic elements of development planning proposals. Further information on this issue is provided in Chapter 6.

2.8 During the course of scheme preparation and construction the Design Office may change, as may the personnel within the Design Team and Audit Team. It is recommended that, where possible, the same Audit Team be used throughout the scheme delivery to ensure a consistent approach.

2.9 Formulation of recommendations for dealing with the identified hazards should make allowance for the fact that strategic decisions on matters such as route choice, junction type, standard of provision and Departures from Standards should already reflect the best balance of a number of factors, including safety. Recommendations requiring major changes in these areas are therefore unlikely to be practicable to implement, particularly after Stage 1 of the road safety audit process.

Safety Health and Welfare at Work Act

2.10 There is little direct overlap between the task of road safety audit (which relates principally to future operational safety of the scheme) and the Safety Health and Welfare at Work Act and its current Regulations. However, it will be important to ensure that Stages F, 1 and 2 road safety audits are received by the relevant Project Supervisor for Design Process for the scheme prior to invitation to tender, and placed in the Safety File. Stage 3 (post-construction) road safety audits should also be placed in the Safety File.

Stages of Audit

2.11 Road safety audits and subsequent actions shall in general be completed at four specific stages in the preparation of the scheme. These stages are:

Stage F: Route selection stage, prior to route choice.

Stage 1: Completion of preliminary design prior to land acquisition procedures.

Stage 2: Completion of detailed design, prior to tender of construction contract. In the case of Design and Build contracts, a Stage 2 audit shall be carried out in accordance with the requirements of the contract.

Stage 3: Completion of construction (prior to opening of the scheme to traffic wherever possible).

2.12 In the case of minor schemes or temporary works some of the stages may be omitted or combined. An indication of requirement of audit

stage by scheme type and complexity is shown in Table 2/1

2.13 Where no previous stage audit has been undertaken then those factors that would normally be considered at an earlier stage shall be included as necessary.

2.14 Where Stages 1 and 2 are combined, there will be only one design stage audit before construction. It is therefore necessary that the level of detail in design submitted for a Stage 1/2 audit is the same as that expected for a Stage 2 audit.

2.15 Where a choice of routes is available, Stage F audits shall be carried out in two phases. Phase 1 shall be a comparative assessment of the routes from a road safety point of view. Once the route has been chosen, Phase 2 of the audit shall be carried out on the chosen route, in the standard problem and recommendation format

Table 2/1: Stages of Road Safety Audit and Type of Scheme

Type and Complexity of Scheme	Stage				
	F	1	2	1/2	3
Major Scheme	X	X	X	-	X
Minor Improvement Category 1 #	-	X	X	-	X
Minor Improvement Category 2 #	-	X	X	-	X
Junction / Traffic Scheme (Complex)	-	X	X	-	X
Junction / Traffic Scheme (Simple)	-	-	-	X	X
Major Development	X	X	X	-	X
Minor Development	-	-	-	X	X
Temporary Traffic Management *	-	-	-	X	X

See Interim Advice Note 85/06 (NRA).

* At discretion of Scheme Project Manager. See Paragraph 2.2.

3. ROAD SAFETY AUDIT PROCESS

Project Management

3.1 The Scheme Project Manager shall provide the link between the Audit and Design Teams for dealing with queries or requests for additional information.

3.2 The SPM shall liaise with the Design Team and initiate the audit process at the appropriate stages, ensuring that sufficient programme time is available to complete the full audit procedure. This should include an allowance for the incorporation of design changes.

3.3 The SPM shall ensure that the Audit Team is given due notice of when the scheme will be ready for audit and the date by which the report shall be required.

3.4 The SPM is responsible for ensuring that representatives of An Garda Síochána and those responsible for network management are invited to take part in the Stage 3 audit.

Audit Team – Proposal and Approval

3.5 The SPM shall examine the curriculum vitae (CV) of each team member of available Road Safety Audit Teams in conjunction with the Road Safety Section of the Overseeing Organisation. Having satisfied him/herself and the Overseeing Organisation as to the qualifications of available Audit Teams, the SPM shall appoint an Audit Team.

3.6 The Audit Team shall have had no previous connection with the design of the scheme.

3.7 Approval shall be given to an Audit Team only for the audit for which it is sought. Further approval must be sought for the next audit.

3.8 In the case of Design and Build projects the procedure for appointment of the Audit Team shall be included in the Works Requirements.

Audit Team Make-up

3.9 A Road Safety Audit Team shall comprise at least two people who are independent of the Design Team. This independence is vital to ensure that the Design Team does not influence the recommendations of the road safety audit and therefore compromise safety at the expense of another issue. Team members should have recent relevant experience of undertaking road safety audits and should also have more general road safety engineering experience.

3.10 One member of the Audit Team shall adopt the role of Audit Team Leader; in general this will be the most experienced member of the team.

3.11 Training of road safety auditors is essential and any Audit Team Member shall have attended recognised road safety engineering training and road safety audit training courses.

3.12 The current NRA requirements for Road Safety Audit Teams are as follows. These requirements are subject to change, as set out in memoranda produced from time to time by the NRA. Three categories of person are identified:

Audit Team Leader

Audit Team Leaders should preferably be road safety engineers with at least two years experience of accident investigation and remedial measures, shall have taken part in ten road safety audits as team member, and shall have attended an accredited three to five day course in road safety audit theory and practice.

In some instances, road engineers with at least two years experience in road design will qualify provided they have taken part in ten road safety audits as team member, and have attended a two week accredited Road Safety Engineering course as well as the three to five day course in road safety audit theory and practice.

Audit Team Leaders shall have done, as team members, at least two audits of a similar stage and scheme type to that for which approval is being

sought. They shall also have done at least five road safety audits within the preceding two years.

Audit Team Member

Audit Team Members will be road safety engineers, road design engineers or road traffic engineers. They shall have taken part as trainees in five road safety audits, and shall have attended an accredited three to five day course in road safety audit theory and practice.

Trainees:

Road engineers who wish to train as road safety audit Team Members may take part in audits as observers – an additional person who does not sign the report.

Audit Team Approval Procedure

3.13 The Scheme Project Manager will request CVs from prospective audit team leaders and team members prior to the appointment of an audit team. These CVs should be submitted to the NRA Road Safety Section for approval. Applications for approval of audit teams must be submitted on the standard form in Appendix D and can be emailed to roadsafetyaudits@nra.ie. Acceptance will be of individuals, rather than of consultancy firms bidding for the work, and the approval process will be carried out for each individual audit. Quality checks will be carried out on a sample of completed road safety audits and the results of these checks may be taken into account when audit teams are being approved.

3.14 The approval procedure must be carried out for each audit stage for each scheme. Although it is recommended that where possible the same Audit Team be used throughout the scheme delivery to ensure a consistent approach, it may in certain circumstances be necessary for NRA to refuse approval for a team.

Audit Brief

3.15 When an audit team is approved, the Scheme Project Manager shall appoint the team and shall prepare an Audit Brief. The checklist in

Appendix E must be completed and must accompany the brief.

3.16 The list below describes the items that should be provided for road safety audit.

- Design Brief;
- Departures from Standard;
- Scheme Drawings;
- Other scheme details, e.g. signs schedules, traffic signal staging;
- Accident data for existing roads affected by the scheme;
- Traffic surveys;
- Previous Road Safety Audit Reports and Designer's Responses;
- Previous Exception Reports;
- Start date for construction and expected opening date;
- Any elements to be excluded from audit;
- Any other information (list separately).

Site Visits

3.17 A site visit shall be carried out at the first audit stage being undertaken by an audit team. Site visits shall also be carried out at Stage 2, unless otherwise agreed with the Scheme Project Manager, and always at Stage 3. All members of the audit team shall carry these out together at every stage requiring a site visit. The team shall take into account the topography, local amenities, tie-ins of the scheme and any other relevant details.

3.18 The Stage 3 site visit shall be made during both daylight and darkness conditions. The Scheme Project Manager shall invite a representative of the Gardaí to attend the Stage 3 visit, along with a representative of the local Roads Authority.

Checklists

3.19 An example of a road safety audit checklist is shown in Appendix B. Road safety auditors may use this or other lists when carrying out their work. However, checklists should be used intelligently, and not simply as a "tick box" system. It is recommended that they be used at the end of the

process, to ensure that no major potential safety issue has been overlooked.

Road User Role Play

3.20 One of the most important checks carried out involves assessing the safety of the scheme from different potential road users' perspectives. The road safety auditor should always be asking the question: "What is it about this scheme that will lead road users to fail to cope with the road environment?"

3.21 During the design stages the auditor has to imagine what it would be like to walk, cycle and drive the scheme. "Driving" should include cars, vans, trucks and buses. "Walking" should be considered from the perspective of the elderly, the child, the wheelchair user and those with sight impairment. Cycling includes children, leisure cycling, and utility or commuter cycling. Where appropriate, the needs of the equestrian should be considered.

Methodology for Design Stage Audits

3.22 The section below describes a working method for carrying out design stage (Stages F, 1, and 2) audits. It is assumed that the Audit Team consists of two members.

- The Audit Team looks through plans to understand the scheme concept;
- Consideration should be given to a meeting between the Audit Team, the Scheme Project Manager and the Design Team, particularly on larger or more complex schemes;
- The Audit Team visits the site. Photographs should be taken, which can be used for later reference;
- Both team members systematically and independently examine all plans and other information provided and write down any comments;
- The team members discuss their individual findings;
- The Audit Team decides which comments are related to safety and discuss possible recommendations. Any comments recorded by team members that do not go forward to the final report should be noted, together

with a reason stating why that issue is not to be included;

- One team member produces a draft Audit Report;
- The second team member checks the report and edits if necessary;

Methodology for Stage 3 Audits

3.23 At Stage 3 it is recommended that the Resident Engineer (or equivalent) and a representative of the organisation responsible for future road maintenance should be available for consultation with the Audit Team as required on the day of the audit. The Gardaí may have specific local information and knowledge of safety issues. The Garda District Superintendent should be notified by the Scheme Project Manager in advance of the Stage 3 audit. The Gardaí are thus given the option of sending a representative to meet the Audit Team on the day of the audit.

3.24 The road safety audit team observers do not sign the audit report.

3.25 A suggested working method for undertaking Stage 3 road safety audits is as follows:

- The Audit Team visits the site during daylight;
- The Audit Team walks, drives and, where appropriate, cycles along and across the scheme;
- One team member takes notes of all the possible safety points;
- The other team member takes photographs of all the possible safety points;
- Before leaving the site a team meeting is held to ensure that the note-taker has covered all safety points;
- The Audit Team visits the site during darkness;
- One team member produces a draft Audit Report and circulates it to all present at the site visit;
- The report is edited following comments from the other team members and observers;

3.26 There is often pressure to open new road schemes as soon as they are completed. This

makes it difficult to carry out the process described above and provide an immediate report. On these occasions it is recommended to undertake a "pre-Stage 3" audit shortly before completion. If the recommendations from the pre-Stage 3 audit are acted upon, the final Stage 3 audit will be less onerous. It may also be possible to provide the Resident Engineer with a copy of the hand-written notes taken during the Stage 3 visit, or with a typed up version shortly afterwards. The Resident Engineer can, if instructed by the Design Team, then start to act upon these notes prior to receiving the formal Stage 3 audit report.

3.27 Particular care should be taken in examining the tie-ins to the existing alignment, both for the final alignment and for temporary traffic management arrangements. Because of the difficulty of seeing these areas in operation before road opening it shall be necessary to return immediately after opening to complete the audit, unless the audit team is satisfied that there will be no change to the observed layout following their visit.

Audit Report

3.28 At each stage, the Audit Team shall prepare a written report, which shall be forwarded directly to the SPM, who shall copy the report to the Design Team Leader and the Project Manager in the Overseeing Organisation. The report must clearly identify the scheme, the audit Stage and the Audit Team membership, including the names of others contributing at Stage 3 site visits. The body of the report should be kept brief and shall contain descriptions of the specific road safety problems that the Audit Team believes would be created. It should include background reasoning in support of the findings together with the Audit Team's recommendations to eliminate or mitigate the hazards identified.

3.29 The report shall contain a signed statement by each Audit Team member confirming team membership and independence from the Design Team.

3.30 The following items should be included in the audit report:

- A brief description of the scheme being audited, and the audit stage;

- The dates when the audit was carried out, the date of the site visit and the weather at the time;
- A list of the Audit Team members and any other personnel attending the site visit;
- A series of road safety problems and recommendations for action. It may be useful to include a plan showing the locations of the problems;
- A statement signed by the Audit Team members to certify that they have examined the scheme;
- For design stage audits, a list of all plans and other information examined;
- Feedback Form for completion by the Design Team Leader and the Audit Team Leader.

3.31 The main element of the report is the section on problems and recommendations. The following points should be borne in mind when writing this section:

- All problems identified in a Safety Audit Report must relate to road safety problems within the audited scheme. Non-safety items or safety items beyond the scope of the road scheme can be itemised in a separate report or letter;
- All safety problems highlighted should be stated as clearly as possible. A clear identification of a problem will help the Design Office or Design Team to consider not only the recommendation in the report but also to consider alternative ways to overcome the safety problem.

3.32 Road safety audit teams should exercise caution in documenting differences in the potential severity of problems, as a problem would not be described in the report unless it were considered to affect the safety of the scheme to some extent. It is recommended that the meeting between Audit Team, Design Team, Scheme Project Manager and NRA Project Manager be used as the primary means to discuss the relative importance of issues raised in the draft report.

3.33 Recommendations should be as practical as possible and be relative to the overall scheme cost. There is little value in putting forward a recommendation that will add more than a small percentage increase to the cost of a scheme. Costs

and benefits are discussed in more detail in Chapter 6.

3.34 It must be recognised that the implementation of certain measures, such as a change to design standards or policy will be outside the authority of the Design Team and Scheme Project Manager. Recommendations to implement such measures should not be included, although such measures may be discussed in the report.

3.35 Safety problems that remain unaddressed throughout the audit process should be repeated at subsequent audit stages. Recommendations may change as appropriate to the stage the design has reached. For example, a Stage 1 audit on a realignment scheme might identify problems with the position of a particular junction, and would consequently recommend either closure or relocation. At Stage 2, if the design shows the junction in its originally proposed location the auditors should note this and recommend alternative measures to mitigate the problem such as additional signing, road markings, change of road surface, etc.

3.36 A sample Road Safety Audit Report is shown in Appendix C.

Subsequent Actions To The Report

3.37 The recipient of a road safety audit report will be the Scheme Project Manager, who shall decide whether or not to act on the recommendations contained in the report

3.38 On receipt of the report the SPM shall forward it to the Design Team Leader and the NRA Project Manager.

3.39 If, following the road safety audit, discussion or clarification of any issues is required by the Audit Team or by the Design Team or SPM, the SPM shall convene a meeting between the Audit Team, the Design Team and the Overseeing Organisation to resolve as many of the audit issues as possible.

3.40 For Stage 1 and 2 Audits this meeting may take place some days after the audit and after a draft report has been completed. Due to time

pressures for Stage 3 audits it is suggested that the meeting, if needed, takes place immediately after the Stage 3 site visit.

3.41 The purpose of the meeting is to clarify issues raised in the draft audit report. The auditors should be prepared to indicate the importance of issues raised in the report, and to justify why the problems are genuine safety issues. They should not be under external pressure to change their report. However, once issues have been clarified the auditors may feel that they can amend sections of the report; for example a recommendation within their report may be amended in the light of new information that demonstrates that their original ideas could not be implemented. As long as the auditors accept that the new recommendation will have a genuine safety benefit, they can change their draft report, and produce a final version.

Design Team Response

3.42 The DTL shall consider the Audit Report and prepare a Design Team Response to each of the recommendations, using the Feedback Form included in Appendix F. The response shall state clearly whether the recommendations are accepted, rejected, or whether an alternative recommendation is proposed. Copies of the Design Team response shall be sent to the SPM and the Audit Team.

3.43 In most cases the Scheme Project Manager will instruct the Design Team to make the recommended changes to the scheme in response to the audit report. Where these are major changes it may be necessary to carry out a re-audit of that part of the scheme. Where there is a proposal to provide an alternative means of addressing a particular problem, the alternative should be described on the Feedback Form.

3.44 The Audit Team shall consider the Design Team response and reply to SPM indicating acceptance or otherwise of the response to each item.

3.45 The Audit Team's response shall take one of the following forms:

- Acceptance of the proposed alternative measure;

- Following discussions with the Scheme Project Manager and Design Team, acceptance of a modified version of the proposed alternative measure;
- Rejection of the proposed alternative measure.

3.46 On completion the Feedback Form shall be signed by all three parties involved: Design Team Leader, Audit Team Leader and Scheme Project Manager.

Exception Report

3.47 For those cases where the Design Team and the Audit Team cannot agree appropriate means of addressing an underlying safety problem identified by the audit an Exception Report must be prepared on each disputed item in the audit report. Table 3/1 indicates those circumstances where an exception report will be needed.

3.48 The Exception Report should be prepared by the Scheme Project Manager. It must address only those items in the Audit Report for which an Exception Report is necessary.

3.49 An Exception Report shall take one of the two following forms:

- Where the Design Team accepts an identified problem, but the Design Team and Audit Team cannot agree on an appropriate recommendation, the Exception Report should describe the reasons why the audit team recommendation cannot be implemented, and outline the alternatives considered and the difficulties involved in implementing them.

- Where the Design Team does not accept that the identified problem exists, the Exception Report should produce some evidence as to why the problem is not valid. It may be that the Audit Team did not have all information available, or that the scheme design has changed since the plans used in the audit were prepared.

3.50 While the road safety auditor concentrates on road safety issues, the Scheme Project Manager will have to weigh up the various consequences of implementing the recommendations within the audit report.

3.51 There will inevitably be some conflict between safety and other issues within the audit process. Some examples are given below:

- Large conspicuous road signs are generally a good idea from a safety point of view, although they can have an adverse affect on visual intrusion;
- Street lighting generally improves road safety but has implications for light pollution;
- Multi-lane approaches to roundabouts can have a poor safety record but will reduce traffic delays.

3.52 When writing an Exception Report it should be noted that both the Road Safety Audit and Exception Reports could be used in future litigation. The legal implications of road safety audit are examined in Chapter 5.

Table 3/1: Feedback Form Responses, Requirement for Exception Report

Problem accepted	Recommended measure accepted	Alternative measures or reasons accepted by auditors	Exception report needed
Yes	Yes	-	NO
Yes	No	Yes	NO
Yes	No	No	YES
No	No	No	YES

3.53 Exception Reports must be sent to the Director of the Funding Authority and Overseeing Organisation for decision. The final decision to accept or reject the disputed recommendations rests with the Funding Authority for the scheme. For national roads this is NRA. The Exception Report Decision Form, given in Appendix G, must be returned to the Scheme Project Manager for action on the decision.

3.54 After the Director's decision, copies of the Exception Report and the Exception Report Decision Form must be sent by the Scheme Project Manager to the Audit Team, the Design Team and NRA Project Manager for the scheme. A copy must also be sent for information to the NRA Road Safety Section. This can be emailed to roadsafetyaudits@nra.ie or sent on CD.

3.55 The SPM shall instruct the Design Team in respect of any changes required during the preparation, design and construction of the scheme resulting from audit.

3.56 The SPM shall send copies of all reports and decisions to the following:

- Project Manager in the Overseeing Organisation;
- Design Team Leader;
- Audit Team Leader; and
- Road Safety Section in the Overseeing Organisation. Receipt of this report is necessary for approval of the road safety audit team for subsequent stages of audit.

Accident Monitoring

3.57 Staff in the Overseeing Organisation who are responsible for network management shall arrange for accident monitoring of audited schemes to be undertaken.

3.58 A record of all the accidents that have occurred on the scheme since opening shall be obtained at 3 years and 6 years after opening in order to monitor the effectiveness of road safety audits. This shall supplement routine monitoring.

3.59 The accident records shall be analysed in detail to identify such factors as:

- a) locations at which accidents have occurred;
- b) accidents which appear to arise from similar causes or show common factors; and
- c) the accident rate and severity ratio after 6 years compared with the average rates for either the type of road or the road before improvement.

3.60 Although this monitoring is necessary, it is of limited use unless it is related back to the original road safety audit reports. A suggested working method for monitoring is outlined below:

- Identify accident locations;
- Identify accident types;
- Identify which items highlighted in the road safety audit report were amended on site;
- Look at the audit reports and compare the recorded accidents against the problems highlighted in the report. Those problems that have not been addressed and where the recommended measures have not been implemented will be of particular interest;
- Prepare a monitoring report for the Overseeing Organisation (with a copy to the original Audit Team);
- It may also be useful to examine maintenance records, as these could highlight where damage-only accidents have occurred.

Guidance

3.61 A flow chart illustrating the Safety Audit process is shown in Appendix A.

4. ROAD SAFETY AUDIT PRINCIPLES

4.1 It is important for road safety auditors to try to base their comments on sound safety experience, and where possible, to have the means to back up the recommendations from documented sources.

General Safety Principles

4.2 Road Safety Audit is a formal procedure that uses experienced auditors with extensive safety engineering knowledge to identify safety deficiencies in road schemes. A broad experience in road, traffic and safety engineering will ensure that a road safety auditor has the knowledge and ability to refer back to the basic principles in road safety, and ask a series of pertinent questions:

- Does the design layout create confusion or ambiguity for road users that could lead to potential road traffic accidents?
- Is there too much, or too little information for road users?
- Is there too little, or too much visibility, or an obstruction to road users' view?
- Does the layout create hazards or obstacles to road users that could contribute to an increased risk of injuries?

4.3 If there is a “yes” answer to any of these questions, then the safety of the scheme could be compromised and remedial measures may be required to remove this potential or actual deficiency. Drivers and other road users have to perceive and process vast amounts of sensory and visual information to negotiate a road layout. The designer's role is to provide a safe road environment that should:

- provide adequate information for road users of the layout and conditions ahead;
- provide adequate warning of hazards or unusual layouts ahead;
- provide positive control of road users' passage through conflict points or unusual sections; and
- provide a road performance that can “forgive” road users' errors or inappropriate behaviour.

4.4 As a minimum, current Design Standards should be used wherever possible and advance information and warning should be used to inform road users of the layout ahead. However, driver overload must be avoided as it may cause road users to focus too much on the unimportant data and shed vital information. Conflicting information, an over abundance of road signs or a lack of delineation can cause overload.

4.5 Therefore, a “safer” road environment can be defined as a layout that:

- provides clear, concise and phased release of road user information;
- provides a consistent standard of road design and traffic control; and
- provides adequate warning of hazards.

Designing for the Road User

4.6 It is important that a road improvement caters for all road users. Often the needs of the motorist are incorporated within a scheme whilst the needs of the vulnerable user are ignored. The vulnerable road users that need to be considered are:

- pedestrians – the old, young and those with mobility or sight impairment;
- cyclists – children, commuters and leisure users;
- equestrians; and
- motorcyclists.

4.7 Each vulnerable road user has different needs from the road network and it is important that designers and auditors are aware of their specific requirements. In the urban environment the pedestrian is likely to be the principal user and designs must incorporate safe crossing locations, adequate visibility to and from the crossings and appropriate lighting.

4.8 In addition to the needs of vulnerable road users, particular attention should be paid to the needs of lorries, buses or other specialist vehicles.

4.9 To assist in the determination and needs for all road users, it is essential that traffic data and local user surveys are used to shape the design process and tailor a 'safer' environment.

Roadway Elements and Safety

Design Context

4.10 Safe road design varies from the urban to the rural road network: a number of external factors can create a situation in which a safe road becomes unsafe due to external factors beyond the designer's control. These factors can include traffic volumes, population density, noise, or road user familiarity.

4.11 The function of a road should be clear to all road users, and a well planned and defined road hierarchy can assist in providing a safe road network. The design speed can also be an important factor in influencing the safety of a road and should be appropriate to the location, local road users and level of private access control.

Junctions

4.12 The most important point to consider with respect to the safety of junctions is that both the layout and control method should be simple and clear, with defined priorities for all road users.

4.13 The assumption that 'straight on' traffic has priority is widely accepted and it needs to be remembered that alterations to this, despite reinforcement with signs and lines can still be confusing if visual clues such as fences, kerbing or lighting remain unchanged.

4.14 It is important to attempt to make any minor approach perpendicular to the main road, and junctions with acute angles should be avoided. These angled junctions pose a particular problem for the elderly or those with restricted neck movements, and forward and side visibility is often restricted. Similarly, it is advisable to avoid intersections on the inside of bends as foliage often encroaches into sight lines after several years.

4.15 Roundabouts used as a form of junction control have their own rules and design requirements. It is important that a roundabout

looks like a roundabout from all approaches, and for all users, in order to prevent potential conflict. One of the primary requirements in good roundabout design is that the radius is tighter on the entry than the exit: this ensures a slow entry and lower circulating speed.

4.16 Visibility is a key requirement for all junction types, all road users need to see and be seen by others. Care should be taken with siting street furniture, such as signs, and vegetation within visibility splays. Vulnerable road users often experience difficulties crossing junctions. It is important that their needs are provided for and that safe crossing places are implemented where required.

Links

4.17 Links that are well designed with few private access points traditionally have a good safety record. However, within the urban environment strict access control is more difficult.

4.18 The principal factors affecting the safety of road links are:

- **Private access control** – there is a direct correlation between the number of access points between links and the accident numbers on any given road. This is also true of central reserve gaps on dual carriageways;
- **Proximity of junctions** – the majority of accidents take place at junctions. It is essential that junction spacing be maximised and consistent junction types used;
- **Horizontal and vertical curves** – accident frequency increases at crests and dips (vertical curvature), and increasing the degree of horizontal curvature increases accident frequency;
- **Visibility** – adequate forward visibility and safe stopping distances to junctions and crossings are crucial to ensure a safe road design;
- **Design Speed** – the design speed influences the likely pre-crash impact speed in a road traffic accident. Therefore, it is important that the road environment and design speed selected are appropriate and where possible excess speed is discouraged;

- *Combinations of elements* – where two or more sub-standard design elements are combined, it is more likely that a hazard will emerge.

Road Features

4.19 The relationship between cross-sectional elements and safety is affected by the type and volume of traffic, and also by the surrounding environment.

4.20 Lane widths can be critical in affecting safety: where they are too narrow, vehicles may collide on horizontal curves and there may also be inadequate space for two wheeled vehicles. Where lane widths are too wide, the alignment may encourage excess speed.

4.21 On high-speed links there is a safety benefit to be gained by the provision of a hard shoulder. Also, central reserve gaps should be of adequate width, depending on the size of vehicles turning.

4.22 Vehicles parked on the carriageway affect the road environment, layout and consequently safety. Safety problems experienced with parked vehicles are:

- parked vehicles causing physical obstructions which are sideswiped or run into;
- parked vehicles causing sudden braking or nose-to-tail shunts;
- parked vehicles which deflect oncoming vehicles into adjacent vehicle paths;
- parked vehicles blocking visibility for any road user; and
- parked vehicles between which pedestrians emerge.

4.23 To reduce the risk of parked vehicles contributing to an accident it is important that designs should minimise parking in main traffic lanes.

4.24 Trees and foliage can greatly enhance the environmental impact of the street scene. However, left un-maintained, they can also restrict visibility considerably. In addition to this, saplings grow into large trees, which can provide an unforgiving road hazard in the event of a road traffic accident.

Forgiving Roadsides

4.25 Studies during the 1960s and 1970s in the USA, followed by work in the 1980's in Europe, demonstrated that single vehicle non-pedestrian accidents are a significant problem on motorways, dual carriageways and inter-urban high speed single carriageway roads.

4.26 In these collisions a high proportion of vehicles that leave the roadside go on to strike trees, lamp columns, road structures or other items of unprotected street furniture. A hierarchy of treatment has been established to minimise the consequence of this type of accident:

- Where possible provide a “clear zone” with all items of rigid street furniture placed at a distance from the carriageway edge appropriate to the operating speed, as defined in NRA TD 19;
- Where this is not possible use passively safe street furniture to EN12767;
- Where this is not possible protect the street furniture with a safety barrier.

5. LEGAL IMPLICATIONS

Background

5.1 There are no formal legal requirements to carry out road safety audits in Ireland. Safety checking processes are referred to in Chapter 9 of “A Guide to Road Safety Engineering in Ireland”, published by the Department of the Environment in 1996.

5.2 Statutory duties that are relevant in the general area of road safety are contained in the Road Traffic Act 1961. This Act has provisions for both Road Authorities and the Minister of the Environment to promote road safety.

5.3 The Roads Act 1993 places a duty on people using public roads to take reasonable care for their own safety and for that of other people using the road. The 1993 Act also places a duty on Road Authorities to construct and maintain roads. In carrying out these duties the Road Authority has a responsibility to consider the needs of all road users, and can provide for the safety of road users.

5.4 The Road Traffic Act 1994 makes provision for the Road Authority to carry out traffic calming measures in the interest of safety.

5.5 With no experience (up to the end of 2006) of claims having been made against Road Authorities in Ireland in respect of deficient road safety audits, the guidance on how to deal with possible litigation can only be speculative. There is increasing evidence, however, of claims being made against Road Authorities in cases of road traffic accidents. There are many reasons given for this, but it appears that there is an increasing awareness on the part of both claimants’ solicitors and the judiciary of the possibility of contributory negligence awards against Road Authorities.

5.6 Following the occurrence of a road accident, it may be possible that a claimant would argue that the Road Authority is in breach of a statutory duty and/or is negligent. Legal proceedings are more likely to ensue in those cases where there is evidence to suggest that a road factor is dominant in accident causation. This might be at a site with a history of similar

types of accidents relating to a road problem, for example poor alignment or road lighting. Or it may be a situation where it can be shown that certain aspects of the drainage or signing were both substandard and contributory to accident occurrence. Or it may be where it can be shown that certain procedures, such as road safety audit, were not carried out in accordance with existing recommended good practice.

5.7 In order to succeed, a claimant must show that the Road Authority failed to take such care as in all the circumstances was reasonably required to ensure that the road was not dangerous to traffic. In this respect authorities could be judged, inter alia, on the basis of the consistency and objectivity of their internal procedures (including road safety audit), and their compliance with any published advice on road safety audit.

Areas of Concern

5.8 The NRA is, therefore, concerned about the legal implications of both general safety engineering work and the requirement for effective road safety audit procedures.

5.9 A number of potential issues arise, once an accident has occurred on a new road scheme or a road improvement. In devising road safety audit guidelines, the NRA has addressed the following issues:

5.10 What are the legal implications on a road where an accident occurs and litigation ensues if:

- *no effective, consistent road safety audit procedures exist?*
It is considered that until there is a statutory obligation to carry out road safety audit in Ireland, a Road Authority is not obliged to do this work;
- *despite publishing a set of specific procedures, a road safety audit has not been carried out on one of the NRA’s roads?*
Although this would be seen as contrary to the written procedures, it is considered likely that

this would be viewed as a mistake, rather than as a breach of statutory duty or negligence;

- *a road safety audit has been carried out, but the recommendations have not been acted upon?*

Misfeasance could apply here. The importance of acting on road safety audit reports, and having a well documented Exception Report process is strongly emphasised;

- *a road safety audit has been carried out, but has failed to identify a relevant problem?*

The road safety auditor is considered likely to be judged on the basis of whether he or she could reasonably have been expected to identify that particular problem.

5.11 It is important that a clear procedure for managing and organising road safety audit is established, that the practice of undertaking and reporting road safety audit is specified clearly, and that the actions are fully and consistently documented.

5.12 In undertaking road safety audits for the NRA, parties involved should:

- Ensure that the terms of reference for each road safety audit are clear;
- Establish exactly what information has been received by the road safety Audit Team and subsequently used as information to assist with the road safety audit;
- In writing road safety audit reports at Stages 2 & 3, ensure that safety issues raised at earlier stages which have not been addressed are re-examined where appropriate. In some circumstances it may be appropriate to suggest alternative solutions at subsequent stages;
- Note that the Stage 3 road safety audit is the final opportunity to examine the scheme from a road safety point of view before it is opened to traffic;
- Ensure that road safety audit team members are aware of their responsibilities in undertaking a road safety audit;
- Ensure that Scheme Project Manager and Design Team staff are aware of their responsibilities in responding to a road safety audit;

- Maintain the documentation of a formal set of road safety audit procedures;
- Maintain a record of the full documentation for each road safety audit undertaken;
- Ensure that road safety audit ties in with responsibilities under the Safety Health and Welfare at Work Act and its current Regulations;
- Monitor the safety performance of road schemes after they are open;
- Give consideration to specific indemnification for road safety audit work carried out by staff working in this area.

5.13 Consultants carrying out road safety audit work on behalf of the NRA shall be expected to provide adequate professional indemnity cover for this type of work.

6. ROAD SAFETY AUDIT ISSUES

Costs and Benefits

6.1 The costs attributed to a road safety audit can be divided into two distinct components. Firstly there is the cost of the audit itself. The cost of a road safety audit is related to the time spent to complete it, rather than the cost of the scheme itself. It takes less time to audit a scheme involving a new link road with a simple junction at each end than it does to audit a complex traffic signal junction in an urban area. Research carried out by the Institution of Highways and Transportation found that the average time taken to complete an audit was 25 hours.

6.2 The second element of cost relates to the implementation of the recommendations contained within the audit report. In general, these costs are not significantly high and items identified at Stages F, 1 and 2 may have no cost implications at all (although they may require some re-design time). There are, however, some instances where audit recommendations, particularly at Stage 3, will add to the cost of a scheme: for example, a recommendation for applying anti-skid surfacing on the approach to a set of traffic signals.

6.3 It is difficult to identify the benefits of carrying out a road safety audit on a scheme in a quantitative way. When an audit has been carried out, the scenarios are that either the recommendations are implemented or they are not. Although the subsequent accident record can be examined only one of the scenarios can be evaluated. It is not possible to judge how an individual scheme that has been audited would have performed had the audit not been carried out.

6.4 Whilst it may be possible to look at schemes in a wider national context and check the performance of audited schemes versus those that have not been audited, it would be inadvisable to leave schemes unaudited as part of an experiment.

6.5 Some work carried out in New Zealand suggests that the benefit to cost ratio for road safety audits is in the order of twenty to one. In Denmark, the first year rate of return for road safety audits has been estimated at over 149%.

This figure was based on estimates for accident savings that might be made by introducing audit recommendations.

6.6 A further qualitative benefit is the extent to which design engineers receive improved safety awareness through the road safety audit process. Local authorities in the United Kingdom who have carried out this work over a decade or more have noticed a reduction in the number of comments being made by auditors.

Risk Assessment

6.7 A road safety auditor may sometimes comment on a safety issue and make a recommendation that has only a small safety benefit but has a cost of implementation which far outweighs any benefit to be gained. It is therefore suggested that auditors carry out an informal risk assessment of each problem documented, assessing both the probability of such a collision occurring and the severity of outcome of the predicted collision. This should be done for both possible situations, with and without the recommendation implemented, so that the expected reduction in risk resulting from implementing each recommendation can be obtained.

6.8 The post-audit meeting between Audit Team, Design Team, Scheme Project Manager and NRA Project Manager can be used as the primary means to discuss the relative importance of issues raised in the draft report.

6.9 The information from the risk assessment can be used by the Scheme Project Manager to help decide whether or not to implement the recommendations.

Auditing Development Schemes

6.10 The auditing of any changes to the road layout that are development-led within the local authority planning process is another area that needs clarification.

6.11 A road safety audit is a requirement for any development scheme that results in a permanent change to the road layout on a national road, whether inside or outside urban areas.

6.12 Guidance on the preparation of Traffic and Transport Assessments of development schemes is available in Traffic and Transport Assessment Guidelines published by NRA.

6.13 Many Road and Planning Authorities require a road safety audit too late in the planning process to address fundamental safety issues. Once planning approval has been given it is difficult to require developers to make significant changes to schemes, especially if they are costly or reduce the amount of land available for development. It is important therefore that the road safety audit process be built into the planning procedure of each authority so that audit reports and their responses can be given due consideration by the Planning Authority.

6.14 The four stages of Road Safety Audit are summarised in Table 6/1. Whether all these stages are necessary depends on the size and impact of the development concerned.

Table 6/1: Road Safety Audit Stages

Stage F:	Concept stage
Stage 1:	Completion of preliminary design
Stage 2:	Completion of detailed design
Stage 3:	Completion of construction.

6.15 In the case of large developments a Stage F audit should be submitted during preplanning talks, and Stage 1 and 2 audits as part of the planning application. In the case of small developments a combined Stage 1/2 road safety audit should be submitted as part of the planning application. In all cases the planning application should contain the report from a detailed design

stage of road safety audit. The Local Authority can then consider any relevant Audit Report and Audit Response before planning permission is granted.

6.16 The findings of the road safety audit may possibly lead to the refusal of the planning application, but it is more likely that the developer would be granted planning permission conditional on specific requirements resulting from the road safety audit report recommendations. Although the developer, as instigator of the scheme and commissioner of the audit, takes on the role of the Scheme Project Manager in the road safety audit process, it is up to the Road Authority to ensure that the resulting road layout is acceptable and safe for public use. Discussions in preplanning and the use of planning conditions provide methods of ensuring that the developer implements the recommendations of the road safety audit report.

6.17 The following are examples of requirements that can be included as conditions to a planning approval.

- *The agreed recommendations from the road safety audit process must be completed by the developer to the satisfaction of County Council, as the Road Authority, before the public road hereby permitted is taken into charge by County Council.*
- *The development shall not open for the approved use intended by the developer until the road safety audit process has been complied with by the developer in accordance with NRA Standard NRA HD 19 and the agreed recommendations from the road safety audit report have been completed by the developer to the satisfaction of County Council, as the Road Authority.*

6.18 The following is an example of a statement of grounds for refusal of planning approval.

- *The development is not permitted because, following the adherence of the road safety audit process, fundamental road safety issues remain. These issues have not been resolved and it is, therefore, considered that were the development to go ahead in its proposed form it would pose a significant traffic hazard to road users*

6.19 If a developer refuses to implement a certain recommendation in the road safety audit report then an Exception Report would be required. The final decision to reject or accept the Exception Report, i.e. to implement the disputed recommendation or not, rests with the Planning Authority and Road Authority.

6.20 Once the change in road layout is completed, a subsequent Stage 3 road safety audit should be carried out. The requirement for this can either be enforced through a planning condition or reached by agreement between the Planning and Road Authority and the developer.

6.21 It must be stressed that currently the road safety audit procedure is not easily facilitated within the planning process. In many Local Authorities at present continual requests for “Further Information” are necessary to ensure that a road safety audit is done on every change to the National Road layout proposed as part of a development scheme. The process would be very much eased if in-house planning application processes were reviewed within each Local Authority, so that the requirement for road safety audit on applications affecting National Roads is included within each county and city development plan.

7. REFERENCES

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8. ENQUIRIES

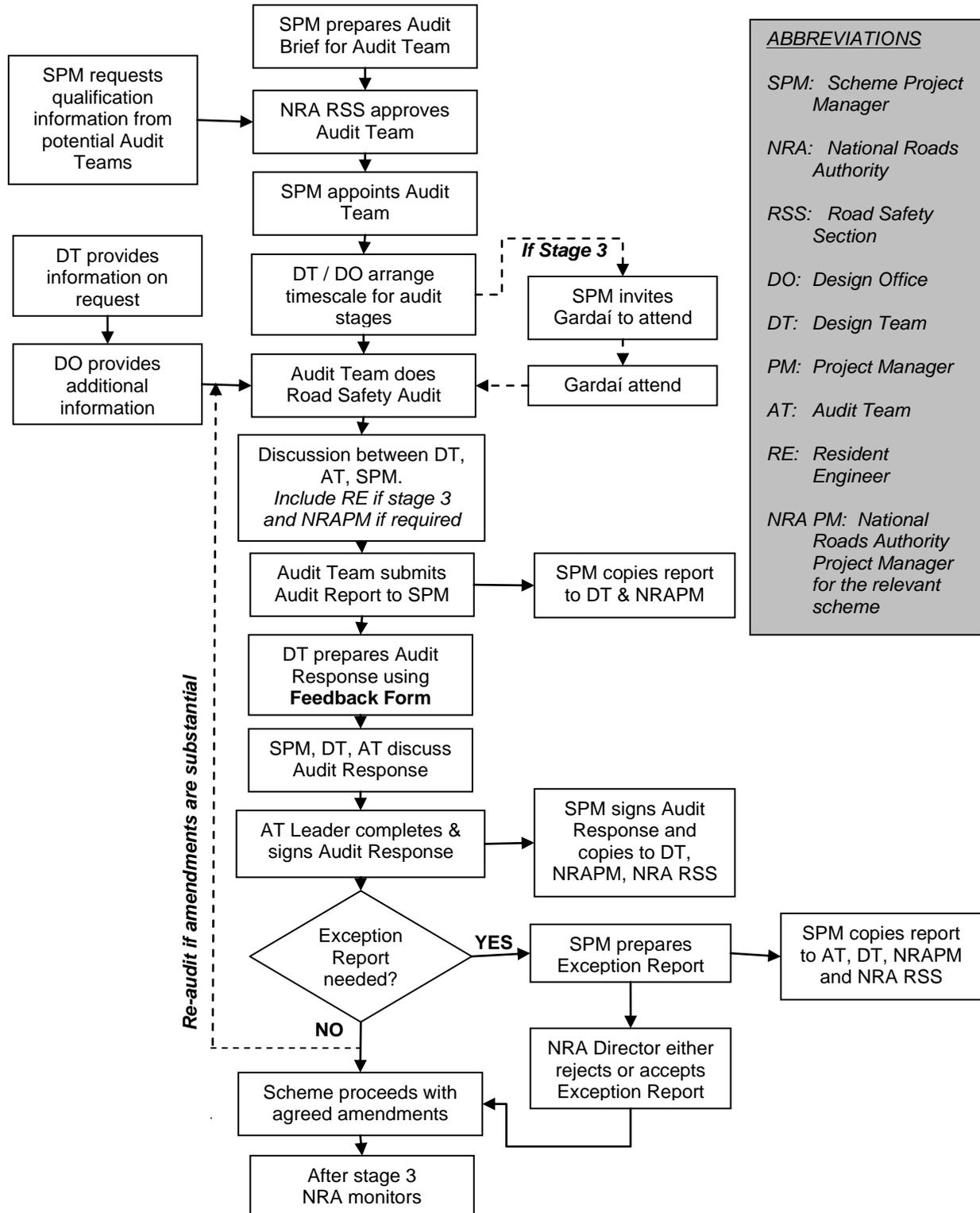
All technical enquiries or comments on this Standard should be sent in writing to:

Head of Engineering Operations
National Roads Authority
St Martin's House
Waterloo Road
Dublin 4



.....
E O'CONNOR
Head of Engineering Operations

APPENDIX A: AUDIT FLOW CHART



APPENDIX B: AUDITOR'S CHECKLIST

(Source: IHT Road Safety Audit Guidelines)

Checklist for Stage F - Feasibility

General

Consistency of standards with adjacent road network, especially at tie-ins;
Secondary effects on surrounding road network;
Where a preferred scheme is being chosen, relative safety performance of options.

Routes

Impact of standard of route, related to design flows and speed, on safety;
Overtaking opportunities;
Consistency of junction arrangements and access control;
Frequency of junctions (public and private) related to safe access;
Location of junctions in relation to horizontal and vertical alignments;
Horizontal and vertical alignments consistent with visibility requirements, both along the road and at junctions;
Facilities for pedestrians, cyclists and equestrians;
Provision for unusual aspects of traffic composition (heavy concentrations of particular types of road user), or environment (e.g. sunrise / sunset glare, fog, or wind).

Area Schemes

Designation of functions for different elements of the road hierarchy;
Scheme consistent with overall safety plan.

Checklist for Stage 1 - Preliminary Design

General

Review any previous Road Safety Audit in order to allow for subsequent design changes;
For major schemes, determine need for land take for safety requirements.

Alignments and Sight Lines

Any elements of horizontal and vertical alignments which may produce hazards due to reduced sight lines, especially where these are combined and/or there are Departures from Standards;
Sight lines obstructed by bridge abutments, parapets, landscaping, structures or street furniture.

Junctions

Minimising potential conflict points at junctions (including numbers of private accesses);
Conspicuity of junctions on approach, and sight lines from minor road approaches and private accesses;
Control of approach speed, and layout of approach roads;
Provision for turning traffic;
Location and access of lay-bys.

Other

Impact of landscaping on visibility and road user perception;
Concept of road marking / signing for road user perception;
Provision for safety aids on steep hills;
Facilities for pedestrians, cyclists and equestrians;
Potential for flooding due to inadequate drainage;
Compatibility with adjacent network at tie-ins;
Servicing access and maintenance arrangements.

Checklist for Stage 2 - Detailed Design

General

Review any previous Road Safety Audit in order to allow for subsequent design changes;

Note: Scope for altering alignments or junction design is less extensive at this stage, so the Road Safety Audit will focus mainly on details of signing, marking, lighting, etc. and issues which affect visibility and drivers' perception of the road scene, and provide aids to safety.

Junctions

Appropriateness of corner radii or curvature in relation to approach speed;
Road users' perception of road layout.

Road Signs and Markings

Locations of signs and markings to aid, inform, and warn of hazards, without obscuring visibility or misleading drivers;
Consistency of signing and marking information.

Lighting and Signals

Consistency of lighting within the scheme and with the adjacent network;
Safe positioning of lighting columns, signals and operational equipment;
Confusion or conflict between lighting and traffic signals;
Positioning of heads for traffic and pedestrian signals to ensure clarity to appropriate road user, and avoid confusion to others to whom they do not apply;
Safe access and servicing arrangements.

Facilities for Vulnerable Road Users

Location and type of crossing facilities;
Visibility;
Dedicated cycle or pedestrian facilities;
Provision of facilities for people with mobility impairments.

Landscaping

Potential obstruction to visibility from landscaping, taking account of future growth;
Potential for trees to become collision objects: choice of appropriate species;
Ability to maintain planted areas safely.

Protective aids

Positioning of safety barriers and guard rails to protect against vehicle conflicts or roadside objects (poles, columns, statutory undertakers' apparatus, etc.), without obscuring visibility;
Use of arrester beds.

Surface characteristics

Appropriate surfacing for high-speed roads, or locations (e.g. bends) which are potentially hazardous when wet;
Appropriate surfacing for approaches to junctions, and thresholds to villages or residential areas in towns, to encourage lower vehicle speeds.

Checklist for Stage 3 - Pre-opening

General

Review any previous Road Safety Audit in order to allow for subsequent design changes.

The main emphasis is to inspect the scheme from the viewpoint of the different road users, considering where appropriate the needs of pedestrians, cyclists, equestrians, public transport operators, and HGVs as well as car drivers.

Inspection at appropriate times of day, in particular in daylight and darkness.

Checklist for stage 2 provides an appropriate aide-memoire.

APPENDIX C: SAMPLE ROAD SAFETY AUDIT REPORT

N99 BALLYMACK BYPASS

ROAD SAFETY AUDIT STAGE 2

1. INTRODUCTION

- 1.1 This report describes a Stage 2 Road Safety Audit carried out on a proposed bypass at Ballymack on N99 in Co Skellig, on behalf of Cullen and Dempsey Partnership. The audit was carried out between 12 and 18 October 2007 in the offices of ABC Consultancy.
- 1.2 The audit team members were as follows:-

Helen Doyle, MSc, MIEI, MIHT, Director, ABC Consultancy, Team Leader;

Daniel McLoughlin, MEI, Engineer, ABC Consultancy, Team Member.
- 1.3 The audit comprised an examination of the drawings relating to the scheme supplied by the design office. Both team members visited the site on 12 October 2007.
- 1.4 The audit team had previously done a stage 1 audit of this bypass scheme in February 2006.
- 1.5 The Ballymack Bypass road scheme is a single carriageway realignment of N99 for approximately 4km. It runs in an approximate north-south direction between Kilmacsouth and Ballynanorth. It is entirely off line and bypasses the town of Ballymack and 5km of existing N99. There are two roundabouts, each at the tie-ins to the existing line of N99. Two overbridges carry local roads over the new alignment.
- 1.6 This Stage 2 audit has been carried out in accordance with the relevant sections of NRA HD 19/07. The team has examined only those issues within the design relating to the road safety implications of the scheme, and has therefore not examined or verified the compliance of the design to any other criteria.
- 1.5 Appendix 1 describes the drawings examined by the audit team.
- 1.6 All of the problems described in this report are considered by the audit team to require action in order to improve the safety of the scheme and minimise accident occurrence.

2. ITEMS RESULTING FROM THIS STAGE 2 AUDIT

2.1 General problems / problems at multiple locations

2.1.1 Problem –Crash barrier end treatments

It is proposed that terminals of the crash barriers shall be ramped down to ground level but not flared away from the road. This can cause problems if errant vehicles leaving the carriageway collide with the terminals. They can be launched from the ramped ends, which can result in severe injury for the occupants

Recommendation

Leading ramped ends must be flared away from the approach direction of traffic. Particular attention should be paid to the leading ramped ends of crash barriers at:

- N99 northbound approach to Muckcross roundabout;
- Carrigstown Road west approach to Muckcross roundabout;
- N99 northbound (3 locations);
- N99 southbound (5 locations).

2.1.2 Problem – Drainage ditches and headwalls

A number of drainage ditches and head walls at culverts appear to be within the clear zone of the road and unprotected. These are hazards and vehicle occupants could be injured if vehicles overturn in ditches or strike head walls.

Recommendation

In the first instance all effort must be made to remove these hazards from the clear zone adjacent to the road. Drainage ditches can be piped and filled in, removing the hazard completely. Culverts can be extended so that the headwall is not within the clear zone.

If this is not possible then crash barrier must be provided to protect each hazard. As each barrier terminal is a hazard in itself care must be taken in placing the barriers. Separate lengths of barrier with gaps shorter than 100m between them should be joined.

The following locations must be reviewed:

- West side of N99 between chainages 400 and 700 approximately (drainage ditch and culverts);
- East side of N99 between chainages 500 and 1200 approximately (drainage ditches and culverts);
- Bog Lane east approach to Bog Lane roundabout (drainage ditch).

2.2 Problems at specific locations

2.2.1 Problem – Attenuation Pond (Carryover from stage 1 audit)

The attenuation pond at the north west corner of Muckcross roundabout appears to be within the clear zone of the road and unprotected. Vehicle occupants could drown if errant vehicles land in the pond. This hazard was identified in the stage 1 audit report, the recommended measure being to relocate the pond so that is not within the clear zone of the road. This has not been done.

Recommendation

If land is available to relocate the pond then do so.

Otherwise provide crash barrier to protect this hazard.

2.2.2 Problem – Bog Lane roundabout

The N99 northbound and the Bog Lane east approaches to the roundabout will be relatively high speed in low flow conditions. These straight approaches could lead to a situation in which drivers lose control and overrun the central island, resulting in injury to vehicle occupants.

Recommendation

Increase roundabout conspicuity, either by using block paved chevrons on the central island or by adding post-mounted chevrons to the central island. Central island chevrons should be mounted on frangible posts.

Provide anti-skid surfacing on the N99 northbound and the Bog Lane east approaches.

Ensure optimum sign face conspicuity for traffic approaching from all entries, reviewing the length, height, position and angle of signs. Chevrons should be directly within the sight of the driver when positioned at stopping sight distance on approach to the roundabout

2.2.3 Problem – Bog Lane / Curragh Road junction

On approach to Bog Lane the bend on the realigned Curragh Road obscures advance sight of the junction. There is a possibility that drivers on Curragh Road will not be aware that they are approaching a junction and that they are required to stop. This may result in overshoot type collisions at the junction.

Recommendation

Provide a junction warning sign in advance of the Bog Lane / Curragh road junction. Provide a STOP sign at the junction.

2.2.4 Problem – Gully at Muckcross Roundabout

A gully is located in the pedestrian route at the footway crossing of Carrigstown Road on the east side of the roundabout. This could be a trip hazard for pedestrians. If the gully becomes blocked the resultant flooding could force pedestrians to cross at another, less safe, location, which may lead to pedestrian injuries.

Recommendation

Site the gully away from the footway crossing.

2.2.5 Problem – Gradient at Bog Lane / Curragh Road junction

The gradient of Curragh Road leading to this junction is approximately 4%, with no level platform at the junction. This can lead to “hill-start” problems, when a driver can have difficulty in emerging quickly from the junction, resulting in junction type accidents when the driver has not allowed for the required amount of time to emerge safely.

Recommendation

Regrade the approach to this junction so that there is a level approach to the junction for at least a length of 15m.

3. AUDIT TEAM STATEMENT

We certify that we have examined the drawings and other information listed in Appendix 1. This examination has been carried out with the sole purpose of identifying any features of the design that could be removed or modified to improve the safety of the scheme. The problems that we have identified have been noted in the report, together with suggestions for improvement which we recommend should be studied for implementation.

Signed.....Helen Doyle, ABC Consultancy

Date.....

Signed.....Daniel McLoughlin, ABC Consultancy

Date.....

APPENDIX 1:

LIST OF DRAWINGS EXAMINED

N99 Ballymack Bypass	Horizontal Layout	01300/D11	Rev A	June 2007
N99 Ballymack Bypass	Vertical Layout	01300/D12	Rev B	June 2007
N99 Ballymack Bypass	Side roads	01300/D13	Rev C	July 2007
N99 Ballymack Bypass	Sign Layout	01300/D14	Rev C	July 2007
N99 Ballymack Bypass	Road Marking Layout	01300/D15	Rev C	July 2007

ROAD SAFETY AUDIT FEEDBACK FORM

Scheme: Ballymack By-Pass

Audit Stage: 2

Date Audit Completed: 12th- 18th October 2007

Paragraph No. in Audit Report	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Describe alternative measure(s). Give reasons for not accepting recommended measure	Alternative measures or reasons accepted by auditors (yes/no)
2.1.1	Yes	Yes		n/a
2.1.2	Yes	Yes		n/a
2.2.1	Yes	No	Will have difficulty installing barrier that provides adequate protection in available space. Suggest providing earth bunds around attenuation pond instead of barrier.	Yes
2.2.2	Yes	Yes		n/a
2.2.3	Yes	Yes		n/a
2.2.4	Yes	Yes		n/a
2.2.5	Yes	Yes		n/a

Signed: _____ **Design Team Leader** **Date** _____

Signed: _____ **Audit Team Leader** **Date** _____

Signed: _____ **Scheme Project Manager** **Date** _____

APPENDIX D: APPLICATION FOR APPROVAL OF AUDIT TEAM

Application For Approval Of Road Safety Audit Team

Name of Scheme / Development: _____

Route no: _____ County: _____ Stage of Road Safety Audit: _____

(If Development) Planning Ref No.: _____ (If NRA scheme) NRA Project Ref No.: _____

(If NRA scheme) Is scheme Traditional Contract / D&B / PPP / ECI? Delete as applicable

Scheme Project Manager: _____

Brief description of proposed change to National Road: _____

Proposed Team Members:

Ensure at least two are proposed.

Attach CVs if individual has not had approval previously or if relevant details have changed

Name			
Completed 3 - 5 day course in Road Safety Audit? (Yes/No)			
Completed 10 day course in Accident Investigation & Prevention? (Yes/No)			
No. of years working in Accident Investigation and Prevention <i>other than on Road Safety Audit</i>			
No of Road Safety Audits completed			
No of audits completed of similar stage and type			
No of audits completed in past 5 years			

Contact in Consultancy firm: _____ Phone no. _____

Name of Firm & Address: _____

Please submit completed form to; NRA Road Safety Section or email to roadsafetyaudits@nra.ie

APPENDIX E: AUDIT BRIEF CHECKLIST

Road Safety Audit Brief Checklist

Project Route/Name:	
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Have the following been included in the audit brief?:

(if 'No', reasons should be given below)

	<i>Yes</i>	<i>No</i>
a) The Design Brief	<input type="checkbox"/>	<input type="checkbox"/>
b) Departures from Standard	<input type="checkbox"/>	<input type="checkbox"/>
c) Scheme Drawings	<input type="checkbox"/>	<input type="checkbox"/>
d) Scheme Details such as signs schedules, traffic signal staging etc	<input type="checkbox"/>	<input type="checkbox"/>
e) Accident data, including location map, for ALL existing roads affected by scheme	<input type="checkbox"/>	<input type="checkbox"/>
f) Garda report forms (C(T)68) of all accidents listed above	<input type="checkbox"/>	<input type="checkbox"/>
g) Traffic surveys for ALL existing roads affected by scheme	<input type="checkbox"/>	<input type="checkbox"/>
h) Previous Road Safety Audit Reports	<input type="checkbox"/>	<input type="checkbox"/>
i) Previous Designer's Responses to Road Safety Audit Reports	<input type="checkbox"/>	<input type="checkbox"/>
j) Previous Exception Reports	<input type="checkbox"/>	<input type="checkbox"/>
k) Start Date for Construction and expected Date of Opening	<input type="checkbox"/>	<input type="checkbox"/>
l) Start Date for Construction and expected Date of Opening	<input type="checkbox"/>	<input type="checkbox"/>
m) Any elements to be excluded from Audit	<input type="checkbox"/>	<input type="checkbox"/>
Is any further information included? <i>(if 'Yes', describe below)</i>	<input type="checkbox"/>	<input type="checkbox"/>

APPENDIX F: AUDIT FEEDBACK FORM

Road Safety Audit Feedback Form

Scheme: _____ Route No. _____

Audit Stage: _____

Date Audit Completed: _____

Paragraph No. in Safety Audit Report	To Be Completed By Design Team Leader			To Be Completed by Audit Team Leader
	Problem accepted (yes/no)	Recommended measure accepted (yes/no)	Describe alternative measure(s). Give reasons for not accepting recommended measure	Alternative measures or reasons accepted by auditors (yes/no)

Signed: _____ Design Team Leader Date _____

Signed: _____ Audit Team Leader Date _____

Signed: _____ Scheme Project Manager Date _____

APPENDIX G: EXCEPTION REPORT DECISION FORM

Road Safety Audit Exception Report Decision Form

Scheme: _____ Route No. _____

(If NRA scheme) NRA Project Ref No.: _____

Audit Stage: _____ Date Audit Completed: _____

Exception Report Item	Paragraph No. in Road Safety Audit Report	Decision by Director (Accept ER / Reject ER)

Signed: _____ Director of Overseeing Organisation Date _____