Improving Pedestrian Safety on Urban Arterials: Learning from Australasia

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16. Abstract
This report documents the findings from an international study tour undertaken as part of the Federal Highway Administration's Office of International Programs, to research Australian and New Zealand approaches to reducing pedestrian fatalities and serious injuries on urban, signalized arterial. The report identifies key innovations in policy, planning, and design that may be successfully applied in the United States to help reverse the current trend of increasing pedestrian and other vulnerable road user fatalities and serious injuries on arterial roadways – the corridors on which a majority of U.S. pedestrian fatalities occur. The report focuses on policies that effectively prioritize, standardize, and fund engineering practices that facilitate integration of new and emerging pedestrian safety strategies on urban signalized arterials. The report also identifies data-driven planning practices and design standards and features that effectively integrate pedestrian safety considerations into urban signalized arterial projects through a Safe System approach, in conjunction with performance-based planning and programming that is coordinated with land use planning.

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Executive Summary

This study was conducted under the United States Department of Transportation (U.S. DOT) Federal Highway Administration (FHWA) Global Benchmarking Program. The Global Benchmarking Program serves as a tool for accessing, evaluating, and implementing proven international practices to improve highway transportation in the U.S.

The purpose of this study was to examine noteworthy approaches and innovations used by other countries to achieve reductions in pedestrian serious injuries and fatalities on arterial roadways. The study team researched strategies from eleven peer countries in Europe, South America, and Australasia (Australia, New Zealand, and surrounding islands) that outperform the U.S. in pedestrian safety outcomes. This research included a literature review and interviews with over 40 subject matter experts to identify the best candidates to inform U.S. approaches to improving pedestrian safety on urban, signalized arterials. Based on their findings, the study team developed an interim desk review, detailing the performance of each country, which is available for public review through the FHWA Office of International Programs (1).

Based on the literature review and interviews, the study team selected New Zealand and Australia for a week-long study tour to learn more about these countries' approach to improving pedestrian safety on their transportation networks, with a focus on arterial roadways. Transportation practitioners in New Zealand and Australia embrace the six principles of the Safe System approach in their pursuit of pedestrian safety (summarized in four bullets – see Figure 1):

Figure 1: Safe System Diagram
Source: FHWA

- Agree that death and serious injuries are unacceptable.
- Recognize the elemental value of pedestrian safety and mobility and the need to prioritize pedestrians because humans are vulnerable, and they make mistakes.
- Take a proactive approach to ensure pedestrian safety and implement redundant solutions at site, corridor, and network scales.
- Accept shared responsibility and seek interdisciplinary and collaborative solutions to mitigate pedestrian safety risks.

New Zealand and Australian agencies hosted the study team. These include Federal, State, and local infrastructure owner-operators, practitioners, and policymakers. As such, they are primarily focused on three of the five Safe System objectives: Safer Speeds, Safer Roads, and Safer People. However, the study team also learned about efforts that support Safer Vehicles and Post-Crash Care.

The Safe System approach is the overarching framework under which New Zealand and Australian transportation practitioners have operated since the early 2000s (2) (3). The U.S. DOT recently adopted the Safe System approach as part of the National Roadway Safety Strategy (4). Studying how our Australasian peers operationalize the Safe System approach will help accelerate U.S. progress along the same path, with a focus on how they have achieved and maintained dramatically lower rates of transportation fatalities and serious injury, especially among pedestrians and other vulnerable road users.

Key Themes

The crisis of pedestrian fatalities on U.S. roads cannot be solved in isolation. It is a result of decades of emphasis on motor vehicle mobility and access, at the expense of all other modes. This emphasis causes negative outcomes, including vulnerable road user deaths and serious injuries, worsening air quality, inequitable access to opportunity, and low-density, sprawling development patterns.

Solving the pedestrian safety challenge requires a shift in our approach to transportation – from crafting high-level government policy and laws, through planning for the future of our built environment, to developing and implementing designs for roads and streets.

The study team identified three high-level takeaways that align with each of these categories of change, which characterize the Australasian approach to transportation. Takeaway #1 relates to "Section 3. Policy and Law," takeaway #2 relates to "Section 4: Planning & Process," and takeaway #3 relates to "Section 5. Project Design & Implementation."

These takeaways enable our Australian and New Zealand peers to address pedestrian safety and the safety of all road users, as well as adjacent issues such as air quality, public health, equitable access, and sustainable land use development.

Takeaway #1: Policy & Law – Pedestrian Safety is Foundational for Wellbeing and Livability

- Pedestrian movement is the foundation of transportation. Traveling on foot – or with the aid of mobility assistance devices – is the most elemental form of access to opportunity. It extends the benefits of other transportation modes to create "complete trips" from door to door, allowing a multimodal system to provide societal benefits in the form of equitable outcomes for all people.

- Transportation systems that prioritize pedestrians are shaped by policies and laws that put human wellbeing at the center of policy goals. Policies that focus on the safe, efficient, and sustainable *movement of people and goods*, rather than the *movement of vehicles*, can more objectively balance multimodal access and mobility to achieve the best societal outcomes.

Takeaway #2: Planning & Process – Movement and Place are an Interconnected System

- Addressing safety, equity, climate, and economic challenges requires communities to understand the role that land use – *place* – plays in contextualizing the priorities for transportation – *movement*. *Movement and Place* is a planning framework created in Australasia that coordinates a community's vision for future transportation with their vision for future land use. This planning approach helps accelerate coordinated public and private investments in the built environment – both transportation and land use development – working collectively to create the future Australian and New Zealand communities want.

- This process allows communities to plan for "smart growth" land use development and aligned development of the transportation system that accommodates and encourages people to walk, roll, bike, and ride public transit in greater numbers. This in turn provides more clarity for developers. It can help break the cycle of self-reinforcing, auto-oriented land use and transportation projects, and lead to the more efficient use of public and private land.

Takeaway #3: Design & Implementation – Pedestrian Safety Challenges Benefit from Proactive and Interdisciplinary Solutions

- Designing roads and streets that are safe for pedestrians and other vulnerable road users benefit from proactive and intentional solutions. The design and implementation of projects at all scales – network, corridor, and block – contribute to a holistic vision that recalibrates modal priorities and is rooted in the Safe System approach. This means designing a transportation system that recognizes humans will make mistakes and mitigates negative outcomes by managing speed, changing roadway designs, and influencing user behavior.

- Communities cannot effectively address discrete transportation issues – safety, equity, public health, congestion, freight – in isolation. Sustainable solutions to these issues require analytical tools and multidisciplinary practitioners who can work outside of their silos to analyze the tradeoffs between different modal emphases through a rational, systemic approach.

Report Audience

This report is intended to inform U.S. practitioners, policymakers, researchers, and advocates. It is applicable at all scales of government: National (Federal/Tribal), State, regional, and local. The report body includes three primary sections that align with the three takeaways shared above:

- Policy & Law
- Planning & Process
- Design & Implementation

Additional sections provide context about the study team's process, preparation, and activities. The report provides context about the U.S. approach to transportation and the alarming rise of pedestrian fatalities across the country that inspired the study objectives. It also includes a summary of proceedings from four virtual exchanges that took place with Australian and New Zealand subject matter experts during the height of the Covid-19 Pandemic. The report provides observations about cultural and societal differences between Australasia and the U.S., which contextualize how and why certain approaches have been successful abroad. Finally, the report closes with a high-level conclusion emphasizing the importance of speed management on all roads and streets, context-classification of streets and roads, and the importance of modal separation on arterials. A forthcoming set of implementation actions will follow publication of this report over the course of a two-year implementation period.

Section 1. Study Motivation and Background

Study Objectives

This study was conducted under the United States Department of Transportation (U.S. DOT) Federal Highway Administration (FHWA) Global Benchmarking Program. The Global Benchmarking Program serves as a tool for accessing, evaluating, and implementing proven international practices to improve highway transportation in the U.S.

The purpose of this study was to examine noteworthy approaches and innovations used by other countries to achieve reductions in pedestrian serious injury and fatalities on arterial roadways. The study team used the following guiding principles to identify strategies from partner countries:

1. Identify policies that effectively prioritize, standardize, and fund engineering practices that facilitate integration of new and emerging pedestrian safety strategies on urban signalized arterials.
    a. Identify innovations that improve pedestrian safety on existing, signalized, urban arterials and "new" arterials (this may include both entirely new facilities, as well as those being converted into arterials to carry higher volumes of travelers).
    b. Focus on engineering and design innovations but consider how the other 'Es of transportation safety' (evaluation, education, equity, enforcement) reinforce and/or supplement engineering approaches.
2. Identify data-driven planning practices and design standards and features that effectively integrate pedestrian safety considerations into urban signalized arterial projects through a Safe System approach, in conjunction with performance-based planning and programming that is coordinated with land use planning.
    a. Identify planning systems that are information-rich, with strong links to the contributing factors of pedestrian crashes and data to plan, design, and evaluate project and program effectiveness.
    b. Identify approaches used to link decision making about land use planning to transportation plans and design implementation that best accommodate the safe movement of pedestrians.

Desk Review

The study team studied eleven peer countries in Europe, South America, and Australasia to identify the best candidates to inform U.S. approaches to improving pedestrian safety on urban, signalized arterials. Based on their findings, the study team developed an interim desk review, detailing the performance of each country, which is available for public review through the FHWA Office of International Programs (1). As part of this process, the team reviewed literature and conducted interviews with over 40 subject matter experts, and used six criteria to evaluate the countries:

1. Policy – documented priorities, data-driven targets, funding protocols and prioritization
2. Planning – practices to align project prioritization with need and policy
3. Design – engineering practices, signal design, geometric design
4. Technology – innovations that make solutions feasible, cheaper, and better
5. Data – information to measure baselines and targets, and to assess performance
6. Context – land use patterns and transportation network attributes

All the potential peer countries acknowledged the need to reduce vehicle speed as part of a systematic or Safe System approach to reducing the risk of pedestrian death or serious injury. European countries frequently integrate pedestrian safety improvements with infrastructure that improves safety and access for people riding bikes. Some countries' multi-national design standards – such as in Australasia – make it easier for engineers to experiment, evaluate, and implement newer infrastructure concepts with less effort. Many countries have national roadway safety policies, and several include time-based, measurable goals to advance pedestrian safety.

Peer Country Selection

Based on the above criteria, the study team determined that the countries with the best combination of innovative practices, demonstrated success in improving pedestrian safety over time, and contextual similarity were New Zealand and Australia. The study team tour focused on the urban areas in and around Auckland, NZ and Sydney, AU. Just over 5 million people live in New Zealand, with one-third of those residing in the city of Auckland. New South Wales is the largest state in Australia with a population of just over 8 million people; 5.3 million of which reside in the city of Sydney. FHWA and the study team coordinated the study tour with three agencies representing three levels of government:

- New Zealand Transport Agency (National)
- Auckland Transport, New Zealand (Municipal)
- Transport for New South Wales, Australia (State)

This report details the study teams' findings from a combination of the initial desk reviews, interviews, a four-part virtual exchange that FHWA held during the height of the COVID-19 pandemic, and the on-site study tour to Auckland, New Zealand, and Sydney, Australia.

Opportunities for Improvement in the United States

Seventy percent more pedestrians were killed in the U.S. in 2021 than in 2010 (5). Over the same interval, Australia and New Zealand experienced relatively stable or dropping figures. Figure 2 illustrates the comparative per capita number of pedestrian fatalities across the U.S., Australia, and New Zealand.

The trend shown over the past two decades clearly illustrates the stark difference in performance between the U.S. and study peers. The U.S. pedestrian fatality count climbed dramatically between 2010 and 2021, while Australia and New Zealand pedestrian fatalities exhibited the opposite trajectory, with per capita rates dropping over the decade.

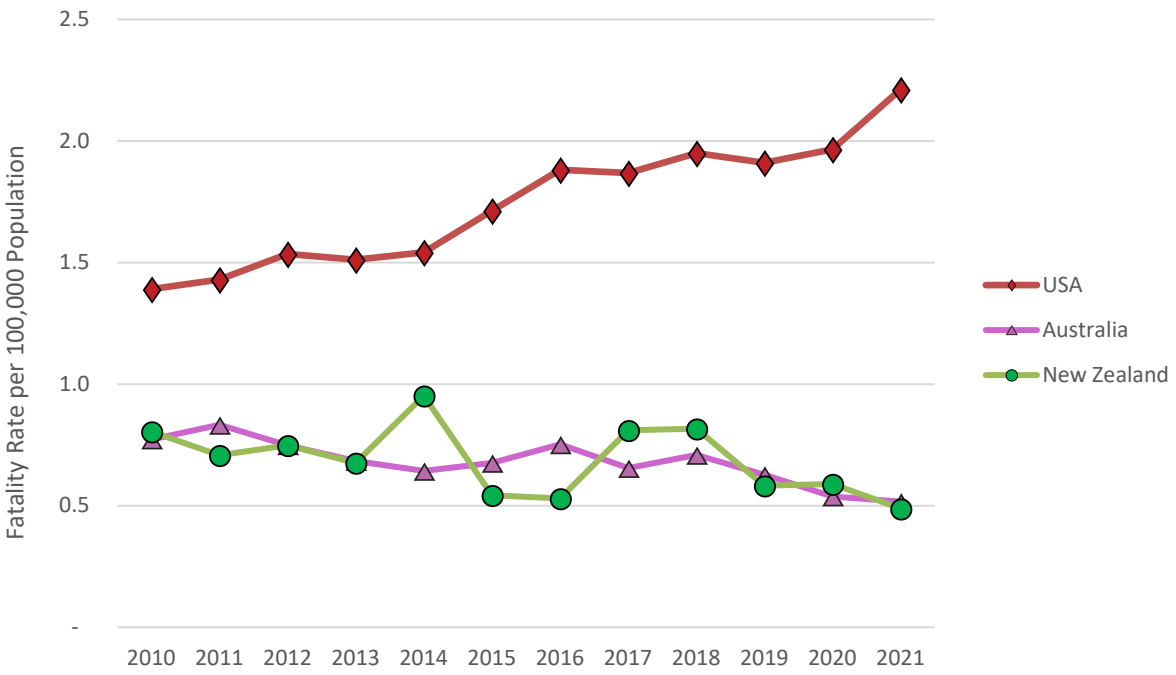


Figure 2: Pedestrian fatality rate per 100,000 population 2010 – 2021
Source: FHWA; Data: (5) (6) (7) (8) (9) (10)

Figure 3 shows the same data but as a percentage of each country's 2000 fatality count. This chart shows how pedestrian fatalities have changed each subsequent year – relative to the year 2000. Australia and New Zealand demonstrate an overall downward trend as of 2021, with Australia dropping 22 percent and New Zealand dropping to 29 percent from their

2000 counts. At the same time, the U.S. trends higher nearly every year, increasing by more than 70 percent above its 2000 count.

Several studies have attributed improvements in roadway fatality rates in Australia and New Zealand to the adoption of Safe System approach to policy, planning, and the design of transportation infrastructure (11). Both Australia and New Zealand were early adopters of the Safe System approach. The Safe System approach acknowledges that there are many "upstream" organizational and policy decisions that can either create or disrupt opportunities for a pedestrian crash to occur.

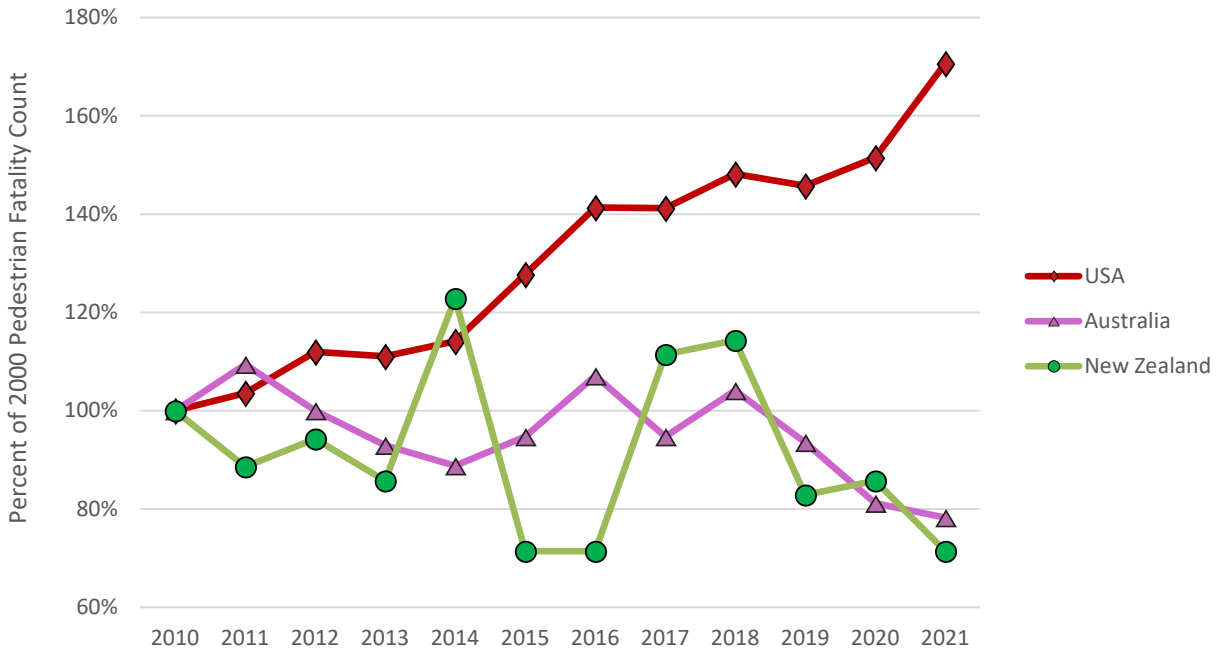


Figure 3: Percent change in pedestrian fatality count since 2010
Source: FHWA; Data: (5) (6) (7) (8) (9)

Study Team

The study team consisted of the following representatives who offered multidisciplinary perspectives from fields including engineering, planning, safety, health, and environmental protection (see Figure 4, from left to right):

- Jonah Chiarenza, Report Lead – U.S. DOT Volpe Center
- Lee Austin – City Traffic Engineer, City of Austin, Texas
- Rachel Carpenter – Chief Safety Officer, California Department of Transportation
- Laura Sandt – Co-Director, UNC Highway Safety Research Center
- Shari Schaftlein, Study Lead – Director, FHWA Office of Human Environment
- Tamara Redmon, Study Co-Lead – FHWA Office of Safety Technology – Pedestrian and Bicyclist Safety Program Manager
- Mark Cole – State Traffic Operations Engineer – Safety, Engineering, Operations – Virginia Department of Transportation

Figure 4: Study Team members on site in Auckland, New Zealand
Source: FHWA

Each member of the project team was assigned a role relevant to their expertise to gather notes and supportive documentation throughout the study tour. Following the site visits and meetings, team members compiled photos, notes, and identified key takeaways. The following sections summarize the most relevant takeaways and key innovations identified for addressing pedestrian safety on US arterial roads.

Site Visit

Site visits and meetings with agency representatives were conducted from September 19 – 21, 2022 in Auckland, New Zealand and from September 22 – 23, 2022 in Sydney, Australia. The study team met extensively with staff and leadership from Waka Kotahi New Zealand Transportation Agency (Waka Kotahi NZTa), Auckland Transport, and Transport for New South Wales. The agencies also led several site visits in the greater Auckland, New Zealand and Sydney, Australia regions. Refer to Table 1 for the itinerary and purpose of each event. Figure 5 shows images from the study tour meetings and site visits.

Table 1: Meetings and Site Visit Summary

Date	Event	Purpose
Sunday, September 18, 2022	**Team Planning Meeting** Auckland, New Zealand	Review itinerary, discuss and determine team member roles, determine opportunities to review information collected, and prepare for the week ahead
Monday, September 19, 2022	**Site Visit:** Wynyard Quarter, Project Wave, and Queen Street	Explore redevelopment area with new roadway designs, and redesign of existing corridor
	Waka Kotahi NZTa Meeting: Advancing Innovation	Focus on Culture Change, Risk Management, Institutionalizing Change Aligned with the Safe System approach
Tuesday, September 20, 2022	**Site Visit:** Quay Street and Karangahape Road	Explore redesign of two major urban arterials
	Auckland Transport Meeting: Balancing Multimodal Safety with Vehicular Flow	Focus on Safe Systems Approach, Roads and Streets Framework, Roadway Typologies, and Context Sensitive Solutions
	Peer Exchange Event	Informal opportunity for information exchange
Wednesday, September 21, 2022	**Waka Kotahi NZTa Meeting:** NZ National Safety Approach	Focus on New Zealand's National Safety Approach

Date	Event	Purpose
	Travel: Auckland, NZ to Sydney, AU	
Thursday, September 22, 2022	**Site Visit:** Parramatta District, New South Wales, AU	Explore redevelopment and redesign of streets around new light rail corridor
Friday, September 23, 2022	**Meeting:** Balancing Multimodal Safety with Vehicular Flow	Focus on policy approaches to speed management
	Meeting: Safe System Assessment Framework for Movement and Place Practitioners, Roadway Typologies, Context Sensitive Solutions	Focus on connection between land use and transportation planning
	Meeting: Advancing Innovation – Manly Project Distributed, Programmatic Projects, Temp/Pilot/pop-up Projects	Focus on the projects highlighted during the Manly site visit, including the Manly 30km/h Pilot Zone and Infrastructure Upgrades
	Meeting: Future Transport	Focus on strategy development and multimodal approaches
	Meeting: Advancing Innovation	Focus on Culture Change, Risk Management, Institutionalizing Change Aligned with the Safe System approach

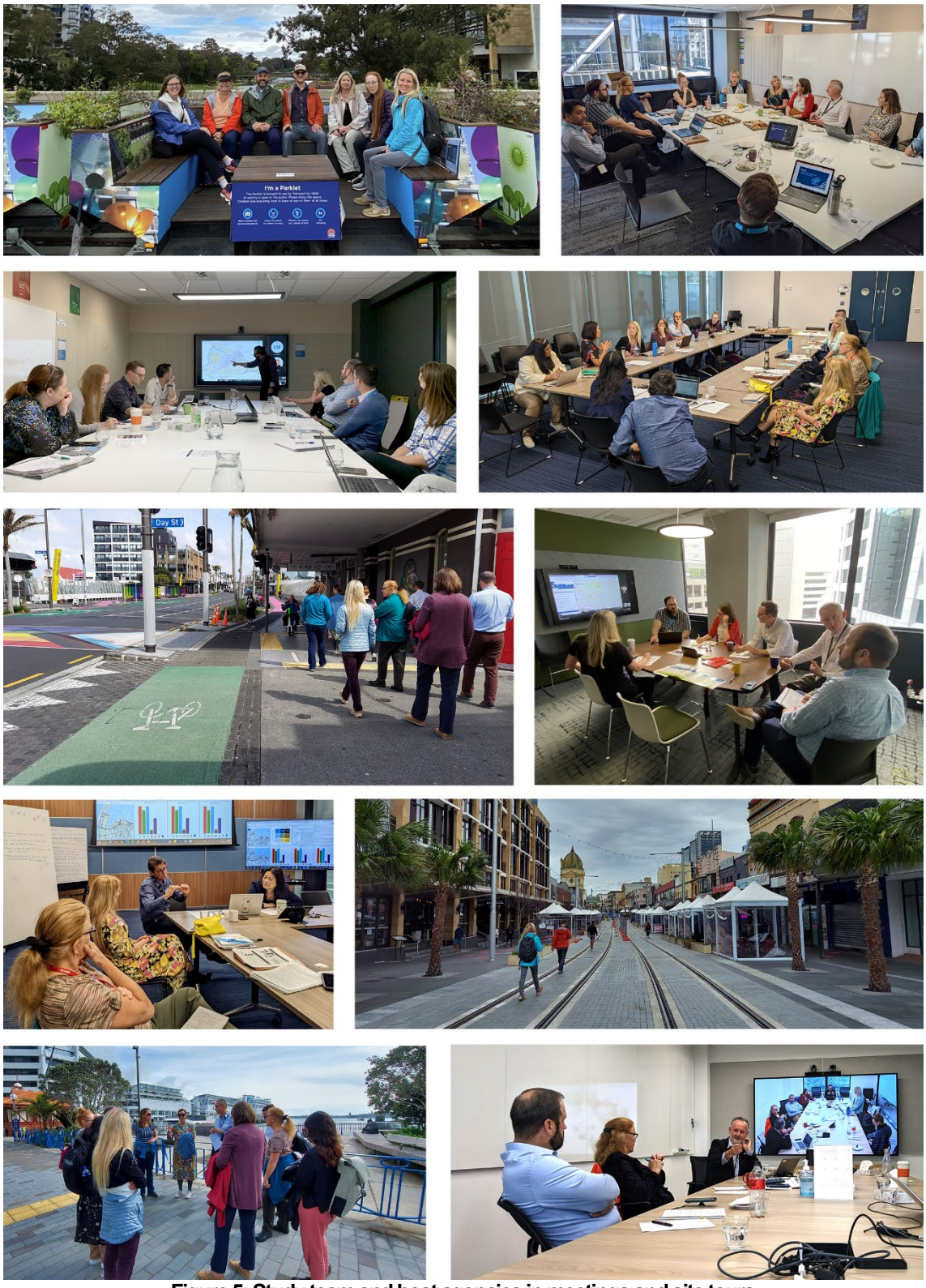


Figure 5: Study team and host agencies in meetings and site tours
Source: FHWA

Virtual Exchanges

Virtual exchanges with the Australia and New Zealand teams set the stage for this study. This section discusses the agendas, high-level summaries, and primary conclusions from each virtual exchange. Agendas for each virtual exchange session are referenced in this section and included in full in Appendix A.

Australia – United States Virtual Exchange

Two virtual exchanges were held between the United States and Australia to discuss adopting and implementing the Safe System approach, with one held on October 13, 2021, and the other on October 19, 2021. During the first session, discussion focused on the history of Australia's adoption of the Safe System approach and its principles; other agencies required to work with in order for the Safe System approach to be implemented; data, modeling, and performance metrics; breaking down roles and responsibilities for operations; legislation and politics; and thinking through frameworks and timelines for national plans. The second exchange focused more on Australia's approach to implementing a Safe System approach. The discussion of this second session was around what tools, data, requirements, and performance measures are required, used, and could be additionally needed for implementing the recommendations from final planning documents; documenting the roles and responsibilities of individuals and agencies involved in the road safety process; considerations for approaching safety over capacity; Australia's Federal funding mechanisms for road safety; and determinations for additional work through activities such as cost-benefit ratios for safe system transformational projects.

High-level summaries of the results from the exchanges were documented following each exchange. Conclusions from the first meeting on the adoption of the Safe System approach are categorized by topics such as culture change, mechanisms and data, land use and transportation, and case studies.

The discussion around culture change follows the first incorporation of Safe System approach by Austroads in documents beginning in 2004; Austroads is a collective of the Australian and New Zealand transport agencies representing all levels of government, which conducts research and provides tools and services to help members to deliver efficient, reliable, and safe mobility (12). Austroads is an invaluable partner to these transportation agencies, collaborating on research needs and developing resources and guidance documents to help advance transportation innovation, similar to the U.S. Transportation Research Board's Collaborative Highway Research Programs.

Initially, the Safe System approach was met with reluctance for its expense and political infeasibility to slow traffic. In 2010, Austroads included the Safe System approach in a 10-year National Road Safety Strategy (2) that allowed States and territories to acclimate to the

new approach, engaged the transportation sector, and communicated an integrated approach including speed limits, roadway design, and behavior campaigns.

Practitioners use several data-driven tools to apply the Safe System approach in assessing risk. For example, the Safe System Assessment Framework (13) is an assessment that all projects valued over approximately $2 million must complete. Every consultant on a given project must complete a Safe System approach training course. As for data, Austroads outlined the national effort (14) to integrate hospital data into crash data for serious injuries, including interim targets. Emerging data collection technologies are under consideration, particularly related to collecting vulnerable road user exposure data, and thinking about how to design roads to account for human error.

The Austroads Movement and Place Framework (15) was discussed for its role in creating a more integrated transportation planning process that considers land use, particularly in supporting vulnerable road users. Note, "Section 4. Planning & Process" provides more detail about Movement and Place, which incorporates the Safe System approach into its guidance for road designers and system operators when designing new or redesigning existing roads.

Finally, the virtual exchange concluded with a review of case studies from New South Wales, Austroads design guides, and the Adelaide Center for Automotive Safety Research. New South Wales has adopted the Movement and Place framework and developed practitioner guidance (16). Implementation on a back-casting approach (17) to target setting, advancing serious injury data (18) (including integrated asset management and crash data), and benefit cost ratios (19) is underway. Two Austroads design guides, Network Design for Road Safety (20) and Road Cross Section Design for Road Stereotypes and a Safe System (21), provide additional information on designing for and implementing elements of the Safe System approach. The Adelaide Center for Automotive Safety Research features some studies using event data recorder data (22).

New Zealand – United States Virtual Exchange

There were two virtual exchange sessions held between New Zealand and the U.S. Similar to the format for the exchanges between Australia and the U.S., the first session held on November 1, 2021 focused on the adoption of the Safe System approach, while the second session held on November 15, 2021 discussed implementation. In the first session, presentations were given by the New Zealand Transport Agency on Implementing Safe System in New Zealand: A Brief History and Improving Road Safety with Māori, mainland New Zealand's indigenous Polynesian people. Discussion followed on how the Safe System approach has gained non-government support, how practitioners are being trained in understanding the Safe System approach, incentives or consequences that ensure meaningful progress, rolling out the Movement and Place-based One Network Framework, and learning activities part of the Road to Zero initiative. The implementation conversation during the second exchange featured a comprehensive review of governance, funding, and

program structures; speed management; tools developed to aid in implementation of the Safe System approach; a "severance program" that seeks to remove physical barriers to accessing community facilities, services, and social networks; an innovating streets program; and data and metrics.

The documented, high-level conclusions from these exchange sessions cover several key considerations for adopting and implementing a Safe System approach. From the initial meeting on adoption, the first finding is that public support is required to avoid backlash on decisions such as setting lower speeds and implementing safer roadway designs. This includes having a social license (23) to conduct policy change and conducting outreach to Māori people. Second, government accountability is important. The government creates meaningful targets for safety and an investment framework. Third, leadership is critical; strong leadership commitments are what enable follow-through on safety target and allow for capacity building, training, and culture change. Leadership also supports pilot and demonstration projects to advance innovation and change and promote findings to change practitioner culture and public opinion. The fourth finding from the adoption discussion is that context is key. Connecting roadway designs with land use context, cultural norms, and emphasizing the One Network Framework and multidisciplinary approaches (24) to design can create safer roadways.

The second virtual exchange on implementation of a Safe System approach concluded with three key takeaways based on the conclusion that implementation takes multiple forms. The first form of implementation entails targeted, proactive, and rapid safety projects. The Innovating Streets Program (25), Safety Intervention Toolkit (26), and road safety audit process (27) are initiatives geared towards rapid implementation and information sharing, as well as ways to streamline project execution. The second form of implementation – large-scale policy, planning, and programmatic efforts – is evident in several ongoing initiatives. The New Zealand Transport Outcomes Framework (28), the Road to Zero Strategy (29), and the Tackling Unsafe Speeds Program (30) each attempt to go beyond recommending existing standards for road networks and lay out long-term planning goals that can be accomplished through transportation systems. The third and final form of implementation is reframing the transportation to consider vulnerable road users in terms of transportation planning and design focus, data, and evaluative metrics. For example, the exchange revealed that one of the biggest barriers to improvement is the lack of metrics for normalizing deaths and serious injuries to road user groups, (e.g., having a *rate* of fatalities of people biking and walking based on the *number* of people biking and walking). A system-level view of how a city functions safely is needed to improve this area. Ongoing initiatives, like the severance program, which focuses on vulnerable road user network connectivity, the National "Gen Less" campaign to reduce energy consumption by switching short trips to a non-motor vehicle mode, and the Sustainability Action Plan (31) are also influential steps related to implementing roadway design changes that are part of a larger cultural shift. Finally, case studies of note that came up during the exchanges include Safe System in Action and One Network Framework Case Studies (24).

Section 2. Safe System

Safe System Approach

The zero deaths vision acknowledges that even one death on our transportation system is unacceptable and focuses on safe mobility for all road users. This idea was first adopted in Sweden in 1997 as "Vision Zero" and since then has spread around the world.

Reaching zero deaths requires the implementation of a Safe System approach, which was founded on the principles that humans make mistakes and that human bodies have limited ability to tolerate crash impacts. In a Safe System, those mistakes should never lead to death. Applying the Safe System approach involves anticipating human mistakes by designing and managing road infrastructure to keep the risk of a mistake low; and when a mistake leads to a crash, the impact on the human body doesn't result in a fatality or serious injury. Road design and management should encourage safe speeds and manipulate appropriate crash angles to reduce injury severity.

There are six principles that form the basis of the Safe System approach: Deaths and serious injuries are unacceptable, humans make mistakes, humans are vulnerable, responsibility is shared, safety is proactive, and redundancy is crucial. Making a commitment to zero traffic deaths means addressing all aspects of safety through the following five Safe System elements that, together, create a holistic approach with layers of protection for road users: safe speeds, safe roads, safe road users, safe vehicles, and post-crash care. See Figure 6 for a diagram that illustrates these principles and elements.

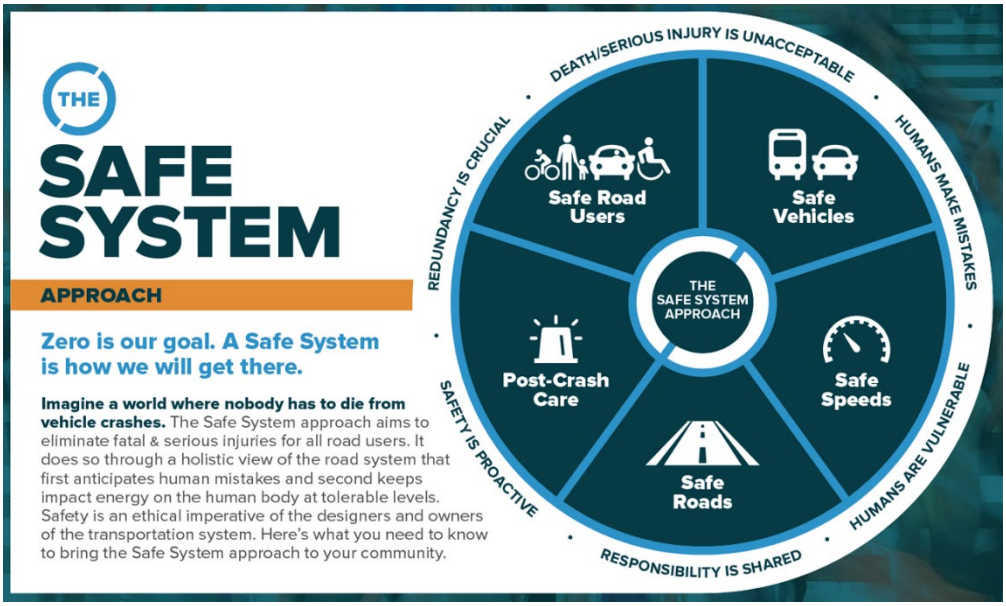


Figure 6: Safe System Approach
Source: FHWA (93)

The Safe System approach requires a supporting safety culture that places safety first and foremost in road system investment decisions. To achieve our zero deaths vision, everyone must accept that fatalities and serious injuries are unacceptable and preventable.

Swiss Cheese Model and Safe System

The "Swiss cheese model" is a frequently used illustration to depict layers of defense that can be penetrated by deficiencies in the system. See Figure 7. Adapting this to the Safe System approach, each element of the Safe System is depicted as a layer of defense, each of which mitigates risk. However, these layers must be fully functional to perform as intended in mitigating risk. If a given layer is deficient in some way – for example, people are allowed to drive beyond the speed limit, or there is insufficient separation between pedestrians and vehicle traffic – the system does not function as intended. The result are unmitigated events, including serious injury and fatal crashes.

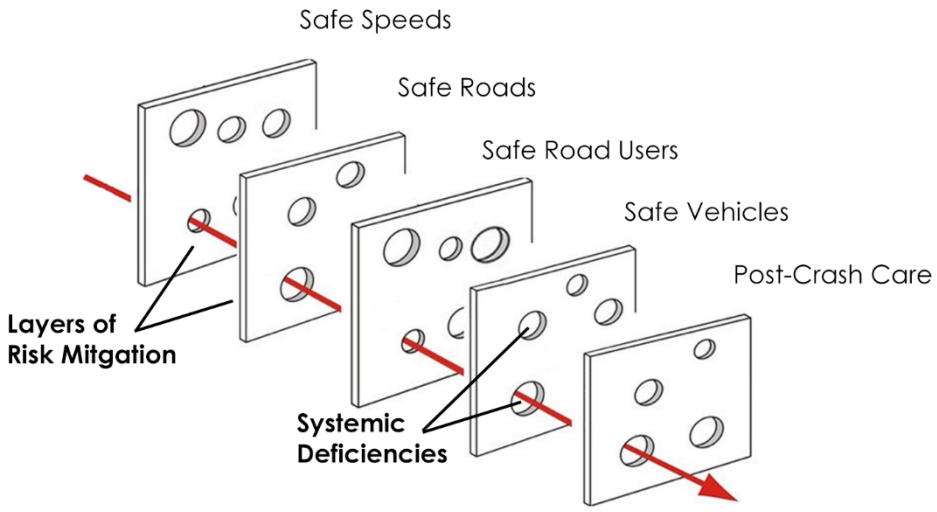


Figure 7: Safe System and the Swiss Cheese Model
Source: FHWA; adapted from James Reason (92

Kinetic Energy and Safe System

The following excerpt from Monash University Accident Research Centre in Victoria, Australia (see orange box below) describes the application of the Safe System approach using a kinetic energy model (see Figure 8) to identify and mitigate risk of injury and death to humans from traffic crashes.

This paper focuses on intersection designs and indicate several formats that mitigate crash risk and injury severity, including raised intersections and roundabouts. However, the principles apply in general, wherein the proposed geometrical and operations designs limit vehicle speeds to 30 km/h (19 mph) or less to protect vulnerable road users or minimize the risk of crashes to a negligible level.

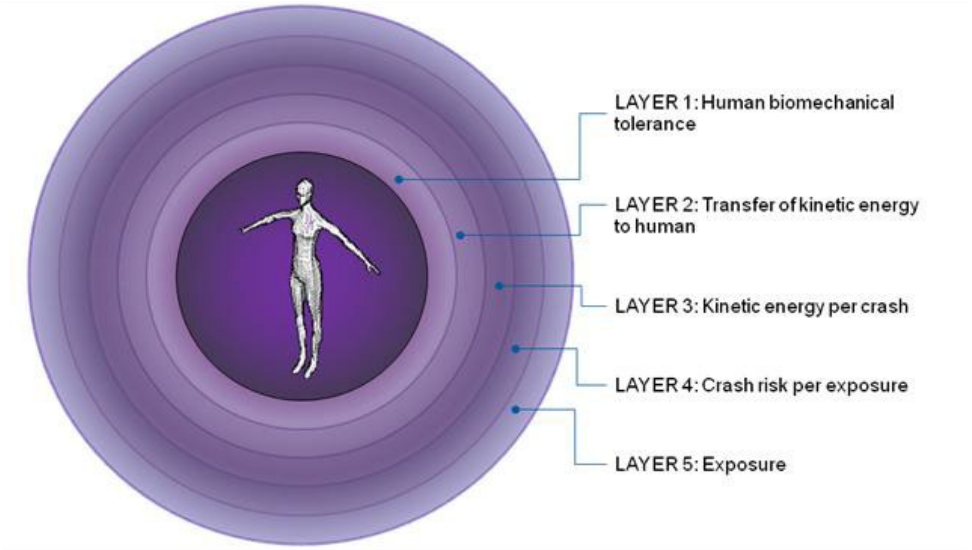


Figure 8: Kinetic Energy Model
Source: Monash University Accident Research Centre (32)

Applying a Kinetic Energy Model to the Safe System Approach (32)

A set of design principles was developed within the context of the Safe System, Dutch Sustainable Safety and Swedish Vision Zero philosophies. Taking into account the requirements of each of these, the following four intersection design and operation principles were formulated:

1. Fewer vehicles – by reducing the number of vehicles in use, fewer opportunities for collisions will arise;
2. Fewer intersections – by minimizing the number of intersections within the road network, and concentrating more traffic movements at intersections with best-practice safety standards, fewer opportunities for high-risk conflict should arise;
3. Fewer conflict points per intersection – by simplifying intersections to produce fewer conflict points, the opportunities for collisions at a given intersection should fall. The resultant reduction in complexity should also have a positive effect on safety;
4. Impact speeds and impact angles constrained to biomechanically tolerable levels – by designing to create speed and angle combinations that result in a low risk of serious injury in the event of a collision. Analysis of the kinematics of traffic collisions shows that:
    - For 90° collisions, impact (and, therefore, travel) speeds should not exceed 50 km/h for vehicle-to-vehicle collisions. For conflicts between vehicles and unprotected road users (i.e. pedestrians, cyclists and motorcyclists), impact (and, therefore, travel) speeds should not exceed 30 km/h;
    - For intersections located in speed limits greater than 50 km/h and not greater than 70 km/h, vehicle-to-vehicle conflicts must occur at less severe angles than 90° to ensure that the biomechanical tolerances of humans are not exceeded. Regardless of geometric layout to influence impact angles, travel speeds in areas where pedestrian and cycle traffic is allocated high priority should not exceed 30 km/h if pedestrian and cyclist risks of death are to remain below the nominated Safe System level of 10%.
    - Where the above speed and angle combinations cannot be met, collision risk must be reduced to a negligible level.

Acknowledging the Difference Between Streets and Roads

Australian and New Zealand peers who participated in this study tour made a point of distinguishing between the words "road" and "street" when describing a transportation facility. One definition offered by Transport for New South Wales observes that:

- "Roads" comprise the segments of a network that serve primarily for *movement* – these are corridors that separate functions and road users, allow higher vehicle speeds, and save us time when traveling.
- "Streets" comprise the segments of a network that serve primarily as *places* – these are corridors that mix functions and road users, encourage or enforce lower vehicle speeds, and invite us to spend time in, rather than just travel through (33).

"Stroad" is a portmanteau or made-up word coined from a combination of the words "street" and "road" that has appeared in informal discussions about transportation in the U.S. over the past decade (34). Stroad is a pejorative term intended to highlight the inadequacy of many U.S. roadways that attempt to be roads and streets at the same time, often failing at both.

In reflecting on the issues that contribute to risk on U.S. arterials for all road users, and especially pedestrians and other vulnerable road users, the study team observed that U.S. arterials suffer from an "identity conflict." Many urban arterials in the U.S. are characterized by high vehicle volumes and speeds, while also featuring people-serving land use development like shops, apartments, offices, and schools, that encourage walking, rolling, cycling, and public transit use. The result is places that people simultaneously want to visit, but also want to travel through. Some stroads attempt to accommodate transit, bicycling, and pedestrian and accessible pathways, but frequently do so without adequate separation in time or space. Building and expanding stroads causes congestion, air quality impacts, modal conflicts, inequitable access, and most significantly, serious injury and death.

At its core, the Australasian approach to transportation safety brings intention to the design of streets and roads that do their distinct duties well. This Global Benchmarking Program report details the policies, planning approaches, design elements, data, and technologies that help Australasian transportation practitioners and their partners take an intentional approach to providing the public with both access and mobility.

Section 3. Policy and Law

Enshrining the Safe System Approach in Policy

Policies establish the principles that underpin decision making about the transportation system and contribute to improved pedestrian safety outcomes both directly and indirectly. Australasian transportation policy has centered on the Safe System approach for over two decades, beginning with Australia's National Road Safety Strategy 2001-2010. Since that time, Australian and New Zealand transportation agencies at the Federal, State, and municipal level have developed increasingly sophisticated and coordinated policies, strategies, and laws to aggressively improve transportation access and safety – especially for pedestrians. The following section details examples discussed during the study tour, and follow-on research performed by the report team.

New Zealand's Road Safety Strategy 2020 – 2030

"We need to build a safe road system that is designed for people. This means doing our best to reduce crashes but acknowledging that crashes will continue to happen. When crashes occur, we can prevent serious harm through safe vehicles, safe speeds, and forgiving road design.

"Road safety goes beyond our obligation to prevent deaths and injuries to improving lives and lifestyles too. It ensures everyone, even our most vulnerable road users, feels safe to use our transport network." (29)

New Zealand's National Approach to Transportation

Staff and leadership from Waka Kotahi NZTa and other local agencies and organizations hosted the study team, together with partners from Auckland Transport, for three days of meetings and site visits in and around Auckland. The following key resources provide an overview of the national policy approaches New Zealand presented to the study team, which address transportation safety, especially for pedestrians and other vulnerable road users.

In 2020, New Zealand published the Government Policy Statement on Land Transport (GPS 2021), a national policy to guide investments in New Zealand's transportation system for the next decade (35). Three of the four national strategic priority areas defined in GPS

2021 inherently relate to pedestrian safety and access: Safety, Better Travel Options, and Climate Change. While the connections are indirect, improving freight connections includes removing conflicts with vulnerable and other road users. These priorities seek to improve human health and advance environmental objectives through transportation (see Figure 9).

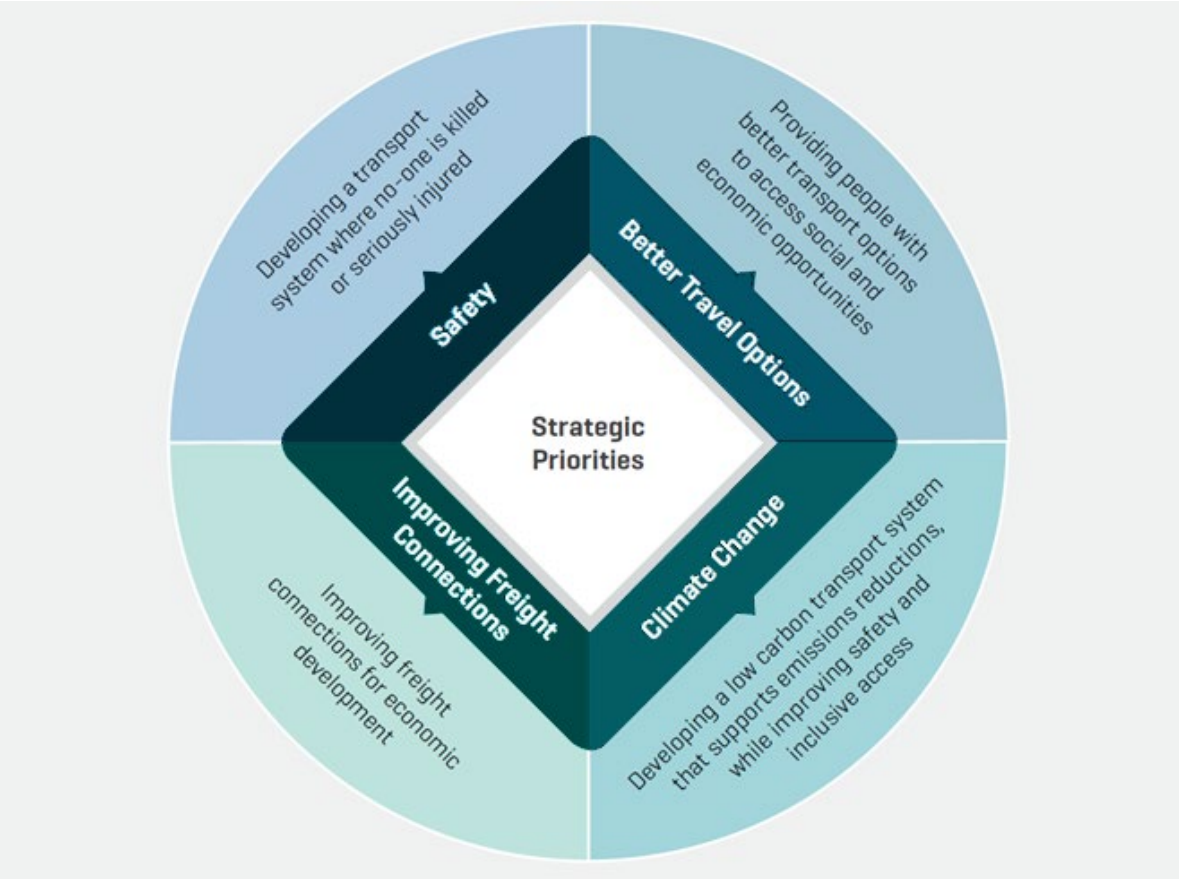


Figure 9: New Zealand National Transportation Strategic Priorities
Source: GPS 2021 (35)

New Zealand's national priority areas are guided by a Transport Outcomes Framework. The word "outcomes" is paramount, because it recognizes how transportation infrastructure and operations ("outputs") influence social, economic, and environmental outcomes. The framework aims for a transportation system that improves wellbeing and livability for all and comprises of five elements: inclusive access; healthy and safe people; economic prosperity; environmental sustainability; and resilience and security (see Figure 10). GPS 2021 links the outcomes to each strategic priority, noting primary and co-benefits for each.

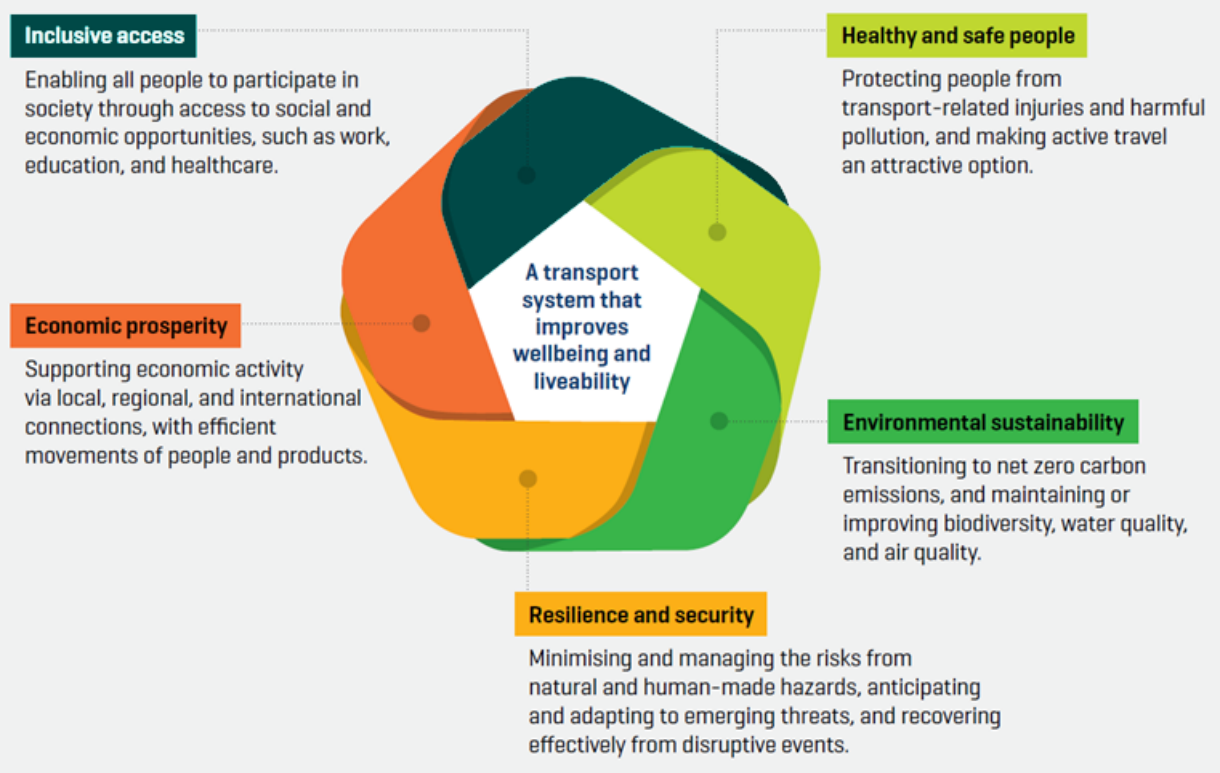


Figure 10: New Zealand National Transport Outcomes Framework
Source: GPS 2021 (35)

Performance-Based Policy

GPS 2021 includes key performance indicators for each priority. This performance-based approach allows the Ministry of Transport to measure national progress towards its policy goals. A selection of the indicators that are most applicable to pedestrian safety are listed under each priority, below.

Strategic Priority: Safety

The primary objective for this priority is straightforward: preventing people from suffering transportation-related fatalities and serious injuries. The primary outcome is healthy and safe people. Additional outcomes include improving a greater share of people's access to opportunity and generating more economic activity – due to increased activity across a safer network – as well as increased resiliency and security of travel due to safer integrated designs.

Safety Indicators:

- Deaths and serious injuries on the road and rail corridor
- Hospitalizations from road crashes
- Pedestrian and cyclist injuries

Strategic Priority: Better Travel Options

The primary objective for this priority is providing people with better travel options to increase their access to "earning, learning, and participating in society" via access to essential goods, services, and opportunities for improving their wellbeing. The primary outcome is more inclusive access. Additional outcomes include increased safe and convenient options for people to travel via active transportation modes – walking, biking, or rolling – which in turn contribute to people's mental and physical health and reduce emissions through shifting trips away from motor vehicles. Improving the safety and access provided by public transit and shared mobility services also contributes to reduced traffic congestions and helps optimize the flow of goods and people. Finally, safer and more convenient travel options increase the overall resilience of the transportation system by providing redundancy during disruptions.

Travel Options Indicators:

- Access to jobs
- Access to essential services (i.e., retail/grocery, education, and health facilities)
- Percent of population with access to frequent public transport services
- Mode share for people (i.e., percent of travel by mode)

Strategic Priority: Climate Change

The primary objective for this priority is transitioning into a low carbon transportation system that meets national emissions reduction targets while improving resiliency. The primary outcome is environmental sustainability. Additional outcomes include emissions reductions by allowing people to shift modes more easily from personal vehicles to public transit and active transportation. Including more elements of mixed use, higher density, and transit-oriented development to direct future and current urban development can help make public and active modes of transportation more feasible.

Climate Change Indicators:

- Tons of greenhouse gases emitted per year from land transport
- Tons of harmful emissions per year from land transport
- Number of people exposed to elevated concentrations of land transport-related air pollution
- Number of people exposed to elevated levels of land transport noise

New Zealand's National Road to Zero Strategy

In the GPS 2021, one of the main strategies outlined to address safety is to support the Road to Zero: New Zealand's Road Strategy 2020-2030 (29). The Road to Zero National Strategy is closely aligned with the safety priority of the GPS 2021, with the vision of no deaths or serious injuries while traveling. The main target outcome of Road to Zero is to reduce

deaths and serious injuries on roads by 40 percent by 2030. To achieve this goal, Road to Zero outlines a comprehensive plan to address road safety through five focus areas: infrastructure improvements and speed management; vehicle safety; work-related road safety; road user choices; and systems management. The GPS 2021 dedicates funding to activities that are outlined by the Road to Zero action plan to address safer infrastructure design and engineering, regulatory and enforcement strategies, awareness campaigns, and system management development.

Changing the Framework to Change Speed Limits

The default speed limit in New Zealand is 100km/h on rural roads and 50km/h on urban streets. Waka Kotahi NZTa staff estimate over 90 percent of roads and streets currently has speed limits that are too high to be considered “safe and appropriate” (see Section 4 for more details about determining appropriate speed limits in New Zealand). Local communities can change these limits, but it is up to their individual speed management plans to transition to safe and appropriate speed limits.

To facilitate this transition, in 2022, the Waka Kotahi NZTa introduced a transformative new rule, Land Transport Rule: Setting of Speed Limits 2022 (36; 37). The objective of this rule is to improve road safety by creating a "whole-of-network" approach that considers speed in terms of safety and infrastructure. It empowers authorities with jurisdiction over roads to set speed limits for such roads and outline the requirements that these road controlling authorities must comply with for setting speeds, including preparing a speed management plan with a ten-year vision and a three-year implementation plan. Under the previous version of this rule, the speed limit on a roadway could only be reduced on a case by case basis, and only to within 10 percent of operating speed without triggering costly infrastructure requirements, which created barriers to reducing speed limits at scale (38).

The rule requires Waka Kotahi NZTA to provide guidance and information on speed management, which takes the form of the Speed Management Guide: Road to Zero edition. This guide commits to focusing on Movement and Place principles as a major factor in determining speeds. The speed management guidance it establishes sets clear speed targets based on roadway function, which in turn is built into the network-wide planning and decision-making processes set forth by the One Network Framework (ONF) (39). The ONF is Waka Kotahi NZTa’s framework for Movement and Place; both Movement and Place principles and the ONF are discussed in more detail in Section 4 of this report. This approach encourages local road authorities to determine road classification and speed limits through monitoring and then implementing incremental changes - such as through design or behavioral enforcement measures – to achieve adequate compliance of road users travelling at the set speed limit. The intent behind this approach is to use speed limit changes to set the foundation for the safe system, and to establish a safety led approach to speed limit setting, rather than a compliance led approach. This approach is informed by the evidence that even a small reduction in mean operating speed can have significant safety benefits.

Such an approach may be applicable in the U.S. In the U.S., the current practice for assigning speed limits is similar to the practice in New Zealand before the implementation of the Setting of Speed Limits law.

U.S. State and local governments hold authority over speed limit setting on most public roads. While the 85th percentile speed is not the only factor that State practitioners evaluate when determining speed limits, it is still a common component of speed setting practice. Speed limit setting policies may be restrictive for local governments in the U.S. seeking to reduce speeds based on local conditions. Many infrastructure improvements that increase pedestrian safety, like raised crossings and curb extensions, cannot be included on streets where driver speeds are too high. In addition to reducing the severity of crashes that do happen, reducing speed limits opens the door to many other engineering and design interventions that can further improve pedestrian safety.

Engineering practice can also be an impediment to improving pedestrian safety. It is possible for engineers to build a road for a *target* speed, but to use a *design* speed greater than the target speed to account for speeding drivers. This practice exists apart from—and exacerbates excessive and unsafe speed limits caused by—adherence to the 85th percentile recommendation in the Manual on Uniform Traffic Control Devices (MUTCD) if due consideration is not given to other factors (40). The FHWA report *Methods and Practices for Setting Speed Limits* explains that this 85th percentile practice has contributed over time to incrementally increasing operating speeds (38). Note that a proposed change to the next edition of the MUTCD would modify this recommendation to only be applicable to freeways, expressways, and rural highways; however, the latter two such facilities are often the arterial—those with posted speed limits and design speeds that result in traffic speeds that are more likely to cause fatal injuries.

New Zealand's approach to Movement and Place principles (their One Network Framework) determines safe and appropriate speed limits by location, context, and use. The 2022 Setting of Speed Limits Rule makes it easier for local road authorities to implement speed management by posting the desired speed limit on a corridor. Speed limits are selected based on the context for Movement and Place, tying speeds to land use. Continually high mean operating speeds indicate to local road authorities that further intervention is needed to ensure people drive at the posted speed. Agencies can then implement changes to elicit improved adherence, in alignment with Movement and Place: geometry, signalization, and other infrastructure changes may be effective. In some cases, enforcement, including use of automated speed cameras, as well as behavioral campaigns, may be effective. Often, a combination of strategies is needed to see greater compliance for driving at posted speeds.

This marks a fundamental shift from the previous guidance on setting speed limits in New Zealand, as speed limits are now set based on a framework that is fully aligned with Safe System principles instead of partially aligned, and constrained by the current operating speed. Setting speed limits in this way in turn allows for prioritizing the safety of other modes on roadways in certain areas, such as around schools. This change in national policy

is enabling greater change and control of speeds and measures to manage speeds on a contextual basis.

The Speed Management Guide

The New Zealand *Speed Management Guide: Road to Zero* edition provides a framework to support regional transport committees (RTCs) and road controlling authorities (RCAs) with speed management planning and decision making (41). RTCs prepare regional surface transportation programs – similar to Metropolitan Planning Organizations (MPOs) in the U.S. – and provide advice as requested by the RCAs, which are the elected councils of government in regions and cities (42). The Speed Management Guide outlines a principles-based approach to establishing speed limits and managing appropriate speeds, in alignment with the requirements of the Land Transport Rule: Setting of Speed Limits 2022 (36). It describes approaches to support RTCs and RCAs in setting and managing consistent speed limits across the country and provides information to inform the development of regional speed management plans.

The guide outlines information across four key principles that guide speed management including 1) Safety; 2) Community Wellbeing; 3) Movement and Place; and 4) Whole of System (see Figure 11). The *Safety* principle supports the goal of decreasing the risk of fatal and serious injury to all road users by reducing impact speeds and crash forces. The *Community Wellbeing* principle highlights the role that speed limits play in improving equitable transportation access and quality of life, particularly for children and other vulnerable road users. The *Movement and Place* principle sets clear speed targets based on roadway function including the One Network Framework (ONF) street categories, design, and infrastructure that takes into consideration the surrounding land use, community wellbeing, local economy, and future development. The *Whole of System* principle supports speed management planning in coordination with other related activities such as regulation, enforcement, communications, engagement, and monitoring. The principles are intended to be applied together to advance an integrated Safe System approach.

Figure 11: New Zealand National Speed Management Principles
Source: Waka Kotahi New Zealand Transport Agency (41)

City of Auckland Transportation Policy

Staff and leadership from Auckland Transport and other local agencies and organizations hosted the study team, together with partners from Waka Kotahi NZTa, for three days of meetings and site visits in and around Auckland. The following key resources provide an overview of the municipal and regional policy approaches Auckland presented to the study team, which address transportation safety, especially for pedestrians and other vulnerable road users.

City Centre Masterplan

In 2020, the City of Auckland's leadership, Auckland Council, published the City Centre Masterplan (CCMP) (43). CCMP is a guiding document that outlines the vision and strategic direction for the growth and development of central Auckland and its waterfront for the next 20 years. Auckland serves as the region's economic and cultural hub. The CCMP aims to ensure that future development will be able to support anticipated growth while making the city more accessible to pedestrians and avoiding environmental degradation. To do this, the CCMP developed a matrix of ten strategies that contribute to the social, cultural, economic, and environmental wellbeing of Auckland city center. One of the outcomes focuses specifically on improving access to the city center with an emphasis placed on road safety, sustainability, and transport options (titled "Accessible City Centre").

Some of the goals under this outcome include safe, healthy, and sustainable ways to access and travel within the city, improving traffic circulation and volume, and no deaths or serious injuries on the streets.

With these outcomes in place providing the strategic direction, the CCMP created an action plan consisting of eight transformational moves to achieve the CCMP's outcomes. Some actions are currently underway, such as the City Rail Link which is scheduled to open in 2024 and will greatly expand the public transit capacity, relieving congestion. The city center also has a 10 km/h speed limit in place for shared streets, while a speed limit of 30 km/h has been proposed for all other streets, specifically to improve pedestrian safety.

Access for Everyone

In support of the Accessible City Centre outcome, the CCMP developed Access for Everyone (A4E) (44), a framework for long-term, holistic development and management of the transport system in Auckland city center. See Figure 12 which depicts key policy approaches to managing travel around, through, and within the city center, and Figure 13, which depicts these travel policies in a composite aerial diagram.

The main principles and actions of A4E focus on making streets safer and more accessible to all users, ensuring that city center design prioritizes people, not vehicles. The simultaneous effort to reduce and optimize traffic while improving pedestrian infrastructure increases safety for all road users, not just pedestrians. This human-centric approach has positive implications for the comprehensive framework, as the impacts translate into environmental and economic benefits as well.

Figure 12: Diagrams showing traffic access points and low-traffic zones surrounding the city center (left); priority transit routes on arterial roadways connecting between regional routes (middle), and the pedestrian-priority "zero emissions area" planned for the core of the city center surrounded by low-traffic zones(left)
Source: Auckland Council (44)

Figure 13: Access for Everyone (A4E) Concept Diagram
Source: Auckland Council (44)

A4E is guided by four main principles:

1. **Each transport mode has access to a specific street network, and efficient forms of transport are prioritized over private vehicles.**

    - Redesign traffic circulation by consolidating traffic to specific and arterial routes to meter and optimize access to the city center, reaching a 20 percent reduction in peak-time traffic levels.
    - Prioritize space-efficient transport modes by improving conditions for pedestrians of all types and capabilities.

2. **Elevate the following as core priorities for city center development: equality of access, quality of public realm, health of city center residents and visitors, and the city's environmental impact.**

    - Establish streets as safe, pleasant spaces for residents and visitors.
    - Center design of city center streets around quality of life and improving overall user experience.
    - Align with the Road to Zero National Strategy.
    - Strategize to reduce environmental impact and mitigate climate change.

3. **Shape decisions based on a city center-wide strategy.**

    - Recognize and examine the complex interconnections across the city center to better inform decision-making processes.
    - Ensure decisions are synergistic with the overall vision for the city center.

4. **Transform the look and feel of city center streets.**

    - Prioritize pedestrians by expanding network and design of paths specifically for people.
    - Increase access for people with disabilities.
    - Create a Zero Emissions Area (ZEA) across the Waihorotiu Queen Street Valley.

Accessibility and Universal Design

While New Zealand does not have national accessibility laws equivalent to the U.S. Americans with Disabilities Act or Architectural Barriers Act, government agencies are actively developing approaches to improve access via Universal Design. The Auckland Transport Design Manual features resources on design for "inclusivity and independence" and "recognizes human diversity and designs for life scenarios, such as pregnancy, childhood, injury, disability and old age" (45). Auckland Transport also released a second iteration of their Accessibility Action Plan in 2022, "to mandate the actions that Auckland Transport will undertake over the next three years to improve accessibility" (46). The new plan lists accomplishments from the prior 2019 plan and identifies a new suite of actions for 2022 to 2024, including making accessibility the "business as usual" approach. As U.S. readers review this report and future resources from the FHWA Global Benchmarking Program's implementation activities, it is important to acknowledge that this is an area of targeted improvement for Australasia and that street and road designs as illustrated and implemented may not align with U.S. requirements for accessibility.

Australia's National Road Safety Strategy

Staff and leadership from Transport for New South Wales hosted the study team for one day of meetings and a site visit. The following key resources provide an overview of the policy approaches New South Wales presented to the study team. These include both national and State policies that address transportation safety, especially for pedestrians and other vulnerable road users.

Figure 14: Australian National Road Safety Strategy infographic
Source: Australian Infrastructure and Transport Ministries (47)

Australia's 2021 – 2030 National Road Safety Strategy seeks to achieve zero traffic-related trauma by 2050 across the country's surface transportation networks (47). The strategy establishes interim targets of a 50 percent reduction in fatalities and a 30 percent reduction in serious injuries by 2030. The National Road Safety Strategy embeds the *Movement and Place* framework into applying Safe System elements. This means considering the context and character of roads and streets when implementing strategies for safe roads, safe road users, safe vehicles, and safe speeds through speed management. See Figure 14.

In addition, the strategy seeks to demonstrate the viability of the goal for zero trauma by also setting a 2030 target to achieve zero deaths among children seven years old and younger, zero deaths in city central business districts, and zero deaths on highways and high-speed roads covering 80 percent of travel across the network. The strategy makes a point to recognize the increasing complexity of urban areas, with a growing diversity of transportation modes, including emerging modes like shared micromobility and anticipated modes like autonomous vehicles. The strategy emphasizes safety for vulnerable road users, especially pedestrians.

The National Road Safety Strategy establishes top safety performance indicators to assess measure effectiveness. The strategy maintains typical "lagging" safety indicators, reactive assessments that measure harm that has already occurred. These include number and rate per capita of road crash fatalities and serious injuries; the national definition for serious injuries includes hospital admittance, regardless of length of stay. During the study tour, leadership from New South Wales indicated that hospital data are critical to providing a

complete understanding of serious injury crashes, noting that 50 percent of motorcycle and 85 percent of bicycle serious injury crashes do not have corresponding police reports.

Australia's National Road Safety Strategy 2021-2030

"The Safe System approach requires us to expand the understanding of Movement and Place to fully recognize walking as a mode of transport. This means greater emphasis is needed for the safety of all types of pedestrian activity across the spectrum… (47)."

The National Road Safety Strategy also includes several leading safety indicators – assessments that measure proactive actions to mitigate harm. These include several performance indicators related to speed management and pedestrian safety:

- Percent of State and territory governments and local councils with a "fit-for-purpose" road safety risk assessment underpinning their infrastructure investment plan.
- Percent of high pedestrian central business districts/urban centers that are designed according to Movement and Place or equivalent approaches with posted speed limits of 40 km/h (25 mph) or less.
- Percent of vehicles at or below speed limit.
- Percent of drivers and riders observed/photographed not using a mobile phone or device.

New South Wales Future Transport Strategy

The State of New South Wales is home to approximately one-third of Australian's population, and includes Sydney, national capital Canberra, and several other central business districts and urbanized areas. Future Transport Strategy provides a long-range policy that guides Transport for New South Wales, the agency responsible for surface transportation and public transportation, and other State agencies with a time horizon of 2061 (48).

This document, while not exclusively focused on safety, includes 14 strategic directions and dozens of strategies that aim for a safer, more accessible future for New South Wales, grouped under three "outcomes" categories.

The following excerpts represent selected strategies that most closely relate to pedestrian safety and access in urban contexts. These strategies demonstrate the holistic approach New South Wales takes to planning for the future of their transportation system, which goes

beyond transportation-related actions and acknowledges the far-reaching outcomes transportation has on other aspects of people's lives. The strategies are:

1. **Outcome: Connecting our customers' whole lives**

    - Integrate a Safe Systems approach
    - Improve the safety of people walking and cycling
    - Deliver safer speed settings and infrastructure safety treatments on regional roads
    - Enhance 30-minute metropolitan cities
    - Support car-free, active, sustainable transport options
    - Integrate emerging mobility choices
    - Provide transport choices for people no matter where they live
    - Develop an inclusive transport system enabling access to services and places for all
    - Make customers feel secure travelling day and night

2. **Outcome: Successful places for communities**

    - Support growth around public transport
    - Support thriving and healthy 15-minute neighborhoods
    - Manage street space as public space
    - Improve the amenity of places along State Roads
    - Help the transport sector achieve net zero emissions by 2050
    - Ensure a net increase in urban trees and no net loss in biodiversity
    - Improve air quality and reduce noise
    - Use space and assets more sustainably
    - Provide customer journey resilience
    - Consider climate change impacts in all our decisions

3. **Outcome: Enabling economic activity**

    - Promote travel behavior change to manage networks
    - Improve the use and efficiency of our roads through road space allocation
    - Improve access and experiences for visitors
    - Optimize the use of our motorways and strategic road network

New South Wales Future Transport Strategy

Transport for New South Wales provides specific actions under each of their strategies. For example, the strategy *"Improve the safety of people walking and cycling"* (C4.5) includes five actions that provide specific, tangible steps to improve pedestrian infrastructure and mitigate speeds. These include "Deliver reduced speeds and speed limits in urban places and local streets" and "support local communities and councils who wish to implement lower speed limits."

Another strategy *"Promote travel behavior change to manage networks"* (E2.1) provides sticks, such as requiring demand management or developing 5-year strategies for mode shift, and carrots, like trialing behavior interventions and conducting research (48).

New South Wales 2026 Road Safety Action Plan

In parallel with the long-range Future Transport Strategy, New South Wales develops five-year interim action plans. The latest, the 2026 Road Safety Action Plan, includes specific Statewide performance indicators, like those developed by the Ministry of Transport for Australia's National Road Safety Strategy (49). Among those measures established by New South Wales, key performance indicators relevant to pedestrian and other vulnerable road user safety include:

- Percent of urban roads with safe speed limits of 40 km/h (25 mph) or less
- Percent of at-grade urban intersections designed at no more than 50 km/h (31 mph)
- Percent of vehicles compliant with 40 to 60 km/h speed limit on urban roads (25 to 37 mph)
- Percent of non-impaired motorists (sober, drug free, and non-drowsy)

New South Wales has been at the forefront of behavior modification for decades. See Figure 15. Their policies rely heavily on automated and randomized enforcement. Since 1982 when random breathalyzer tests were instituted, through the 2000s, New South Wales has championed the "safe road users" element of the Safe System. In 2003, the State enacted wholesale speed limit reductions in urban areas, dropping the posted speed limit to 50 km/h (31 mph). As a result of a compounding campaign of speed management, deployment of mobile speed cameras, continued drug and alcohol checks, and increased points on licenses in extenuating circumstances such as on holidays and when enforcement staff are limited, New South Wales fatalities dropped to fewer than 300 for the first time, as of 2020.

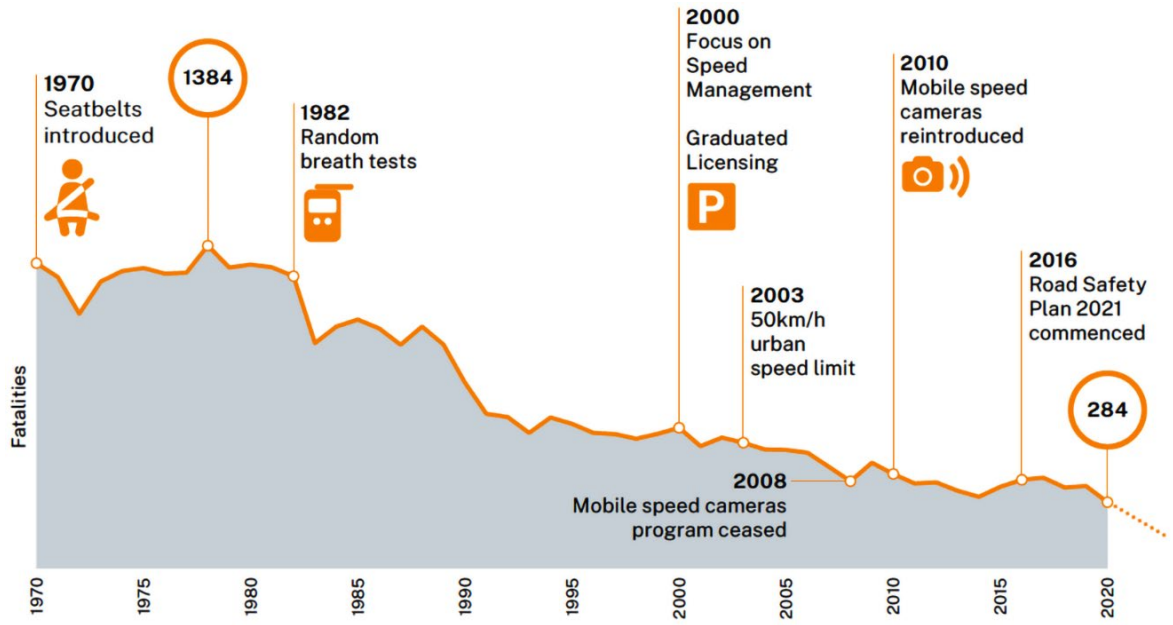


Figure 15: New South Wales traffic fatalities and key interventions 1970 – 2020
Source: Transport for New South Wales (49)

New South Wales 2021 Road Safety Progress Report

New South Wales issues an annual Road Safety Progress Report aligned with each Action Plan. The latest report was released for the year 2020 to 2021 (50). The report notes that one-third of fatalities and two-thirds of serious injuries occur in urban areas. Significant progress in applying programmatic and enforcement-based approaches to improve safety are documented in the following sections.

Programmatic Pedestrian Safety

Transport for New South Wales' 2021 Road Safety Progress Report highlights several achievements delivered through programs that are designated specifically to improve pedestrian access and safety. Under the State's Livable and Safe Urban Communities initiative, the State delivered 44 projects at over 118 urban intersections. These upgrades include retrofitting intersections with new roundabouts, upgrading signal displays, installing raised islands and raised safety platforms (equivalent to U.S. speed tables or raised crosswalks), and removing "filtered right turns" (equivalent to U.S. unprotected left turns).

Two other programmatic delivery mechanisms also produced large sets of improvements across the transportation network. The Pedestrian Protection Program installed leading pedestrian intervals (LPIs) at 557 intersections. An LPI is a signal design that provides a pedestrian "walk" signal for several seconds before the green signal for vehicles, allowing pedestrians to establish themselves in the crosswalk. Australia prohibits left turns on red (the U.S. equivalent of right turn on red) in urban areas, but New South Wales also added red arrows to hold traffic in locations where driver compliance was an issue. Transport for New South Wales leadership reports a 30 to 40 percent reduction in injury crashes where LPIs were installed, and negligible impact to traffic flow. The agency now incorporates LPIs into routine signal maintenance, with staff adding them whenever they touch a signal.

Transport for New South Wales' High Pedestrian Activity Program is another programmatic effort to target corridors that were reduced to 50 km/h (31 mph) in the 2000s, from their earlier posted speed of 60 km/h (37 mph). Between 2020-2021, 29 of these zones were further reduced to 40 km/h (25 mph) in areas with high pedestrian traffic, including around bus interchanges, train stations, and shopping districts. While the 60 to 50 km/h changes were made largely with signage alone, the 40 km/h changes were paired with other "self-enforcing" changes via roadway design elements, including vertical deflection.

In two locations, several existing 40 km/h zones were reduced to 30 km/h (19 mph) zones: the Liverpool central business district 25 miles west of Sydney and the beachside community of Manly, 15 miles north of Sydney. In both locations, consideration of many pedestrian-generating land uses, including tourist destinations and local uses such as schools and other educational facilities, hospitals, medium density residential, and commercial retail businesses factored into the decision to reduce the speed limit. In addition to lowering the speed limit, road features like speed tables, anti-skid surfaces, and

conspicuous crossings at intersections and mid-block crossing contribute to "self-enforcing" street design. New South Wales leadership indicated they have implemented over a dozen of these 30 km/h zones already within Liverpool and Manly.

Finally, a programmatic effort to upgrade school-area safety launched in 2021, with a dedicated $59m AUD budget. This program improves school access through public transit infrastructure and active transportation upgrades. It also adds elements to reduce vehicle speeds and create more physical and temporal separation between modes. In some cases, separation includes channeling pedestrians to designated crossings, and prohibiting mid-block or undesignated crossings with fencing.

Enforcement Programs

One of the prevailing mechanisms to enforce speed limits in New South Wales has been automated enforcement via mobile and fixed camera units. Part of the "Saving Lives Accelerated Package," these units are almost always deployed with advance signage to notify motorists of the cameras, and some fixed units are paired with roadway designs that include lane reductions, chicanes or bump out treatments at gateways, and other features that signal to motorists to reduce their speed. New South Wales tripled the hours of enforcement from 7,000 to 21,000 per month in mid-2021.

Automated Enforcement Programs

Advance Warning Signage
Source: FHWA

Mobile Phone Camera
Source: TfNSW (50)

The Mobile Phone Detection Camera Program checked over 89 million vehicles in 2020 to 2021 using roadside cameras and machine learning algorithms to determine if motorists were complying with the law against mobile phone use while driving. The program was piloted in 2019 and detected a non-compliance rate of 1.2 percent. During the 2020 to 2021 period, non-compliance dropped to less than a quarter of a percent, more than a fivefold

improvement. Leadership from New South Wales indicated the cameras can tell if someone has a phone in their lap, not just in their hands. The program netted over $42 million AUD during the reporting period, with all revenue directed into a Community Road Safety Fund. New South Wales is currently evaluating the programs' capabilities to detect seatbelt use (focusing on passengers visible through the front windshield).

New South Wales leadership indicated that, when 99 percent of motorists are compliant with speed and mobile phone laws, then the system switches to issuing warnings. When more than one percent are non-compliant, the system reverts to issuing citations. With a police force of 16,000 people and 8 million registered drivers, automation has helped scale up enforcement. Automated mobile photo detection raised the number of citations issued from 16,000 before implementation to over 183,000 as of 2021. Motorists can apply for a review of their offense and have a privacy commissioner review footage and issue a decision. Citations include financial penalties and license points, which can quickly result in license suspension. There are payment systems for low-income populations, and New South Wales is investing in a driver's license access program to help low-income populations earn their licenses back, as many require a license to earn their living.

In addition to camera-based detection, the New South Wales Police Force delivers an Enhanced Enforcement Program that includes random breathalyzer and mobile drug testing. In the 2020 to 2021 reporting period, police conducted over 2.7 million breathalyzer and nearly 95,000 drug tests. Leadership indicated that 40 percent of roadway fatalities in the 1980s involved alcohol. That rate has decreased to less than 15 percent today due to random testing, as well as alcohol interlock devices, and a lower threshold for maximum blood alcohol content. Testing is staff-intensive, but New South Wales estimates an effective rate of testing at approximately 12.5 million tests per year. At that rate, New South Wales would administer an average of approximately 1.5 tests per year to every registered motorist.

Road Safety Audits

A Road Safety Audit (RSA) is a formal safety performance examination. Practitioners apply RSAs to both existing and proposed road or intersection designs. The RSA qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. RSAs are performed by a qualified, independent, multidisciplinary team, providing a "check and balance" for project design teams. RSAs are not a substitute for quality control, design, peer review, project redesign, or other review processes and tools currently in use (51).

Safe System Audits

Waka Kotahi NZTa's Safe System audits apply the Safe System approach to the traditional road safety audit procedure. Safe System audits are formal, technical assessments of transport safety risks associated with transport improvement and renewal projects in New Zealand completed by independent, qualified audit teams. Unlike traditional RSAs, Safe System audits apply Safe System principles to ensure the transport network will operate as safely as practicable by eliminating fatal and serious injury crash potential. They are critical to achieve Waka Kotahi NZTa's Vision Zero aspirations (52).

Audit Processes

Austroads publishes the Guide to Road Safety series of policy guidance resources. The Austroads resource, "Managing Road Safety Audits," provides a comprehensive review of approaches to implementing road safety analyses throughout the planning, design, implementation, and operational lifecycle of transportation projects and programs (53). One of the most helpful resources in the document is a generic framework to show an idealized alignment of safety actions to the project lifecycle stages – see Figure 16. This framework groups safety actions into four categories: 1) safety vision, 2) proactive techniques, 3) predictive techniques, and 4) reactive techniques.

Waka Kotahi NZTa recommends a Safe System audit be completed at various project stages. These stages are not rigid, and Waka Kotahi NZTa indicates that the Safe System audit stages should match a project's complexity. The earlier an audit is undertaken, the easier and less expensive it is to adjust the project. At a minimum, it is recommended to undertake a Safe System audit at the design stage for all works within a public space. It is also recommended to embed Safe System auditing requirements for transport projects in appropriate policy documents (54).

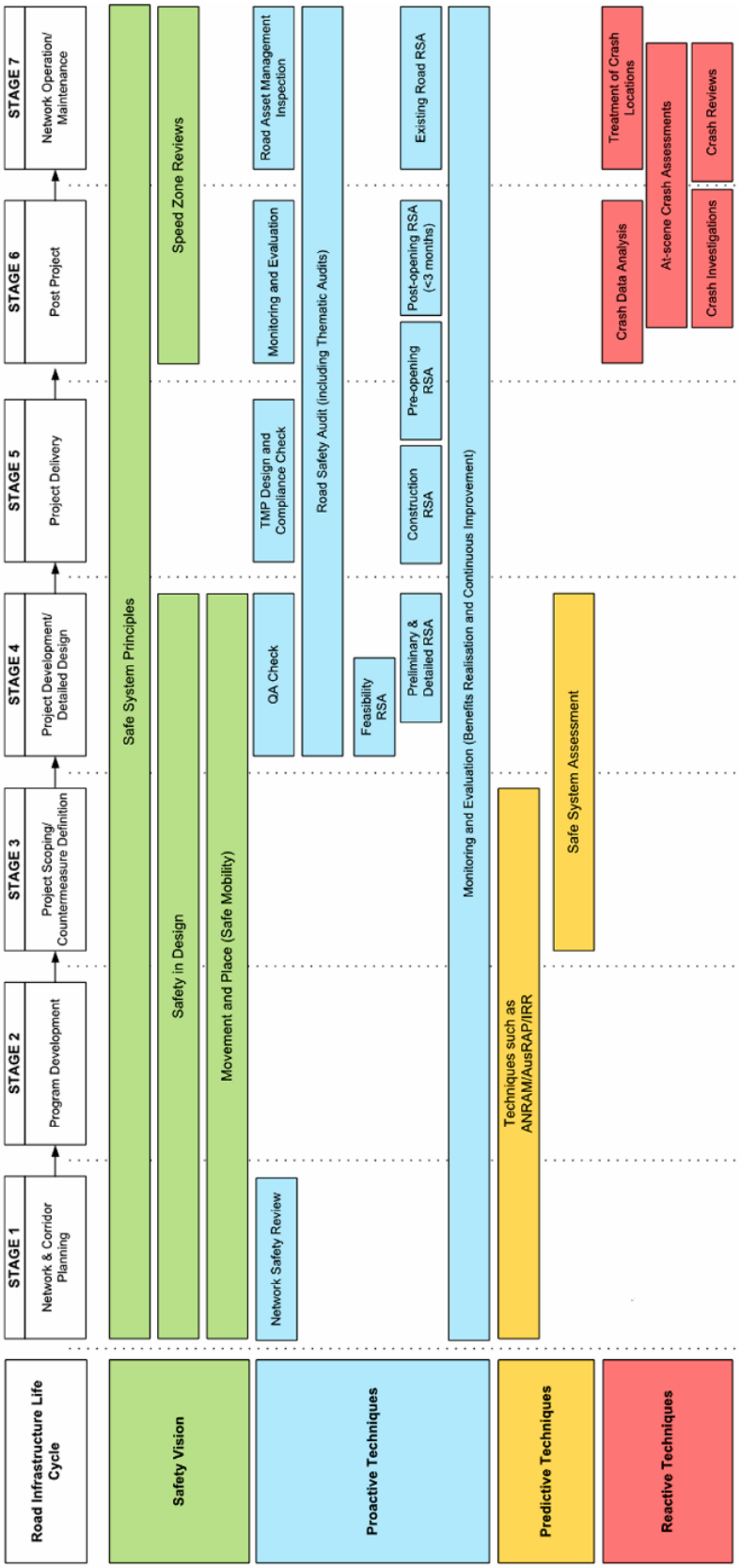


Figure 16: Austroads road safety network management framework
Source: Austroads (53)

Queensland Department of Transport and Main Roads (TMR) requires that all Road Safety projects must include a Network Safety Plan, Safe System Assessment, Road Safety Audit, and the Safe Systems Project Management Control Checklist, as outlined in the Queensland Road Safety Policy and Austroads Road Safety Audit Policy in the Guide to Road Safety (55), (53). TMR has produced a series of fact sheets, which are designed to assist project managers, engineers, and designers to implement 13 interim safety standards, in accordance with Queensland's Road Safety Policy. These safety standards will be applied in the planning and design of road infrastructure and operations projects.

TMR has also developed a Safety Assessment Framework, in which each project phase has a "gate" with specific requirements depending on a project's value that must be completed before progressing to the next phase. There is a Safe System Audit in each gate, and a Road Safety Audit in most gates, depending on project value (56).

Roles and Responsibilities

The roles in a Safe System audit vary, but typically include the client, designer and/or contractor, and the Safe System assessment or Safe System audit team. The audit team consists of at least two members who understand Safe System principles and have the professional knowledge, skills, and experience in Safe System engineering or crash investigation, and knowledge of road design or traffic engineering principles. Waka Kotahi NZTa recommends an audit team of at least two or three members to incorporate diverse backgrounds, experience, disciplines, knowledge, and encourage cross-fertilization of ideas through discussion. Larger teams benefit more complex projects.

According to Waka Kotahi NZTa, the Safe System audit team *must be independent of the client, designer, or contractor* so that the project outcome is unbiased. Waka Kotahi NZTa notes that practitioners are expected to have attended a Safe System engineering workshop or similar training designed specifically for those undertaking Safe System audits (54).

Audit Stages

Waka Kotahi NZTa's Safe System audit guidelines outline the audit stages and their alignment with a project's development and implementation stages, as shown in Figure 17. The Safe System audit process begins with an audit brief that includes general information, project background and requirements, and a formal commencement meeting to confirm process, scope, responsibilities, and any additional requirements. Following the meeting, the audit team will review background documents and discuss initial observations.

Next, the Safe System audit team completes a project site inspection. This step is recommended at each stage in a project. It is performed to see how proposed actions interact with its surroundings and to visualize impediments and conflicts for all road users. A debrief meeting is then held to seek clarification on any concerns, give preliminary feedback to the designer and client regarding any identified safety concerns, and informally discuss possible solutions to problems.

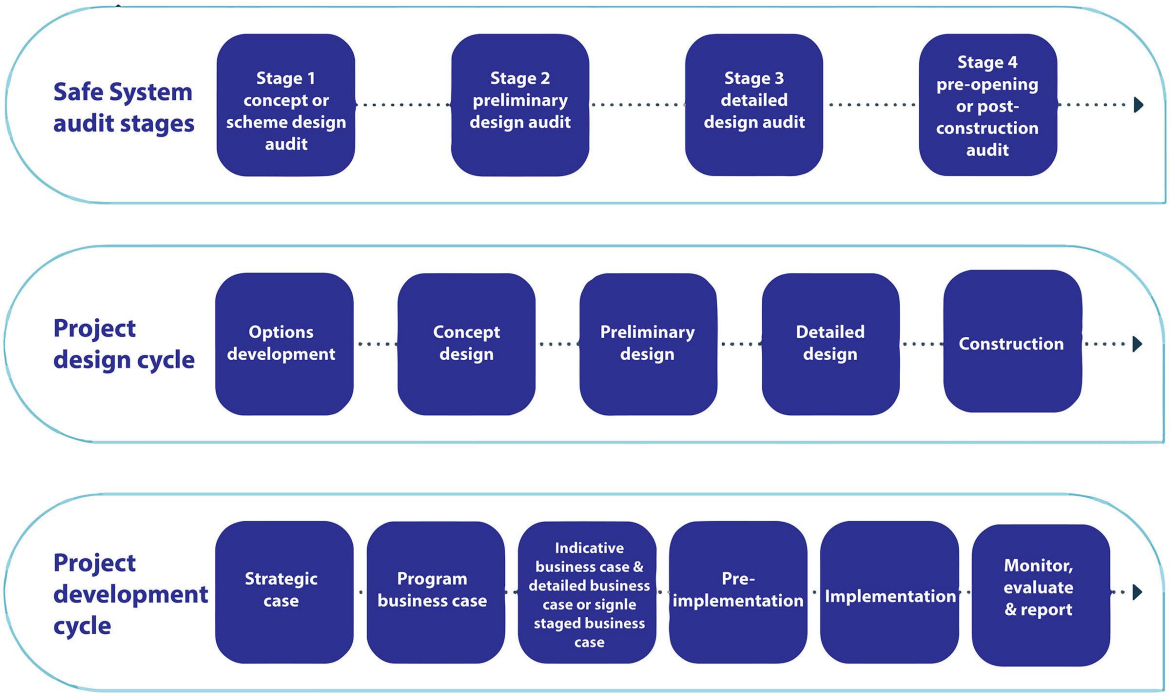


Figure 17: Safe System audit stages within project development
Source: Waka Kotahi New Zealand Transport Agency (54)

The Safe System audit team writes a report to document the audit scoring and findings. The report includes the safe system assessment and evaluation of various aspects of project where safety concerns have been identified and risks have been assessed against the safety concern risk rating matrix with recommendations about corrective actions.

The client makes the final decision about whether recommendations are adopted. If a recommendation is not adopted, the reasons are clearly documented by the client. Following the end of the audit, the safety concern decision tracking table is embedded at the end of the report and documents the designer's response, the client's decision, and the action taken (54).

Audit Scoring

Safe System audit scoring evaluates the project's alignment with Safe System principles and identifies ways to improve alignment with a focus on minimizing fatal and serious injuries.

The Safe System assessment table is used to assess existing conditions and project options against Safe System principles. A lower score indicates greater alignment with the Safe System. The Safe System assessment scoring system is used to assess each safety concern and is available in the Waka Kotahi NZTa Safe System audit guidelines (54).

Section 4. Planning & Process

Movement and Place

Many transportation agencies design and engineer corridors one at a time, applying a reactive approach to safety based on crash history, and forecasting transportation demand based on motor vehicle volume. In many communities, residents, business owners, and elected leaders heavily influence transportation priorities. While local projects benefit from incorporating local data and equitable stakeholder input, they also benefit from considering community-wide, regional, Statewide, and national policy goals. This is difficult if the agency cannot link their local and project-specific decision making to a strategic and comprehensive planning approach. The Movement and Place planning framework and process can serve as that link between policy making and the design and implementation of transportation projects. The core of Movement and Place is about understanding context and calibrating how a community wants their roads and streets to operate in each context. See Figure 18.

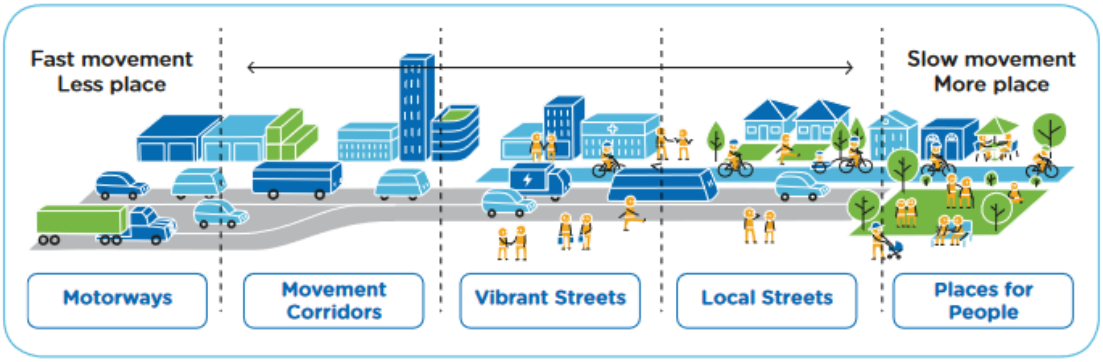


Figure 18: The Movement and Place continuum
Source: Transport for New South Wales (57)

This framework allows practitioners to design and operate their roads under the guidance of a network-scale approach that considers how a transportation system can advance many societal goals, rather than narrowly serve motor vehicle transportation.

Principles of the Movement and Place Framework

There are three core principles to Movement and Place:

1. Establish a common basis for decision making
2. Consider all modes
3. Coordinate the transformation of transportation and land use

Movement and Place applies these principles to overcome common barriers to implementing changes to the transportation network, such as complete streets, transit priority, placemaking, and other transformative projects. This type of planning process ensures multimodal connectivity, efficiency, and an appropriate match between transportation facilities and adjacent land uses.

1) Establish a common basis for decision making

New Zealand's version of Movement and Place describes this holistic approach to transportation planning as: *providing a foundation for consistent conversations* (58).

At its core, the Movement and Place Framework helps to establish the priorities for how each road functions within a larger network. This provides agencies with a consistent basis for setting priorities across the entire network, at whichever scale is being considered – local, regional, statewide, or national. Movement and Place is a planning tool for change. It documents existing modal priorities and land uses and facilitates a process for designating how roadways can evolve to prioritize modes differently in the future, in coordination with changing land uses. This process allows a range of stakeholders to participate in developing and agreeing upon a collective plan for the character and emphasis of future transportation and land use projects. The complex requirements of building a safe and connected multimodal network can only be met at the network scale, linking land use and transportation decision making to achieve broad climate, public health, and economic opportunity goals.

Movement and Place is a planning process that classifies roads holistically, based on a desired future land use and transportation configuration.

"Movement and Place is a multi-disciplinary, place-based approach to the planning, design, delivery, and operation of transport networks. It broadens our thinking about our roads and streets beyond their functional role in supporting movement - they are also places for people to live, work and spend time."

"It is part of an international shift towards embracing the importance of people and place when designing, planning, or operating streets and roads. It recognizes the complementary relationships between place and movement and matching the road or street to its desired function within the wider network." (90)

2) Consider all modes

Movement and Place shifts the focus of transportation planning from moving vehicles to moving people and goods, by any mode. The framework incorporates walking, rolling, cycling, freight, and public transit, in addition to motor vehicle traffic. This also broadens the definition of "transportation network" to include off-street routes like multiuse paths that can serve as important non-motorized transportation links.

Movement and Place documents existing roadway characteristics as the baseline or departure point for developing the future network. Practitioners consider how changes to existing modal priorities could better serve all modes to move goods and people efficiently, whether through filling gaps in connectivity for people walking or bicycling, or by recategorizing major corridors to prioritize different modes. Shifting a network's priorities to emphasize more walking, rolling, and riding can often result in a more efficient use of the network, as public transit, bicycle, and pedestrian travel are more efficient uses of space than motor vehicle travel. Making the case for these changes is easier at a network scale as they can be coordinated to form more complete networks that serve all modes.

Movement and Place helps practitioners take an objective and proactive approach to the ongoing evolution of the transportation network.

Planning with the Movement and Place framework establishes a defensible logic for each project and project management team that subsequently sets out to transform the network, one segment or corridor at a time, as contributing to the implementation of a larger strategic plan at a network-scale.

Practitioners often have difficulty making the case to remove vehicle travel or parking lanes at a segment or corridor-level to make space for other modes. By considering non-motorized travel and transit connectivity at a network scale, Movement and Place allows these conversations to happen objectively, preempting the challenges of implementing changes at the segment or corridor level.

3) Coordinate the transformation of transportation and land use

Finally, Movement and Place incorporates more than just planning for movement – it also considers the value of *planning for place* (59). Place, in this context, means private or public development – residential, commercial, industrial, institutional, civic, and other uses. Place also refers to land use density, architectural design, and urban design, including the design and function of the public realm around buildings and public spaces.

Auto-oriented arterial roadways are generally characterized by auto-oriented developments. These development patterns are inconvenient, unsafe, and sometimes impossible for non-motorized travelers and public transit riders to access. As with existing transportation

networks, Movement and Place establishes these existing land use characteristics as a baseline or departure point for the process of envisioning a desired future set of places. That process incorporates community goals for future land uses and the public realm, which can work in tandem with future movement goals to help define different modal emphases – with commensurate speed limits and infrastructure – on different parts of the network.

Land use patterns and transportation networks both evolve incrementally, perpetuating or transforming existing patterns of Movement and Place over time. By establishing a coordinated vision for future transportation and land use, Movement and Place helps accelerate the coordinated evolution of both public and private investments in the built environment. This process reduces uncertainty. It allows communities to develop zoning, architectural design guidelines, and municipal policies that facilitate the kinds of development that encourage and accommodate people walking, rolling, biking, and riding public transit in greater numbers. This in turn provides more clarity for developers, and can help break the cycle of self-reinforcing, auto-oriented land use and transportation projects, and lead to more efficient use of public and private land for Movement and Place.

Examples of Movement and Place in Practice: New Zealand

New Zealand's One Network Framework

New Zealand's version of Movement and Place is called the One Network Framework (ONF), led by Waka Kotahi NZTa (39). The study team identified One Network Framework as the most robust and well-documented example of a Movement and Place framework. This report provides an in-depth review, with references to the many documents and web resources available through Waka Kotahi NZTa.

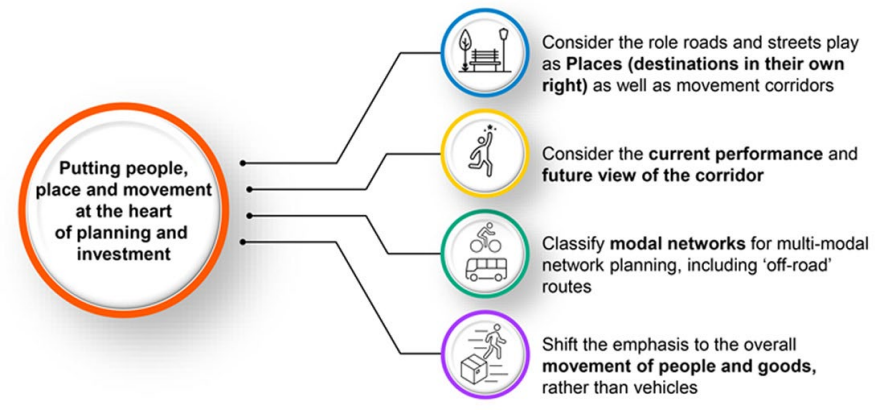
Originally driven by a focus on motor vehicle level of service (LOS) and system congestion, the new classification system incorporates travel by all modes and considers land use and urban design context on New Zealand roadways. One Network Framework builds on a series of network-level projects and programs that have led New Zealand to progressively redefine their roadway classification system and how they use it to manage speed limits, prioritize modes, and strategically align operations and infrastructure investments, over time.

As noted in Section 3, New Zealands' RCAs are the entities that change speed limits on the roads and streets in their jurisdictions. They can now use a combination of context-categorization via ONF and the speed setting guidance in the new Land Transport Rule to guide their targeted speed reduction efforts.

New Zealand Approach to Movement and Place

"The ONF (One Network Framework) uses the Movement and Place framework to determine the function of all roads and streets, acknowledging that roads and streets perform two functions – they help move people and goods and are places where people spend time" (91).

The ONF provides a shift in focus as shown below (39):



New Zealand's One Network Framework strives to:

- Improve the integration of land use and transportation planning, to support more strategic and informed decision making.
- Create a common language for discussing the function of roads, with an easy-to-understand mechanism to inform conversations about the complexity of transportation networks, including competing demands, strategic objectives, and potential investment.
- Consider both the current and future Movement and Place function of the network and use these layers in tandem to identify network gaps and guide investment decisions that work to close them (58).

The One Network Framework Classification Matrix shown in Figure 19 illustrates how the Movement and Place functions merge to create twelve categories, five for rural areas and seven for urban areas. ONF ranks the highest Movement and Place functions as "1" and the lowest as "5." Waka Kotahi NZTa's ONF website summarizes each categories' Movement and Place characteristics and highlights the speed limits considered "safe and appropriate" for each (60).

By cross-referencing Movement and Place functions, One Network Framework helps practitioners set speed limits and design investment decisions. Speed and design are based on modal priorities for the network that accomplish the safe and efficient movement of people and goods, while supporting complementary goals like public health, economic activity, and livability.

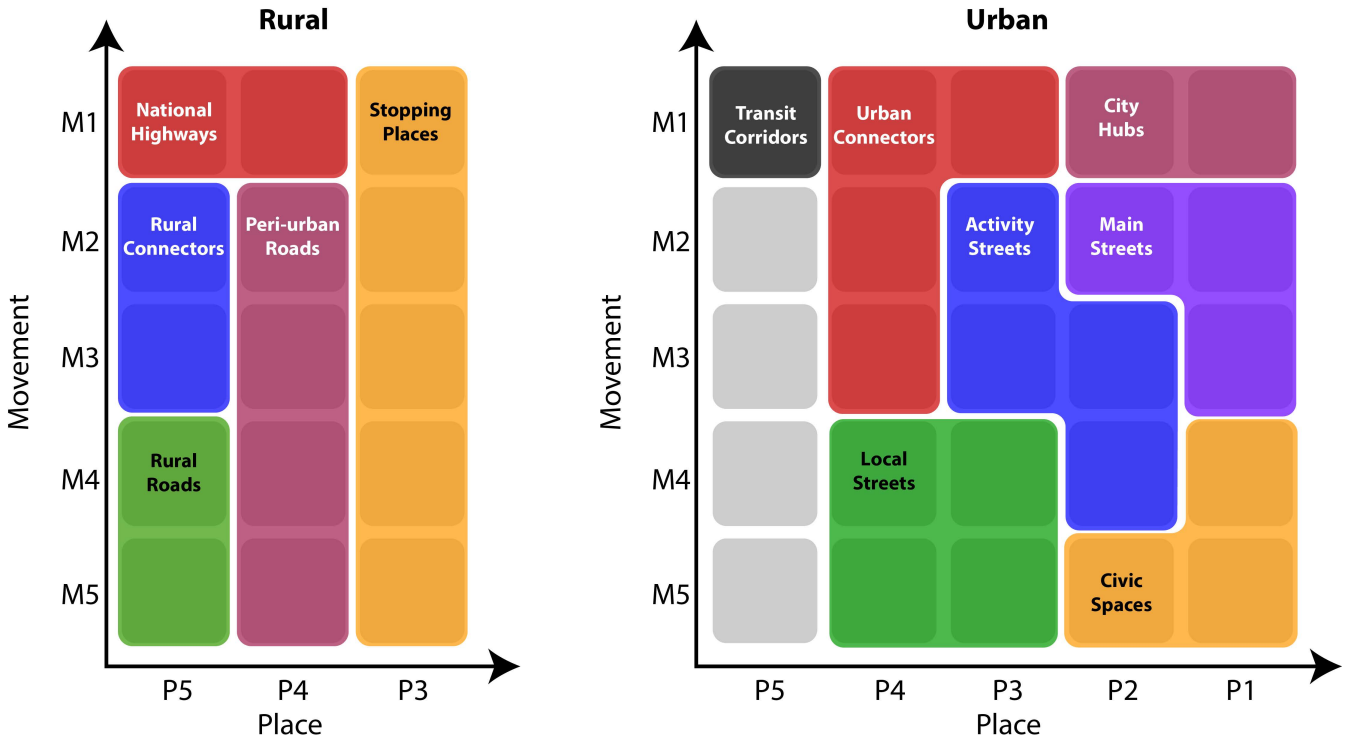


Figure 19: One Network Framework Classification Matrix
Source: Waka Kotahi New Zealand Transport Agency (39)

Classification Characteristics

One Network Framework uses a five-point scale to classify Movement and Place functions, as shown in the classification matrix in Figure 19 (61). Movement function (vertical axis on the matrix) is based on the daily volume of people traveling through a corridor using all modes of transportation, and the nature of that movement. See Table 2 for the generalized characteristics associated with each movement function.

Place function (horizontal axis on the matrix) is based on the level of on-street activity happening within a corridor, including pedestrian activity and movement across the corridor, and the adjacent land uses. See Table 3 for the generalized characteristics associated with each place function.

Table 2: Characteristics of the One Network Framework movement functions. Source: (61)

Movement function	Movement significance	Nature of movement, primarily along the corridor	Daily volume of people (all modes) along the corridor
M1	Major	Mass movement of people and goods, both regionally and nationally	More than 20,000
M2	Significant	Movement of people and goods on regional and local routes linking major destinations and urban centers	10,000 – 25,000
M3	Moderate	Movement of people and goods within a town, city, or region	3,000 – 12,000
M4	Minor	Local movement by people for short trips or to connect to higher-movement segments	300 – 4,000
M5	Low	Local movement by local people	Fewer than 500

Table 3: Characteristics of the One Network Framework place functions. Source: (61)

Place function	Typical adjacent land use and characteristics of on-street activity, including movement across the corridor	Level of on-street pedestrian activity
P1	High rise office blocks and apartments, major commercial centers, and central business districts; major movement across the corridor and highest frequency of people spending time at locations on the corridor	Very high - More than 1,000/hour or 5,000/day
P2	Mid-density office and low-rise apartments, entertainment venues, retail and community facilities; significant movement across the corridor and high frequency of people spending time	High - More than 2,500/day
P3	Low-rise office and apartments, entertainment venues, retail, commercial trade, and community facilities; some movement across the corridor and moderate frequency of people spending time	Medium - More than 1,000/day
P4	Residences, schools, community facilities, low-intensity industrial and commercial facilities; limited movement across the corridor and minimal or infrequent activity	Low - Less than 1,000/day
P5	Rural context or limited-access corridors in urban areas; little to no movement across the corridor and minimal activity	Negligible

Urban Arterials and the One Network Framework

As the primary focus for this study, U.S. urban "other principal arterials" and "minor arterials" have an Average Annual Daily Traffic (AADT) of 3,000 to 27,000 (62). These U.S. arterials are most equivalent to the urban One Network Framework categories with higher movement functions (consult Figure 19 for reference): **City Hubs**, and some **Urban Connectors**, **Activity Streets**, and **Main Streets**. The **Transit Corridors** category is comparable to limited access U.S. expressways but is included for completeness and because the One Network Framework speed and design characteristics for these corridors play an important role in improving safety for all road users. *Note, the name "transit corridors" should not be confused with the U.S. use of the term "transit," which references public transit service and transit vehicles like buses and trains.*

Speed limits play an important role in enabling the kinds of Movement and Place desired in each of these categories. Each category notes the safe and appropriate speeds, and the commensurate interaction or separation of modes, needed to facilitate the desired Movement and Place characteristics. The following summaries describe the characteristics and differences between these One Network Framework categories (see Figure 19 for reference):

Transit Corridors provide the highest movement function (M1) and the lowest place function (M5), clearly prioritizing movement over place. Transit corridors facilitate the fast and efficient movement of people and goods within urban areas. These facilities are usually access controlled, limiting or eliminating the presence of people walking, rolling, or cycling on these roads. Transit corridors serve motor vehicles and freight and include heavy rail networks and transit routes.

Because interaction with vulnerable road users is minimized or eliminated through access control, most transit corridors have a safe and appropriate speed of 80 km/h (50 mph), though some may reach 100km/h (62 mph) where they can meet Speed Management Guide criteria.

Urban Connectors provide higher movement functions (M1 to M3) and can also provide a range of place functions (P1 to P4). Some may prioritize movement over place, while others may balance or inverse those priorities. Urban connectors serve high levels of personal motor vehicle and freight traffic, and often serve public transit and provide major cycling routes.

Where walking and cycling facilities are separated from traffic, and on-street parking is prohibited, urban connectors can have a safe and appropriate speed of up to 60 km/h (37 mph). That speed limit drops to 50 km/h (31 mph) if the corridor includes higher vehicle volumes and multiple lanes of travel in the same direction, or travels through a non-residential area and has a median divider. Corridors with no median or which travel through residential areas are limited to 40 km/h (25 mph).

City Hubs provide the highest movement function (M1) and the highest place functions (P1 to P2). These are the "dense and vibrant" areas, featuring shopping, employment, entertainment, and other businesses, that prioritize both Movement and Place. To do so, this category relies on more efficient modes of transportation to achieve a high movement function, supporting very high levels of people walking, cycling, and using public transit. City hubs' high place function includes the need for goods movement via freight, as well as taxi, ride share, and personal motor vehicle use.

With frequent interaction between people walking, rolling, cycling, using public transit, and others using motor vehicles, the safe and appropriate speed for city hubs is 30 km/h (19 mph). Where formal cycling facilities exist, both on-street and separated, and pedestrian crossings are improved with markings, signals, and infrastructure, city hub speeds can be increased to 40 km/h (25 mph).

Activity Streets provide a mix of movement functions (M2 to M4) and place functions (P2 to P3). These are active streets that feature apartments, retail, entertainment venues, and community facilities, and provide access to commercial trade and industrial uses. People spend a significant amount of time working, shopping, eating, and residing in these corridors, which support a high volume of people walking, rolling, cycling, using public transit and motor vehicles, including freight.

As with city hubs, frequent interaction between modes means the safe and appropriate speed for activity streets is 30 km/h (19 mph). Where formal cycling facilities exist, both on-street and separated, and pedestrian crossings are improved with markings, signals, and infrastructure, activity street speeds can be increased to 40 km/h (25 mph).

Main Streets provide a mix of higher movement functions (M2 to M3) and the highest place functions (P1 to P2). These are similar to activity streets but emphasize retail and entertainment venues that support public life. People spend a significant amount of time working, shopping, eating, and residing in these corridors, which need to balance a high volume of people walking, rolling, cycling, using public transit and motor vehicles, including freight and goods delivery.

As with city hubs and activity streets, frequent interaction between modes means the safe and appropriate speed for main streets is 30 km/h (19 mph). Where formal cycling facilities exist, both on-street and separated, and pedestrian crossings are improved with markings, signals, and infrastructure, main street speeds can be increased to 40 km/h (25 mph).

Non-arterial categories strongly prioritize place over movement, with speed limits that match. **Local Streets** and **Civic Spaces** feature safe and appropriate speeds of 30 km/h (19 mph) and 10 km/h (6 mph), respectively.

Existing Conditions Classification

To create the One Network Framework, Waka Kotahi NZTa created an "automated" One Network Framework base (existing conditions) layer in their Road Asset and Maintenance Management (RAMM) system – a national Geographic Information System (GIS) (63). Inputs to the One Network Framework base layer include classifications from the prior LOS-based system, AADT as a proxy for level of movement, and land use based on an Infrastructure Risk Rating as a proxy for place. This base layer generated both a movement classification and a place classification, each describing the existing context on every public road, public transit corridor, and pathway. To vet the automated One Network Framework for accuracy and to ensure national consistency, each Road Controlling Authority (RCA) in New Zealand – elected councils that oversee municipal and regional governance – participated in a series of workshops to review and adjust the automated base network.

Future Conditions Classification

Waka Kotahi NZTa, local transportation agencies, and local RCAs are still in the process of implementing the One Network Framework. Part of that process is developing a future classification layer that confirms or updates existing classifications from the base layer. RCAs use a digital interface called "Mega Maps" to identify changes to the classification of various corridors to help to close gaps in modal networks, ensure safe and appropriate speed limits are in place to provide safety for all road users, and better match future transportation investments to emerging and future land use contexts (64). MegaMaps provides a comprehensive set of infrastructure and contextual data to assist RCAs in updating the future conditions classifications. The eLearning module for MegaMaps provides an overview of operational layers (65).

The One Network Framework Classification Guidance for RCAs notes that "there will be cases where a road or street appears to have two functions. In these cases, it is important to determine the predominant or primary function" (58). Roads and streets can do different jobs – their movement characteristics will not always be their defining characteristics throughout an entire corridor. Practitioners can use the One Network Framework process to resolve differences between the One Network Framework base and future classification layers. This identifies where and how RCAs may need to change the Movement and Place characteristics of roads and streets to better meet their needs.

For example, an Activity Street (M3/P2) with a medium movement characteristic and a speed limit of 40 km/h (25 mph) may feature a cluster of shops and restaurants or a collection of municipal buildings and a village green as it passes through a town center. These uses generate increased on-street activity and more frequent desire for movement across the corridor. Without any changes to existing land uses, the RCA may reclassify the relevant road segment to better reflect its existing characteristics and overall role in the network. The segment with shops and restaurants could be reclassified to a Main Street (M3/P1) with a speed limit of 30 km/h (19 mph) and the segment with municipal buildings

reclassified to a Civic Space (M4/P1) with a speed limit of 10 km/h (6 mph). The RCA may choose to institute automated speed enforcement cameras or periodic police enforcement to encourage adherence to the lower speed limits. Where the RCA observes or expects people to cross the street on foot, marked crosswalks can increase visual conspicuity, and raised crossings with anti-skid treatments can help slow vehicles and reduce stopping distances.

In another example, an arterial Urban Connector (M2/P4) with significant movement might feature properties that are evolving from low-density commercial uses into mid-rise mixed uses via redevelopment projects. Practitioners could use the One Network Framework to reclassify the Urban Connector (M2/P4) identified in the base layer as an Activity Street (M2/P3) in the future layer. This reclassification helps the RCA shift the corridor's emphasis toward higher place, encouraging a wider sidewalk and public realm with buildings fronting the street instead of set behind surface parking lots. The RCA could lower the speed limit from 50 km/h (31 mph) to 40 km/h (25 mph) and "detune" the corridor by converting vehicle lanes or on-street parking into transit priority lanes and separated bicycle lanes. These changes would be in service of the increased land use density and activity emerging along the corridor and might help incentivize further reinvestment. Meanwhile, the movement function would not be changed from M2. The improved facilities for public transit and cycling can move the same volume of people via those more efficient modes because of roadway space converted from less efficient motor vehicle lanes, and operational changes that prioritize bus travel during peak hours.

In another example, a corridor may already feature high place function, but the existing roadway is designed for high movement function alone. This is common where arterial roads enter urban centers. These corridors may function as Transit Corridors (M1/P5) or Urban Connectors (M1/P4 or P3) outside of urban centers. Practitioners can use the One Network Framework to reclassify them as City Hubs (M1/P2 or P1) once they enter the urban core. Such a reclassification can allow the RCA to reduce the speed limit from upwards of 80 km/h (50 mph) to 40 km/h (25 mph) or less. As vehicles enter the urban core, they lose priority to people walking, rolling, bicycling, and riding public transit along and across the corridor. Here the reclassification as a City Hub further enables the RCA to reduce vehicle capacity and intersection level-of-service to better accommodate other modes.

Interdisciplinary Collaboration

These examples show how the One Network Framework future classification layer may influence changes in what speed limits the RCA establishes on a corridor, or how it plans and designs investments in future infrastructure and operations projects. Getting to this point, and then applying the rationale for speed limit and design changes, requires an interdisciplinary approach.

The One Network Framework Detailed Design Manual includes an introductory graphic showing the roles planning and design disciplines play in relation to Movement and Place (see Figure 20). RCAs are encouraged to engage their transportation planners, traffic engineers, and asset management specialists, along with land use planners and urban designers, in the ONF process. By doing so, RCAs can leverage the diverse competencies of their practitioners to help realize a transportation system that improves safety for all road users, in addition to advancing broader goals related to public health, equity and opportunity, and economic and environmental resilience.

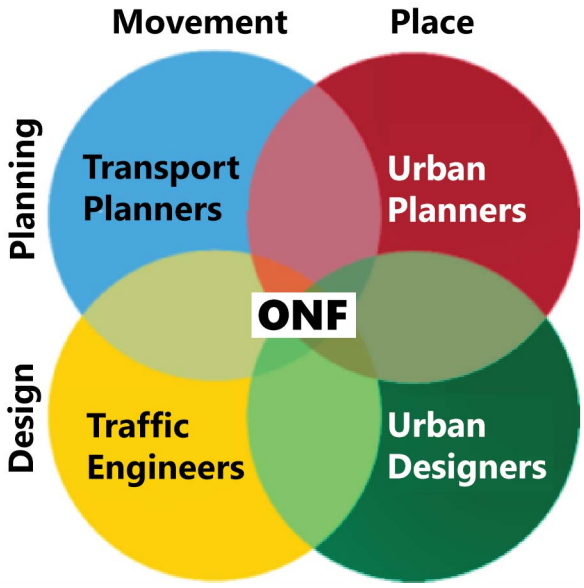


Figure 20: Practitioner roles aligned with the One Network Framework. Source: Waka Kotahi New Zealand Transport Agency (58)

Auckland Transport and the Network Effect

The hypothetical One Network Framework examples noted above describe potentially dramatic shifts in movement and/or place characteristics, but municipalities often find it challenging to implement significant road diets and reduce vehicle capacity on arterials. This is especially true if the corridor is not already an area of significant pedestrian activity. Nevertheless, urban areas across Australasia and the U.S. continue to grow. Maintaining or increasing the volume of people and goods that can safely move about an urban area – without expanding rights-of-way – requires a share of people to shift from motor vehicles to public transit, cycling, and other mobility services that use roadway space more efficiently. Demonstration projects in high-volume pedestrian destinations play an important role in illustrating the value of the Movement and Place framework as a planning process. Rail transit projects are necessary to dramatically increase the viability of public transit over motor vehicle travel in many regions. But even these significant investments require complementary first mile/last mile connections via walking, cycling, or other local mobility options, often on high-movement corridors. Once some of these major investments are

made, municipalities (or States, for that matter) can use Movement and Place to illuminate the remaining gaps in the network of walking, rolling, cycling, and public transit infrastructure. This can facilitate a cascade of smaller changes to lower-volume roads and bigger changes to major intersections and arterial roads that create entirely complete networks, not just a collection of individual complete streets.

Future Connect

Future Connect is Auckland Transport's long-range transportation plan (66) (67). It applies a systems-level planning framework to assessing problems and identifying opportunities across Auckland's transportation network. It seeks to be specific enough to help project-level planners and designers understand the modal priorities and safety needs along each segment of the *strategic networks*; however, it does not explore any design solutions, project evaluation, or funding allocations, and it does not address issues on the *supporting networks* (see below for more details about strategic and supporting networks). The plan delivers three outputs to guide future program- and project-level investment and decision making:

- **Strategic and Supporting Networks** – Define each strategic modal network and outline the most important links for movement of people, goods, and services.
- **Deficiency and Opportunity Mapping** – Compares existing and future states, highlighting the most significant problems and opportunities on the Strategic Networks.
- **Indicative Focus Areas** – Describe the most critical multimodal, safety, and environmental problems and opportunities located on the Strategic Networks that require further investigation.

Strategic and Supporting Networks

Future Connect establishes a set of networks as a strategic planning tool. Eschewing the "arterial, collector, local" road classification system, Future Connect emphasizes that all modes are equally important, and designates *strategic networks* for each mode: public transit, freight, cycling and micromobility, and general traffic. The pedestrian network is subject to an ongoing planning process and will be incorporated later. Strategic networks represent the most critical links for movement of people, goods, and services to be managed as part of an integrated multimodal network. The strategic networks are classified according to a three-level hierarchy: the *primary* network provides for longer distance journeys and typically carries the highest volumes of people and goods; the *secondary* network provides major connections to the primary network and key destinations; and the *tertiary* network connects between important, but more local, destinations. In contrast to the *strategic networks*, Future Connect's *supporting networks* are non-strategic links that connect people to the strategic networks. See Figure 21 for an example of the *strategic network, primary links* as designated for the first decade of Future Connect.

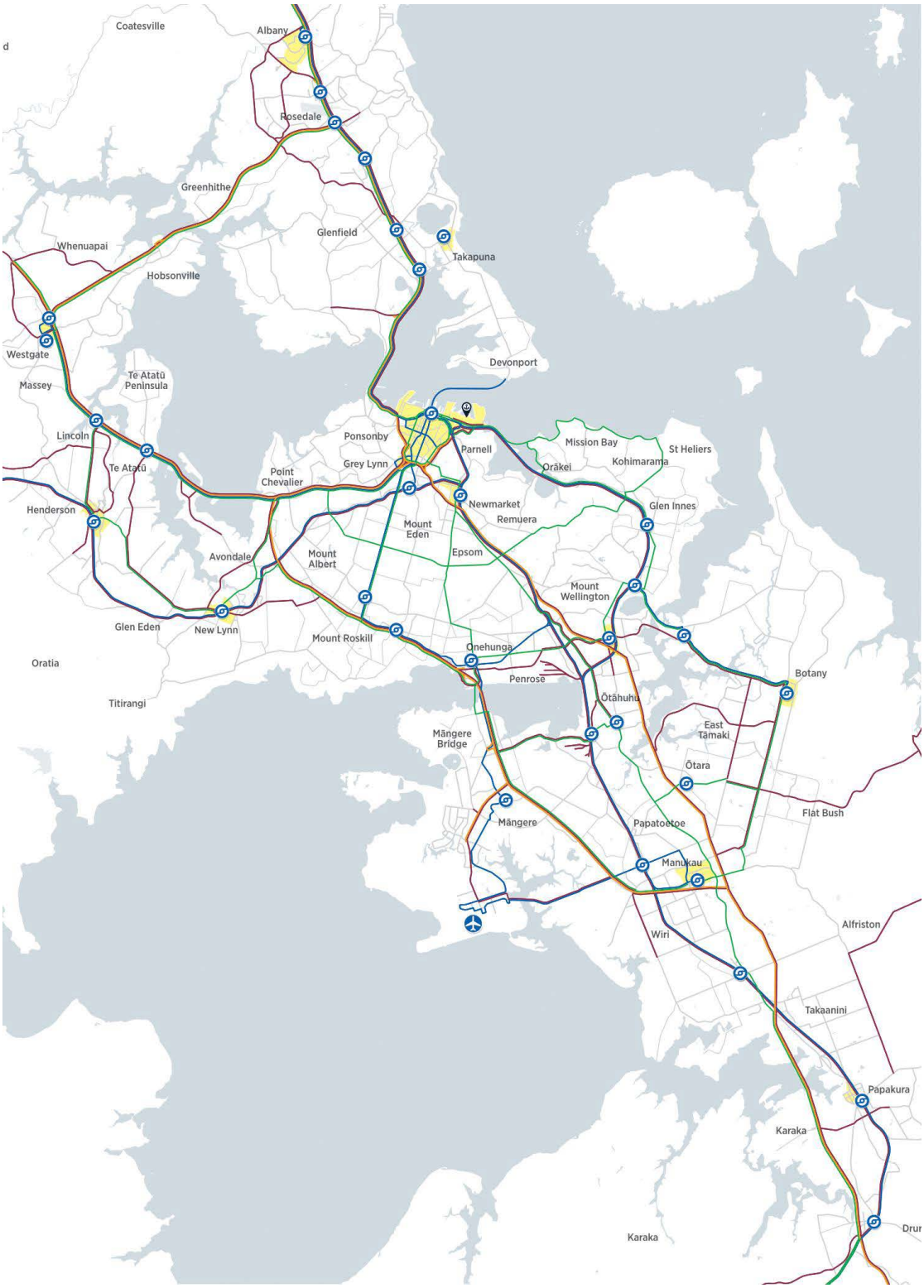


Figure 21: Future Connect Strategic Networks Map
Source: Auckland Transport (67)

Deficiency and Opportunity Mapping

Future Connect applies deficiency and opportunity indicators to rank each segment of the strategic networks for each mode. Indicators vary based on the mode; for the cycling and micromobility strategic network, the indicators are *safe and appropriate facility type* and *priority investigation areas* (for future detailed analysis), see Figure 22.

Because the cycling facilities are reviewed at a network scale, it is clearer where "key high-deficient links" interrupt what would otherwise be a continuous set of cycling routes along the designated strategic network. This helps the agency target investments to these locations and overcomes some of the challenges of making the case for trade-offs at a segment-by-segment level, because the deficiencies have already been identified at a network-scale. However, the solutions to address these deficiencies are still developed at the project or programming scale, leaving the important details of design and community engagement and coordination with other stakeholders for local project management teams.

Future Connect also provides two overlay network analyses: *Safety* (see Figure 23) and *Environment*, each with their own indicators. Safety has three key indicators: 1) *collective risk* as defined by KiwiRAP, the New Zealand version of iRAP, the International Road Assessment Program (68), 2) *active road user risk*, and 3) the *difference between posted speeds and "safe and appropriate" speeds*. These rankings help distinguish between competing priorities for future project investments, indicating those which rise to the top due to a combination of deficiencies across modes, for these two cross-cutting categories.

Indicative Focus Areas

Finally, Future Connect aggregates the ranked deficiencies and opportunities across all modes and issues to define *Indicative Focus Areas*, which represent the highest conglomeration of issues across the Strategic Networks (see Figure 24). Because these focus areas include special characteristics – for example, the central business district, or a corridor or neighborhood experiencing accelerated land use changes – Future Connect recommends developing a Strategic Rationale to "ensure a clear rationale and strategic alignment will underpin a new project" (67).

Cycle and Micromobility – First Decade Deficiency and Opportunity Ranking

Indicators and Ranking

1. **Safe and appropriate facility type**
   Lack of safe and appropriate cycle facilities (as defined by the Transport Design Manual) based on vehicular travel speed and volume.
2. **Priority Investigation Areas**
   Priority areas for investigation according to the Cycling Programme Business Case or Urban Cycleways Programme, without appropriate infrastructure in place already.

High

1. Unprotected existing facilities on roads with high volume/speed environment; or
2. First Decade Priority Investigation Areas (Cycling Programme Business Case or Urban Cycleways Programme)

Moderate

1. Inadequate shared path widths or shared paths with driveways; or
2. Other Cycling Programme Business Case Links

Hierarchy	Ranking Matrix		
Regional	3	2	1
Major	3	2	1
Connector A	4	3	2
	Low	Moderate	High
	Deficiency		

% Of Cycle Strategic Network	
1	25%
2	18%
3	47%
Other	10%

Key Findings

As the cycle network is dense and lacks the maturity of other networks there is a high prevalence of deficient links. Highlighted in green on the map: all Cycling PBC Investment Areas funded by the 2018-2028 RLTP (including additional areas for consideration by 2031).

Key high-deficient links and areas are: Strategic routes to and from the City Centre, links between isthmus and north shore, Henderson, Mangere and Manukau areas.

Ranked Deficiencies and Opportunities

Figure 22: Cycle and Micromobility Network Deficiency and Opportunity Ranking
Source: Auckland Transport (67)

Safety – First Decade Deficiency and Opportunity Ranking

Indicators and Ranking

1. **Urban KiwiRAP collective risk corridors**
   Safety risk allocated to a corridor based on the number of deaths and serious injuries in the last 5 years.
2. **Active Road User aggregated corridor risk level**
   A measure of relative risk to active road users. Higher classification where network presents higher risk to people using active travel modes based on the number of DSIs in the past 5 years.
3. **Difference between posted speed and safe & appropriate speeds**
   Where the difference between the posted speed and the Waka Kotahi recommended 'safe and appropriate speed' flags a risk.

High

1. High and Medium-High risk corridors; or
2. Active Road User Corridor Risk High or Medium-High; or
3. Speed difference ≥10 kph near metro/town centre

Moderate

1. Medium risk corridors; or
2. Active Road User Corridor Risk Medium; or
3. Speed difference ≥10kph

Mode	Ranking Matrix		
PT	4	2	1
GT	5	3	2
F	5	3	2
Cycle	4	2	1
	Low	Moderate	High
	Deficiency		

% Of all Strategic Networks	
1	17%
2	29%
3	9%
Other	45%

Key Findings

First ranked deficiencies and opportunities affect primary mixed-use urban arterials and related centres, particularly the city centre – areas with numerous conflicts between vehicles and vulnerable road users.
Second ranked deficiencies and opportunities affect a large number of connecting corridors.
All of these have a high number of deaths or serious injuries per annum relative to other similar road types in the region.

Ranked Deficiencies and Opportunities

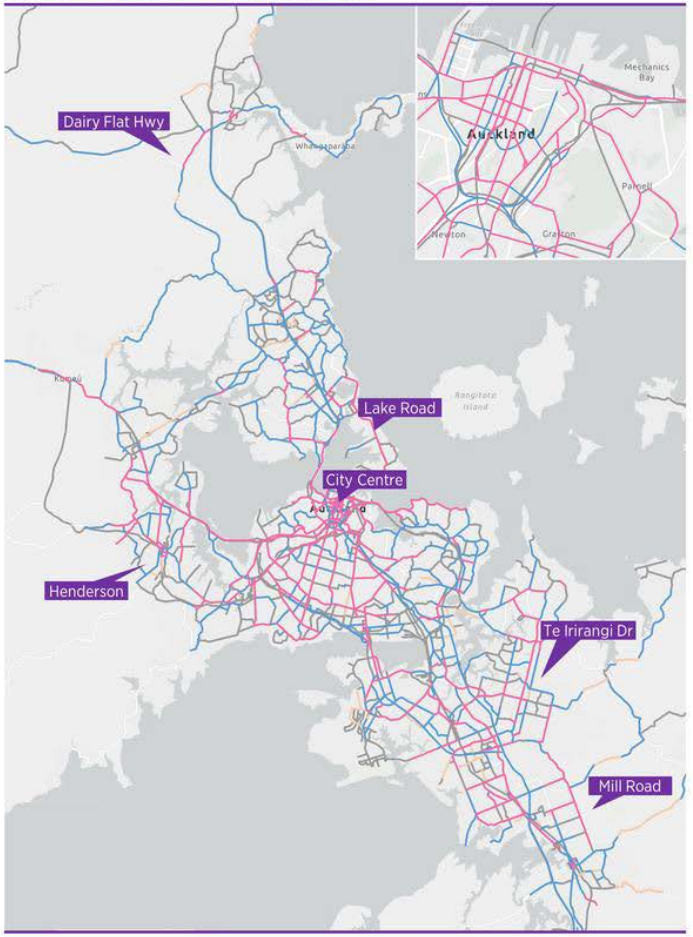


Figure 23: Safety Deficiency and Opportunity Ranking
Source: Auckland Transport (67)

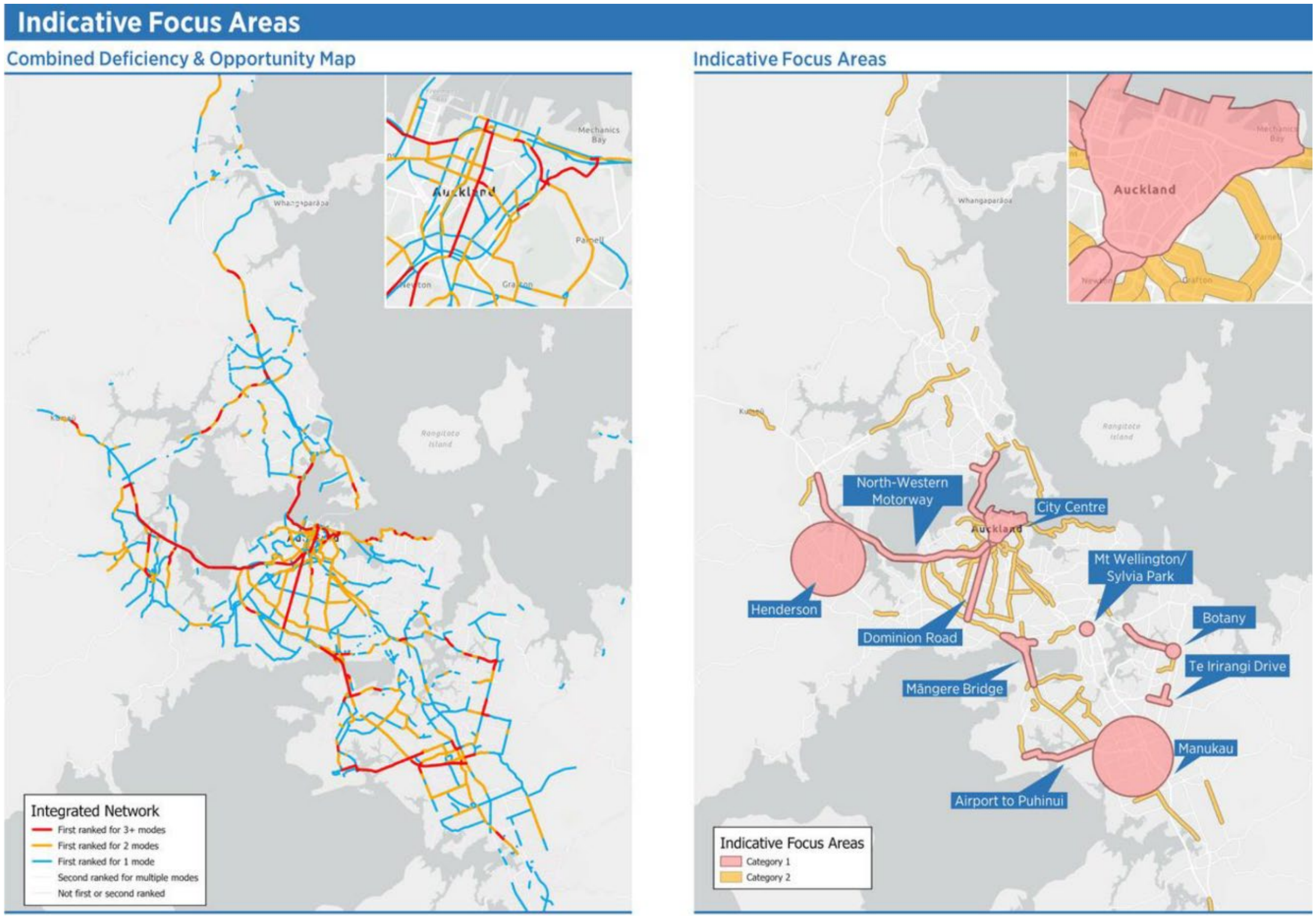


Figure 24: Indicative Focus Areas
Source: Auckland Transport (67)

Roads and Streets Framework (RASF)

The Roads and Streets Framework (RASF) is Auckland's version of the Movement and Place framework, describing the functions of roads and streets – and their contexts. The RASF is embedded within a broad planning framework; this aligns programmatic-level business cases for projects with geometric and operational design guidance from the Transport Design Manual (45). Figure 25 illustrates this broader framework and the connections between various policy, planning, and design elements.

RASF is the tool Auckland Transport applies to link planning and design, aligned with the planning priorities established in Future Connect long-range transportation plan. As with the One Network Framework, RASF follows a process to develop and apply context-sensitive transportation typologies, as organized in Figure 26. Critically, this process is also how Auckland Transport compares the existing and future network typologies and modal priorities. The first step is gathering information on place and movement. The second and third steps are assessing the typology and modal priority for existing and future states. The fourth step is preparing the RASF mandate, and the fifth step is applying it to the design process.

RASF ranks the significance of *place* based on the importance of a road or street's land use and public realm context as a destination itself. RASF ranks the significance of *movement* based on a road or street's level of strategic importance within the transport network. Movement is based on moving people and goods efficiently between locations and accessing key destinations – regardless of mode. Figure 27 shows the nine-part RASF typology matrix.

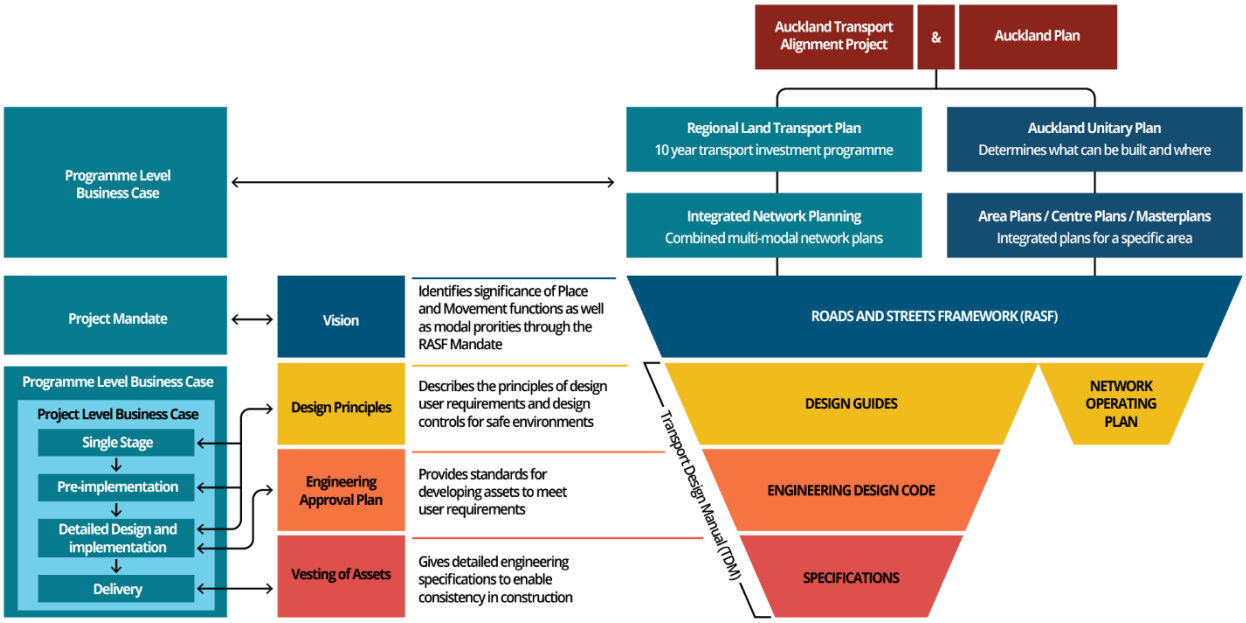


Figure 25: The RASF within the broader planning framework
Source: FHWA; adapted from Auckland Transport (45)

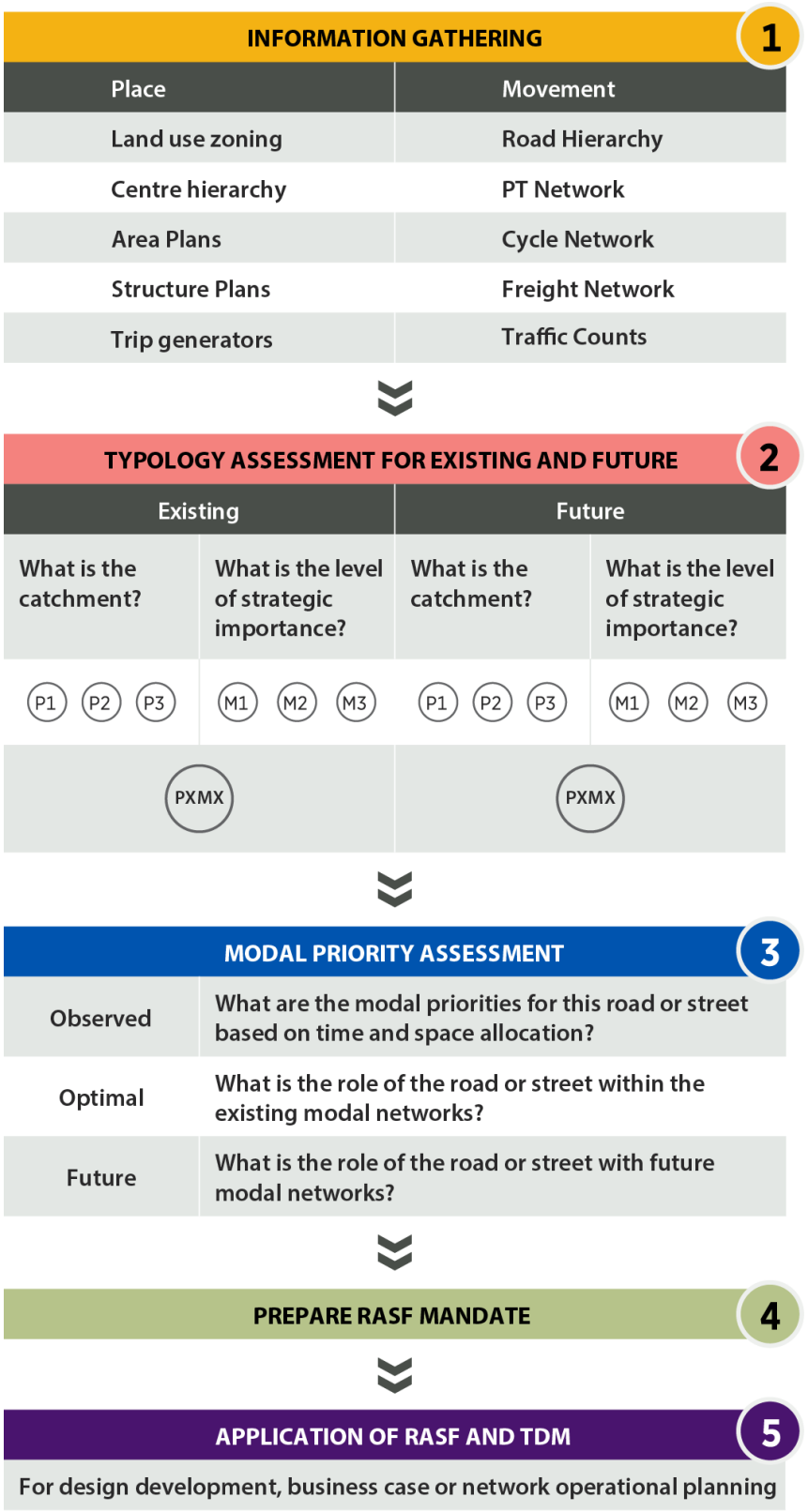


Figure 26: RASF Process
Source: Auckland Transport (69)

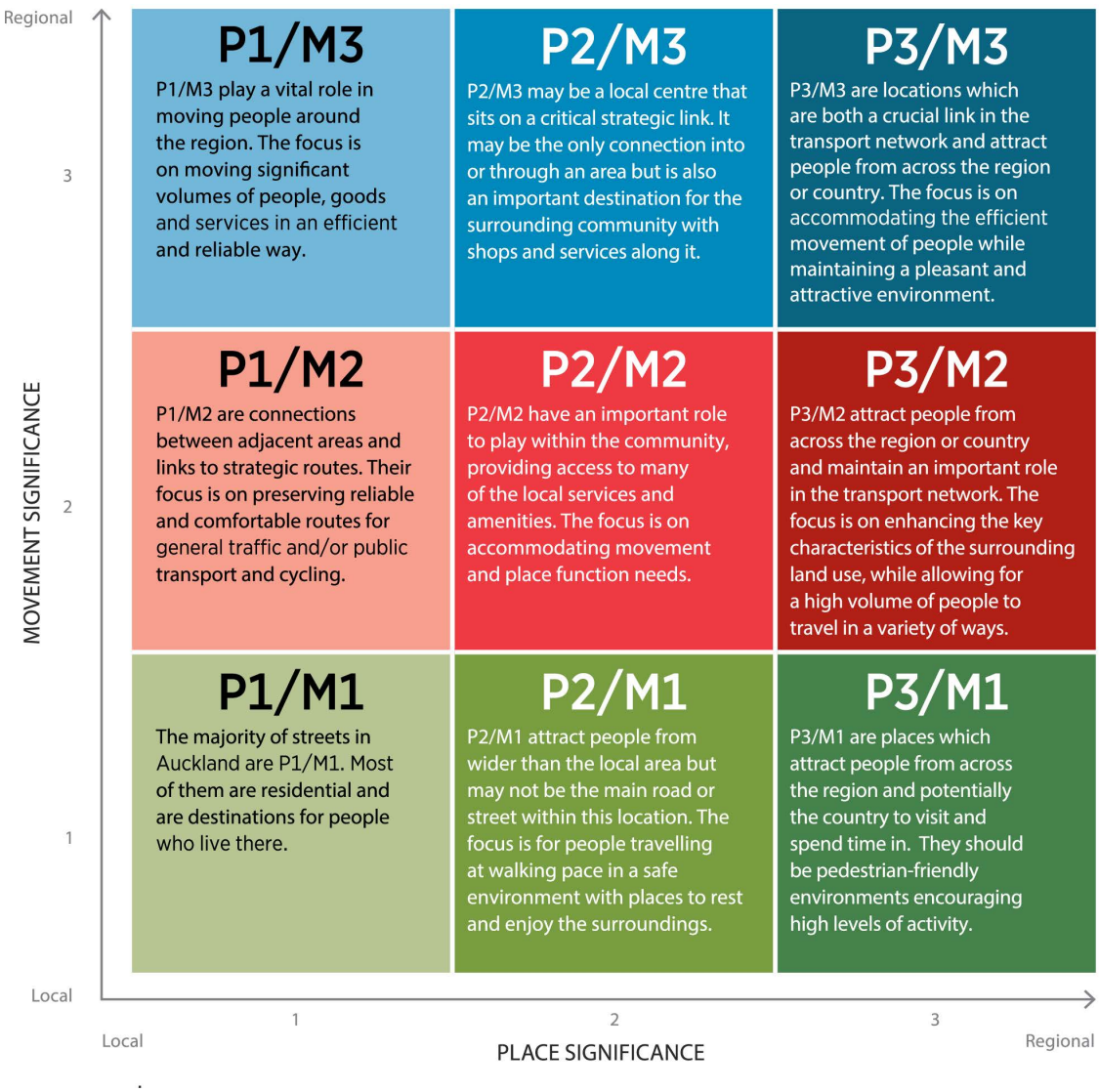


Figure 27: RASF Typology Matrix
Source: Auckland Transport (69)

Examples of Movement and Place in Practice: Australia

New South Wales

The Australian State of New South Wales also applies the Movement and Place framework to their transportation planning (70). Transport for New South Wales identifies how their planning documents and policies integrate movement and place. They created a useful diagram to show this integration into the lifecycle of planning, designing, implementing, operating, and retiring assets, see Figure 28. This "Practitioner's Guide to Movement and Place" outlines a six-step process for planners, urban designers, engineers, and others responsible for implementing a Movement and Place approach. The process starts with developing a vision, studying place and movement on the system, applying design principles, developing options, selecting a preferred design, and applying design standards. Once the project is implemented, it is monitored, operated, and maintained, with ongoing improvements as necessary to refine performance. Finally, the asset or design is retired once it has reached end-of-life.

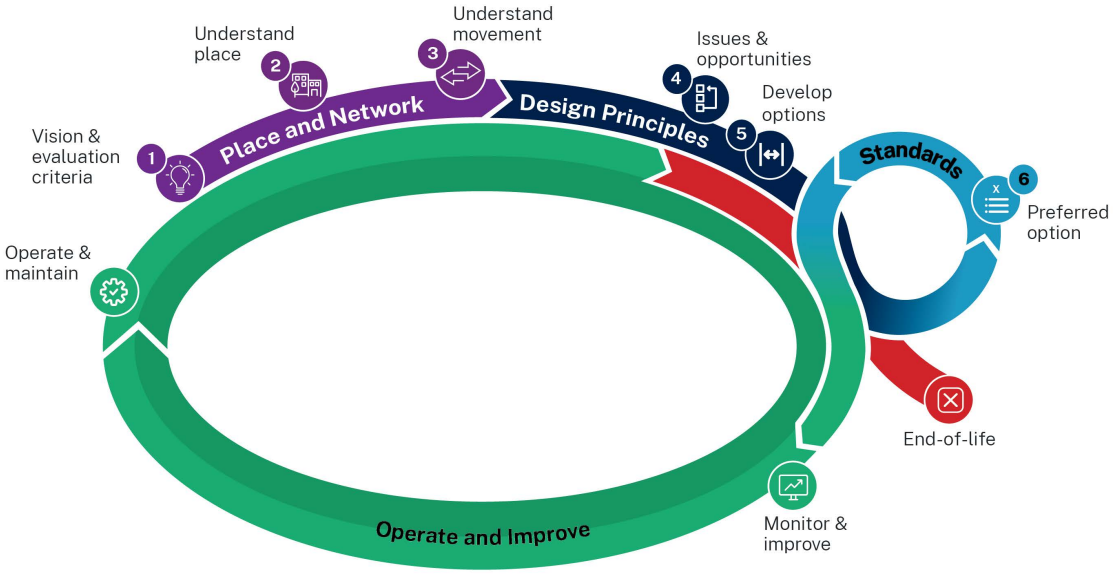


Figure 28: Transport for New South Wales "How it all fits together" Diagram
Source: Transport for New South Wales (71)

Design of Roads & Streets

Transport for New South Wales' movement and place framework is embedded in their "Design of Roads & Streets" resource, which differentiates between streets and roads with respect to function (72). *Streets* provide property access, are public spaces, support social and economic activity, while enabling movement and supporting freight and servicing. *Roads* enable movement to support journeys and economic activity and have their own form of place value. The movement and place framework identifies 21 road and street types

within four different environments – main roads, main streets, local streets, and civic spaces. As with One Network Framework and RASF, and Transport for New South Wales charts their road and street types according to their Movement and Place functions. See Figure 29. For each environment, it articulates a vision and identifies issues and opportunities. For each type, it specifies the appropriate urban context – urban center, urban, suburban, enterprise, peri-urban, or rural – and cites examples. It also includes design parameters for each environment and design elements for each function.

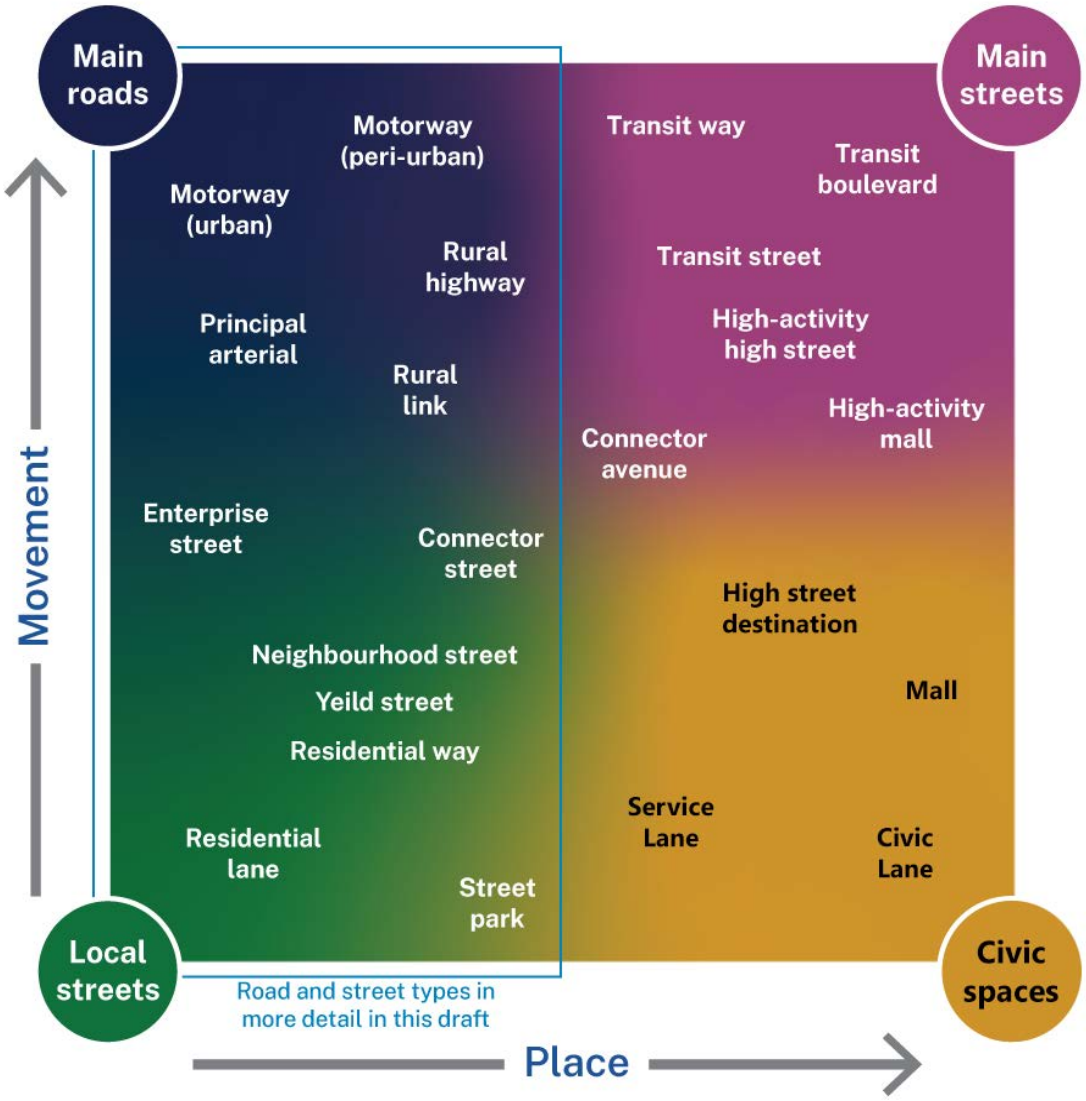


Figure 29: Transport for New South Wales Movement and Place Framework
Source: Transport for New South Wales (72)

Learning Hub

In addition to "Design of Roads and Streets" and dedicated guides for practitioners and

evaluators, NSW hosts a Learning Hub with six modules about Movement and Place: overview, core principles, place and network, design principles, standards, and operate and improve (73).

Austroads Reports and Webinars

For more information on the nexus between the Movement and Place framework and the Safe System approach to road safety, see "Integrating Safe System with Movement and Place for Vulnerable Road Users," a February 2020 report and webinar from Austroads that offers guidance to road designers and system operators on designing for pedestrians and cyclists (74). "NSW Movement and Place Framework" is a webinar from November 2022 from Austroads on NSW's Movement and Place Framework in relation to Austroads Guidance, Australian Standards, and the Global Street Design Guidelines (75).

Equity Considerations

Giving local municipal authorities the ability to classify their road network and establish future classification goals is an important form of equity. This distributes power to those closest to the issues, rather than making design decisions at the State or national levels. For example, local New Zealand council decisions around future One Network Framework classifications involve a democratic process, and Waka Kotahi NZTa staff indicate that each local council has dedicated Māori representation as well as relationships with the sight-impaired and disability community who are paid to be involved in planning and project review.

Section 5. Project Design & Implementation

Designing with Movement and Place

Transportation facility design in Australia and New Zealand is intimately connected with Movement and Place context classifications. Each country, State, and in some case cities (notably Auckland) create their own version of the Movement and Place framework, complete with their own classification and names for different typologies. However, the same engineering principles apply across Australasia, and designers apply similar treatments and operational strategies to improve pedestrian safety throughout the spectrum of roads and streets.

The following three examples from Transport for New South Wales appear in their highly detailed *Design of Roads and Streets* manual (72) which is also available as an interactive website (76). Refer to the Transport for New South Wales Movement and Place framework to understand the context of each facility type (see Figure 30).

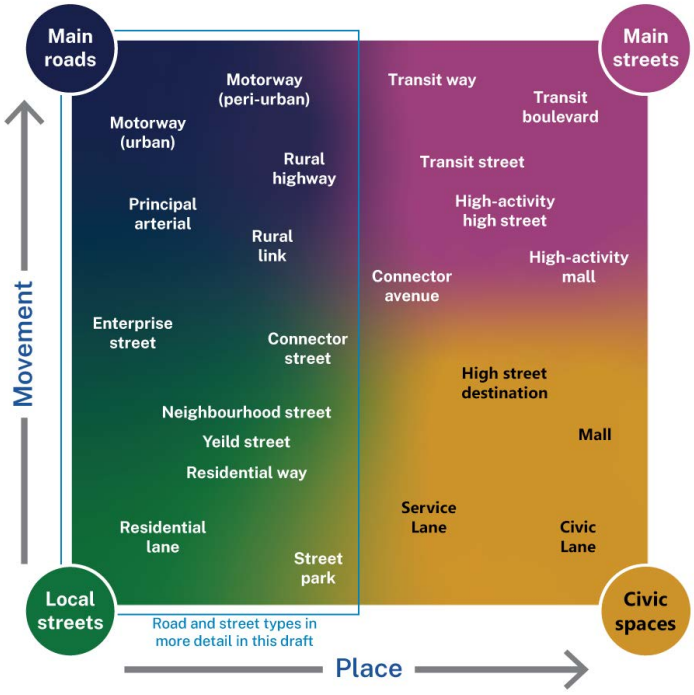


Figure 30: Transport for New South Wales Movement and Place Framework
Source: Transport for New South Wales (72)

Designing a Civic Lane

On streets with low speed limits, designers allow modes to interact and cross paths, in some cases sharing one singular space. In the Design of Roads and Streets manual, New South Wales notes several examples of the "Civic Lane" typology, "a vibrant and informal narrow street for spending time, often featuring local art and culture, and with shared or restricted access to motor vehicles" (72). Grosvenor Lane in Neutral Bay was a former alley (see Figure 31) that designers transformed into a shared zone with a 10 km/h (6 mph) speed limit with shared modal access, retail activity, and landscaping (see Figure 32).

Figure 31: Grosvenor Lane, Neutral Bay, New South Wales (2009)
Source: Google Street View (77)

Figure 32: Grosvenor Lane, Neutral Bay, New South Wales (2021)
Source: Google Street View (78)

Designing a Connector Avenue

Design typologies separate vulnerable road users from vehicles—in both time and space—along segments of the network with a higher intensity of movement significance for driving, public transit, cycling, and walking. Because vehicle speeds are higher, and freight and transit vehicles are more prevalent, this context dictates design features that mitigate the risk and severity of higher-speed crashes.

The Transport for New South Wales Design of Roads and Streets manual features several examples of the "Connector Avenue" typology, "a street with moderate place intensity and movement function that connects neighborhoods, urban centers, or enterprise areas" (72). Bourke Road in Alexandria was previously a four-lane road, with two travel lanes and two parking lanes (see Figure 33). The speed limit remains 50 km/h (31 mph), and it now features a two-way separated bicycle lane with concrete curbs at periodic intervals, sidewalks separated from the roadway by a landscaping strip, and floating bus boarding islands (see Figure 34).

Figure 33: Bourke Road, Alexandria, New South Wales (2007)
Source: Google Street View (79)

Figure 34: Bourke Road, Alexandria, New South Wales (2020)
Source: Google Street View (80)

These features are also flexible, making the best use of limited right of way while maintain the principles of movement that are appropriate for this typology. For example, at the location of the floating bus island, through-movement for vehicles is preserved by creating a pull-out space that the bus occupies while it is stopped to let passengers board and alight. To make space for this additional bus lane, parking is prohibited, and the travel lanes shift laterally. This trade-off maintains separation for cyclists and pedestrians, while eliminating the amenity of on-street parking to preserve vehicle through-movement.

Behind the bus island, the two-way separated bicycle lane also shifts laterally, and the sidewalk crosses it to reach the bus island precisely at the spot where cyclists must slow down to negotiate the tight curves. Pedestrians can continue along the bus island or may choose to walk along the two-way separated bicycle lane, which exposes them to a brief shared space with bicyclists but keeps them away from the roadway.

Speed cushions placed periodically along the corridor compel motorists to check their speed, which protects all road users including drivers. To ensure they do not attempt to drive around the speed humps, edge islands with low landscaping and mountable curbs occupy the parking lane and confine motorists to their travel lanes, bound on the other side by the raised curb separating the two-way separated bicycle lane. Again, the through movement and separation of cyclists and pedestrians is preserved, while the amenity of on-street parking is exchanged for these edge islands. Additionally, the two-way separated bicycle lane is highlighted with a green surface treatment for enhanced conspicuity at conflict zones, which include frequent driveways for industrial-commercial uses along this corridor (see Figure 35).

Figure 35: Bourke Road, Alexandria, New South Wales
Source: Google Street View (81)

Designing a Principal Arterial Road

"Principal Arterial Roads" as described by Transport for New South Wales, are those roads with the highest movement significance intended for travel suburban and must prioritize vehicles. Many of these roads provide regional connections and, in some cases, prohibit non-motorized travel. Those which also prioritize public transit service and their passengers (pedestrians), along with cyclists, must implement additional design features and separation to balance these uses.

The Northern Road in Oran Park, New South Wales, fits the Design of Roads and Streets manual typology "Principal arterial road." Designated route A9 on the outskirts of metropolitan Sydney, Northern Road was previously a rural, two lane, undivided highway, with long slip lanes for merging and exiting the corridor, and an 80 km/h (50 mph) speed limit (see Figure 36). Development transformed farmland along the corridor into new, mixed-use, planned developments, including one called Oran Park. In concert with these land use changes, Transport for New South Wales transformed the design of Northern Road to accommodate transit, pedestrians, and cyclists, as well as increased traffic volumes (see Figure 37).

Figure 36: Northern Road, New South Wales (2009)
Source: Google Street View (82)

Figure 37: Northern Road, Oran Park, New South Wales (2022)
Source: Google Street View (83)

The Northern Road now features a divided highway design, with six lanes of traffic, two for vehicles and one dedicated public transit lane in each direction, separated by a wide landscaped median. Speed limits in the corridor range from 60 km/h (37 mph) to 80 km/h (50 mph). To ensure road safety for motorists, mobile speed cameras are deployed in the corridor. Along one side of the road, a separated multiuse path provides access to periodic bus stops and provides a continuous bicycling route along the arterial. The landscaping that separates the multiuse path from the roadway is mown short at bus stops and where the roadway approaches intersections, to maintain visibility. The landscaping in the separation zone grows taller in the rest of the corridor, acting as a visual shield between the fast-moving vehicles, and pedestrians and cyclists on the multiuse path (see Figure 38).

Figure 38: Northern Road, Oran Park, New South Wales
Source: Google Street View (84)

At intersections that provide access to communities along the corridor, large median refuges provide space for pedestrians and cyclists crossing the wide road cross-section, which is 125-feet from curb-to-curb. The crosswalks on either side of the medians are offset, encouraging pedestrians and cyclists to angle towards on-coming traffic as they approach the subsequent leg of the crossing. This helps people confirm that vehicles are stopped before entering the crosswalk. See Figure 39 for an aerial and street-level view. Signal controls help protect pedestrians crossing the merge lanes to the pork chop islands, and the geometry of the merge lanes provide a direct, frontal view on drivers' approach of the crosswalk and encourage drivers to maintain slower speeds before making turns.

Figure 39: Northern Road and Cobbitty Road Intersection, New South Wales
Source: Google Street View (85)

Interdisciplinary Collaboration

Design is an interdisciplinary activity. Policies and plans exist on paper, even if their subject is a matter of life and death. But design is literally where the rubber meets the road and all the complexities of building and operating infrastructure come together. To solve challenging design problems requires many different people, with many different skillsets, working collaboratively.

Team-Based Project Design

The study team experienced firsthand how Australia and New Zealand compose their project design teams. On site tours and in meetings, the study team learned that Auckland Transport and Waka Kotahi NZTa pulled staff and managers from many divisions to form independent project teams for signature corridor and district design plans. By composing teams for specific projects, these agencies created a hybrid version of their organizations, set apart from each person's home base. These teams often inhabit their own joint office space, where they can develop an integrated culture of collaboration.

Auckland Transport Design Manual

"The Transport Design Manual [TDM] brings together the key players… the process is deliberately holistic and multi-disciplinary, recognizing that no one profession or organization has all the answers in how to achieve integrated and place-sensitive solutions for roads and streets."

"The TDM is for everyone who plays a part in managing, designing, improving, or determining the quality of roads and streets in Auckland, including engineers, planners, urban designers, project managers, developers, politicians and users." (45)

In addition, the study team learned that many Auckland Transport and Waka Kotahi NZTa staff have worked in each other's agencies, including some who have changed emphases and even careers between planning, engineering, urban design, placemaking, development, advocacy, accessibility, and politics, among other disciplines. The sentiment in our meetings and site tours was that this fluctuation of roles and responsibilities helps team members appreciate a broader array of approaches to problem solving. Staff noted that having perspective from outside your organization was helpful in overcoming institutional barriers to innovations in design, as well as process. As staff return to their offices and join other project teams, these lessons spread, promulgating a culture of innovation, and an appetite for trying new approaches and constant learning.

Staff also credited the Road Safety Audit process as helping their teams gel. The audit process includes milestone analyses at key stages of a project, from planning through programming, scoping, design, implementation, and post-construction management, with feedback from the external auditors all along the way. External feedback focuses the team on proactively working to achieve core safety goals. This helps to align the team members' objectives, encouraging everyone to contribute to performance-based design outputs – and ultimately project outcomes – that are measured independently.

In a similar vein, Transport for New South Wales credits the Safe System approach, and specifically the Safe System Assessment model developed by Austroads, as bringing their planning, design, and engineering teams together. Transport for New South Wales itself is the product of the former transit authority and former road authority, which merged to form a new, unified agency in 2018. Leadership credits having all surface modes as part of one agency with allowing them to act as a unified authority, with fewer "fiefdoms" and a collective understanding of the task: to move people and goods, agnostic of mode. As a combined agency, Transport for New South Wales developed their recent Future Transport 2056 long-range plan, and updated it with the Future Transport Strategy (2061 time horizon).

System Supports

Throughout the study, the team observed other major cultural and structural characteristics – which differ significantly from the U.S. – that likely contribute to supporting a culture around traffic safety and a willingness to adopt pro-pedestrian safety policies, plans, and processes to improve pedestrian conditions in all contexts, including along arterial roads.

As the U.S. considers adoption of practices from New Zealand and Australia, we may contemplate how cultural and structural differences may affect the political willingness to implement these practices in the U.S., as well as the effectiveness of the interventions in contexts that lack supportive structures. These differences may also indicate opportunities for additional research to better understand the associations between policy and social issues and pedestrian outcomes.

Post-Crash Care

- The Accident Compensation Corporation (ACC) in New Zealand monitors incidents and covers the cost of transportation-related injuries, regardless of fault. From the ACC website: "Everyone in New Zealand is covered by ACC's no-fault scheme if they're injured… This includes children, beneficiaries, and students. It doesn't matter if they're working, unemployed or retired. It also includes visitors to New Zealand. The coverage we provide helps pay for the costs of your recovery. This includes payment towards treatment, help at home and work, and help with your income" (86).

- In both New Zealand and Australia, nationalized health care provides preventative care, mental health care, and post-crash emergency response services to all residents at no cost. This incentivizes governments to reduce crashes for economic, not just humanitarian, reasons. Crash victims are also more likely to seek and receive treatment than in the U.S. because care is funded and guaranteed. This is significant in terms of pedestrian outcomes; one study of pedestrians injured in North Carolina reported that, "the most reported expected source of payment was 'self-pay,' with 28 percent of injured pedestrians reporting this form of payment" (87).

Enforcement

- Australia and New Zealand both exhibit a high tolerance for technology-assisted enforcement, a controversial approach to safety in many U.S. States and cities. Australia has been utilizing automated speed and red light enforcement for several decades, and New Zealand has been implementing it more recently. As technological capabilities expand via camera-based artificial intelligence and machine learning to recognize illegal driver activities, enforcement has the potential

to increase dramatically, and potentially avoid inequitable distribution associated with in-person traffic stops.

- While rates of alcohol consumption are similar across the U.S., New Zealand, and Australia, rates of drug use – including cannabis, opioids, cocaine, and amphetamines – are much lower in Australasia than in North America (88). Opioid related deaths remain higher in the U.S. than any other developed country, with an opioid-related death rate of 277 per million population, compared to that of 72 per million population for Australia (89). Rates of drug treatment are also different in the U.S. compared with Australia and New Zealand, which likely has had some impact on pedestrian injury and outcomes.

- New Zealand and Australia are reckoning with the inequitable outcomes of colonization that has deeply affected Aboriginal Australian communities and the Māori in New Zealand. However, the history and community values around the role of law enforcement for traffic safety cannot be easily compared to experiences and perceptions in the U.S.

Transit and Active Transportation Mode Share

- In New Zealand and in Australia there are significant heavy and light rail systems, extensive bus networks, and robust ferry operations. Continued investments in public transportation projects like these provide (and require) opportunities to make safety and walkability improvements for first-last mile connections and Complete Trips.

Civic Engagement and Trust

- Voting rates in New Zealand are near 80 percent of the population and there is a higher sense of trust and support for government programs than in the U.S. This may affect the degree and pace of advancing traffic safety initiatives.

Section 6: Conclusion

Essential Principles for Pedestrian Safety

In a network that provides safe and continuous accessibility for people – first and foremost those walking and rolling – as well as people cycling, riding transit, driving vehicles, and moving freight, the characteristics of corridors that serve these multiple modes are similar across the spectrum of Movement and Place typologies.

Despite the complexity of policies, planning, risk assessment, and other factors described throughout this report, the study team identified three essential principles that guide us to achieve pedestrian safety on multimodal corridors, aligned with the Safe System approach:

- **Reduce vehicle speed** to mitigate kinetic energy using infrastructure and operational strategies, including emerging technologies like automated enforcement.
- **Separate vulnerable road users** and motorized vehicles in time and space when vehicle speeds exceed survivable levels.
- **Design roads and streets to suit their desired context**, considering future land use, as well as economic, climate, public health, and equity goals.

The Safe System approach to framing risk reinforces these three essential principles. Risk is based on the *severity of impact* and the *level of exposure and likelihood of a crash taking place*. Speed management, separation of modes, and contextual design mitigate these factors to reduce risk. Figure 40 illustrates this framework.

Figure 40: Risk calculation factors
Source: Auckland Transport (45)

Appendix A: Virtual Exchange Agendas

Australia – United States Virtual Exchange

Virtual Exchange Session #1: Adoption of the Safe System Approach

Time	Agenda Item	Details
	Welcome and Overview	
10 min.	Welcome and Introductions	Hana Maier, FHWA
10 min.	Overview and Objectives for Session #1	Mike Griffith, FHWA Gabby O'Neill, ORS
40 min.	**What is the history of Australia's adoption of the Safe System approach and its principles?**	Rapid presentations followed by Q&A Guiding questions focus on policy, process, and data
10 min.	**Break**	
40 min.	**How did the Safe System approach and its principles gain broad non-governmental support?**	Rapid presentations followed by Q&A Guiding questions focus on public and practitioner engagement and challenges
10 min.	**Summary Conclusions**	Tamara Redmon, FHWA

Virtual Exchange Session #2: Implementation of the Safe System Approach

Time	Agenda Item	Details
	Welcome and Overview	
10 min.	Welcome and Introductions	Hana Maier, FHWA
10 min.	Recap of Session #1 and overview of Session #2	Darren Buck, FHWA Gabby O'Neill, ORS
60 min.	**How do the policies, funding, and planning processes supported by Australia's Safe System approach support pedestrian safety?**	Rapid presentations followed by Q&A Guiding questions focus on tools, data, and transportation and land use connections
10 min.	**Break**	
25 min.	**Summary conclusions and items for further exploration during in-person study tour**	Open forum moderated by Jonah Chiarenza, U.S. DOT Volpe Center
5 min.	**Wrap-up**	Hana Maier, FHWA

New Zealand – United States Virtual Exchange

Virtual Exchange Session #1: Adoption of the Safe System Approach

Time	Agenda Item	Details
	Welcome and Overview	
10 min.	Welcome and Introductions	Hana Maier, FHWA
10 min.	Overview and Objectives for Session #1	Mike Griffith, FHWA
40 min.	**What is the history of New Zealand's adoption of the Safe System approach and its principles?**	Rapid presentations followed by Q&A Guiding questions focus on policy, process, and data
10 min.	**Break**	
40 min.	**How did the Safe System approach and its principles gain broad non-governmental support?**	Rapid presentations followed by Q&A Guiding questions focus on public and practitioner engagement and challenges
10 min.	**Summary Conclusions**	Tamara Redmon, FHWA

Virtual Exchange Session #2: Implementation of the Safe System Approach

Time	Agenda Item	Details
	Welcome and Overview	
10 min.	Welcome and Introductions	Hana Maier, FHWA
10 min.	Recap of Session #1 and overview of Session #2	Darren Buck, FHWA
60 min.	**How do the policies, funding, and planning processes supported by New Zealand's Safe System approach support pedestrian safety?**	Rapid presentations followed by Q&A Guiding questions focus on tools, data, and transportation and land use connections
10 min.	**Break**	
25 min.	**Summary conclusions and items for further exploration during in-person study tour**	Open forum moderated by Jonah Chiarenza, U.S. DOT Volpe Center
5 min.	**Wrap-up**	Hana Maier, FHWA

Appendix B. Acknowledgements

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Priscilla Phommaly – Portfolio Engagement Manager
Evan Walker – Executive Director, Emerging Technology

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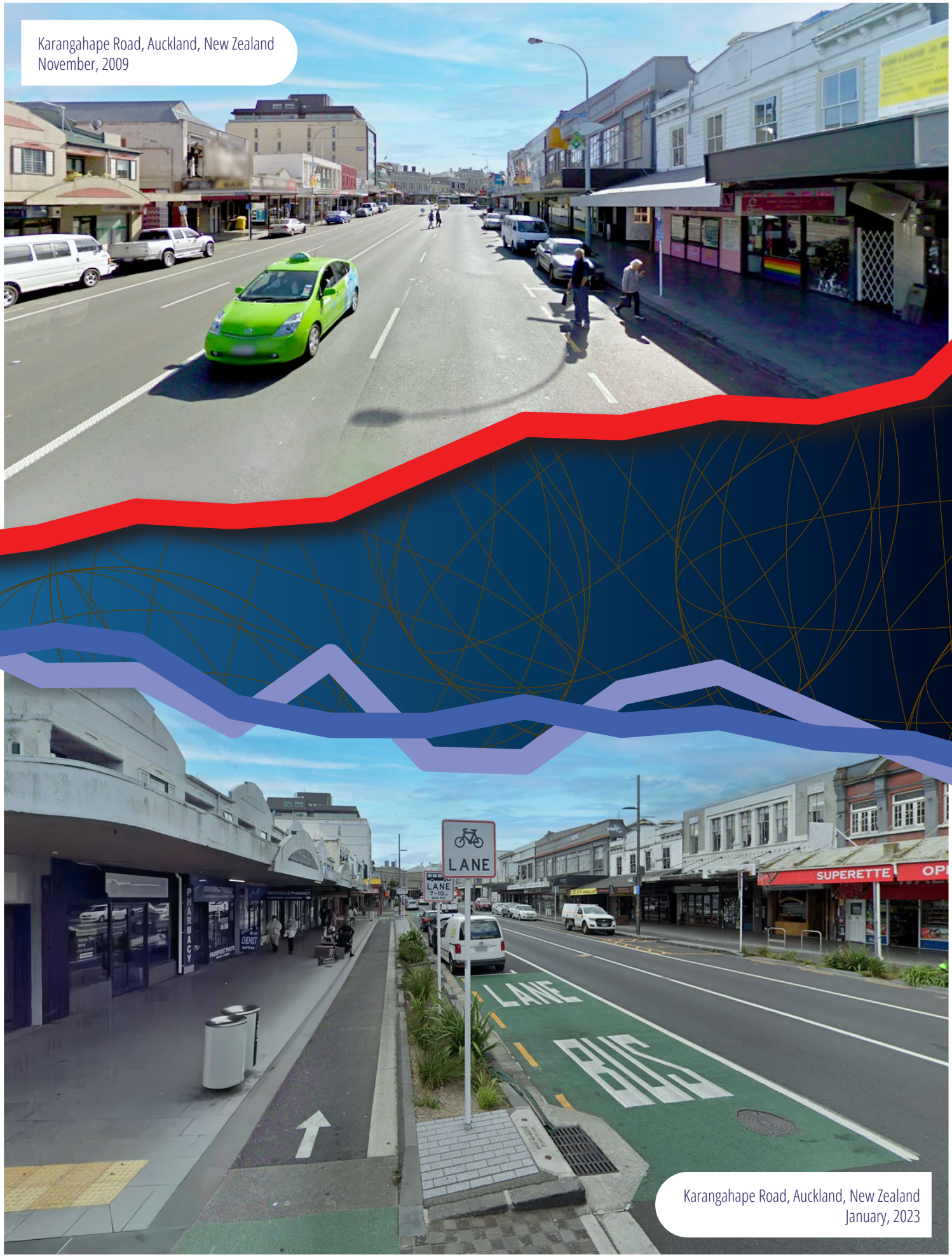
Karangahape Road, Auckland, New Zealand
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