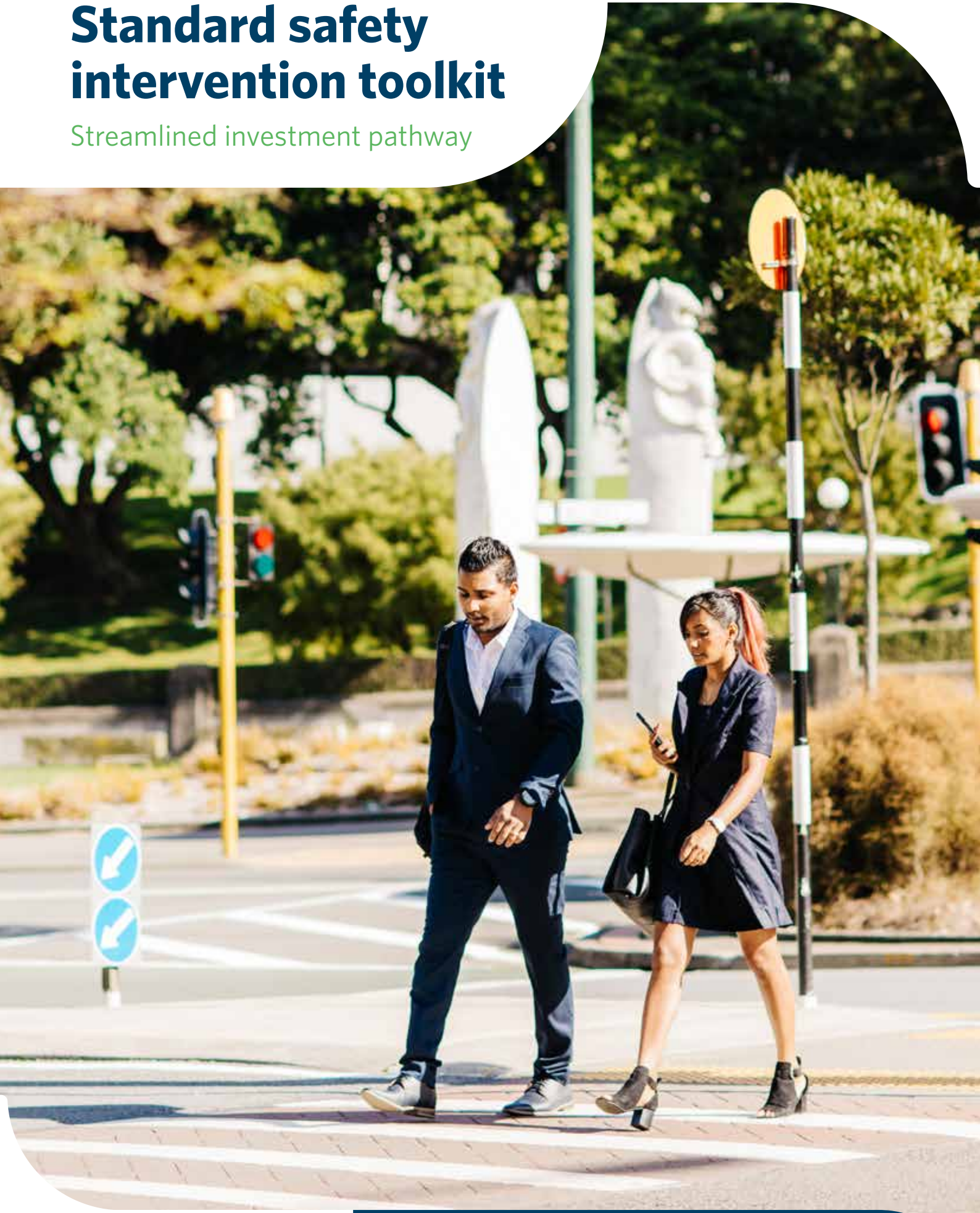
Standard safety intervention toolkit

Streamlined investment pathway



WAKA KOTAHI
NZ TRANSPORT AGENCY

ROAD TO ZERO

Te Kāwanatanga o Aotearoa
New Zealand Government

Waka Kotahi NZ Transport Agency
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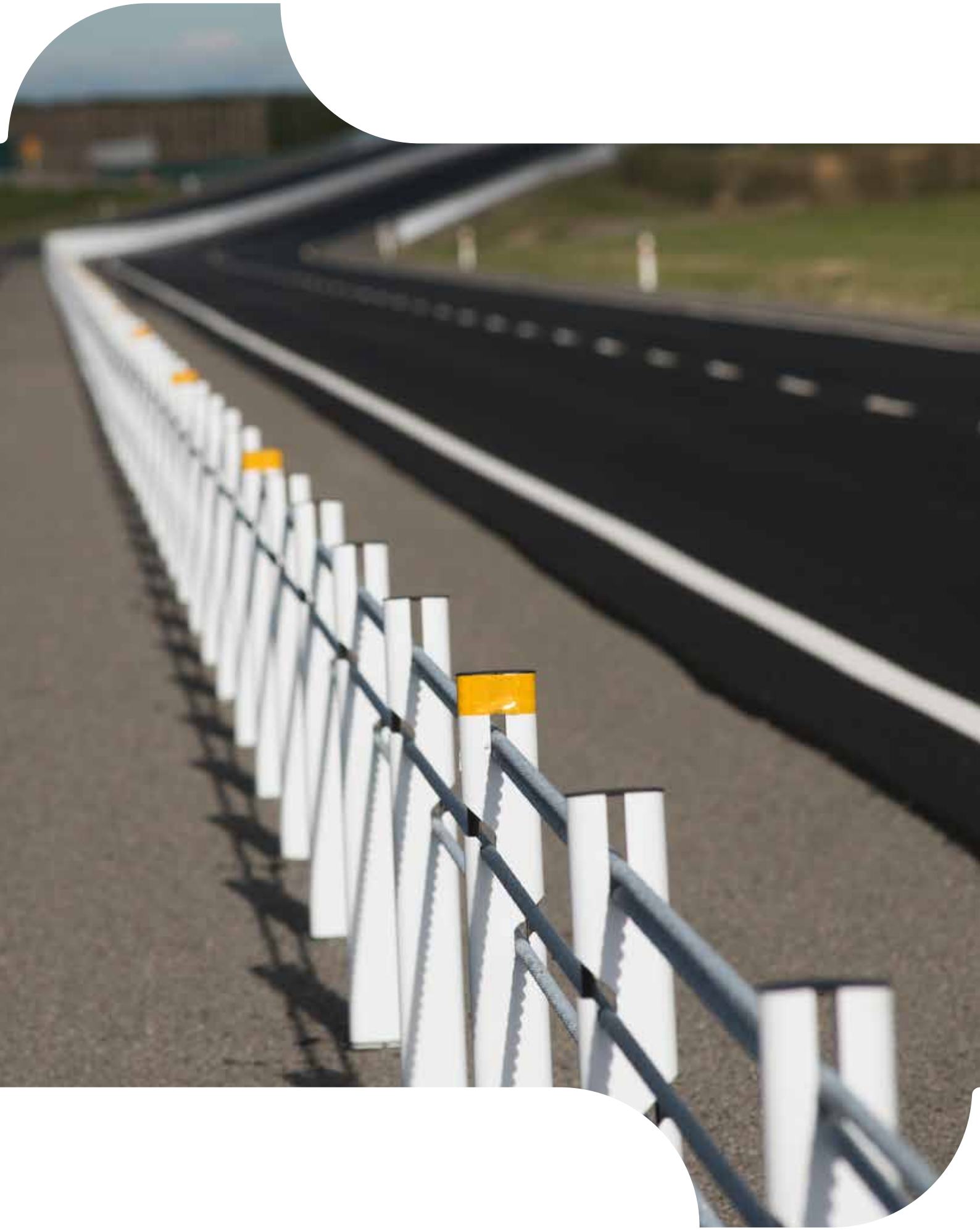

Introduction

Imagine an Aotearoa New Zealand where no-one is killed or seriously injured on our roads.

A vision of an Aotearoa New Zealand where everyone, no matter their age or ability, can get around safely, where speed limits are safe. Where everyone recognises the vulnerability of people to crash forces and where roads help protect people's lives by being designed in a way that is forgiving of mistakes. Imagine that our vehicles offer the highest levels of protection and our transport system improves people's health and well-being, as well as all the places and spaces we love.

Currently, on average at least one person is killed, and seven people are reported seriously injured in road crashes every day in Aotearoa New Zealand.

To help us address this challenge the government and Waka Kotahi New Zealand Transport Agency (Waka Kotahi) has committed to Road to Zero - Aotearoa New Zealand's road safety strategy for 2020-2030.

Road to Zero, Vision Zero and Safe System

Road to Zero is the government's strategy to significantly reduce road trauma over the period 2020 to 2030. The strategy's vision is an Aotearoa 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.

The strategy puts in place an ambitious target of reducing deaths and serious injuries on our roads by 40 percent over the next 10 years. A series of action plans that outline the priority actions required to help us reach this target will be released over this 10-year period. The first action plan was released at the same time as the strategy and covers three years from 2020-2022.

Road to Zero is based on the ethical stance of Vision Zero and is underpinned by the Safe System approach.

Vision Zero acknowledges human error and fragility but doesn't accept that death or serious injury should be inevitable or an acceptable outcome of travelling on our roads, streets, cycleways and footpaths. Adopting Vision Zero means 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.

Underpinning this vision is the Safe System approach, which acknowledges that we all make mistakes on our roads but that these mistakes should not cost us our lives.

The Safe System approach aims to provide a more forgiving transport system that acknowledges people make mistakes and are vulnerable in a crash.

- **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** System designers and people who use the roads must all share responsibility for creating a road system where crash forces do not result in death or serious injury.
- **We need to strengthen all parts of the system** We need to improve the safety of all parts of the system – roads and roadsides, speeds, vehicles, and road use so that if one part fails, other parts will still protect the people involved.

By designing all aspects of the transport system to protect people from death or serious injury when they are involved in a crash, we can make progress towards zero deaths and serious injuries on our roads.

The Road to Zero action plan 2020-2022 has a continued focus on areas of greatest risk and disproportionate harm and presents opportunities for the use of current and emerging technologies. This includes increased investment in primary Safe System treatments that create roads that are safe for the prevailing speed limits and reduce the risk of:

- head-on and run-off road crashes (such as through the installation of median and side barriers)
- urban and rural intersection crashes (such as through the installation of roundabouts or speed management devices), and
- harm to vulnerable road users, including pedestrians, cyclists, mobility impaired (such as through segregated facilities, markings or speed management devices, including raised platforms at roundabouts, traffic signals, and pedestrian facilities).

To achieve significant and sustained reductions in deaths and serious injuries to reach the Road to Zero target requires a joint effort and collaboration between Waka Kotahi, our local authority partners, and other central and local government stakeholders.

Responding to government priorities

Waka Kotahi NZ Transport Agency is guided by the four themes in the Government Policy Statement 2021 (GPS 2021), which outlines the government's strategic priorities for the land transport system. Safety continues to be a key strategic priority within the GPS 2021, which gives effect to but is not limited to Road to Zero.

The GPS 2021 also prioritises better travel options in our towns and cities and supports investments for improving freight connectivity through rail and coastal shipping. By including climate change as a strategic priority, the GPS highlights the government's commitment to reducing greenhouse gas emissions in the transport system.

The GPS 2021 continues the government's commitment to safety within the transport system and the Road to Zero activity class brings the safety related activity classes together to invest for a 40% reduction in road deaths and serious injuries. Investment from other activity classes may also be used to fund activities with a safety outcome.

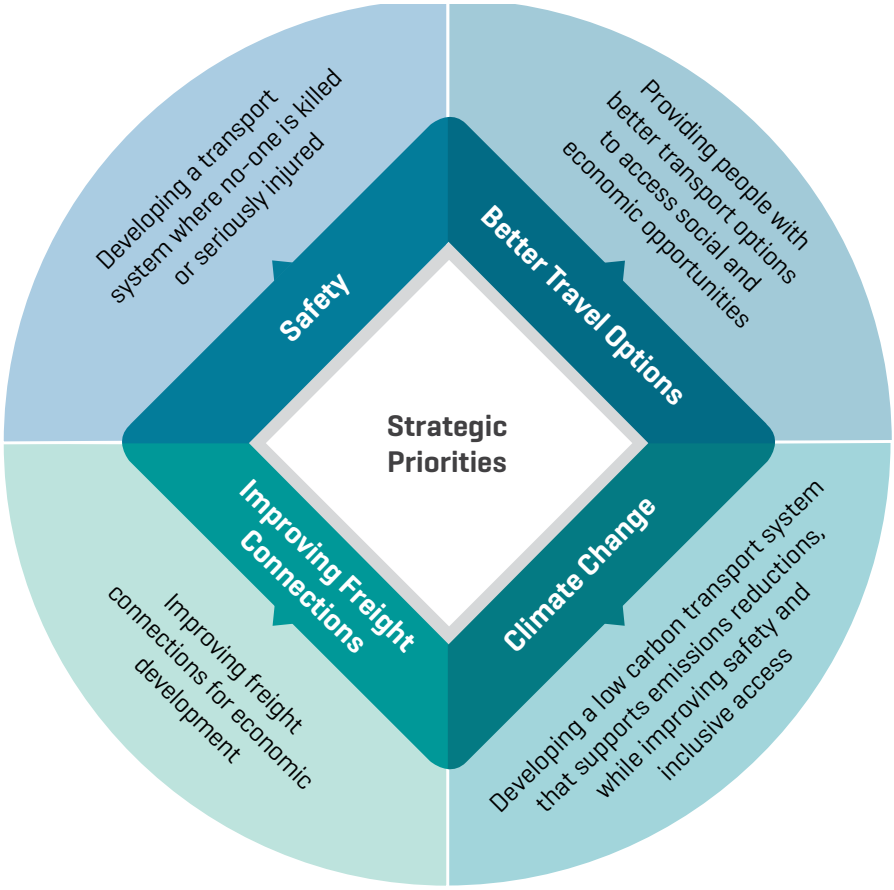

Figure 1 GPS 2021 strategic priorities

Road to Zero speed and infrastructure programme

The Road to Zero Speed and Infrastructure Programme is a collaborative programme that aims to reduce the amount of people killed or seriously injured on New Zealand's highways and local roads, through a range of proven road safety interventions.

To ensure that the speed and infrastructure outcomes sought by the GPS, Road to Zero Strategy and Action Plan are met, Waka Kotahi has led the development, in partnership with Local Authorities, and approval of a single Road to Zero Speed and Infrastructure Programme Business Case for Local Roads and State Highways. This sets the intervention treatment philosophy and the indicative level of investment for each corridor and/or intersection within the programme until 2030.

The successful delivery of the programme is critical as it is expected to deliver approximately half of the Road to Zero target of reducing the amount of people killed or seriously injured on New Zealand's roads by 40%.

The Road to Zero Speed and Infrastructure Programme Business Case was submitted and endorsed by the Waka Kotahi Board at the Wednesday 24th February 2021 meeting.

> Endorsement of the 10 Year Speed and Infrastructure Programme by the Waka Kotahi Board provides Waka Kotahi staff, local authority partners, communities and the sector with a clear signal of the importance of the programme, which will ensure delivery momentum and eliminate any potential relitigating of the programme's outcomes and investment priority.

The endorsement of the Road to Zero Speed and Infrastructure Programme Business Case 2021 – 2030 includes the endorsement of the programme's investment ratings and priority, which will be used for all project level investment decisions.

Streamlined investment pathway

The streamlined investment pathway was initially developed to support the delivery of the Safe Network Programme and has been updated to support the delivery of the Road to Zero Speed and Infrastructure Programme. However, the streamlined investment pathway and standard safety interventions can be used by other programmes that have an approved Programme Business Case or equivalent (eg AMP).

The streamlined investment pathway is informed by the Standard Safety Intervention Toolkit for the implementation of interventions valued above the low-cost low risk threshold that form part of the Road to Zero Speed and Infrastructure programme or other approved programme business case or equivalent.

This streamlined investment pathway can only be used for interventions that meet the applicable cost ranges and standard safety intervention (SSI) criteria as detailed in the next section or by exception.

Multiple standard safety interventions can be grouped together in a single funding application form where appropriate. This may be due to a project treatment philosophy, location, regional programming and/or where there are delivery efficiencies. For example, a project that has a Safer Corridor Treatment Philosophy may involve three (3) standard safety interventions - roadside barrier at high risk locations, audio tactile pavement marking and a roundabout.

Further guidance can be sought from the appropriate programme team on how standard safety interventions can be combined or packaged together that meet the programme management agreed process and controls eg the Road to Zero Programme Manager.

Standard safety intervention toolkit

This Standard Safety intervention Toolkit is intended to provide investment assurance for the streamlined investment pathway and intervention guidance for transport practitioners of all types and levels of professional experience, including road safety and transport engineers, asset managers, town planners, civil designers and community road safety coordinators. It is relevant to both state highway and local authority networks.

The standard safety intervention toolkit is not design guidance or a specification; it is a tool to assist project teams in demonstrating value for money to support investment decisions on interventions that form part of an approved Programme Business Case.

The standard safety intervention toolkit is not intended to replace any Waka Kotahi and/or Austroads road design or road safety publications as a source of in-depth technical information.

The primary objective of this Toolkit is to support the streamlined delivery of the Road to Zero Speed and Infrastructure programme for both Waka Kotahi and local authorities.

The standard safety intervention toolkit provides photographic examples of individual standard safety interventions and, for most treatments technical references are provided along with links to internet sites containing relevant documents.

Safe System implementation hierarchy

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

On corridors and/or intersections where primary Safe System interventions cannot be achieved, interventions should provide the highest safety performance possible whilst being supportive of, and acting as a steppingstone towards, future achievement of primary Safe System interventions. For example:

- A wide central painted median with audio-tactile lines may be installed with adequate width to allow for future installation of a central median barrier, whilst also allowing for further widening of the road cross-section in the future; whereas,
- Long continuous lengths of roadside barrier installed in the short-term may need to be removed and/or relocated in the longer term in order to allow for a median barrier and/or additional widening.

Safe System interventions

The interventions outlined in the table below are presented as either primary or supporting which indicates their Safe System alignment as per the definitions above.

Primary Safe System intervention	Supporting Safe System intervention
• Continuous 3 barriers • Median barrier • Roundabout • Raised safety platforms (at existing signalised intersection/roundabouts) • Midblock raised pedestrian crossing (priority and signalised) • Traffic calming • Signalised intersection with raised safety platforms (from an uncontrolled/priority controlled)	• Wide Centreline • Roadside barrier at high risk locations • Audio tactile pavement marking (ATP) • Shoulder widening at high risk locations • Skid resistance at high risk locations • Signs and markings • Intersection speed zone • Signalised intersection • Speed management

Safe System treatment philosophy

The Safe System treatment philosophy gives the indicative level of infrastructure change and investment required to achieve the desired level safety outcome. Note that, within the treatment philosophy diagram below, some measures will cross boundaries. Also note that this is a guide to the types of treatments that are the most appropriate for the level of risk.

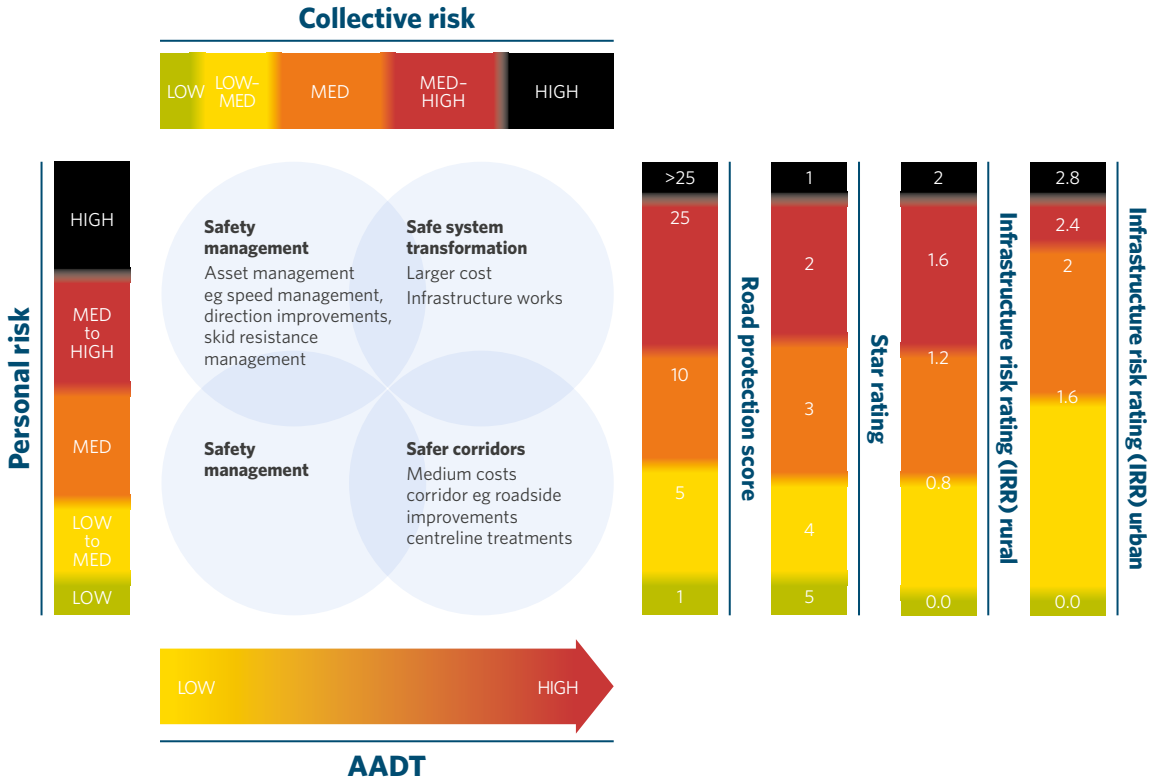

Figure 2 Safe System treatment philosophy

The treatment philosophy provides an indication of the level of safety service that is required when identifying sites that, although lower risk, are performing worse than would be expected. While the focus is on high-risk intersections and corridors (those typically located in the upper or right quadrants of figure 2), it is important to remember low-cost safety management treatments may still apply to those intersections or corridors that fall into the bottom left quadrant.

Intersections or corridors that do not fall into the upper or right quadrants of figure 2, are not precluded from treatment; however, the improvements should be proportional to the problems exhibited.

Safe System transformation treatment philosophy

Indicates that higher cost infrastructure measures which are primary Safe System interventions such as median barriers, roundabouts and approach raised safety platforms that offer the highest road safety performance are the most appropriate.

Safer corridors and safer intersection treatment philosophy

Indicates that medium- to low-cost infrastructure measures which are supporting Safe System interventions such as wide centrelines, speed management, Roadside barrier at high risk locations that generally offer medium to low road safety performance are the most appropriate.

Safety management treatment philosophy

Indicates that lower-cost measures which are supporting Safe System interventions such as ATP markings, signage and delineation improvements are the most appropriate.

Safety maintenance treatment philosophy

Is the maintaining and renewal of safety assets to ensure that minimal safety levels of services are maintained.

Streamlined investment pathway

This section outlines the process for applying for funding endorsement of standard safety interventions with a total cost above the low-cost, low-risk improvement threshold.

The project or programme team will determine the appropriate investment pathway for the implementation of their respective projects and submit the appropriate documentation for funding endorsement and approval.

For information regarding other investment pathways refer to the Waka Kotahi Planning and Investment Knowledge Base.

Exclusions

Interventions that are considered complex or high-risk will generally be required to proceed through the single stage business case or alternative pathway. As the business case process is scalable, the level of effort and deliverables required to develop the investment case should be appropriate to the size and risk of the problem and the proposed investment.

Interventions that are deemed to be complex or high-risk, taking into consideration factors unique to the corridor or intersection, will generally include, but are not limited to, the following:

- The intervention requires complex solutions due to difficult engineering issues;
- The intervention has multiple outcomes that all require careful consideration;
- The intervention is located within a high-risk, sensitive receiving environment (environmental, social, cultural or historical);
- The intervention does not comply with Waka Kotahi standards, specifications, guidelines or professional services specialist recommendations.

Each intervention should also be assessed with reference to the problems and benefits in the context of its contribution to programme level investment objectives. Interventions that have a total cost less than the low-cost, low-risk improvement threshold should use that investment pathway. Instructions for the application and process for low-cost, low-risk improvements can be found on the Waka Kotahi Planning and Investment Knowledge Base.

Funding approvals

All funding applications for Standard Safety Interventions are required to be applied for using the Streamlined Investment Pathway Application Form (see application template form in appendix).

Multiple standard safety interventions can be grouped together in a single funding application form where appropriate. This may be due to a project treatment philosophy, location, regional programming and/or where there are delivery efficiencies. For example, a project that has a Safer Corridor Treatment Philosophy may involve three (3) standard safety interventions - roadside barrier at high risk locations, audio tactile pavement marking and a roundabout.

Further guidance can be sought from the appropriate programme team on how standard safety interventions can be combined or packaged together that meet the programme management agreed process and controls eg the Road to Zero Programme Manager.

Streamlined Investment Pathway funding applications that form part of the Road to Zero Speed and Infrastructure Programme must be submitted to the Programme Development Manager prior to going through the agreed review process. Applications may then be submitted for recommendation of funding endorsement and release by the appropriate delegation dependent on the scale and cost of the application as per Waka Kotahi business delegations.

For other Streamlined Investment Pathway funding applications (not part of Road to Zero Speed and Infrastructure Programme) please follow the funding approval process as per the Waka Kotahi Planning and Investment Knowledge Base and Waka Kotahi business delegations.

Exceptions

For applications where the Standard Safety Intervention (SSI) criteria or applicable cost range is not met, they can still be considered for funding endorsement by Waka Kotahi appropriate delegated authority but may require further information to support the application.

Standard safety interventions

The standard safety interventions included within the toolkit are proven road safety interventions that deliver beneficial safety outcomes by improving the existing road network; they are not intended to be used for offline or new road corridors.

Intervention implementation guidelines

Implementation guidelines have been developed to assist project teams to ensure the proposed standard safety intervention/s are appropriate for the site/corridor being addressed.

These guidelines do not provide an exhaustive list of possible safety interventions and suitably trained and qualified practitioners will need to engage in a critical assessment of the site/corridor to ensure that the road safety issues identified are being treated appropriately.

Safe System intervention hierarchy

Each standard safety intervention has an associated Safe System intervention hierarchy which indicates its Safe System alignment either as a primary or supporting Safe System treatment.

Safe System treatment philosophy

Each standard safety intervention has an associated Safe System treatment philosophy, which gives an indication of the type of intervention and appropriate level of investment needed to address the level of risk at the corridor and/or intersection.

Standard Safety intervention (SSI) criteria

The Standard Safety Intervention criteria presented under each Standard Safety Intervention is the criteria used to evaluate the appropriateness of funding (value for money) through the streamlined investment pathway.

Intervention cost ranges

For each intervention there is an assumed low to high cost range, which is a best effort at determining the appropriate design and construction cost based on past experiences.

Costs at the low end of the stated range typically apply when the intervention can be implemented with little or no supporting infrastructure changes, such as widening the road cross-section. Conversely, high costs are generally associated with substantial supporting infrastructure changes, typically to meet more conservative or desirable practices and standards.

Projects that exceed the cost ranges will generally not qualify for the streamlined investment pathway, unless by exception.

Land acquisition

The costs associated with land/property purchase will need to be included in the funding application however, it does not need to be included within the intervention applicable cost range.

Assessed economics – deaths and serious injuries (DSIs)

For the economics and effectiveness of the interventions is all referred to as deaths and serious injuries (DSIs).

The assumed cost per DSI for rural environments is $1.4 million and for urban environments is $1.1 million.

Assessed economics – benefit cost ratio (BCR)

A full BCR range has been calculated for each intervention based on the Safe and Appropriate Speed as the 'Do Minimum' approach, with inclusion of travel time disbenefit and vehicle operating costs.

A whole-of-life cost factor based on past experiences has been used eg Safe Roads Alliance, Waka Kotahi and Local Government projects. It allows for the detailed design, site supervision and discounted maintenance costs over a 40-year intervention life.

Interventions which have a higher multiplicative factor are those which have elements that require more frequent renewal. For example, flexible barriers have regular (sometimes monthly) strikes which require regular repair and renewal throughout the intervention life or; road markings which may be remarked every year during a 40-year economic life. Interventions that use more structural elements, such as widening or installation of a roundabout, will have a longer design life and require less maintenance in proportion to the initial capital works cost.

A technical note has been produced that supports this document named Testing of Updated Standard Safety Interventions Toolkit. The technical notes outline the methodology, assumptions made through the economic evaluation of all the standard safety interventions contained within the toolkit as well as the calculated benefit cost ratio ranges. The Technical note is available online along with the toolkit.

If there are any differences in the criteria, cost ranges or information of any of the standard safety interventions the information provided within the Standard Safety Interventions Toolkit supersedes the information provided in the technical note.

Continuous 3-barrier (median and roadside barrier)

Assessed economics for streamlined investment pathway

Applicable cost range:
$2M to $5M per km

Assumed DSI reduction:
75%

Continuous 3 barrier is a continuous central and roadside barrier system installed along a corridor, which provides separation between opposing traffic lanes and protection from roadside hazards and furniture.

Continuous lengths of barrier are at present the only way to effectively mitigate the severe harm being caused by road departure and head on crashes and compensate for driver errors.

Three barriers can be effectively retrofitted on two-way two-lane roads, 2+1 and dual lane carriageways. In most cases this will require widening of the carriageway.

Implementation needs to consider a good standard of turnarounds, provision of roundabouts at major intersections and audio tactile pavement marking.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System transformation

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 10,000 vehicles per day.
- Collective risk is medium-high or higher or predictive collective risk is medium-high or higher.
- Posted speed limit is 80km/h or higher.

The applicable cost range reflects the installation of the 3-barrier intervention on an existing corridor and includes but is not limited to professional services fees, construction costs (establishment, traffic management etc.), pavement widening, audio tactile pavement markings, signage, drainage, full roundabouts, turnarounds and rural intersection activated warning signs. The cost range does not allow for passing lanes and land acquisition.

Intervention implementation guidelines

To assist project teams with the selection of suitable sites for 3 barriers, the following guidelines have been developed:

- A relatively high AADT typically greater than 10,000 vehicles per day, although corridors with a lower AADT may still be considered.
- Is there evidence of runoff road and head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?
- Are there significant roadside hazards that require continuous protection?

Other considerations

While road safety barriers can be installed over shorter lengths, they are most effective when installed over longer lengths of a corridor. This is to minimise the number of terminal ends and potential conflicts as they can pose a greater risk if struck by an errant vehicle.

On national (HV) and regional ONRC corridors, which are identified and agreed as over dimension load routes, an appropriate offset of roadside objects should be considered as per the Waka Kotahi guidance. Roadside objects include streetlights, signage and vegetation.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network according to Waka Kotahi guidance. However, on other corridors, narrower shoulders will be appropriate.

Audio tactile profiled (ATP) markings should be installed on/adjacent to the white edge line and centreline unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

The designer must consider the appropriate offset location of roadside barriers opposite and either side of intersections, access ways and/or entranceways to ensure safe ingress and egress.

The designer must also consider ongoing maintenance activities, including signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for appropriate maintenance vehicles, police vehicles etc.

References and guidelines

www.nzta.govt.nz/resources/road-safety-barrier-systems/

Median barrier

Assessed economics for streamlined investment pathway

Applicable cost range:
$1M to $4M per km

Assumed DSI reduction:
65%

State Highway 1 Centennial Highway, Wellington – median barrier treatment

A median barrier consists of a continuous central barrier system installed along a corridor. Median barriers are generally either a rigid or flexible road safety barrier system. A median barrier is most effective at reducing the number and injuries severity of crashes that would have resulted in head-on type (cross centreline) crashes involving two vehicles. The median is also effective at reducing the severity of single vehicle loss of control crashes to the right, which may have started as a lane departure to left followed by an overcorrection travelling over the centreline. As such, a median barrier is the preferred Safe System intervention treatment, where continuous 3 barriers cannot be installed, and roadside safety barriers are being considered.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System transformation and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost (excluding land acquisition) must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 6000 vehicles per day.
- Collective risk is medium-high or higher or predictive collective risk medium-high or greater.
- Posted speed limit is 80km/h or higher.

The applicable cost range reflects the installation of the median barrier intervention on an existing corridor and includes but is not limited to professional services fees, construction costs including establishment and traffic management, pavement widening of up to 1.5 metres on both sides, audio tactile pavement markings, signage, roadside barrier, drainage, compact roundabouts, turnarounds and intersection speed zones. The cost range does not allow for passing lanes, land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for median barriers, the following guidelines have been developed:

- An AADT typically greater than 6000 vehicles per day, although corridors with a lower AADT may still be considered.
- Is there evidence of runoff road or head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?

Other considerations

While median barriers can be installed over shorter lengths, they are most effective when installed over longer lengths of a corridor. This is to minimise the number of terminal ends and potential conflicts as they can pose a greater risk if struck by an errant vehicle.

On corridors, which are identified and agreed as over dimension load routes, an appropriate offset of roadside objects should be considered in accordance with Waka Kotahi guidance. Roadside objects include streetlights, signage and vegetation.

Audio tactile profiled (ATP) markings should be installed on/adjacent to the white edge line and centreline unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network according to Waka Kotahi guidance. However, on other corridors, narrower shoulders will be appropriate.

The project team should also consider ongoing maintenance activities including signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for including but not limited to maintenance vehicles, emergency services and police vehicles.

References and guidelines

https://www.nzta.govt.nz/resources/road-safety-barrier-systems/

Wide centreline

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.25M to $1.5M per km

Assumed DSI reduction:
35%

Wide centrelines consist of two lines marked in the centre of the road which provide greater separation for opposing traffic than standard centreline markings. This separation helps reduce the likelihood of head-on crashes and are typically used on rural roads where 'crossing the centreline' type crashes either exist or there is potential risk of them occurring.

Wide centrelines are appropriate where traffic volumes may not yet warrant a central median barrier. However, the design should allow for the future proofing of the installation of a median barrier to allow for changes in traffic growth and/or crash risk.

Wide spaced centrelines can be used where space between lanes is not intended to be used for turning traffic and must be marked with two approximately parallel lines spaced not less than 0.5 metres and not more than 1.5 metres apart.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safer corridors, and/or Safe System transformation corridors.

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT 3000 or greater
- Collective risk medium-high or greater or predictive collective risk medium-high or greater
- Speed limit 80km/h and above

The applicable cost range reflects the installation of the wide centreline intervention on an existing corridor and includes but is not limited to professional service fees, construction costs including establishment, traffic management, some pavement widening, roadside barriers, drainage, pavement marking changes, ATP markings and signage. The cost range does not allow for passing lanes, land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for wide centreline, the following guidelines have been developed:

- Is there evidence of head-on type reported crash types (crash codes BA – BO)?

Other considerations

Wide centreline pavement markings must be designed and installed in accordance with the draft Waka Kotahi Traffic control devices manual: Part 5 – Traffic control devices for general use – between intersections.

ATP markings should be installed on/adjacent to the white edge line and within the wide spaced centreline markings in accordance with the draft Waka Kotahi Traffic control devices manual: Part 5 – Traffic control devices for general use – between intersections.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network according to Waka Kotahi guidance. However, on other corridors, narrower shoulders will be appropriate.

The project team must consider future traffic growth to ensure that the design of the wide centreline intervention could accommodate the future installation of a median barrier.

References and guidelines

https://www.nzta.govt.nz/assets/resources/wide-centreline-trial/docs/wide-centrelinetrial- infosheet.pdf

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkingsguidelines/docs/atp-guidelines.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

Roadside safety barrier at high-risk locations

Assessed economics for streamlined investment pathway

Applicable cost range:
Between $0.1M to $0.6M per km (based on treating approx. 250 metres per km)

Assumed DSI reduction:
30%

Roadside safety barriers are effective at reducing the severity of crashes involving errant vehicles leaving the road and colliding with more severe roadside hazards. Roadside safety barriers include flexible barriers (wire rope), semi-rigid barriers (typically steel beam) and rigid barriers (concrete).

The installation of flexible barriers is more cost effective and better safety performance than clear zones.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safer corridors and/or safety management

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Collective risk is medium or higher or predictive collective risk medium or greater.
- Posted speed limit is 60km/h or higher.

The applicable cost range reflects the installation of the roadside barrier at high-risk locations intervention on an existing corridor and includes but is not limited to professional service fees, construction costs (establishment, traffic management etc), some pavement widening, ATP markings and signage. The cost range does not allow for land acquisition, service relocations and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for roadside barriers at high-risk locations, the following guidelines have been developed.

- Is there evidence of runoff road reported crash types (crash codes CA – CO, DA and/or DB)?
- Are there significant roadside hazards that require protection?
- Flexible barriers should be considered for use before other barrier types
- That the location of the barrier is not within Commercial Big Box/Industrial, Commercial Strip Shopping and Urban Residential land uses

Other considerations

ATP markings should be installed on/adjacent to the white edge line unless there are practical reasons they cannot be installed. The installation of ATP markings may also reduce the amount of nuisance strikes.

Shoulder widening may need to be considered to achieve the desired layout, if the minimum sealed width cannot be achieved.

Roadside barriers should also be offset as much as possible to achieve the desired offset and not impact on the 'effective shoulder width' (being a combination of sealed and unsealed pavement), this may require roadside barriers located with grass berms, or unsealed shoulders.

The sealed shoulder width will need to accommodate cyclists if the corridor is part of the identified cycle network according to Waka Kotahi guidance. However, on other corridors, narrower shoulders will be appropriate.

The designer will need to allow for pull-over areas at regular intervals for heavy vehicles, maintenance vehicles and slower vehicles.

The designer must consider the appropriate offset location of roadside barriers opposite and either side of intersections, access ways and/or entranceways to ensure safe ingress and egress.

The designer must also consider ongoing maintenance activities, eg signage, lighting, drainage and vegetation. The designer may need to consider pull-over areas and breaks in the barrier to allow access for appropriate maintenance vehicles, ego police vehicles.

References and guidelines

https://www.nzta.govt.nz/resources/road-safety-barrier-systems/

Shoulder widening at high-risk curves

Assessed economics for streamlined investment pathway

Applicable cost range: **$0.2M-$0.45M per site (based on an approx. 250 metre site length)**

Assumed DSI reduction: **25%**

Figure 8
Widened shoulder on a rural road

A sealed shoulder provides drivers with an appropriate surface on which to regain control of an errant vehicle.

A high risk or out of context curve is where the curve radius is less than 250m radius and up to 400m radius and/or when the difference between the approach and the curve speed exceeds 15km/hr.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Is a high-risk or out of context curve.
- AADT is greater than 1000 vehicles per day.
- The corridor collective risk is medium risk or higher or predictive collective risk medium or higher.
- Posted speed limit is 60km/h or higher.

The applicable cost range reflects the installation of the shoulder widening at high risk locations on an existing corridor and includes but is not limited to design fees, construction costs (eg establishment, traffic management), pavement widening of up to 1.5 metres on one side of the road up to a length of 250 metres. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for shoulder widening at high-risk locations, the following guidelines have been developed:

- Is there evidence of runoff road reported crash types (crash codes CA – CO, DA and/or DB)?
- Is there evidence of edge break or vehicle tracking over the edge of sealed shoulder?

Other considerations

On curves, the vertical and horizontal geometry should be reviewed, and appropriate design vehicles used to determine the extent of appropriate shoulder widening.

Shoulder widening should not exceed 2 metres, as drivers may use them as an additional lane.

Shoulder widening should be initially prioritised to the outside of curves (up to 2.0 metres) as this gives the greatest crash benefits.

Shoulder widening on the inside of curves or on straight sections of a corridor to achieve a total seal width of 1.0 metre will provide good benefits, any widening beyond the 1.0 metre only deliver small incremental benefits unless there is an identified need/warrant for additional shoulder widening width.

References and guidelines

https://www.nzta.govt.nz/assets/resources/state-highway-geometric-design-manual/docs/shgdm-part-6.pdf

Audio tactile pavement markings (ATPM)

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.01M and $0.05M per km

Assumed DSI reduction:
20%

Figure 9
Centre and edge line audio tactile pavement markings

ATP markings can be provided along the edgeline and/or centreline of a roadway and provide audio and tactile feedback to road users. They may replace or supplement standard edgeline markings on sections of road.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safer corridors and/or safety management

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Posted speed limit is 80km/h or higher.

The applicable cost range reflects the installation of the audio tactile pavement marking intervention on an existing corridor and includes but is not limited to professional service fees, construction costs (establishment, traffic management etc), ATP markings including RRPMS and pavement marking removal. The cost range does not allow for whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for ATP marking intervention, the following guidelines have been developed:

- Is there evidence of runoff road or head-on type reported crash types (crash codes BA – BO, CA – CO, DA and/or DB)?
- Is there evidence of crashes where fatigue or driver distraction may have been a contributing factor?
- Are there specific site problems such as poor visibility, frequent or heavy rain, or night-time crash history?
- Will the installation of ATP markings unduly affect nearby residents?

Other considerations

ATP markings should be used as a continuous treatment system rather than as a series of 'spot' treatments at high crash risk locations.

ATP markings must be installed in accordance with Waka Kotahi's Traffic control devices manual.

ATP markings should be omitted from major access ways and intersections but continuous across minor entrances unless noise is a problem for residents.

References and guidelines

https://www.nzta.govt.nz/resources/audio-tactile-profiled-roadmarkings/

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkingsguidelines/docs/atp-guidelines.pdf

https://www.nzta.govt.nz/assets/resources/audio-tactile-profiled-roadmarkings/docs/audio-tactile-profiled-roadmarkings-notes.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

Intersection speed zones

Assessed economics for streamlined investment pathway

Applicable cost range:
Up to $0.5M per site

Assumed DSI reduction:
65%

Figure 10
State Highway 1 Himatangi Beach intersection

Intersection speed zones are installed on the major approaches to the intersection and are activated by a right turning vehicle (from the major approach) or an approaching vehicle on the minor leg of the intersection.

Rural intersection crashes mostly involve turning and crossing vehicles colliding with high speed through-traffic. By reducing the speed of the vehicles on the through road at the intersection, it can reduce the number and severity of crashes at rural intersections.

Intersection speed zones reduce speeds and raise awareness of an intersection with deficiencies or crash problems where transformational works are not appropriate or possible.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safer intersection, although they may still be a viable solution for Safe System transformation intersection sites if primary Safe System solutions are not possible.

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Collective risk or personal risk is medium-high or greater.
- Posted speed limit is 80km/h or higher.

The applicable cost range reflects the installation of the intersection speed zones intervention at an existing intersection and includes but is not limited to professional service fees, construction costs (establishment, traffic management etc) electronic sign infrastructure, poles, detector system, power and communications. The cost range does not allow land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for intersection speed zones intervention, the following guidelines have been developed:

- Does the intersection have a high-risk rating?
  - Have there been 3 or more fatal or serious crashes over a 5-year period, or
  - 2 or more DSI equivalents (estimated from all injury crashes), or
  - Medium-high collective or personal risk or higher.
- Is there evidence of reported crossing and turning crash types (crash codes HA, JA, KA and KB)?
- Is the traffic volume proportionally higher on the through route than the side road traffic volume lower, but not so low that exposure is minimal? Initial evaluation advice from Sweden was that the optimum traffic volumes would be approximately 10,000 vehicles per day on the through road and 2000 vehicles per day on the side road. However, we have sites well above that, even if the higher the crossing/turning volumes, the more often the lower speed limit is activated.
- Does the intersection have approach visibility issues (too little or too much)?
- Does the intersection have relatively simple geometry (T or X), without complicating factors such as multiple lanes on through road (accepting that many intersections have acceleration lanes and right turn bays)?

Other considerations

The project team needs to fully understand and consider if there are regional site works planned for the intersection over the short to medium term.

Intersection speed zones can be considered an appropriate interim safety solution where a longer-term Safe System transformational project is planned or being considered.

References and guidelines

https://www.nzta.govt.nz/assets/network/operating/safely/doc/Intersection speed zones -info-sheet.pdf

https://www.nzta.govt.nz/assets/planning-and-investment/knowledge-base/Uploads/Documents/Speed-Management-Toolbox-and-Appendices-combined-Final-July-2016.pdf

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

Roundabout

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.5M - $6M per site

Assumed DSI reduction:
75%

Figure 11
Rural roundabout

A roundabout is a safer form of intersection control compared to most other types. As they are effective method of reducing both the number and severity of injury crashes. This is due to the reduced number of conflict points, lower relative impact speeds and more favourable impact angles when compared with other layouts.

In many situations' roundabouts provide a similar capacity to signals, but may operate with lower delays and better safety, particularly in off-peak periods.

Where additional capacity is required, or the minor flows are suffering significant delays, partial or full signalisation of the roundabout should be considered.

Signalised roundabouts have been shown to have an even better safety performance than unsignalised roundabouts and improve safety for vulnerable road users.

They provide smoother traffic flow and fewer delays for drivers in off-peak periods and can mean less delay for pedestrians.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System intersection transformation

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater.
- 3 or more injury crashes in 5 years

The applicable cost range reflects the installation of the roundabout intervention on an existing intersection and includes but is not limited to professional service fees, construction costs (establishment, traffic management etc), pavement widening, lighting, signage, pavement markings and drainage. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for a rural roundabout intervention, the following guidelines have been developed:

- Is there evidence of crossing/turning type crashes?

Other considerations

Speeds and collision angles need to be managed down on the approaches, so as not to result in unacceptably high entry speed onto the circulating carriageway.

Two thirds of DSIs at rural roundabouts involve loss of control or colliding with roadside objects downstream of the exit. So clear zones in these areas are crucial.

Ensuring optimum visibility on the approach to the roundabout – excessive visibility particularly to the right – has been shown to result in early decision making and high entry speeds.

Visibility should (both around the circulatory and on approach to) also be even to avoid differential speeds.

Where there is insufficient exit deflection to adequately manage vehicle speeds, raised speed platforms on the approaches could be considered as an alternative solution. However, while being trialled overseas, the concept is new to New Zealand and should be discussed with the Waka Kotahi Intersection Working Group.

The exit radius should also be easier than entry to reduce likelihood of vehicles losing control. Multiple approach lanes can result in vehicles straight lining the roundabout and losing control on exit. For example, islands to separate the left turn lane can reduce this likelihood.

A well-designed roundabout could have an advantage over traffic signals in reducing right turn opposed type crashes and overall delays. Smaller (mini) roundabouts may be installed using simple markings or raised islands but are best applied in conjunction with plantings that beautify the street and the surrounding neighbourhood. Careful attention should be paid to the available lane width and turning radius used with traffic circles.

Single lane roundabouts are safer for all road users, particularly vulnerable road users and should be used where possible.

On-road cyclists can use roundabouts safely enough if vehicle speeds are managed to 30 km/h or less, and road crossings for cycle paths can be used at/near roundabouts.

Installation of raised zebra crossings clarify where pedestrians should cross and that they have priority of approaching vehicles.

Raised safety platforms
(at existing signalised intersection/roundabouts)

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.3M - $2M per site

Assumed DSI reduction:
40%

Figure 16
Mid-block raised pedestrian crossing

Picture credit: Department of Transport Victoria

The installation of raised safety platforms on the approaches of an existing signalised intersection or roundabout intersection. Raised Safety Platforms (RSPs) are a vertical deflection device increasingly used to reduce the maximum comfortable operating speed for vehicles to Safe System collision speeds, particularly at intersections.

Raised Safety Platforms have historically been associated with use in lower speed environments, they are increasingly being used in higher speed environments and for other locations where pedestrians and cyclists would typically be injured.

Raised Safety Platforms are essentially speed tables; however, they are distinguished from other vertical deflection devices when being designed for use in higher speed environments, with the aim to achieve Safe System speeds while not unduly impacting comfort and speed of motorists. Identified benefits of RSPs include relative ease of installation and replication compared to other more transformative treatments, such as raising a whole intersection (if approach platforms are chosen), with similar benefits to different road users, and lower cost (Pratt and Aumann 2014).

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System intersection transformation and/or safer intersection

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater
- 3 or more injury crash types.
- Speed limit 60km/h and below.

The applicable cost range reflects the installation of the raised safety platform intervention at an existing intersection and includes but is not limited to professional service fees, construction costs including establishment and traffic management, pavement construction, signage, pavement markings and drainage. The cost range does not allow for land acquisition, lighting and whole of life costs

Implementation guidelines

To assist project teams with the selection of suitable sites for raised intersection platforms, the following guidelines have been developed:

- Is there evidence of turning/crossing type reported crash types and/or crashes involving vulnerable road users?

Other considerations

Where two one-way streets intersect, there will be two corners around which no drivers turn. This can be designed with the smallest constructible radius.

References and guidelines

https://www.vicroads.vic.gov.au/-/media/files/technical-documents-new/road-designnotes/road-design-note-0307-raised-safety-platforms-rsp-oct-2018.ashx

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

https://austroads.com.au/publications/traffic-management/ap-r642-20/media/AP-R642-20_Effectiveness_and_Implementation_of_Raised_Safety_Platforms.pdf

Signalised intersection with raised safety platforms
(from an uncontrolled/priority controlled)

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.5M - $2M per site

Assumed DSI reduction:
55%

Figure 14
Gordonton Road Intersection, Hamilton City Council

Signalising an existing uncontrolled or controlled intersection including the signalisation of roundabouts which must include the installation of raised safety platforms and to fully control the right turn phases to eliminate right turn filtering.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System Transformation and/or Safer intersection

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Intersection collective risk medium-high or greater
- 3 or more injury crash types
- Speed limit 80km/h and below

The applicable cost range reflects the installation of the upgrade to a signalised intersection intervention and includes but is not limited to professional service fees, construction costs including establishment and traffic management, and additional signal aspects, right turn arrows, protected pedestrian phases, advance cycle stop box, splitter islands, high friction surfacing and lighting. The cost range does not allow for land acquisition and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for this intervention, the following guidelines have been developed:

- Is there evidence of turning/crossing type reported crash types and/or turning crashes involving vulnerable road users?

Other considerations

Drivers that are attempting to turn right, are often not looking for and fail to see approaching cyclists and motorcyclists and fail to give way to them resulting in high severity injury crashes. Exclusive right turn phases are particularly beneficial to motorcyclists and cyclists.

Protected right turn phases may result in excessive delays to pedestrians waiting to cross and increase the number of pedestrians crossing against the lights. Signal timings should be reviewed and optimised, so pedestrians are not frustrated at the delay and cross against a red signal.

References and guidelines

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

Mid-block raised pedestrian crossing

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.03M - $0.3M per site (based on an approx. 250 metre site length)

Assumed DSI reduction:
20%

Figure 16
Mid-block raised pedestrian crossing

Raised mid-block crossings facilitate movement between places that people want to go, but that are not well served by the existing traffic network. The raised pedestrian crossing can either be priority controlled (zebra crossing) or signalised depending on the volume of pedestrian and vehicles.

These pedestrian crossings, which commonly occur at schools, parks, museums, waterfronts and other destinations, have historically been overlooked or difficult to access, creating unsafe or unpredictable situations for both pedestrians and vehicles.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System transformation and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Urban Connectors, Activity Streets and Main Streets
- Posted speed limit is 60km/h and below.

The applicable cost range reflects the installation of the mid-block raised pedestrian crossing intervention and includes but is not limited to professional service fees, construction costs including establishment and traffic management, pavement construction, signage, pavement markings and drainage. The cost range does not allow for land acquisition, lighting and whole of life costs.

Implementation guidelines

To assist project teams with the selection of suitable sites for mid-block raised pedestrian crossing intervention, the following guidelines have been developed:

- Is there is a need for a priority pedestrian crossing?
- Is there evidence of pedestrian related crashes or near misses?

Other considerations

The use of the raised mid-block raised pedestrian crossings can be applied to locations where there is existing crossing infrastructure including zebra crossing, and central refuge islands.

Parked vehicles, street furniture and/or vegetation in advance of a crossing needs to be removed to ensure pedestrians are more visible to motorists and cars more visible to pedestrians. This may be accomplished by restricting parking and/or installing a curb extension.

At key access points to parks, schools and waterfronts, and at intersections with local streets, raised crossings increase visibility, driver stopping behaviour, and create a safer pedestrian crossing environment.

Priority controlled crossings should be highlighted using additional warning signage, high visibility lighting and markings and traffic calming features, such as build outs and midblock curb extensions. To achieve the safety benefits of the raised platforms they need to be installed at a minimum height of 75mm and between 100mm. The length of the ramp on the approach and departure side of the table will determine the ride quality.

Where mid-block pedestrian crossings are in a low volume downtown commercial or neighbourhood residential area, a designer may consider the application of a shared street treatment. Specific street design including street furniture and landscaping may be required to make the street self-explaining and manage speeds to below 30km/h.

Walking speeds should always be estimated conservatively with additional allowances where needed:

- Some pedestrians, notably the elderly, who can take up to 1.5 seconds longer to start crossing.
- People at the back of a large group of pedestrians, who will take some time to enter the crossing.
- If the crossing is narrow, there may be obstructions and delays between pedestrians walking in opposite directions.

References and guidelines

https://www.nzta.govt.nz/assets/resources/pedestrian-planning-guide/docs/pedestrianplanning-guide.pdf

https://austroads.com.au/network-operations/network-management/pedestrian-facilityselection-tool

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/

Skid resistance at high-risk locations

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.03M - $0.3M per site (based on an approx. 250 metre site length)

Assumed DSI reduction:
20%

Figure 17
Skid resistance

Skid resistance is a very complex issue that includes factors such as speed, water and/or detritus, macro and micro texture and stone shape. There are strong proven relationships between skid resistance values and crash rates in both wet and dry conditions.

Enhancement to the skid resistance at high-risk locations may include, but not be limited to, the approaches to railway level crossings, traffic signals, pedestrian crossings, one lane bridges and rural high-risk curves (out of context) and/or curves that are less than 250m radius and up to 400m radius.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safety management and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- 2 or more skid related crashes.
- Speed limit 50km/h and above.
- A high-risk location as defined as above.

The applicable cost range reflects the installation of improved skid resistance at high-risk locations and includes but is not limited to professional service fees, construction costs including establishment and traffic management, high friction surface and pavement markings. The cost range does not allow for pavement or surfacing defects and whole of life costs

Implementation guidelines

Skid resistance levels and requirements can be determined in variety of ways. These include regular network surveys, such as the annual SCRIM survey that is undertaken on the state highway network, high-risk site surveys using smaller trailer type devices or the British pendulum meter.

Desired minimum levels of skid resistance for various situations can be found in the Waka Kotahi's T10 specification, however providing even higher levels of skid resistance at high-risk sites is often very beneficial and cost effective.

Methods for improving skid resistance include water blasting (temporary), scabbling, resurfacing with higher polished stone value aggregates, melter slag, or specific manufactured products such as calcium bauxite.

To assist project teams with the selection of suitable sites for skid resistance at high-risk locations intervention, the following guidelines have been developed:

- Is there evidence of crashes or near misses related to the poor skid performance on bends, approaches to intersections, crossing etc?
- Where improved skid resistance will reduce stopping distances and likelihood of crashes.

However, implementation should not be restricted to these situations. It should be considered at high-risk locations referred to above where improved skid resistance and shortened stopping distances will reduce the likelihood and/or severity or crashes, as similar BCRs are likely to be achieved.

Other considerations

Ensure that the surface drainage is appropriate as it will lead to increased water depths on the road surface. Attention should be given to crossfall, grades, moving crowns and similar surface features.

Consider the surface contaminants that affect the skid resistance such as bitumen, oil, grease, tyre rubber, mud, clay and organic (plant) matter.

Consideration needs to be given to the pavement construction and condition, as well as the sub-surface as this needs to be good condition when considering high friction surfacing types. Poor pavement or exiting surface condition can lead to premature failure of high friction surfacing.

Consider what the treatment life will be and what crash migration might occur when high skid resistance treatments are used at some sites, but not adjacent to similar situations. Skid resistance will continue to deteriorate over time, especially in high demand, high volume sites.

References and guidelines

https://www.nzta.govt.nz/assets/resources/skid-resistance-investigation-treatmentselection/docs/T10-skid-resistance-investigation-treatment-selection-201306.pdf

https://www.nzta.govt.nz/assets/resources/skid-resistance-investigationtreatment-selection/docs/T10-Notes-to-specification-for-highway-skid-resistancemanagement-201306.pdf

Signage and marking

Assessed economics for streamlined investment pathway

Applicable cost range:
Up to $0.1M per km

Assumed DSI reduction:
10%

Figure 18
Signs and markings delineation upgrades

Signs and marking delineation upgrades may include but are not limited to the installation and/or upgrading of several traffic control devices, centreline, edge lines, reflective raised pavement markers (RRPMS), edge marker posts and curve warning signage.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safety management and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- AADT is greater than 1000 vehicles per day.
- Posted speed limit is 60km/h or higher.

The applicable cost range reflects the installation of the signs and marking delineation upgrades intervention on an existing corridor and includes but is not limited to professional service fees, construction costs including establishment and traffic management, installation of high-performance pavement markings including RRPMS, edge marker posts and signage. The cost range does not allow for audio tactile pavement markings or whole of life costs.

Implementation guidelines/site selection

To assist project teams with the selection of suitable sites for signs and marking delineation upgrades, the following guidelines have been developed:

- On corridors where there are inconsistences of the delineation.
- Evidence of loss of control and night-time type of crashes.

Other considerations

Edge lines can reduce shoulder damage, reducing maintenance costs and aid in curve negotiation.

Edge marker posts (EMPs) should be used where other sources of delineation (such as line marking) are not sufficient and cannot be correctly placed.

Any gaps in the sequence of EMPs reduces the overall effectiveness of the delineation.

Visibility of the chevron signs in both directions needs to be considered and a sign for one direction should not be visible to traffic travelling in the opposite direction.

References and guidelines

https://www.nzta.govt.nz/resources/motsam/part-1/

https://www.nzta.govt.nz/resources/motsam/part-2/

https://www.nzta.govt.nz/resources/traffic-control-devices-manual/index.html

https://www.nzta.govt.nz/resources/traffic-notes/traffic-notes/

Speed management (speed limit changes)

Assessed economics for streamlined investment pathway

Applicable cost range:
up to $0.1M per km

Assumed DSI reduction:
Varies based on Nilssons Power Model but typically 15% - 30%

Speed management includes changes to the posted speed limit on corridors and/or outsides school in line with the current speed management guide and rule.

Speed limits need to reflect the risk on a road as safe speed limits help to minimise the severity of crashes when they occur.

Speed and road safety are inversely correlated. In that context, speed limit reduction has a significant positive impact on road safety.

Safe System intervention hierarchy

Supporting Safe System intervention

Safe System treatment philosophy

Safety management and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- The safe and appropriate speed is less than the current posted speed limit

The applicable cost range allows for but is not limited to the professional service fees, construction costs including establishment and traffic management, installation of the signs and marking changes require to support the speed limit change.

Implementation guidelines/site selection

Speed limit changes will need to be aligned to the current rule and speed management guidance.

References and guidelines

https://www.nzta.govt.nz/assets/Safety/docs/speed-management-resources/speed-management-guide-first-edition-201611.pdf

Traffic calming

Assessed economics for streamlined investment pathway

Applicable cost range:
$0.2M to $1M per km

Assumed DSI reduction:
30%

Traffic calming describes a range of techniques used to manage road users and the road environment to ensure speeds are appropriate to the local environment and the safety of other road users. When implemented correctly, traffic calming offers advantages to vulnerable road users, encourages modal choice and helps manage travel demand.

The visual appearance of any street should make it clear to a driver what is expected of them and what speed is reasonable. The design features and processes used to achieve this are known as traffic calming or traffic management.

Safe System intervention hierarchy

Primary Safe System intervention

Safe System treatment philosophy

Safe System transformation and/or safer corridors

Standard Safety Intervention (SSI) criteria

For the project to meet the criteria for the streamlined investment pathway, the total project cost must fall between the applicable cost range and the meet criteria below:

- Activity Streets, Main Streets or City Place
- Posted speed limit is 60km/h and below
- 2 or more injury crashes per km in 5 years

The applicable cost range reflects the installation of traffic calming devices on an existing corridor or site and includes but is not limited to professional service fees, construction costs including establishment and traffic management, high friction surface and pavement markings. The cost range does not allow for pavement or surfacing defects and whole of life costs

Implementation guidelines/site selection

To assist project teams with the selection of suitable sites for signs and marking delineation upgrades, the following guidelines have been developed:

Traffic calming features can be combined as a package but generally fall into the following groups:

- vertical features
- horizontal features
- traffic management and control
- traffic signs and road markings
- zonal treatments.

References and guidelines

https://www.nzta.govt.nz/assets/planning/process/trial-ip-toolkit/docs/traffic-calming.pdf

https://www.onlinepublications.austroads.com.au/items/AP-T330-17

https://nacto.org/publication/urban-street-design-guide/

https://www.nzta.govt.nz/walking-cycling-and-public-transport/cycling/cycling-standards-and-guidance/cycling-network-guidance/

https://austroads.com.au/publications/road-safety/ap-r498-15

Summary of assessed economics of standard safety interventions

Intervention	Standard Safety Intervention (SSI) criteria	Low cost	Medium cost	High cost
Continuous 3-barrier (median and roadside barrier)	• AADT 10,000 or greater • Collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed Limit 80 km/hr and above	$2 million per km	$3 million per km	$5 million per km
Median barrier	• AADT 6,000 or greater • Collective risk medium-high or greater or predictive collective risk medium-high or greater • Speed Limit 80 km/hr and above	$1 million per km	$2 million per km	$4 million per km
Wide centreline	• AADT 3,000 or greater • Collective risk medium-high risk or greater or predictive collective risk medium-high or greater • Speed limit 80 km/hr and above	$250,000 per km	$700,000 per km	$1.5 million per km
Roadside barrier at high risk locations	• AADT 1,000 or greater • Collective risk medium risk or greater or predictive collective risk medium or greater • Speed limit 60 km/hr and above	$100,000 per km	$250,000 per km	$600,000 per km
Shoulder widening at high risk curves	• Is a high risk or out of context curve? • AADT 1,000 or greater • Collective risk high risk or predictive collective risk high • Speed Limit 80 km/hr and above	$200,000 per site	$325,000 per site	$450,000 per site

Audio Tactile Pavement Marking (ATPM)	• AADT 1,000 or greater • Speed limit 80 km/hr and above	$10,000 per km	$15,000 per km	$50,000 per km
Intersection speed zone	• Medium-high or greater intersection Risk • Speed limit 80km/hr and above	Up to $500,000 per site		
Roundabout	• Intersection collective risk medium-high or greater	$500,000 per site	$3 million per site	$6 million per site
Raised safety platforms (at existing signalised intersection/ roundabouts)	• Intersection collective risk medium-high or greater • 3 or more injury crash types • Speed limit 60km/hr and below	$300,000 per site	$400,000 per site	$2 million per site
Signalised intersection with raised safety platforms (from an uncontrolled/priority controlled)	• 3 or more injury crash types • Speed limit is between 30km/hr and 80km/hr	$500,000 per site	$200,000 per site	$2 million per site
Midblock raised pedestrian crossing	• Urban connectors, activity streets and main streets • Speed limit 60 km/hr and below	$100,000 per site	$160,000 per site	$750,000 per site
Skid resistance at high risk locations	• 2 or more wet skid crashes • Speed limit 50km/hr and above • A high-risk location as defined in the description	$30,000 per site	$120,000 per site	$300,000 per site
Signage and markings	• AADT 1,000 or greater • Speed limit 60 km/hr and above	Up to $100,000 per km		

Speed management (speed limit changes)	• The safe and appropriate speed is less than the current posted speed limit	Up to $100,000 per km		
Traffic calming	• Activity streets, main streets and city hub • Speed limit 60 km/hr and below • 2 or more injury crashes per km in 5 years	$200,000 per site	$400,000 per site	$1 million per site

Summary of DSI effectiveness of standard safety interventions

Standard Safety intervention	DSI effectiveness references and research	SSI Toolkit Assumed DSI Reduction
Continuous 3-barrier (median and roadside barrier)	• 92% Reduction in head on DSI, 67% reduction in all DSI, 34% reduction in intersection& other: Safe Roads NZ Rural SH mid barrier site before/after study Feb 2018 • 70% - Flexible median barriers (undivided rural highways): Austroad's Road Safety Engineering Toolkit • Austroads Research Report AP-R560-18: Towards Safe System Infrastructure – A compendium of Current Knowledge March 2018 – 87% for severe head on and road departure on the Hume Hwy – 83% for severe head on and road departure on the Eastern Fwy	75%
Median barrier	• 92% Reduction in head on DSI, 67% reduction in all DSI: Safe Roads NZ Rural SH mid barrier site before/after study Feb 2018 • 60% Reduction or more: IRAP safety tool kit • 70% - Flexible median barriers (undivided rural highways): Austroad's Road Safety Engineering Toolkit • Austroads Research Report AP-R560-18: Towards Safe System Infrastructure – A compendium of Current Knowledge March 2018 – Queensland – Bruce Hwy Head on and loss of control over centreline crashes reduced by 75%. Reduced fatal crashes by 75% – Ray, Silvestri et al. (2009) 100% reduction in median cross over incursions and >90% reduction in cross median road departures – DoT (2009) 64% reduction in severe injury median crashes – 44% reduction in fatal median crashes – FHWA and Turner-Fairbank Highway Research Centre (2008) 83% reduction in fatal cross median crashes – 89% reduction in all cross median casualty crashes	65%

Wide centreline	• 50-80% reduction in head-on; 60% reduction in all crash types: Austroad's AP-R519 16 Guidance on median and centreline treatments to reduce head-on casualties. • 20-60% Reduction in DSI: NZTA Wide Centreline Trial • 10-25%: IRAP Toolkit • 67% reduction in severe crashes Bruce Highway before/after study: TMR Queensland	35%
Roadside barrier at high risk locations	• 45% reduction in run off road injury crashes: HRRRG • 40% reduction in all crashes: HRRRG • 83-87% reduction in severe crashes: Austroad's AP-R498-15 Improving the Performance of Safe System Infrastructure	30%
Audio Tactile Pavement Marking (ATPM)	• 30% reduction in run off road crashes for edgeline & 30% reduction in head-on crashes for centreline: NZTA EEM Crash Compendium • Average 27% reduction in crashes, 32% reduction in run-off-road crashes, 42% reduction in fatal crashes: HRRRG ('the usability and safety of audio tactile profiled roads markings' 2009 NZTA research report 365) • 10-25%: IRAP Toolkit • 20% reduction for edgeline and 15% for centrelines: Austroad's road safety toolkit	20%
Shoulder widening at high risk curves	• 14-30% reduction in ROR crashes: HRRRG • 30% reduction in ROR casualty crashes - sealing existing unsealed shoulder (0.6-1.0 m): Road Safety Engineering Toolkit • 25-40% reduction: IRAP Toolkit	25%
Intersection speed zone	• 69% reduction in Fatal and Serious crashes: Waka Kotahi Intersection speed zone Safe System case study	65%

Roundabout	• 75% reduction in death and serious injury equivalents: Waka Kotahi rural roundabout Safe System case study • 90% reduction in serious and fatal crashes: HRIG • 70% for rural roundabout: Austroad's Road Safety Engineering Toolkit • 65% Reduction in casualties: Austroad's AP-R556-17 Understanding and improving Safe System intersection performance • 75% reduction in crashes: Austroad's AP-T330-17 'Safe System infrastructure on mixed use arterials' • 90% reduction in fatal and serious crashes & 25-80% reduction in all crashes from uncontrolled intersection (urban/rural not defined): HRRRG	75%
Raised intersection platforms (at existing signalised intersection/ roundabouts)	• 50% reduction in injury crashes: Bruce Corben (2014) Criteria for the use of elevated stop lines at traffic signals • 53% reduction in casualty crashes (urban roads): ARRB Criteria for the use of elevated stop lines at traffic signals • Reduction from 80km/h to 50km/h operating speed will reduce risk of fatal side impact crashes by 65% based on Nilsen curves • 40% decrease in fatal and serious crash risk Source: Jurewicz et al. (2016) based on Bahouth et al. (2014), Davis (2001)	40%
Signalised intersection with raised safety platforms (from an uncontrolled/priority controlled)	• 25% reduction in crashes for improving signal conspicuity: HRIG 27-35% reduction for right turn phases • 35% reduction in all casualty crashes for fully controlled right turn phase: Austroad's road safety toolkit • 25-40% reduction: IRAP Toolkit • 15-30% reduction in all crashes from uncontrolled: HRIG • 50% reduction in injury crashes: Bruce Corben (2014) Criteria for the use of elevated stop lines at traffic signals	55%

Midblock raised pedestrian crossing	• 40% reduction in casualty crashes & 45% reduction in vehicle-pedestrian crashes: Austroad's AP-T330-17 'Safe System infrastructure on mixed use arterials' • 50% reduction in fatal and serious (interpolated based on reducing impact speed from 60km/h to 40km/h): Source: Jurewicz et al. (2016) based on Bahouth et al. (2014), Davis (2001)	40%
Skid resistance at high risk locations	• 40% wet road crashes (E&V) • 25-40% (IRAP toolkit) • 35% reduction in wet road & 20% in all crashes (HRRRG)	20%
Signage and markings	• Install edgelines 10% reduction (assumes no edgeline): NZTA EEM Crash Compendium • 20-40% Reduction in crashes for improved signage: HRRRG	10%
Speed management (speed limit changes)	• 30% reduction in death and serious injury equivalents: Waka Kotahi speed Safe System case study	Varies based on Nilssons Power Model but typically 15% - 30%
Traffic calming	• Road Safety Observatory: Traffic Calming – Bunn et al (2004) a reduction of 37% in fatal road traffic incidents (RTI), 11% in injury RTIs and 5% in all RTIs. – RTI reductions of 86% have been reported for schemes containing speed cushions at sites in Huddersfield and Northampton. An average of 40% reduction in RTIs was seen at 4 sites where thermoplastic 'thumps' were used. • Safety cube: Traffic calming • Høye (2014) 35% reduction in injury crashes • (Elvik, 2001) 34% reduction in injury crashes on local roads	30%

Frequently asked questions

Do I have to undertake a point of entry for a standard safety intervention?

No, a point of entry is not required for interventions that form part of the Road to Zero Speed and Infrastructure Programme as this has been covered within the board endorsed strategic and programme business case.

What if the activity or project's total cost is under the LCLR cost threshold?

For safety activities less than LCLR threshold, the 'low cost low risk' work category can be used to obtain release of funding.

What if my project is not part of an approved programme business case or the Road to Zero Speed and Infrastructure Programme?

The project or activity is not eligible for the streamlined investment pathway using standard safety interventions.

What happens if the standard safety intervention I apply for has a BCR below 1?

If it forms part of the Road to Zero Speed and Infrastructure Programme or another approved programme business case with a BCR greater than 1, it can be approved for funding.

What happens if my proposed intervention cost exceeds it applicable cost range?

The application would need to be submitted to the Road to Zero Speed and Infrastructure Programme Leadership team with a recommendation from either the relevant Area Programme Manager and/or SIP Programme Development Lead as they will consider them in the context of the programme prior to being sent to delegations as they are deemed exceptions to the programme.

Why are some safety interventions not included in the Toolkit?

We are focussing on interventions that are aligned with Safe System infrastructure treatments.