Safe System audit guidelines

Safe System auditing procedures for transport projects

Road to Zero edition

WAKA KOTAHI
NZ TRANSPORT AGENCY

ROAD TO ZERO

Te Kāwanatanga o Aotearoa
New Zealand Government

ROAD TO ZERO
TE ARA KI TE ORA

Imagine an Aotearoa where everyone gets to where they're **going safely.**

WAKA KOTAHI
NZ TRANSPORT AGENCY

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Waka Kotahi NZ Transport Agency
Published August 2022

ISBN **978-1-99-004498-4** (online)
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Waka Kotahi NZ Transport Agency
(22-325)

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Introduction

This document provides guidance for undertaking Safe System audits for transport projects in Aotearoa New Zealand. It updates and replaces the road safety audit procedures for projects guideline interim release May 2013.

This guidance brings together key elements of both the Safe System assessment framework and road safety audit procedures to provide a comprehensive audit that assesses both the Safe System alignment, and any road safety concerns of transport projects.

Since the previous draft interim release in May 2013, Waka Kotahi has reviewed how we audit transport projects, recognising that Safe System and operational context have since substantially evolved. Most notable has been the emergence of the Safe System assessment framework to assist the transport industry in moving towards a Safe System and the increased focus on how people access and use the transport network.

The Safe System assessment framework considers and quantifies the degree of alignment of a design or concept with Safe System principles with the objective of minimising death and serious injury.

Application of this approach is a material enhancement in transport project planning which ensures consistent consideration of high-risk crash types and injury risk and prompts an assessment of the three components of risk management as they apply to each crash type, namely crash severity, exposure and crash likelihood.

The Safe System audit combines the use of both the Safe System assessment framework and the identification of road safety concerns (using the traditional road safety audit procedures), into a single Safe System audit for use throughout the project development lifecycle.

Integrating the Safe System assessment into the audit process will help to:

- understand how well aligned a transport project is with a Safe System
- relate possible crash forces to tolerable levels of the human body before death and serious injuries occur
- categorise audit findings and treatment options by their Safe System alignment.

Other updates to guidelines include:

- the safety concern risk rating matrix
- the Safe System audit template
- the Safe System audit exception form
- the Safe System audit checklists.

Objective

The objectives of this guide are to:

- raise the awareness of practitioners new to Safe System principles and concepts (especially project clients and project managers) and ensure that audits are being competently undertaken to maximise their benefits
- ensure that practitioners have an awareness of up-to-date operating environments and contexts (for example the Safe System assessment framework now included as part of the Safe System auditing process)
- to support the design and implementation of transport projects that contribute towards a Safe System by identifying and ranking potential safety concerns for all road users.

Purpose

The purpose of a Safe System audit is to identify the projects alignment with Safe System outcomes and the degree to which the project contributes to New Zealand's Vision Zero objective. This audit also identifies elements of the project which are not well aligned and will need to be strengthened to achieve a Safe System.

This guide also provides clients, project managers and project sponsors with information on current practice in the management and delivery of the Safe System audit process.

For any project, there is a responsibility on the road controlling authority to maximise alignment with a Safe System through their design and implementation of transport projects.

This guide clarifies the roles, responsibilities and relationships of the client team, project sponsor, project manager, audit team and audit team leader. It also provides advice on the important factors in managing an audit, including the project brief, meetings, responding to the audit, closing out the audit and record keeping.

It also provides an ability for precedence where-by should a design standard and a Safe System direction become competing or conflicting, then the context of the better outcome can be decided accordingly with Vision Zero in mind.

This guide is an interim release to operate for a trial period during which we would be grateful for feedback from all users on the merits and concerns of these procedures.

Email any comments to trafficandsafety@nzta.govt.nz

Reference to Austroads road safety guides

Austroads has also published road safety audit procedures which continue to serve as additional guidance for New Zealand[1] [2]. At present the published Austroads procedures do not include the Safe System assessment Framework and are therefore not reflective of the desired New Zealand practice at the current time. However, Austroads provide extensive technical practice notes on the area of Safe System assessment Framework[3] and reference to these documents is still recommended.

1 Austroads (2022) *Guide to road safety part 6: road safety audit*, AGRS06-22. Sydney, Australia.
2 Austroads (2019) *Guide to road safety part 6a: implementing road safety audits*, AGRS06A-19. Sydney, Australia.
3 Austroads (2016) *Safe System assessment framework*. Research report AP-R509-16, Sydney, Australia.

Road to Zero

In December 2019, the government launched *Road to Zero: New Zealand's road safety strategy for 2020–2030*.

The vision adopted by Road to Zero is based on Vision Zero and commits Aotearoa New Zealand to:

> A New Zealand where no one is killed or seriously injured in road crashes. This means that no death or serious injury while travelling on our roads is acceptable.

Vison Zero is an ethics based, world-leading approach that says death and serious injuries while travelling on our roads, streets, cycleways and footpaths are unacceptable and preventable.

Safe System underpins this vision and acknowledges that we all make mistakes but argues that these mistakes should not cost us our lives. To do better, we must commit to creating a transport system that protects human life so that no one is killed or seriously injured in road crashes. This aligns strongly with Waka Kotahi Safe System position that:

> ...it is unacceptable for anyone to be killed or seriously injured while travelling or working on the road transport system.

Road to Zero aims to protect human life and health, while acknowledging human error and fragility. It's recognising and accepting human error will occur, then designing and managing the transport system from that premise. Adopting this ambitious vision represents a commitment for Aotearoa New Zealand to make some transformative changes, such as stronger leadership, committing to safety as a critical priority for investment and decision-making, and a greater focus on system changes rather than on addressing human error alone. It requires us to set clear targets and measure our progress against them over time.

To help us realise this vision, Road to Zero has seven guiding principles that are grounded in and build on the Safe System approach. This approach takes a holistic view to the road transport system and the interactions between roads, roadsides, speeds, vehicles and people. It is an inclusive approach that caters for all groups using the transport system.

The Safe System principles are:

1. We promote good choices but plan for mistakes.
2. We design for human vulnerability.
3. We strengthen all parts of the road transport system.
4. We have a shared responsibility for achieving a Safe System.

The principles are supported in Road to Zero by the following additional principles:

5. Our actions are grounded in evidence and evaluated.
6. Our Safe System actions support health, wellbeing and liveable places.
7. We make safety a critical decision-making priority.

As a step towards achieving the vision, Road to Zero has a target of 40% reduction in deaths and serious injuries by 2030. It will take time, investment and teamwork to achieve this target, and we need to be truly committed to the vision and continue to hold ourselves to account.

Figure 1: Road to Zero implementation plan

The Safe System

A Safe System is a forgiving road system that takes human fallibility and vulnerability into account. Under a Safe System we design the whole transport system to protect people from exposure to high crash forces that lead to death and serious injury.

As Safe System audits are an innovative, unique and streamlined process, integrating Safe System principles into audits is a critical step in achieving New Zealand's Vision Zero outcomes.

What does a Safe System look like?

Achieving a transport system that aligns with Safe System means that no one will be killed in transport related crashes and serious injuries will be increasingly rare. It is where it's safe to drive to work and home again or visit whanau and friends. Where it's safe to ride bikes and let tamariki walk to school. Where transport improves our health and wellbeing, creating liveable places for our communities.

Critical parts of the system will be considered together and approached in a 'system-design' to ultimately forgive errors.

For example:

- Geometric design of roads, streets and roadsides – transport and urban planning will be safe for all road users.
- Safe and appropriate speed limits that align with community wellbeing objectives, as well as with the movement and place function, design and infrastructure of the road or street.
- Vehicle technology – that will increasingly advance with safety features, including electronic stability control, front and side curtain airbags and head restraints, collision avoidance systems.
- Road users – that are expected to be alert and aware of the risks and drive or ride to the conditions, yet will still make mistakes.

Safe System principles

To achieve a Safe System, we must recognise that:

- people make mistakes – we need to recognise that people make mistakes and some crashes are inevitable
- people are vulnerable – our bodies have a limited ability to withstand crash forces without being seriously injured or killed
- we need to share responsibility – those who design the road system and those who use the roads must all share responsibility for creating a transport system where crash forces don't result in death or serious injury
- we need to strengthen all parts of the system – as any fatal or serious injury crash is considered a system failure.

Safe System boundary conditions

We know people are vulnerable and we understand the key crash types and associated crash forces that people can be exposed to in Australia and New Zealand[4], which lead to death or serious injuries. A Safe System manages crash forces within these limits so that people are protected.

The human tolerance to force dictates the Safe System boundary conditions and we need to be able to identify where these boundary conditions are likely to be exceeded when planning and managing the transport system.

Effectively for system designers this means either adequately protecting people from high crash energies which exceed these boundary conditions through infrastructure and vehicle design or reducing the impact forces by reducing travel speeds. Under a Safe System people need to be protected from impact speeds that exceed the following[5]:

Table 1: Safe impact speeds for different situations

Road and section types combined with road users	Target Safe System speed
Roads and sections used by cars and vulnerable users	30km/h
Intersections with possible side-on conflicts between cars	50km/h
Roads with possible frontal conflicts between cars	70km/h
Roads with no possible frontals or side-on conflicts between vehicles and no vulnerable road users	>100km/h

Source: ECMT, 2006

Safe System treatment hierarchy

The selection of treatment measures should start with the objective of aiming to achieve a Safe System by first considering interventions that are most likely to eliminate the occurrence of fatal and serious injuries. Often there is a suite of measures that can be implemented to manage a particular risk, with some measures typically being more effective than others.

Primary Safe System, or transformational, treatments are those that most closely align to Safe System outcomes[6]. On corridors where Safe System transformation (primary treatments) cannot be achieved, interventions should provide the highest safety performance possible whilst being supportive of, and acting as a stepping stone towards, future achievement of Safe System transformation.

For example, a median barrier is a primary, or transformational intervention. Some examples of considerations associated with supporting treatments include:

- Pavement widening to facilitate a wide centreline and ultimately a centre median whilst also allowing for further widening of the road cross-section in the future to accommodate roadside barriers.
- Where long continuous lengths of roadside barrier are already installed, they may need to be removed and/or relocated in the longer term in order to allow for a median barrier and/or additional widening.

4 (Austroads 2016, Marsh & De Roos 2016, Tate & Brodie 2014)

5 ITF (2016), *Zero road deaths and serious injuries: leading a paradigm shift to a Safe System*, OECD Publishing, Paris. dx.doi.org/10.1787/9789282108055-en

6 Austroads (2018) *Towards Safe System infrastructure: a compendium of current knowledge*, Research Report AP-R560-18. Sydney, Australia,

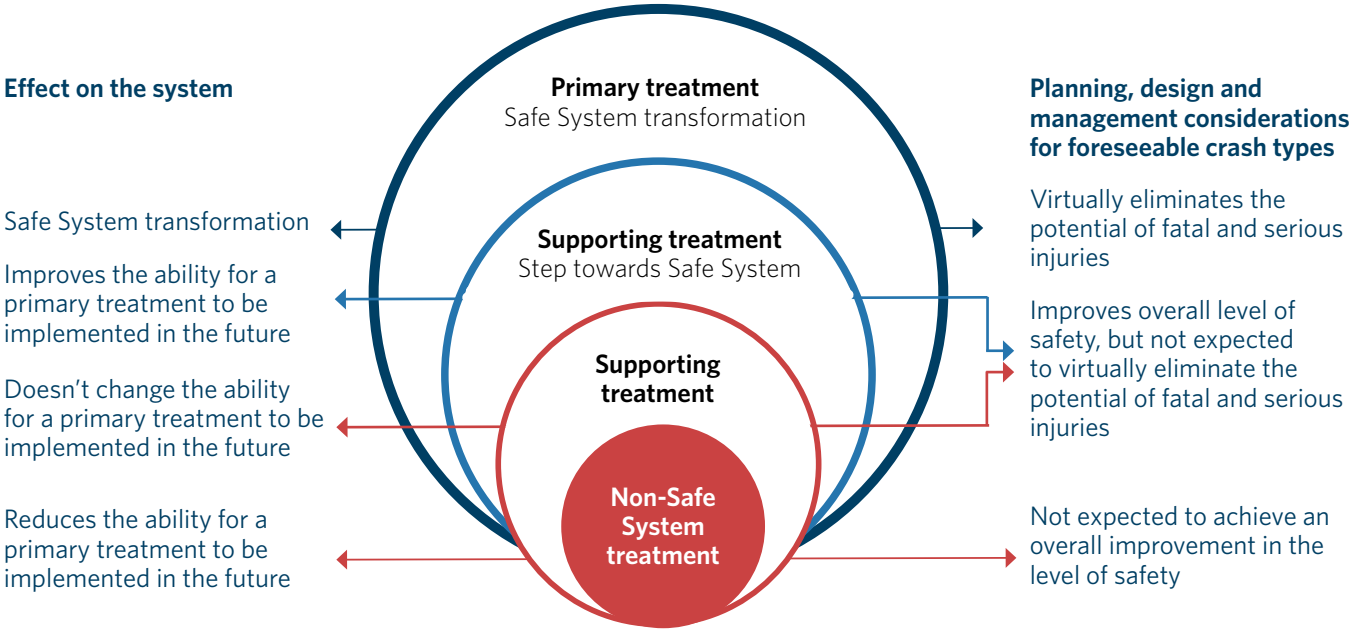

Figure 2: Safe System treatment hierarchy

What is a Safe System audit?

A Safe System audit is a formal, robust technical assessment of transport safety risks associated with transport improvement and renewal projects that:

- are completed by independent and qualified audit teams
- consider the safety of all people
- are completed by applying Safe System principles while seeking to ensure that the transport network will operate as safely as practicable by eliminating fatal and serious injury crash potential.

The objective of the Safe System audit is to identify opportunities for improved energy management for all people. The Safe System audit process provides a method for better managing energy wih the aim to ultimately eliminate fatal and serious injuries.

Safe System audits are applicable to all types of transport projects and on all types of roads and streets. Projects can be as small as a pedestrian crossing, a set of raised safety platforms, or as large as an expressway and may be located within a public road, other public property or private property.

Thus, it's not the scale of the project that is important – it's the project's alignment with Safe System principles and therefore all projects, unless fully Safe System aligned, will benefit from a Safe System audit.

During the Safe System audit, it can be easy to identify features that are not to current standards, or which are not 'perfect'. Remember that standards do not necessarily equal safety. A simple test to decide whether a component requires improvements is to ask if the (kinetic) energy within this part of the system will potentially cause death or serious injury.

A Safe System audit is not:

- a substitute for a quality control review, a design review or a peer review
- a judgement of the quality of a project (as the project will likely have other components)
- a compliance check with standards, guidelines or drawings and specifications (a separate review is required for this purpose noting that compliance with standards or other documents does not necessarily result in a safe system)
- a redesign of a project.

Engineering standards and guidelines provide a sound starting point from which a good design can evolve. However, their application alone does not necessarily result in a safe road environment.

Safe System audit roles, responsibilities and relationships

Parties to a Safe System audit

The parties typically involved in the Safe System audit vary but typically include the client, asset manager (where different from the client), designer and/or contractor and the Safe System assessment or Safe System audit team.

The client

The organisation commissioning the project. For many road projects this will be either the RCA or the developer.

The audit team

Consists of at least typically two members who understand Safe System principles and meet the requirements of audit procedures in relation to professional knowledge, skills and experience (as a minimum, experience in safe system engineering or crash investigation, and knowledge of road design or traffic engineering principles)

Audit team leader

Must have a strong understanding of Safe System principles, up-to-date professional experience and knowledge of current research.

Experience in a relevant road design, road construction or traffic engineering field (typically 10 years minimum but team leaders for audits of more complicated projects should have significantly more experience). Experience in other regions of New Zealand or other countries can also benefit a client, as the auditor will be more able to challenge inadequate local practices. Additional skills include:

- Demonstrated management and reporting skills.
- A wide range of Safe System engineering experience.
- A record of participation as a team member in a range of relevant formal safe system audits (at least five formal safe system audits, including at least three for the same stage of audit).

Team members

Team members may be more varied in their backgrounds than the team leader and should have experience that achieves the balance required for the audit.

Team members should have attended a Safe System audit training course (for example, Safe System engineering workshop) and participated in Safe System audits as an observer, preferably for different project stages.

Team members should possess:

- a good understanding of Safe System principles and Safe System engineering experience
- crash reduction study skills
- experience in a relevant road design, road construction or traffic engineering field (typically three years minimum)
- up-to-date professional experience and knowledge of current research.

Observers

Observers can be included in a Safe System audit for a variety of reasons, such as a training exercise to be considered as future Safe System audit team members, or simply to observe the process. They may come from a variety of backgrounds. However, those aspiring to become team members and ultimately team leaders should note the criteria above.

Road safety engineer

Advisor to the client on safety issues. Where the asset manager differs from the client, a safety engineer may be separately engaged to advise each party.

Project manager

Person delegated to manage the project on behalf of the client.

Designer

The team undertaking the investigation, or the design, or the supervision of the construction of the project. 'Designer' is a generic term and may be part of the RCA, consultant or contractor's organisation.

Contractor

The team engaged by the client to construct the project.

When to undertake a Safe System audit

The Waka Kotahi investment policy specifies that Safe System audits are undertaken at the key stages of a project's development and implementation stages:

- Stage 1 scheme/concept.
- Stage 2 preliminary design stage.
- Stage 3 detailed design stage.
- Stage 4 pre-opening and/or post-construction stage.

These stages should not be seen as rigid, as all projects are not the same and will not always follow all the development stages as described above. The stages of a Safe System audit should match the project's complexity and actual development stages. However, the earlier a Safe System audit is undertaken, the easier and less expensive it is to make changes. A Safe System audit only at the post-construction stage should be avoided, as often it is too late to make significant improvements if required.

It is recommended that each road controlling authority embed the requirements for Safe System audits in appropriate policy documents, including but not limited to asset plans, safety management systems and development codes.

As a minimum it is recommended that a Safe System audit be undertaken at the design stage for all works within a public space. For requirements specific to a particular road controlling authority, refer to the policy of that road controlling authority.

Desirably a post-construction Safe System audit should be undertaken before opening the project for public use. If in practice this is not possible, the Safe System audit should be undertaken as soon after opening as possible. For projects that are constructed in sections, the Safe System audit may be conducted at the completion of each section.

The Safe System audit report and the project manager's responses must be attached to the Transport Investment Online (TIO) funding application.

Procurement

The method of procurement should not be a deterrent to ensuring that the principles of Safe System audit are followed. An example is design and construct: for projects of this nature it is important that the independence of auditors is not compromised by the

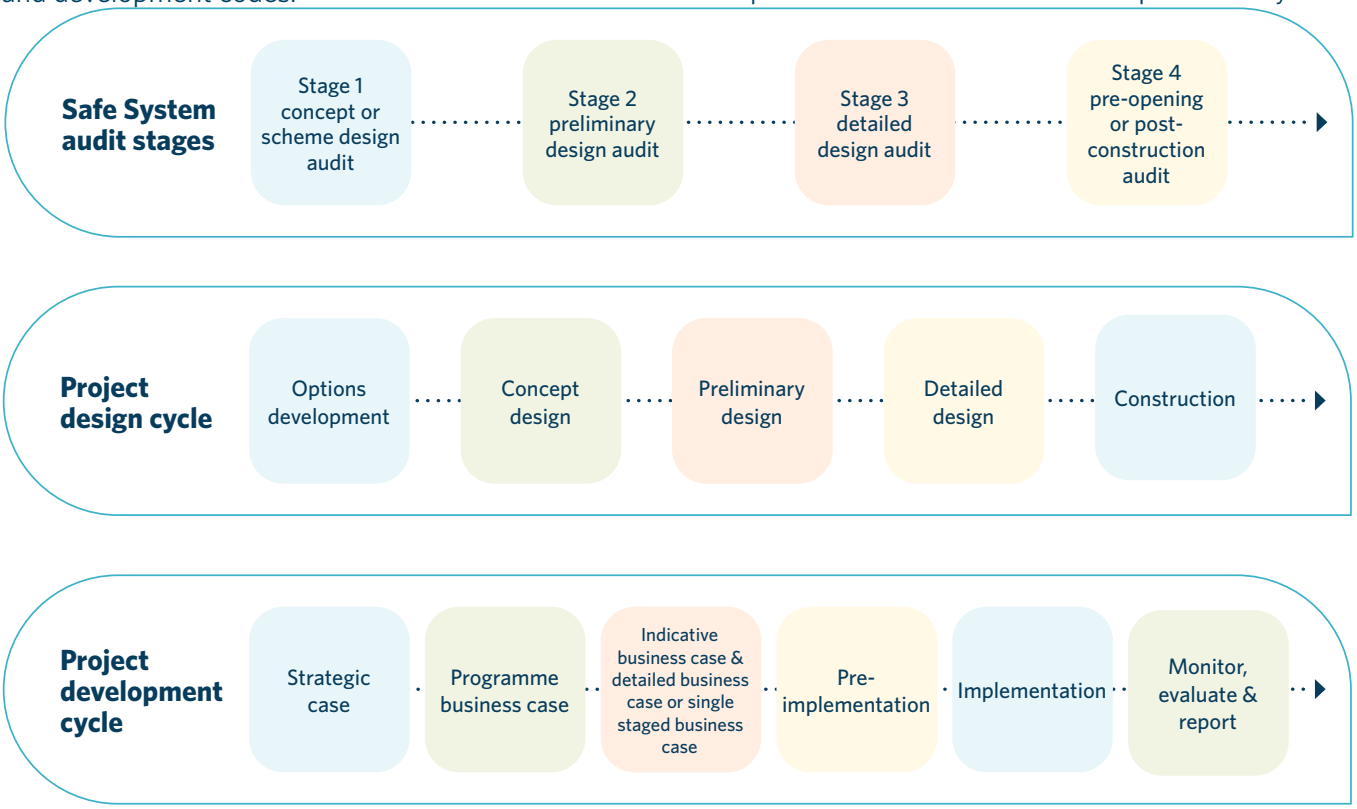

Figure 3: Safe System audit stages within project development

respective objectives of the client and contracted parties. The authority to make decisions about an audit's recommendations and the responsibility for their implementation should be clearly defined in the contract between the client and the contracted parties.

National Land Transport Fund investment requirements

Waka Kotahi requires that these audit procedures be applied to any improvement or renewal project or activity that involves vehicular traffic, and/or walking and/or cycling, proposed for funding assistance from the National Land Transport Programme.

It does not apply to auditing of the existing network or specialist applications, such as traffic control at roadwork sites.

While all improvements and renewal activities require a Safe System audit, a single audit report could cover several projects or activities depending on the size, scale and costs of these projects.

As the need for Safe System audits are required over a range of projects that will vary in size, scale, and cost, the project life cycle may vary between them and consideration will need to be given on how the Safe System audit process will be managed.

Current planning and investment planning knowledge base guidance

- **Undertake Safe System audit at the key stages of a project's development and implementation.** Safe System is a priority for Waka Kotahi and Safe System audits should be routine and common practice. The audit report and the project manager's responses must be attached to the TIO funding application

OR

- **Complete an exemption declaration** that adequately demonstrates the scope of the project and that Safe System issues arising from any changes are sufficiently negligible that a Safe System audit is not warranted for a particular stage or stages.

The exemption declaration must be completed by the road controlling authority's project manager and must be attached to any TIO funding application. A copy of the exemption form is available online.

Improvement projects

Is either for local road or state highway improvements where investment is being made in improving the levels of service for new or existing local or state highway transport corridors or sites.

- Small Projects less than $50,000.
- Low cost, low risk improvement less than $2 million.
- Capital improvements greater than $2 million.

These are typically:

- Walking and cycling improvements.
- Public transport.
- Rapid transit.
- New bridges or other structures.
- New, reconstructions or realignment of roads (expressways/motorways).
- New intersection upgrades or installations.
- Temporary traffic management schemes (from a Safe System perspective, not as a compliance review).
- Local area traffic management schemes (such as commercial areas and residential streets), and their component parts.
- Intelligent transport systems.
- Subdivision roads.
- Seal extensions, seal widening.

Renewal projects

Investment in renewal of existing state highways and local roads to deliver an appropriate level of service.

Traffic renewals – this provides for the renewal of existing road furniture, lighting, signs and markings, and traffic management equipment and facilities.

Pavement rehabilitation – this provides for granular overlays, rip and relay, pavement stabilisation, asphaltic overlays or grader-laid asphaltic material, pavement replacement (including the use of recycled materials) and structural asphaltic concrete rehabilitation.

Drainage renewals – this is for the renewal of drainage facilities that is not routine in nature. For example, renewal of culverts having a cross-sectional area less than 3.4 square metres or repair and replacement of kerb and channel, provided that the deterioration is likely to adversely affect the performance of the pavement.

Maintenance activities

Are excluded from the requirement – investment in the maintenance of existing state highway and local roads to deliver an appropriate level of service, excluding asset upgrades.

Exemptions

When a project manager can demonstrate that the project or activity is a low risk and the principles of Safe System alignment have been met, an exemption from the Safe System audit can be undertaken by completing a Safe System audit exemption form by the project manager with the endorsement of an experienced specialist road safety engineer.

The exemption form will need to document the reasoning why a project or activity is low risk and alignment with Safe System principles is deemed to be met. It may also document any identified risks and proposed mitigation measures.

As the cost of a project is not a good indicator of risk for safety outcomes. The project manager with the support of an experienced road safety engineer will need to understand the impacts of the project or activity on the safety on all users.

An exemption declaration could cover several projects or activities depending on the size, scale and costs of these projects.

The Safe System audit process

Once a decision has been made to undertake a Safe System audit, the audit team needs to be selected and appointed. The project manager and audit team will then work through the process. If a decision is made not to undertake an audit, then this should be documented using the Safe System audit exemption form.

At any time through the Safe System audit process the audit team members should not be unreasonably requested or put under any pressure to withdraw or modify any findings.

Safe System audit process steps		Role responsible
Confirm audit stage	Identify project audit stage required or complete exception form	**Client**
Audit team selection	Select the Safe System audit Team Leader and team members including observers	**Client/Safe System audit team leader**
Safe System audit brief	Provide the Safe System audit team a brief including all relevant project information	**Client/designer**
Commencement meeting	Hold	**Client/designer/Safe System audit team**
Review of project background documents	Assess all necessary documents	**Safe System audit team**
Project site inspection	Identify project audit stages requires or complete exception form	**Safe System audit team**
Debrief meeting	Identify project audit stages requires or complete exception form	**Client/designer/Safe System audit team**
Report writing	Complete audit report and forward to client	**Safe System audit team**
Designer response to report	Designer provides responses to safety concerns raised within report	**Designer**
Road safety engineer response to report	Road safety engineer provides responses to safety concerns	**Road safety engineer**
Client decision	Client reviews comments, responses and make decisions	**Client**
Complete report with decisions	Complete audit tracking within report and feedback response to designer and Safe System audit team	**Client**
Implement client decision	Document final actions and finalise audit tracking	**Client**

Figure 4: The steps in a road safety audit

Audit team selection

The most appropriate size of a Safe System audit team depends on the complexity of the project, Waka Kotahi recommends that an audit team of at least two people with a team of at least three people desired as this allows for:

- the diverse backgrounds, experience, knowledge and approaches of different people
- the cross-fertilisation of ideas through discussion
- simply having more than one pair of eyes.

While audits can be carried out by a one-person team, the client will need to manage the potential risks by ensuring the person is sufficiently experienced and capable of the audit requirements for the project.

Within each team there must be a nominated team leader, whose role is to manage the team and process. The client should appoint the audit team following discussion with the team leader. The team leader shall ensure that the audit team (or individual) has the necessary skills and experience appropriate to the complexity and type of project being audited.

While continuity of core members of the audit teams through the stages is desirable, audits at the different stages may require different skills.

Experience in Safe System engineering is the key essential ingredient in any Safe System audit team. Ideally this should be linked to an understanding of:

- the application of Safe System principles to road design and safety audits, including safe roads, safe speeds and safe road use principles – they should be able to recognise situations where road use errors with the potential for fatal or serious injury outcomes are most likely to occur
- crash reduction studies
- traffic engineering and management of traffic and other people
- road design and road construction/maintenance techniques.

In applying the Safe System principles, a person who understands people behaviour and human perception is also likely to be able to develop Safe System audit skills. This understanding is, in fact, a very desirable skill because of the highly interactive nature of people with the other elements of the Safe System.

The most successful auditors can use their skills to see the road project from the point of view of the different types of 'customer' or people.

Independence of the audit team

Safe System auditors must be independent of the client, designer or contractor, so that the project outcome is viewed with fresh eyes and is unbiased.

The client has the ultimate responsibility for accepting that the level of independence is adequate and credible. To avoid an inappropriate 'culture' of the designer or contractor being incorporated, auditors should be commissioned from other organisations.

Waka Kotahi requires Safe System auditors to be appointed separately from the Professional Services Contract drawn up for all projects.

Potential risks if auditors are not independent and/or have a vested interest can be as follows:

- Risks and hazards are ignored or not properly identified (in terms of exposure, likelihood and severity) and subsequently mitigated.
- Unethical behaviour, breaches of confidentiality and malpractice are not reported.
- Explanations are accepted without checking.
- Undeserved positive feedback is given.
- Records are falsified, incomplete or not kept.

While the concept of auditors being independent of the design team is recognised, in practice, the following signs of dependence can exist in the relationship between the audit team and the client team, which should be recognised and addressed:

- The audit team promotes certain positions held by the project manager or project sponsor/developer.
- The audit team applies limited professional scepticism due to over sympathy.
- The audit team is requested or pressured to effectively design/re-design countermeasures in response to preferred treatment recommendations.

Safe System auditors

There is currently no formal accreditation scheme for Safe System auditors.

However, practitioners are expected to have attended the Waka Kotahi Safe System engineering workshop or similar training designed specifically for those undertaking Safe System audits. If practitioners can demonstrate their relevant experience and knowledge, they can undertake a Safe System audit in accordance with this document.

Specialist safety auditors

Specialist safety auditors may need to be co-opted onto the safety audit team for specific areas of expertise, for example traffic signals, lighting, cycle facilities, public transport and temporary traffic management. Those team members who are engaged because of their Safe System engineering experience should have specialist knowledge relevant to the project.

Observers

To support the ongoing development of Safe System auditors, the inclusion of observers within the audit team is encouraged.

Safe System audit brief

Preparing an effective brief, including a clear statement of the audit scope and the desired outputs, is critical in the process of procuring and managing audits.

The audit brief needs to set out:

General information

- Contact details of the client and audit teams.
- Stage (timing) of the audit (for example preliminary design, pre-opening).
- Project location and descriptions.

Project background

- List of relevant documents (for example plans, drawings and visualisation).
- List of previous audits, Safe System assessment and corrective action reports.
- Key road and traffic characteristics (for example volumes, speed environment and crash data).

Project requirements

- A clear requirement that the audit should be carried out with a focus on Safe System principles.
- On-site inspections to cover relevant road conditions and/or specific people groups (for example thematic audits).
- Timeframe and milestones (including provision for commencement and completion meetings).

Specific considerations

- Out-of-scope items (for example, issues related to interface with adjacent land use and rail corridor, structural integrity, personal security and network operation considerations).
- Audit team composition and expertise (for example additional expertise required in human factors or a vulnerable people group).
- Use of control data, namely evidence-based sources such as Austroad's guidelines and research publications, to support the audit findings.
- Whether recommendations for treatment options to address issues are required; if so, the recommendations are to be presented in accordance with their alignment with Safe System principles.

Commencement meeting

A formal meeting has been found to be the most efficient way for the client team to instigate communication with the audit team. The objectives of the commencement meeting are as follows:

- To confirm the purpose and scope of the audit.
- To discuss the process, including the roles and responsibilities and timeframe.
- To formally provide the audit team with a hard and/or electronic copy of the brief and associated documents, and an opportunity for discussion and clarification.
- To confirm any further requirements, including time periods for inspection (at night, during school holiday or off-peak hours) and consideration of weather conditions.

With input from the project sponsor and the design team, the project manager is responsible for organising such a meeting and ensuring that any key issues and constraints are properly discussed, and agreement/actions recorded.

It is also possible to hold the meeting at the site/location, which allows the project and audit team, the chance to drive and/or walk through the site and gain a better understanding of the immediate areas of interest and any adjacent areas.

Review of project background documents

This should take place prior to the site inspections. The audit team discusses their initial observations and reviews the documents in detail.

Specific tasks may be allocated to various team members, for example one team member may review the geometry of the road, while others review the drainage, lighting and delineation.

Project site inspection

Inspections of the site are a key component of the audit and are recommended for each stage of an audit.

An inspection provides the opportunity to see how the proposal interacts with its surroundings and to visualise impediments and conflicts for all people.

The audit team should complete the necessary health and safety requirements and briefing, and be adequately equipped with appropriate PPE, cameras, measuring equipment and whatever else they'll need.

The inspection should include adjacent sections of road, so that interface and consistency with the project are considered. Inspections should be undertaken in the range of traffic and environmental conditions likely to be expected, where possible. Both night-time and daytime inspections are desirable, with night-time inspections being essential in the post-construction stage.

During the inspection, the high-level checklists can be referenced, to ensure that no concerns are overlooked. Observed practice is that experienced auditors use the checklists as a backup at the end of inspections, while less experienced auditors will use the checklists throughout the inspection.

Debrief meeting

As with the commencement meeting, the need for a debrief meeting prior the drafting of the report depends on the project, but it is highly desirable. It provides the opportunity to:

- seek clarification on concerns
- give preliminary feedback to the designer and client about the safety concerns identified (particularly those that require urgent attention)
- discuss the reasons behind concerns
- informally discuss possible solutions to the problems
- resolve misunderstandings or errors of fact.

Report writing

The primary task of the audit report is to succinctly document the Safe System audit scoring and findings which consists of a Safe System assessment and an evaluation of various aspects of the project where safety concerns have been identified and risk assessed against the safety concern risk rating matrix with recommendations about corrective actions.

Recommendations may indicate the nature or direction of a solution, but they do not specify the details of how to solve the concern. Responsibility for the solution rests with the client.

The safety concerns should be listed in a logical order with a numbering system that makes them easy to refer to in follow-up reports.

All safety concerns identified in the report should be of sufficient importance to require action.

Issues from previous Safe System audit reports that have been responded to, and a decision made by the client, do not need to be repeated in subsequent audits.

The report should not be cluttered with trivial matters. Aspects like amenity or aesthetics, which are unrelated to Safe System, should not be mentioned. Likewise, traffic capacity issues should not be discussed unless they have a bearing on safety outcomes.

By their nature, Safe System audit reports appear to be negative documents as they typically raise only concerns. Positive design elements are not necessarily mentioned, as the assumption is that all designs contain good elements. However, a notable or excellent element which improves safety can be mentioned, if appropriate.

Reporting requirements

A report should contain the following:

Introduction

- Title.
- Brief description of the Safe System audit process undertaken.

- Clear statement of what is being audited.
- Safe System audit team: names and affiliations.
- Dates that the Safe System audit was carried out.
- Brief description of the project and its objectives.
- Project information.
- A list of drawings and documents made available for the audit.
- Other supporting information used.
- Plans which identify the extent of work.

Findings

- Description of the speed environment (very important).
- Overview of alignment Safe System key principles including areas where Safe System impact speed boundary conditions are exceeded, such as head-on crashes above 70km/h, side impacts above 50km/h and pedestrian or cyclist crashes above 30km/h.
- Safe System assessment matrix.
- Sequential listing of identified safety concerns describing the safety risk and assigning a risk rating, including photos (use of which is to be encouraged), annotating findings on a suitable set of plans, where emphasis is desirable.
- Ranking of concerns to aid designers and project managers.

Formal statement

- A draft report should be circulated to team members for comment, review and agreement. As the Safe System audit team has a position of independence, a draft of the report does not have to be provided to the client or designer for comment.
- A signed and dated statement by the auditors.

Response and decision reporting

- Record of the designer response, safety engineer response, client decision and action taken for each item in the Safe System audit report (it is expected that the report will remain a live document until all items have been decided and the final report signed by the project manager).
- Final report with responses and decisions forwarded to the client to record designer's response and client's decision.

Responding to findings

It is the client who makes the final decision about whether recommendations are to be adopted. The client may seek independent safety advice. Where a recommendation is not adopted, the reasons should be documented by the client.

When considering the results of an audit, it is critical for the project manager to consider each finding, the importance assigned to it and its alignment with the Safe System principles. For each finding, the project manager must document the rationale and decision-making process in all the decisions ultimately reached within the decision tracking form. In doing so, the project manager may seek input from the design team and specialist advisors. Any contentious or outstanding issues should be identified for discussion during an interactive completion meeting.

In many instances the client and the asset manager will either be the same entity or directly linked. In cases where the client is a third party, such as for a development, then the designer's response should be provided to the asset manager for their comment before the client makes the final decision.

For each audit team recommendation that is accepted, the client shall brief the designer to make the necessary changes and/or additions. As a result of this instruction the designer shall action the approved amendments. The client may ask their safety engineer to comment to aid with this decision.

Closing out the audit

There are three options for a client in responding to an audit finding and the associated recommendations:

Accept the finding and recommendation in its entirety

The next step is straightforward and involves documenting the proposed action(s) in a corrective action report and implementing the agreed changes accordingly.

Accept the finding and recommendation in part only

The project manager reaches this decision by undertaking a local context and risk assessment, considering:

1. outcomes from the audit team;
2. the project sponsor and designer's assessment of the risk;
3. severity of the harm and effectiveness of the suggested treatments (including improving on the recommendation);
4. cost and effectiveness of potential alternative treatments.

Often, due to constraints, only certain aspects of the risk can be addressed through the implementation of the selected treatment(s) in stages (for example short, medium and long term). As such, the project manager is required to recognise and document the residual risk associated with the design or certain elements of the road network and rationale for not adopting recommendations or accepting gaps in Safe System alignment.

Reject the finding and take no action

A project manager may decide to reject the finding and take no action but should do so cautiously. In these circumstances, it is the project manager's responsibility to justify and document the decision with supporting rationale and evidence.

Safety concern decision tracking table

It is an important responsibility of the project manager to keep the decision tracking table up to date as it is an important part of the Safe System audit process. A decision tracking table is embedded into the report format at the end of each set of recommendations to be completed by the designer, road safety engineer and client.

The decision tracking table documents:

- The designer's response.
- The client's decision (and in some cases as noted above, the asset manager's comment).
- The action taken.

Safe System audit scoring

The Safe System audit brings together both the Safe System assessment and safety concern ratings into one report.

The Safe System assessment evaluates a project's alignment with Safe System principles and identifies ways to improve the alignment with a focus on minimising fatal and serious injuries. It investigates the inherent risk of the infrastructure and includes consideration of road user exposure.

The safety concern ratings are to identify individual aspects of the project that are a concern with an associated risk profile as per the concern ratings matrix. Safety aspects to be considered during an audit are listed in the high-level checklists supplied in appendix

Safe System assessment

The Safe System assessment matrix is to be completed and is used to assess the extent to which existing conditions and project options align with Safe System principles.

Table 2: Safe System assessment table

	Run-off-road	Head-on	Intersection	Other	Pedestrian	Cyclist	Motorcyclist
Exposure	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4
Likelihood	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4
Severity	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4	/ 4
Product	**/ 64**	**/ 64**	**/ 64**	**/ 64**	**/ 64**	**/ 64**	**/ 64**
Total Safe System assessment score						**/ 448**	

This is achieved through a scoring system which considers seven crash types and the exposure, likelihood and severity associated with each crash type.

Each combination is assigned a score out of four. The exposure, likelihood and severity scores for each crash type are multiplied to give a product out of 64. These are then added to determine the total safe system assessment score, with a maximum of 448.

A score of zero or close to zero indicates a high level of alignment with the Safe System.

Safe System assessment crash types

Table 3: Crash types

Crash type	Description
Run-off-road	A crash that occurs when a vehicle leaves the roadway to the left or right without impacting another vehicle. Includes run-off-road crashes at intersections. Does not include crashes involving motorcyclists or cyclists as they are considered separately.
Head-on	A crash that occurs when one vehicle crosses onto the wrong side of the road and impacts head-on with another vehicle. Includes head-on crashes at intersections. Does not include crashes involving motorcyclists or cyclists as they are considered separately.
Intersection	Crashes occurring at intersections, including side impacts involving vehicles from adjacent directions, collisions between right turning and opposing vehicles and rear-end crashes. Does not include run-off- road, head-on, pedestrian, cyclist or motorcyclist crashes at intersections (these crash types are considered separately)
Other	Any relevant crash types that are not covered by the specific categories in this table. May include crashes involving vehicles entering or leaving driveways, side swipes, collisions with parked vehicles, loss of control without leaving the carriageway and crashes involving animals.
Pedestrian	All crashes involving pedestrians, including persons boarding or alighting from a vehicle and anyone working on the road or roadside.
Cyclist	All crashes involving cyclists.
Motorcyclist	All crashes involving motorcyclists.

Safe System assessment scoring

The table below provides guidance on how to score each category. Half scores may be used for likelihood or severity where it is considered that the situation being assessed falls between the guidance provided in two adjoining rows. Generally, half scores would not be used for exposure.

It is recognised that there will be a level of subjectivity in scoring depending on who's undertaking the assessment. It's necessary that the assessment of existing conditions and all proposed design options is undertaken by the same audit team.

Scores for a project should not be directly compared against those of another project.

Practitioners may find it difficult to differentiate between people exposure and crash likelihood as these factors are usually combined as likelihood in traditional risk assessment methods. In the Safe System assessment process, exposure and likelihood are considered separately.

Exposure is the number of people that have the potential to be involved in the crash type.

Likelihood reflects the probability that an individual (vehicle occupant, pedestrian, cyclist or motorcyclist) will be involved in a crash. In some cases, the volume or number of vehicles or people affects likelihood.

Table 4: Scoring system

Score	People exposure	Crash likelihood	Crash severity
0	There is no exposure to a certain crash type. This might mean that there is no side flow or intersecting roads, no cyclists, no pedestrians or no motorcyclists.	There is only minimal chance that a given crash type can occur for an individual people given the infrastructure in place. Only extreme behaviour or substantial vehicle failure could lead to a crash. This may mean, for example, that two traffic streams do not cross at grade or pedestrians do not cross the road.	Should a crash occur, there is only a minimal chance that it will result in a fatality or serious injury to the people involved. This might mean that kinetic energies transferred during a crash are low enough not to cause a fatal or serious injury (FSI), or that excessive energies are effectively redirected or dissipated before being transferred to the people. Users may refer to Safe System critical impact speeds for different crash types, while considering impact angles, roadside hazards and barriers that are present.
1	Volumes of vehicles that might be involved in a particular crash type are particularly low, therefore exposure is low. For run-off-road, head-on and 'other' crash types, AADT is <1,000 vehicles a day. For cyclist, pedestrian and motorcycle crash types, volumes are <10 people a day.	It is highly unlikely that a given crash type will occur.	Should a crash occur, it is highly unlikely that it will result in a fatality or serious injury to any people involved. Kinetic energies are low during a crash, or the majority are effectively dissipated before reaching people.

2	Volumes of vehicles that might be involved in a particular crash type are moderate, therefore exposure is moderate. For run-off-road, head-on and 'other' crash types, AADT is between 1,000 and 5,000 vehicles a day. For cyclist, pedestrian and motorcycle crash types, volumes are 10 to 50 people a day.	It is unlikely that a given crash type will occur.	Should a crash occur, it is unlikely that it will result in a fatality or serious injury to any people involved. Kinetic energies are moderate, and the majority of the time are effectively dissipated before reaching the people.
3	Volumes of vehicles that might be involved in a particular crash type are high, therefore exposure is high. For run-off-road, head-on and 'other' crash types, AADT is between 5,000 and 10,000 vehicles a day. For cyclist, pedestrian and motorcycle crash types, volumes are 50 to 100 people a day.	It is likely that a given crash type will occur.	Should a crash occur, it is likely that it will result in a fatality or serious injury to any people involved. Kinetic energies are moderate but are not effectively dissipated before reaching the people.
4	Volumes of vehicles that might be involved in a particular crash type are very high or the road is very long, therefore exposure is very high. For run-off-road, head-on and 'other' crash types, AADT is >10,000 vehicles a day. For cyclist, pedestrian and motorcycle crash types, volumes are >100 people a day.	The likelihood of individual people errors leading to a crash is high given the infrastructure in place (for example high approach speed to a sharp curve, priority movement control, filtering right turn across several opposing lanes, high speed).	Should a crash occur, it is highly likely that it will result in a fatality or serious injury to any people involved. Kinetic energies are high enough to cause a FSI crash and it is unlikely that the forces will be dissipated before reaching the people.

Table 5: Exposure measures and typical likelihood factors

Crash type		Description
Run-off-road	Total volume of vehicles (AADT) using the road.	• Horizontal and vertical alignment. • Pavement condition. • Shoulders – width, sealed or unsealed. • Number, type and offset to roadside hazards such as poles, trees or steep batters. • Presence of barriers, barrier type and position. • Speed limit and operating speed. • Volume of heavy vehicles. • Potential for driver fatigue.
Head-on	Total volume of vehicles (AADT) using the road.	• Horizontal and vertical alignment. • Pavement condition. • Number and width of lanes. • Separation between opposing traffic streams. • Median or centre line barriers. • Overtaking opportunities. • Speed limit and operating speed. • Volume of heavy vehicles. • Potential for wrong way movements.
Intersection	Total volume of vehicles (AADT) entering the intersection.	• Intersection type – for example, cross, T, multi-leg or grade separated. • Intersection control – signalised, roundabout, stop or give way. • Intersection features – for example, dedicated turns lanes, channelisation or movement bans. • Number of conflict points and complexity. • Minor road volumes and movements. • Volume of heavy vehicles. • Right turn volumes.
Other	Total volume of vehicles (AADT) using the road.	• Varies according to the crash type being considered.

Pedestrian	Number of pedestrians.	• Controlled or uncontrolled crossings. • Crossing type – for example, signalised, zebra, wombat or grade separated. • Pedestrian characteristics – for example, young, elderly, mobility impaired or intoxicated. • Presence of a refuge or median. • Volume of traffic. • Speed of traffic. • Crossing distance and number of lanes. • Separation from vehicular traffic, including heavy vehicles.
Cyclist	Number of cyclists.	• Cyclist characteristics – for example, age, commuting, recreational or training. • Presence and type of cycling infrastructure – for example, separated paths, on-road bicycle lanes, wide kerbside lanes, bike boxes, controlled crossings or refuges. • Volume of motorised traffic. • Separation from motorised traffic, including heavy vehicles. • Speed limit and operational speed of traffic.
Motorcyclist	Number of motorcyclists – assume 1% of AADT if specific data not available.	• Horizontal and vertical alignment. • Pavement condition. • Number and width of lanes. • Speed limit and operating speed. • Number and type of roadside hazards. • Volume of other vehicles. • Sight line restrictions. • Right turn control at intersections.

Safety concern risk assessment

The following key questions should be raised for each of the safety concerns identified. An affirmative response reflects a high severity risk, making it the primary focus of the subsequent risk rating matrix:

1. Is it possible to have a head-on crash at a speed greater than 70km/h?
2. Is it possible to have an intersection (right-angle) crash at a speed greater than 50km/h?
3. Is it possible to have a run-off-road (side impact with a rigid object) crash at a speed greater than 40km/h?
4. Is it possible to have a vulnerable road user – for example, pedestrian, cyclist or motorcyclist, crash at a speed greater than 30km/h?

Safety concern risk rating matrix

Auditors should use the following risk rating matrix described below for all Safe System audits otherwise the rating matrix used should be defined in the report and will need to consider the frequency of a crash occurring, and the likely outcome. With the adoption of the Safe System, the emphasis is on avoiding the more severe casualty outcomes.

The recommended and preferred rating of safety concerns is outlined below.

Table 6: Safety concern risk rating matrix

		Severity outcome				
		Non-injury	**Minor**		**Serious**	**Fatal**
		Property damage only (PDO)	Injury which is not 'serious' but requires first aid, or which causes discomfort or pain to the person injured.	**Safe System injury threshold**	Injury (fracture, concussion, severe cuts or other injury) requiring medical treatment or removal to and retention in hospital.	A death occurring as the result of injuries sustained in a road crash within 30 days of the crash.
Probability of a crash	**Very likely**	Minor	Moderate		Serious	Serious
	Likely	Minor	Moderate		Serious	Serious
	Unlikely	Minor	Minor		Significant	Serious
	Very unlikely	Minor	Minor		Significant	Significant

Definitions of severity outcome

Reference to historic crash rates or other research for similar elements of projects, or projects, can help with understanding the likely crash types, frequency and severity that may result from a particular concern.

Table 7: Severity outcome

Severity outcome	Description	Examples
Fatal	Where Safe System boundary conditions are exceeded. A death occurring as the result of injuries sustained in a road crash within 30 days of the crash.	• High-speed, multi-vehicle crash on an undivided road. • Car runs into crowded bus stop. • Heavy vehicle collisions. • High or medium-speed intersection crossing/ turning crash.
Serious	Where Safe System boundary conditions are exceeded. Injury (fracture, concussion, severe cuts or other injury) requiring medical treatment or removal to and retention in hospital.	• High or medium-speed vehicle/vehicle collision. • High or medium-speed collision with a fixed roadside object. • Pedestrian or cyclist struck by a vehicle.
Minor	Where Safe System boundary conditions are met. Injury which is not 'serious' but requires first aid, or which causes discomfort or pain to the person injured.	• Some low-speed vehicle collisions. • Cyclist falls from bicycle at low speed. • Left-turn rear-end crash.
Non-injury	Where Safe System boundary conditions are met. Property damage crashes.	• Some low-speed vehicle collisions. • Pedestrian walks into object (no head injury). • Car reverses into post.

Concerns categories

While all safety concerns should be considered for action, the client will need to decide what the appropriate course of action will be considering the guidance given in the table below, advice from road safety advisors and programme or project sponsor. A suggested action for each concern category is given in table below.

Table 8: Concerns categories

Concern	Suggested action
Serious	Serious safety concern that must be addressed and requires changes to avoid serious safety consequences.
Significant	Significant concern that should be addressed and requires changes to avoid serious safety consequences.
Moderate	Moderate concern that should be addressed to improve safety.
Minor	Minor concern that could be addressed where practical to improve safety.

In addition to the ranked safety issues, it's appropriate for the audit team to provide additional comments about items that may have a safety implication but lie outside the scope of the Safe System audit.

A comment may include: items where the safety implications are not yet clear due to insufficient detail for the stage of project; items outside the scope of the audit such as existing issues not impacted by the project; an opportunity for improved safety that is not necessarily linked to the project itself, or drawing/signage issues that should be addressed but are not necessarily safety related. While typically comments do not require a specific recommendation, in some instance's suggestions may be given by the auditors.

Post audit feedback

A key part of maintaining a Safe System requires a self-improvement process. Integral to this is the dissemination of knowledge gained either from the Safe System audit process or following project construction.

The following actions should be considered to promote the healthy sharing of knowledge within the industry either formally or informally:

- Regularly review previous audit reports to identify recurring issues or issues for industry-wide dissemination.
- Disseminate information relating to safe system audits or safe system generally to the industry by either direct communication with interested parties or a website.
- From the review process identify issues that should be considered for a review of standards or guidelines.

It is also recommended that the safety performance of project sites is monitored following the post-construction audit to verify the effectiveness of decisions made.


Every 15 minutes until midnight