

ROAD TO ZERO – SPEED & INFRASTRUCTURE PROGRAMME

(This paper has not been peer reviewed)

ABSTRACT

We have a vision of an Aotearoa where no one is killed or seriously injured on our roads.

Road to Zero, New Zealand's road safety strategy, sets us on a path to achieve this vision, as well as introducing clear targets to reduce road trauma. We are aiming to reduce the number of people killed and seriously injured on our roads by 40% by 2030.

Waka Kotahi has developed the speed and infrastructure programme (SIP) in response to one of the focus areas in Road to Zero. This prioritises investment in infrastructure improvements and speed management that can prevent crashes from happening or prevent people from being killed or seriously injured if a crash does occur.

Through SIP, around 635 deaths and serious injuries will be prevented annually on New Zealand roads (from 2030), contributing around half of the 2030 Road to Zero target.

This paper will provide an overview of SIP, cover the progress to date (including project case studies) and explore key philosophy and design principles underpinning the State Highway infrastructure sub-programme.

Waka Kotahi, in partnership with two consortia, are delivering proven safety infrastructure interventions on New Zealand's state highways. These include flexible road safety barriers, roundabouts and other interventions underpinned by Safe System principles.

Successes and challenges will be discussed, along with a look forward to the remaining years of the strategy.

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INTRODUCTION

New Zealand has a poor road safety record. On average, 1 person is killed and another 7 are seriously injured on New Zealand roads every day, causing suffering to victims and their families, and costing society close to \$5 Billion each year (Ministry of Transport, 2021). To increase taha tinana (physical health), the Government wants to significantly reduce the number of casualties on New Zealand’s roads and has implemented the Road to Zero strategy.

ROAD TO ZERO

In November 2019, the Government published its Road to Zero (RtZ) strategy for 2020-2030. The strategy sets out Vision Zero, to have “a New Zealand where no one is killed or seriously injured in road crashes” (New Zealand Government, 2019). The strategy sets out five key focus areas and seven underlying principles to aid decision making (Figure 1 below). An initial target of “a 40 percent reduction in deaths and serious injuries by 2030” has been set (New Zealand Government, 2019).

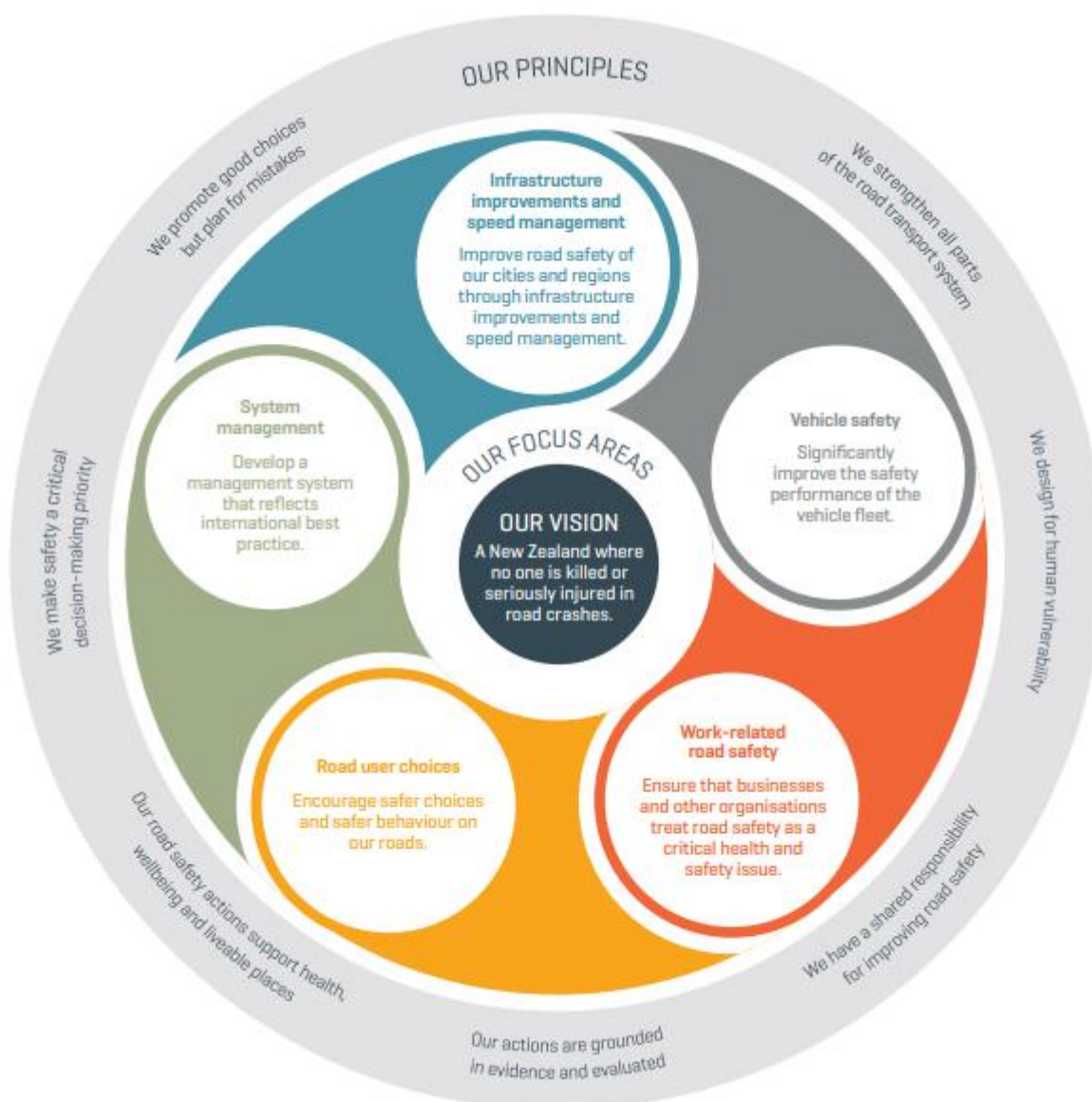


Figure 1 Road to Zero's vision, focus areas and principles (New Zealand Government, 2019)

The Government set out its strategic priorities (Figure 2) for land transport in its Government Policy Statement on Land Transport (GPS). As one of the strategic priorities, safety has funding set aside under the National Land Transport Plan (NLTP) to fund Road to Zero initiatives.

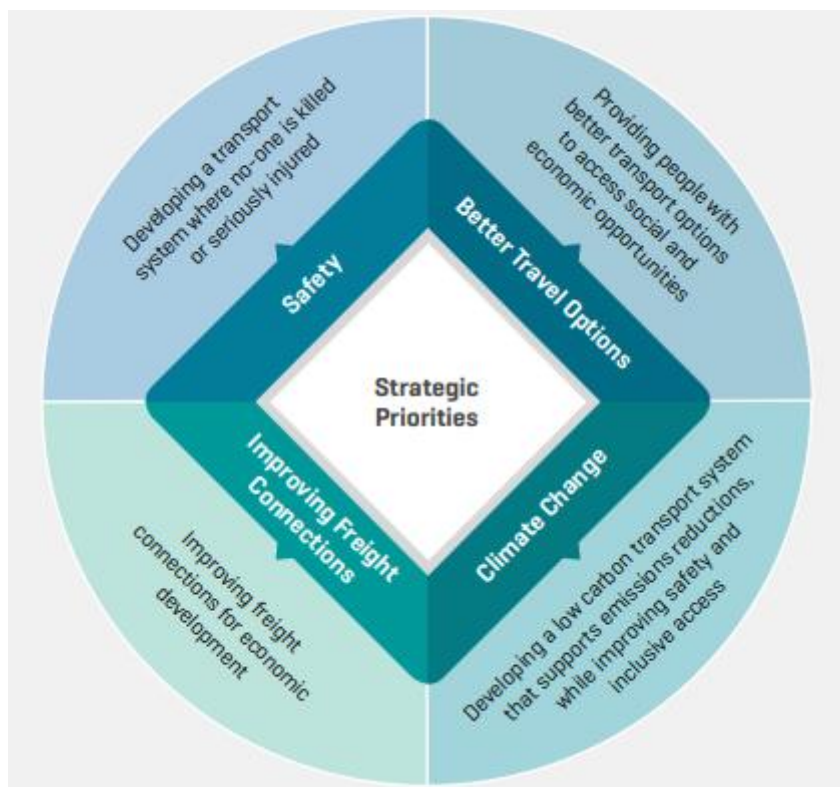


Figure 2 Strategic Priorities of the 2021 GPS (New Zealand Government, 2020)

Waka Kotahi is responsible for helping to deliver Road to Zero (RtZ) and improving the safety of New Zealand’s roads. Road to Zero is guided by the Safe System approach. This system recognises that mistakes are inevitable, but deaths and serious injuries from crashes are not. The Safe System approach prioritises taha tinana (physical health) by creating a safe and forgiving road system.

SPEED AND INFRASTRUCTURE PROGRAMME

In the 2021-24 NLTP, the Government has set aside \$2.9 Billion in a new Road to Zero activity class (Waka Kotahi NZ Transport Agency, 2021) to reduce deaths and serious injuries on New Zealand roads. Over the next 10 years, the Government anticipates investing about \$10 Billion towards Road to Zero initiatives. Upon completion in 2030, it is estimated the Road to Zero initiatives will be saving 151 deaths and 1120 serious injuries per year (Waka Kotahi NZ Transport Agency, 2021).

Most of the savings will come from effort and investment in proven intervention types:

- infrastructure improvements (e.g. median barriers, intersection treatments);
- increased enforcement, both automated (i.e. safety cameras) and police officer presence for speed, and enhanced roadside testing for alcohol;
- speed limit changes in urban areas and on the highest risk parts of the network.

A decent portion of the \$2.9 Billion set aside for Road to Zero this NLTP will be spent on infrastructure and speed management activities, within the Speed and Infrastructure Programme (SIP).

Figure 3 below shows the organisation of the Speed and Infrastructure Programme, which will deliver improvements on both state highways and local roads. On state highways, there is a focus on transformational infrastructure improvements, speed management and low-cost low-risk improvements. The infrastructure teams work with the speed management team to ensure integrated approaches along a state highway corridor.

This paper will focus on the transformational infrastructure improvements to state highways, being delivered by two consortia and other (healthy market) companies.

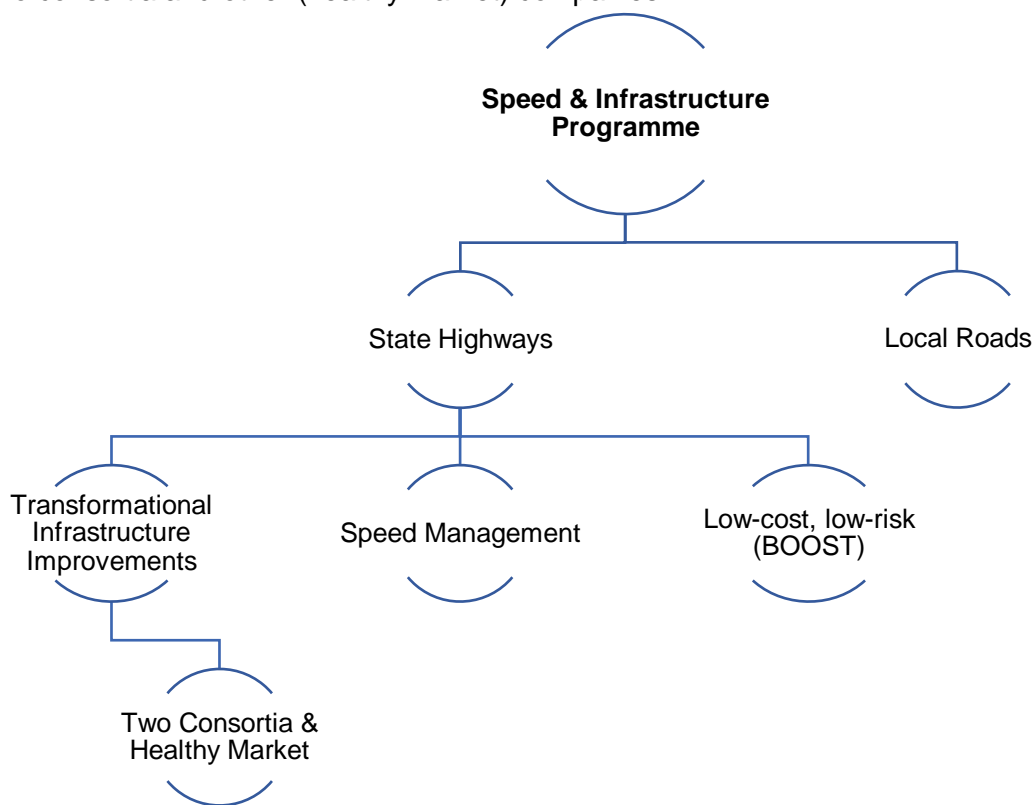


Figure 3 Speed and Infrastructure Programme Breakdown (State Highway focus only)

The Road to Zero (RtZ) Speed and Infrastructure Programme (SIP) is tasked with achieving about half of the overall RtZ Death and Serious Injury (DSI) reduction target. It will achieve this through the delivery of speed management and infrastructure projects.

PROGRAMME DEVELOPMENT

SIP has systematically developed a 10-year programme of interventions. This programme has already begun delivery and will continue through until mid-2030.

The Road to Zero Speed and Infrastructure Programme is underpinned by a strategic model. This model identified several thousand individual corridor and intersection interventions. Collectively, these were estimated to cost \$5 Billion and could deliver an estimated 635 DSI saved per annum (Waka Kotahi NZ Transport Agency, 2021). An excerpt of the model can be found in Figure 4 below. The strategic model identified a mix of high-level interventions, ranging from safe system transformations to safe system treatments. The mix of interventions was developed to support a balanced programme, which achieved some quick-wins and also longer-term transformative safety improvements.

The next step in programme development was to undertake a series of regional workshops to convert the strategic programme into a deliverable implementation programme. The regional workshops helped to:

- Remove interventions proposed by the strategic programme if they were no longer valid or were not feasible;
- Refine interventions proposed by the strategic programme into more practical and deliverable projects;
- Group interventions into logical packages of work; and
- Add interventions outside of the strategic programme if there was good evidence to do so.

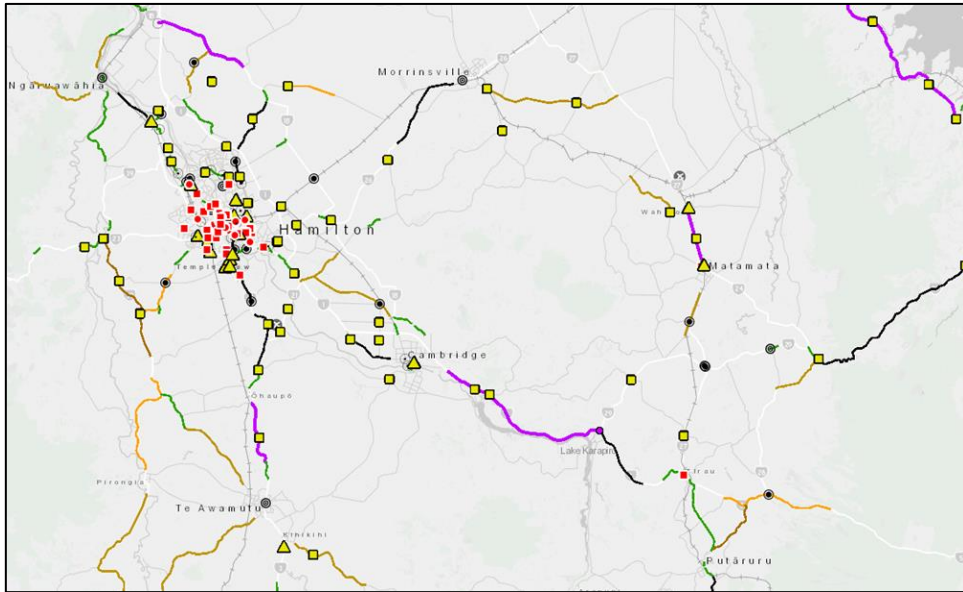


Figure 4 Map excerpt taken from the Road to Zero Strategic Programme

The ‘top-down’ strategic model approach used to develop the programme was often challenging for regional and local stakeholders. This was because they wished to:

- Spread the investment more thinly across the network (less transformative interventions) to address a greater number of local stakeholder concerns;
- Fund non-safe system treatments or treatments in lower risk areas to address perceived safety concerns;
- Fund projects that had a mix of safety and other outcomes such as efficiency or resilience.

For the 2021-24 NLTP, at least 47 projects are underway. Projects are located right across New Zealand, as illustrated in Figure 5 below.

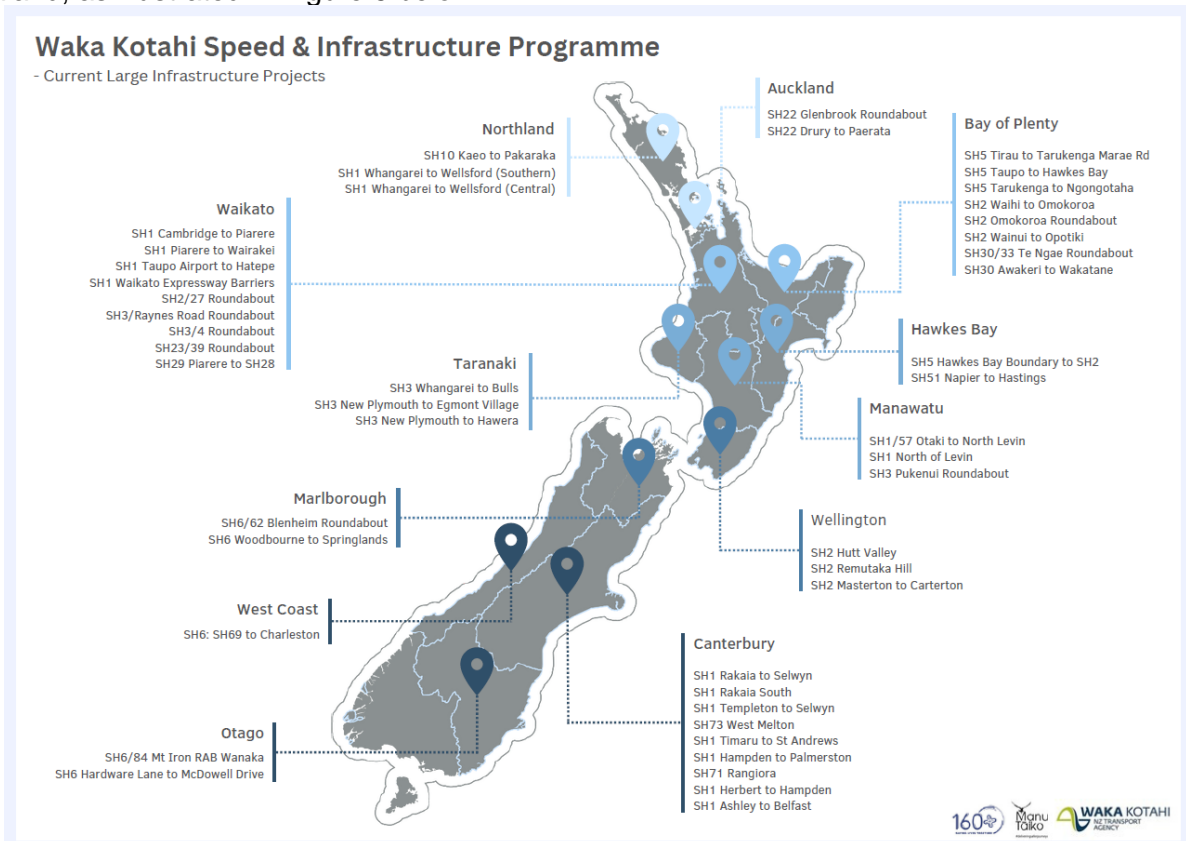


Figure 5 Speed and Infrastructure Programme – Current Large Infrastructure Projects

STANDARD SAFETY INTERVENTIONS

For SIP Infrastructure Projects, standard safety interventions (SSIs) are used in line with Waka Kotahi's *Standard Safety Intervention Toolkit (2021)*. These interventions are proven to enhance taha tinana (physical health) by reducing deaths and serious injuries. Table 1 below shows some of these safety interventions and the corresponding death and serious injury (DSI) reduction following their implementation.

Safety Intervention	Assumed DSI reduction
Continuous 3-barrier (median and roadside barrier)	75%
Median barrier	65%
Wide centreline markings	35%
Roadside barrier at high-risk locations	30%
Roundabouts at high-risk intersections	75%
Raised safety platforms (at existing or new signalised intersection/roundabouts)	40%
Audio tactile pavement markings	20%
Improved signs and line markings	10%

Table 1 Standard Safety Interventions from SSI Toolkit (Waka Kotahi NZ Transport Agency, 2021)

TOOLS

For SIP, Waka Kotahi has developed some key tools and documents to provide consistent delivery. These include:

- *Standard Safety Intervention Toolkit (2021)* – outlining appropriate safety interventions to use on SIP projects.
- *Road to Zero Speed and Infrastructure Programme Design Framework (Nov 2021)* – outlining key design principles, design standards and guidance to be applied to SIP Projects.
- *SSI Safety Benefit Calculator Tool* – used to consistently and accurately estimate death and serious injury reductions from road safety projects as projects progress from concept to construction.

PROJECT DELIVERY MECHANISM

The current SIP Infrastructure projects are mainly delivered by two consortia, appointed after a competitive procurement process in 2019:

- 160+, comprising WSP, Aurecon and BBO; and
- *Manu Tāiko*, comprising Beca, Stantec and Abley.

Each of these consortia receive approximately 40% of the work being delivered by the programme. The remaining 20% of work is delivered by companies outside the two consortia. This “Healthy Market” was established to maintain safety engineering expertise across the wider industry and maintain tension on costs.

There is a strong focus on collaboration within SIP. The two consortia work together and with Waka Kotahi to achieve the best safety outcomes, sharing innovations and lessons learned – adopting a mantra of “there is no IP in safety”. Quarterly road safety forums with Waka Kotahi and representatives from both consortia and the healthy market are in place to help drive best practice. The design framework, design standards and other key SIP tools have been developed collaboratively. The Consortia also assist healthy market designers when they take over a project.

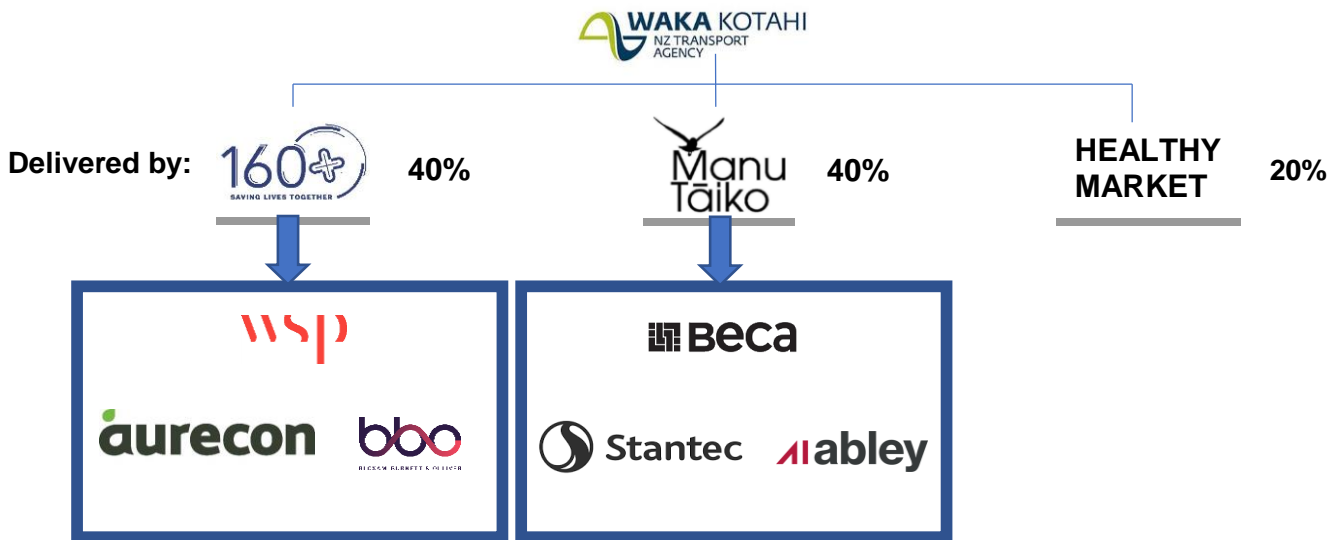


Figure 6 SIP Distribution of Work

Once a project is identified within the Programme (and funded), it is delivered through three phases shown in Figure 7 below.

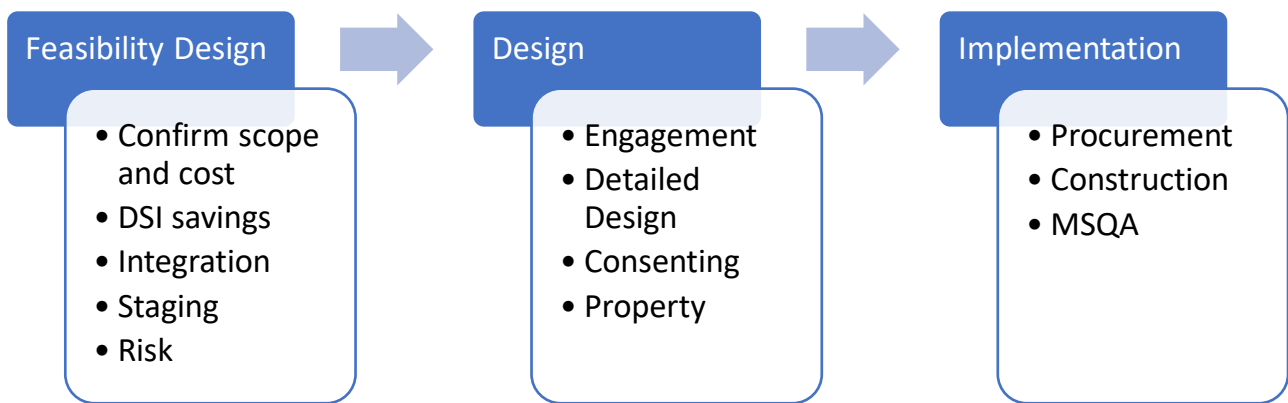


Figure 7 SIP Project Phases and indicative outputs

PROGRAMME STATUS

Regular monitoring and reporting is critical to keep everyone on track towards the 2030 SIP target, and provides a transparent way to assess and review progress on actions.

Road to Zero has an outcomes framework that covers programme delivery, system performance and outcomes across all focus areas of the RtZ strategy). This enables Waka Kotahi to take stock of where things are at, identify areas where more action is needed, and report publicly on progress annually.

The *Road to Zero Annual Monitoring Report* (Ministry of Transport, 2022), notes that there has been under-performance in the delivery of infrastructure improvements. For example, by the end of the 2020/21 financial year, only 50 kms of median barrier had been installed on the network.

This is less than the anticipated delivery rate to meet a target of 1000kms installed by 2030. The shortfall reflects the complexity in installing effective road safety infrastructure on existing corridors. More effective road safety treatments, such as median barriers, are also more time consuming and expensive to install. Waka Kotahi continues to investigate measures to help increase the rate of infrastructure delivery.

HOW SIP IS DOING THINGS DIFFERENTLY

A number of challenges, successes and lessons have been learnt by SIP so far including the following:

Progress over perfection

Trying to get everything right all the time can easily result in delays, increases in cost, or abandoning projects altogether. Early in the development of SIP, “**progress over perfection**” was adopted as a catch cry to prioritise these safety projects. The Programme acknowledges that compromises are needed and promotes working with stakeholders and designers to make sure that the projects get built and start saving lives.

Programme Business Case

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.

Waka Kotahi is also moving away from project-by-project funding to allow more flexibility and agility in delivery including better **alignment and integration** with planned maintenance and renewal activities. The 24-27 NLTP will be an opportunity to seek programme level funding, however we are implementing a number of steps towards this approach in the meantime which will enable delivery at pace.

Innovation

The Programme has successfully innovated to improve delivery, including:

1. **Streamlining Investment Applications** - The Standard Safety Intervention Toolkit (Waka Kotahi, 2021) outlines a series of well-researched and proven safety interventions. If the criteria are satisfied at a particular site, the intervention qualifies for a streamlined investment pathway, bypassing the need for a Business Case. This approach accelerates delivery by streamlining investment applications for individual projects in the SIP programme
2. **Benefit-cost ratio analysis** - When calculating benefit-cost ratios (BCR) for safety projects, the monetised travel time disbenefits can sometimes outweigh the safety benefits, resulting in a low or negative BCR, even for high-risk corridors and intersections. For SIP it was agreed that the ‘do minimum’ safety state would be the Safe and Appropriate Speed for corridors and the Safe Speed for intersections. This approach was more in line with Safe System thinking and helped present the safety interventions more favourably.
3. **A SIP Design Framework** gave clear direction as to acceptable design approaches and standards. This framework built on many years of safety experience on the NZ roading network and reduces the need to start design discussions from scratch each time
4. **The Standardised Contract Documents and Technical Specifications** developed for SIP result in quicker tender approvals and more consistent Contracts for the construction industry to price with less surprises.
5. **DSI assessment tools** for standardised calculation of DSI savings on projects, resulting in more consistent comparison of projects across the country for prioritisation and highlighting how a project compares to the original safety intent (e.g. the required output that is sought).
6. To minimise property impacts and reduce costs, teams looked to **minimise the size of roundabouts**, using innovative designs to address vehicle approach speeds and

increase pedestrian and cyclist safety. A collaborative approach to design between consortia and Waka Kotahi was used to challenge the layout of the roundabouts and come up with pragmatic solutions such as raised safety platforms and alternative geometric controls.

7. Use **Standardised designs** to minimise the design effort and accelerate the projects to construction, backed up by design support on site to resolve any issues encountered during construction.
8. Use of **Mobile Lidar Survey (MLS)** to provide information for design. MLS has multiple benefits; it is highly cost effective, particularly for long corridor projects, as well as substantially reducing the exposure of surveyors to traffic hazards.
9. Utilisation of **non-invasive FWD pavement testing** to quickly determine the quality of the existing pavements and minimise the risk to workers on the corridor.

Construction Safety

Recent serious incidents involving construction and maintenance workers on the road network has led to an industry rethink about how to protect these workers. In collaboration with Waka Kotahi, the Consortia are planning the construction works during the Feasibility and Detailed design phases, with a focus on eliminating worker safety risks during construction. The draft NZ Guide to temporary traffic management (Waka Kotahi NZ Transport Agency, 2022) puts forward a risk-based approach to temporary traffic management (TTM) and is being used on selected SIP projects.

The risk-based approach (in order of preference) seeks to improve safety risk to workers by diverting traffic away from sites (elimination); specify the installation of temporary barriers (isolation); set up stop-go traffic arrangements under reduced TTM speeds (minimisation); or anything in between.

The BOOST programme successfully trialled the approach by utilising full corridor shutdowns to lay ATP marking. The SH1 Dome Valley and Waikato Expressway projects are utilising temporary steel barriers to isolate workers from traffic, protecting workers and increasing productivity through having a more open workspace. See Figure 8 adjacent showing these barriers in action.

Lessons have also been learnt that early comms and engagement to critical road users (trucking industry and emergency services) is important where diversions or shutdowns might affect day-to-day operations.



Figure 8 Temporary steel barriers used to increase productivity and create a safer workspace

Retrofitting existing State Highways

Before even looking to build safety improvements in an efficient and safe manner, the correct and optimised intervention must be found and bought into by numerous internal and external stakeholders. The design of a safety intervention on an existing corridor, while seemingly simple, must provide value for money, return the required safety benefits and consider the whole of life impacts of the solution. Such considerations that make the process rewarding, albeit complicated are:

- The final **carriageway width** and whether to **widen on one side or both** are key design decisions that impact temporary traffic management, utility relocations, roadside stormwater management, the rate of construction and costs. Solutions are often sought to widen on one side only to provide better value.
- For narrow existing roads requiring significant widening, keeping the **pavement crown** out of the lane, and avoiding reshaping the entire highway, are other factors influencing the decision to widen on one side or both.
- The widening is designed to avoid having **pavement joints under wheel paths**.
- Management of **ghost markings** through either full corridor reseals as a part of the project, or interface with NOC resealing programmes.
- **Pavement quality**, specifically noting that these projects are not funded to repair the corridor, there might be the opportunity to align safety and rehabilitation programmes to minimise overall disruption and return a better end product.
- **Impacts on Stormwater** with proactive discussions with Regional Councils and Iwi how to best deal with minor carriageway widening, while improving stormwater quality (when needed) in order to meet consent requirements and partnership responsibilities.
- Special road users (**over-dimension vehicles, agricultural vehicles, emergency vehicles**) require specific consideration especially where median barriers are proposed with or without side barriers, as the barriers significantly constrain use of the full width of the highway. Safe pull over areas for vehicles to pass are accommodated along with consideration of how organisations might be able to change their operational plans.
- **Maintenance of the corridor and whole of life safety by design** decisions are made early to determine the safe operation of the corridor during maintenance and barrier repair work. This could include diversion routes, ability to drop median barrier easily, and coordinate pull over areas with maintenance sites.
- **Turnaround facilities** – adding a median barrier to a highway removes the ability to turn right into side roads or property accesses. Considering the volume and type of traffic along with any local constraints, options to provide access include gaps in the barrier (with or without right turn bays), use of nearby intersections to turn around, specific “jug-handle” turnarounds, or a roundabout.

Long-term Partnerships with Industry

In 2022 Waka Kotahi engaged with Industry to consider the best procurement approach for SIP. Moving to a long-term partnership approach with the construction industry will provide the construction partners with more certainty to invest in resources to support delivery of the programme, particularly with securing personnel in regional centres and specialist equipment for installing barriers and road widening.

CASE STUDIES

Case Study One – SH1 Cambridge to Piarere, the Evolution of Median Barrier Delivery Process

A Case for Safety Improvements

The SH1 Cambridge to Piarere corridor, located south of Hamilton in central Waikato, met all SSI criteria for median barrier – AADT of 15,000 (>6000 min), posted speed limit of 100km/hr (>80km/hr min) and high predictive and collective risk. Early in the delivery of SIP, this corridor was a prime candidate for median barriers.

The feasibility phase recommended the desired safety benefits could be achieved by re-purposing the extensive existing passing lanes to provide room for the median and wire rope barrier. Some efficiency losses might occur, however in the future, offline solutions were being considered. Where the corridor tightened, the new design could be narrowed at pinch points.

Figure 9 below shows the commencement of median barrier installation. Important lessons were learnt in this early project that have shaped SIP.



Figure 9 Median Barrier Installation – SH1 Cambridge to Piarere

The Primary Safety Intervention is not the only consideration

Early median barrier delivery wins were identified on the corridor by utilising existing shoulder widths and relocation of edge lines to create a 1.5m median. Residual risk resulting from relocated traffic loading towards the toe of earthworks embankments was deemed to be low by the project team and should allow construction to commence quickly to deliver DSI benefits.

While Waka Kotahi decision makers acknowledged the importance of saving lives quickly, Subject Matter Experts (SMEs) still needed to be engaged for endorsement, through discussion, justification and departure approval. SME approvals and involvement are now run in parallel to the design process to minimise approval delays.

Re-purposing passing lanes to deliver median barriers was initially seen to be a quick win and value for money solution. However, impacts to the wider transport system still needed to be considered.

To the southern side of the corridor, the Waikato River posed a critical constraint. Iwi partnership discussions did not support any impacts on the river. To the north, the topography was steep requiring expensive geotechnical interventions, potentially requiring high-cost solutions that could threaten the viability of the project. A compromise was developed that balanced cross section criteria, engineering solutions and passing lane re-purposing – this compromise was supported by decision makers and internal and external stakeholders.

The decision to re-purpose passing lane seal widths is now typically only accepted if there is a robust evidence-based process presented and safety is compromised, or the passing lane is ineffective. While it is a low-cost approach, it may not be an overall value for money solution when considering the wider impacts on stakeholders and partners. This approach is now embedded into the standard SIP process.

Safety must be considered holistically within the Transport System

The SH1 Cambridge to Piarere corridor provided valuable lessons for the SIP and project teams that have formed the processes we utilise today to implement median barriers.

Case studies reviewed both nationally and internationally have revealed the importance of involving and seeking support from a wide range of internal and external stakeholders throughout the project lifecycle. While quick wins can be made with minimal consultation, political capital and trust is quickly expended and such approaches are short-lived and are not sustainable. The Speed and Infrastructure programme needs to deliver 1000km of median barrier by 2030 and will only be successful with stakeholder support and if it is considered holistically within the transport system, specifically:

- **Technically robust solutions endorsed by all SMEs**; they are experts and have a role to play for Waka Kotahi.
- **SSI toolkit interventions** may still need to be compared against other more extensive improvements that could ultimately be a better solution.
- **Iwi Partners and critical external stakeholders** have important roles to play in the support and development of technical solutions.
- **Operational and maintenance implications** also need to be fully considered and addressed to ensure adequate, efficient and safe maintenance can be undertaken and is not unduly hindered by the median barrier. Maintenance areas should be provided and plans for barrier strike repair should be prepared.
- **Passing lanes serve a full transport system purpose** and their removal and modification needs careful consideration.
- **Safety must not be considered in isolation** as the longevity of the Programme relies on genuine engagement with all parties.

Case Study Two - SH6/SH62 Roundabout

The SH6/SH62 roundabout was the first project completed under the new SIP framework. It progressed from concept to completion in less than 18 months – a great example of what can be achieved by a team focussed on delivery.

The three-leg roundabout was built to replace the existing priority “T” intersection about 12km west of Blenheim. A 35m internal diameter (including concrete apron) was adopted with a 7m wide circulating lane. Roundabouts with a smaller diameter were considered in the feasibility design but were not adopted as the larger roundabout provided the best safety outcome in this situation and outweighed the higher cost and property impacts. Long splitter islands were adopted to emphasise the change of speed environment at the intersection.

Site investigations were delayed due to Covid lockdowns. To avoid delays that could have pushed the physical works out of summer construction, the design work continued on the basis of reasonable assumptions that were confirmed on-site once restrictions were lifted.

Early and productive engagement with affected landowners helped property purchase and access negotiations to proceed well – avoiding a common roadblock to delivery of roundabout projects. Excellent engagement and co-operation with Marlborough District Council throughout the design period resulted in the required statutory approvals being obtained within 6 months of starting the design.

HEB Construction were awarded the contract to construct the roundabout - work began in November 2020 and was completed ahead of schedule in May 2021. The completed roundabout is shown below in Figure 10.

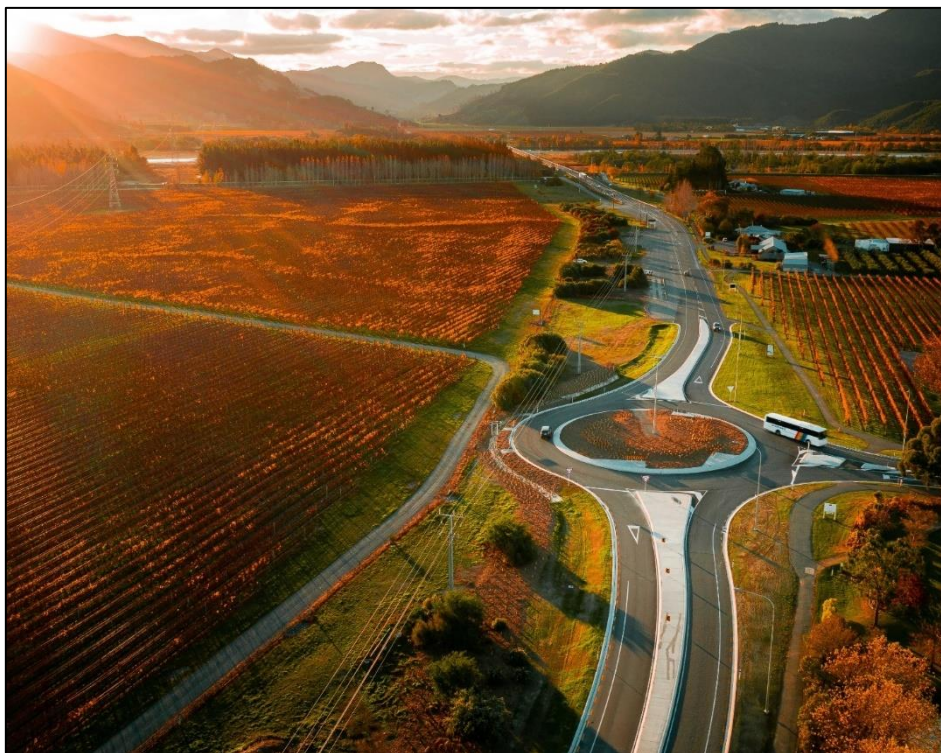


Figure 10 Completed Roundabout at SH6/SH62 Intersection

REFERENCES

- Ministry of Transport, 2021. *Social cost of road crashes and injuries 2020 update*. [Online] Available at: <https://transport.govt.nz/about-us/news/social-cost-of-road-crashes-and-injuries-2020-update/>
- Ministry of Transport, 2022. *Road to Zero Annual Monitoring Report 2021*, Wellington: Ministry of Transport.
- New Zealand Government, 2019. *Road to Zero: New Zealand's Road Safety Strategy 2020-2030*, Wellington: New Zealand Government.
- New Zealand Government, 2020. *Government Policy Statement on Land Transport 2021/22 - 2030/31*, Wellington: New Zealand Government.
- Waka Kotahi NZ Transport Agency, 2021. *DSI Calculator*, Wellington: Waka Kotahi NZ Transport Agency.
- Waka Kotahi NZ Transport Agency, 2021. *National Land Transport Plan 2021-24*, Wellington: Waka Kotahi NZ Transport Agency.
- Waka Kotahi NZ Transport Agency, 2021. *Road to Zero Speed and Infrastructure - Programme Business Case*, Wellington: Waka Kotahi NZ Transport Agency.
- Waka Kotahi NZ Transport Agency, 2021. *Road to Zero Speed and Infrastructure Programme - Design Framework*, Wellington: Waka Kotahi NZ Transport Agency.
- Waka Kotahi NZ Transport Agency, 2021. *Standard Safety Intervention Toolkit - Streamlined Investment Pathway*, Wellington: Waka Kotahi NZ Transport Agency.
- Waka Kotahi NZ Transport Agency, 2022. *New Zealand guide to temporary traffic management (NZGTTM)*, Wellington: Waka Kotahi NZ Transport Agency.