# Part F: Physical TTM Control Measures

Detailed information on physical control measures to enhance the safety and accessibility of vulnerable road users in temporary traffic management.

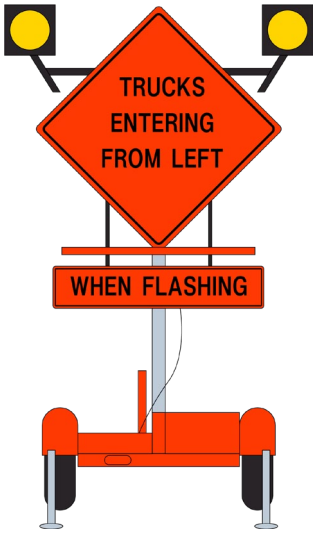
# Part F: Physical TTM Control Measures



There are **many other possible control measures** that can help keep vulnerable road users safe in temporary traffic management environments.

This selection is the common or emerging **physical controls** with evidence in New Zealand or overseas. This list can always be added to, so if you think a control measure would be valuable to include in this practice note, email info@civilcontractors.co.nz.

## *Advanced Technologies*




Advanced Technologies in TTM leverage digital tools to enhance VRU safety by providing timely and context-specific warnings and guidance.

These tools include Bluetooth-triggered alerts on users' devices, electronic signage that changes based on traffic flow or pedestrian density, and sensors that activate warnings when VRUs approach hazards.

Technological solutions can be tailored to meet diverse needs, such as auditory alerts for the visually impaired and vibration signals for the hearing impaired.

### Specific Requirements

- Technologies must be compatible with various devices and accessible to all VRUs.
- Systems should have failsafe mechanisms in place to prevent misinformation.

### Control Measure Variations

Variations may range from simple app-based alerts to complex sensor networks that adapt to real-time conditions.

### Advantages

- Provides dynamic and interactive safety measures.
- Can be updated instantaneously to reflect current TTM changes.
- Personalised warnings increase user attention and compliance.

### Disadvantages

- May exclude those without access to the necessary technology.
- Dependence on power and connectivity can lead to failure points.

### Installation and Removal Considerations

Setup involves software configuration and possible physical installation of sensors. Setup can be time-consuming and involved, meaning this control measure may be more suitable for longer-term work sites.

### Risks that this control may introduce

- Over-reliance on technology could reduce vigilance.
- Technical malfunctions may lead to a lack of warnings.
- Privacy concerns if personal data is collected.

### Maintenance Requirements

- Regular software updates and hardware checks to ensure optimal operation.
- Continuous monitoring for system integrity and data protection measures.

*Electronic responsive signage can enhance the safety of VRUs. There are temporary options available for use in TTM environments. Image Credit lxxiii: HMI Technologies New Zealand.*

## *Advanced Warning*



*Advanced warning can help inform drivers and VRUs about upcoming hazards. Make sure not to place signs where they become a hazard themselves. Image Credit lxxiv: Christchurch City Council.*

Advanced warning alerts road users to upcoming changes in road conditions, guiding them to adapt their behaviour accordingly to ensure safety. Advanced warning also improves reaction time as users are more prepared for changes up ahead.

Advanced warning is used on approach to hazards for motor vehicle drivers, pedestrians, or cyclists to inform them of the changing conditions ahead.

Advanced warning signs provide only one method of sharing information (visually). Important information should be shared in multiple ways, i.e., having a worker look out for visually impaired pedestrians to give verbal information or using an audible messaging device.

### Specific Requirements

Signs are a traffic control device – and must be designed and installed following the Land Transport Rule: Traffic Control Devices 2004.

Signs must allow for sufficient reaction time. Refer to **Appendix F.**

### Control Measure Variations

Usually, static, fixed signs are used; however, electronic signs are also valuable where variable messages are needed.

### Advantages

- Increases situational awareness.
- Reduces speed ahead of worksites.
- Can be updated for real-time information (electronic variants).

### Disadvantages

- Fixed signs may be less effective over time due to familiarity.
- Due to not giving specific instructions (usually), signs can become lost and have a limited impact on behaviours.

### Dimension Requirements

All signs must comply with the Land Transport Rule: Traffic Control Devices 2004. Further information can also be found in Waka Kotahi's M23 Appendix F.

### Installation and Removal Considerations

Installation and removal should consider the safety of users at the time (i.e. be considerate of crossing paths or walkways).

### Risks that this control may introduce

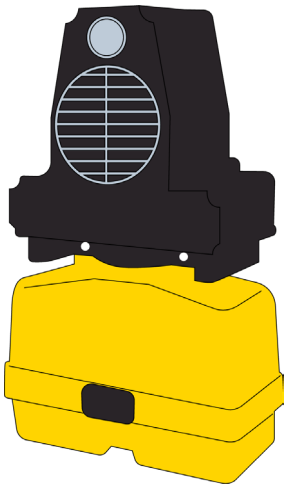
If poorly placed, they can obstruct views or be a trip hazard. If signs are no longer relevant (no longer apply), they can confuse road users.

### Maintenance Requirements

Regular checks to ensure signs are undamaged, clean, and not presenting risk to passing users.


*When not installed properly, all signs can be hazardous for the public. If signs are in place for some time, consider a detectible edge for cane users safety. Image Credit lxxv: Minnesota Department of Transportation.*

## *Audible Messaging*



Audible messaging devices can convey critical TTM information and instructions to VRUs through sound, enhancing situational awareness and safety, especially for the visually impaired.

This control is used to provide oral instructions for navigating TTM environments. Devices are activated manually or by sensors to broadcast messages about detours, worksite dangers, or crossing points.

It offers an essential navigational aid for visually impaired VRUs, ensuring equitable access to safety information.

### Specific Requirements

- Messages must be concise, clear, and broadcast at a volume audible over background noise but not disruptive.
- Devices should be positioned to prevent obstruction or entanglement with pedestrians.

### Control Measure Variations

- Push-button-activated messages.
- Motion sensor-triggered broadcasts.
- Continuous loop messages for high-traffic areas.

### Advantages

- Direct communication method for vital safety information
- Enhances compliance of users through clear audio cues
- Beneficial in noisy environments where visual cues may be missed.

### Disadvantages

- Can be ignored or misunderstood if not clear or loud enough.
- Potential noise pollution in quiet areas.
- Requires regular maintenance to ensure clarity and functionality.

### Dimension Requirements

Devices should be installed at a height accessible to all users, including wheelchair users, without causing an obstruction.

### Installation and Removal Considerations

Installation may require technical expertise to ensure correct audio levels and sensor range.

### Risks that this control may introduce

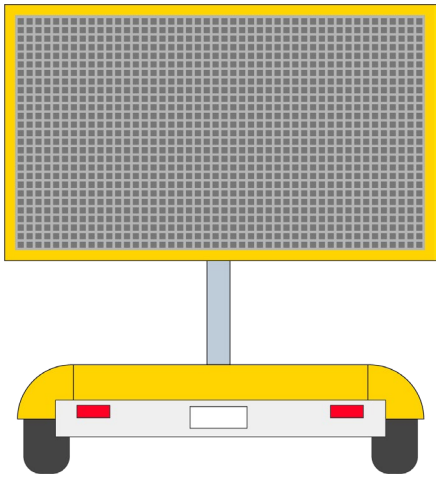
- Over-reliance on audio cues may reduce attention to visual signs.
- Inaccurate messaging could mislead VRUs and confuse them.

### Maintenance Requirements

- Regular testing for audio clarity and volume.
- Ensuring messages are up-to-date with current TTM changes and layout.

**In deploying audible messaging, it is vital to balance disseminating essential information with minimising additional noise and disruption in the TTM environment.**

## *Communications with the Public*



Public communication aims to ensure that all road users, including VRUs, are well-informed, engaged, and guided effectively to ensure compliance with TTM controls for their safety and the smooth progression of the works.
This control involves informing the public about TTM activities through notifications, visual aids, and engagement forums. It ensures that road users understand changes and can navigate safely and confidently.
Materials should be accessible to all, including formats for those with disabilities, such as braille, large print, and audible messages, to ensure equal access to information.

### Specific Requirements

- Information must be clear, concise, and presented in a non-technical language.
- Engagement methods should be tailored to diverse community needs, including language and cultural considerations.

### Control Measure Variations

- Traditional methods: letter drops, public meetings.
- Digital platforms: social media updates, real-time traffic websites.
- Ongoing engagement: feedback forms and focus groups throughout the project duration.

### Advantages

- Encourages public cooperation and understanding.
- Reduces frustration and confusion for road users.
- Facilitates safer navigation through worksites.

### Disadvantages

- Misinformation can spread if messages are unclear or inaccurate.
- May require significant resources to manage effectively.
- Public engagement can be time-consuming and may delay project timelines.

### Risks that this control may introduce

- Insufficient communication can lead to non-compliance and increased risk of incidents.
- Overloaded information may result in public disengagement.

### Maintenance Requirements

- Regular updates and accuracy checks on all communication channels.
- Monitor feedback mechanisms to ensure they remain effective and responsive.

**Effective communication with the public is foundational to the success of TTM operations, directly impacting the safety of VRUs and the overall efficiency of TTM.**

## *Cone Bars*

Cone bars are a temporary access deterrent, providing a visual barrier to direct pedestrian flow and deter entry into hazardous or restricted areas.

In simple terms, cone bars span between traffic cones to create a quick and easily adjustable boundary. They are commonly used to guide pedestrians and demarcate safe zones within TTM environments.

**Cone bars lack a detectable lower edge, making them less suitable for visually impaired individuals who use canes, as they may not be detected at cane height.**


*Cone Bars do not stop users and provide little security that access to hazards is prevented. In this instance its clear a user can bypass the control measures into the hazard. Image Credit lxxvi: Parallaxx.*

### Specific Requirements

Cone bars should span between standard cones and be visible. They must not be used as a permanent fence or left unattended, as they do not offer structural rigidity.

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- Cone Bars should not be left unattended. They should only be used when personnel are present onsite to monitor the continuous effectiveness of these devices.
- Cone Bars should not be used where visually impaired users are present.

### Advantages

- Quick to deploy and reposition.
- Lightweight and portable.
- Enhances visual demarcation of safe areas.

### Disadvantages

- Not a robust physical barrier.
- Prone to theft due to their portability.
- Inadequate for containing animals or unsupervised children.

### Dimension Requirements

- Diameter: 35mm minimum, 100mm maximum.
- Weight: No more than 7kg for ease of handling.
- Retro-reflectivity: Must comply with AS1906.1:2017 for visibility.

*This image from the U.S. shows the concept of a detectible edge – illustrating a limitation of using cone bars in TTM. Image Credit lxxvii: Dan Burden.*

### Risks that this control may introduce

- Can be easily bypassed, offering a false sense of security.
- May create a trip hazard if not properly secured or if they sag due to insufficient tension.

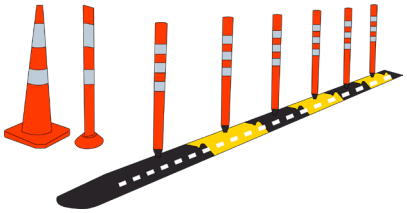
### Maintenance Requirements

- Regular checks to ensure high visibility and structural integrity.
- Immediate replacement if damaged to maintain effective delineation.

**Given their limitations, cone bars should be used cautiously and always in conjunction with other control measures. Their usage must be continuously monitored and should never be relied upon as a preventive measure against entry into hazardous areas.**

*A shortfall of cone bars is they have no detectible edge for cane users. Image Credit lxxviii: Waka Kotahi.*

## *Delineation (Cones, Tubular Delineators, Flexible Traffic Separators)*



- Delineation in TTM is essential for guiding and informing road users, delineating the path they should follow, and indicating the presence of potential hazards.
- Delineation devices such as cones, tubular delineators, and flexible traffic separators visually guide drivers and pedestrians, creating clear demarcations between safe zones and areas under construction or repair.
- While these devices are primarily visual, their placement and the tactile nature of some delineators can aid individuals with visual impairments, especially if combined with other sensory warning devices.

### Specific Requirements

- Be fluorescent orange with specified chromaticity coordinates.
- Feature white or silver retro-reflective bands.
- Have markings indicating compliance date.
- Remain stable and visible even if knocked over.

**For more detailed specifications for delineation devices, refer to Waka Kotahi's M23 Appendix F.**

*Delineation serves to channel differe types of road users with a primary purpose of being visible. Image Credit lxxix: Parallaxx.*

### Control Measure Variations

- Cones have two retro-reflective bands and a standard height of 900mm.
- Tubular delineators follow similar specifications but can vary in shape.
- Flexible traffic separators are larger and used for more pronounced channelisation.

### Advantages

- High visibility in various lighting conditions.
- Quick to deploy and versatile in application.
- Essential for channelling traffic flow and enhancing road user safety.

### Disadvantages

- Can be displaced by wind or impact if not secured.
- May be ignored by road users if overused or placed without a clear purpose.
- May not deter through access for VRUs.

### Dimension Requirements

- Height for standard cones and tubular delineators: 900mm (+20mm, -0mm).
- Weight: No more than 7kg.
- Retro-reflective bands must meet Class 300 photometric performance.


*When placing delineation next to traffic lanes – don't put it right up to the lane line/edgeline. Leave space for a small 'shoulder space' for safe cycling (at least 0.5m). Image Credit lxxx: Glen Koorey.*

### Risks that this control may introduce

- Improper placement can confuse road users and create hazards.
- Displacement can lead to ineffective delineation and increased risk of accidents.

**In practice, delineation is a dynamic control measure that needs constant assessment to remain effective. Its success is dependent on correct, consistent application and maintenance.**

## *Escorting Vulnerable Road Users (Footpath Controllers)*

- The primary purpose of escorting vulnerable road users (VRUs) through TTM environments is to provide targeted assistance, ensuring their safe navigation around or through temporary hazards.
- Footpath controllers, or escorts, are positioned in TTM zones to guide pedestrians, including those with disabilities, around active work areas, especially when usual paths are obstructed or present variable hazards.
- This measure significantly benefits individuals with disabilities by offering human assistance for navigation, thereby reducing the risk of confusion or accidents in TTM zones.

### Specific Requirements

- Footpath controllers should have clear protocols for operation, be appropriately trained, and wear high-visibility clothing. Their deployment should align with periods of heightened risk or activity.

### Advantages

- Provides tailored assistance to VRUs.
- Enhances the safety of individuals with specific needs.
- Adaptable to varying risk levels and work zone activities.

### Disadvantages

- Resource-intensive, requiring dedicated personnel.
- Not practical for long-term, unattended sites.
- Introduces additional personnel into the hazard zone.

### Risks that this control may introduce

- Potential for footpath controllers to be at risk from work zone hazards.
- If not managed properly, can create additional points of conflict between VRUs and work zone activities.

### Maintenance Requirements

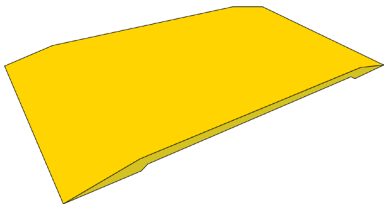
- Ongoing training and monitoring of footpath controllers to ensure effective and safe operation.
- Regularly review work zone conditions to assess the need for escort presence.

**Footpath controllers are a dynamic and responsive safety measure that can effectively mitigate risks during peak hazard periods. However, their use requires careful planning, considering the availability of resources and the specific needs of the TTM environment. For example, during tree pruning operations, pausing work to allow pedestrians to pass minimises disruption and eliminates the hazard temporarily. Clear communication protocols must be established to ensure footpath controllers can effectively manage the movement of VRUs and interact with work zone personnel to minimise risk exposure.**

*Having staff on hand to escort and assist those with disabilities is a very effective way to ensure sites are able to be navigated safely by even the most disadvantaged of users. Image Credit lxxxi: Parallaxx.*


*Visually impaired users especially benefit from being escorted through road works due to the highly challenging nature of TTM and the number of hazards. Image Credit lxxxii: Carina Duke.*

## *Excavation Covers (Trench Covers)*



- Excavation covers are used to cover open excavations securely to prevent falls and injuries to pedestrians and ensure safe passage over or around construction zones.
- These covers are deployed to bridge over trenches or holes during construction or maintenance work, allowing pedestrians and light vehicles to traverse safely.
- When designed in compliance with standards like AS 1428.1, these covers support accessibility by providing a stable and non-slip surface for individuals with mobility aids.


*Some excavation covers are rated for vehicle and VRU use. Image Credit lxxxiii: Transport for London.*

### Specific Requirements

Covers must be anchored securely to prevent movement, have a non-slip surface, and sit flush with the pavement to avoid trip hazards. Specific requirements can be found in Waka Kotahi's M23 Appendix F.

### Control Measure Variations

Variants may include different materials like steel-framed fibreglass and differing weight ratings, dimensions, and colours for visibility, with some designed to cover larger excavations and others for pedestrian-only access.

### Advantages

- Provide a stable surface over hazards.
- Enhance pedestrian safety.
- Support continued access to businesses and residences during work.

### Disadvantages

- Heavy and may require machinery or multiple people to install.
- Can be costly, especially if custom sizes are needed.
- Require monitoring to ensure they remain secure.

### Dimension Requirements

Dimensions vary based on the excavation but must support distributed weight and point load requirements, such as a 2.0-tonne distributed weight rating and a 500kg point load.

### Installation and Removal Considerations

Installation and removal may require machinery for heavy covers.

*Some excavation covers can be heavy, therefore installation and removal using mechanical means is preferred. Image Credit lxxxiv: Oxford Plastics*

### Risks that this control may introduce

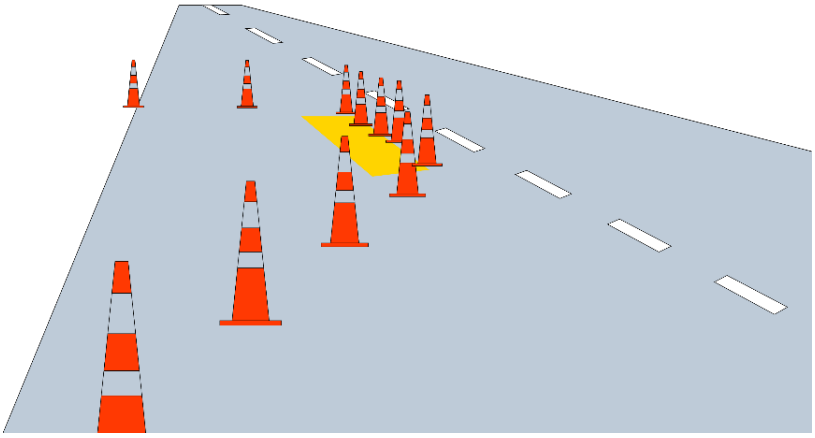
Improper installation can result in trip hazards or covers that shift under load, while inadequate maintenance can lead to reduced slip resistance over time.

*Covers placed on footpaths should be bright and flanked by devices that show clearly the safe path for VRUs. Image Credit lxxxv: Carina Duke.*

### Maintenance Requirements

Regular inspections ensure slip resistance is maintained, especially in wet conditions, and the covers remain securely anchored without creating trip hazards.

## *Exclusion Zones (Safety Zones)*



- Exclusion zones serve as a safeguarding buffer, creating a physical space that separates road users and vulnerable road users (VRUs) from potential hazards (or each other), thus mitigating the risk of incidents.
- These zones are typically allocated around hazards or work areas to prevent unauthorised access, ensuring a safe distance between the public and potential dangers.

### Specific Requirements

Exclusion zones should be based on the hazard type and adjacent traffic speed. Exclusion zones alone are insufficient to mitigate risk; they must be accompanied by other controls (such as fencing, barriers, or delineation) that prevent access to those areas for them to be effective.

### Advantages

- Provide clear boundaries to enhance safety.
- Reduce the likelihood of accidental incursions into hazardous areas.
- Serve as a preventative measure for worksite accidents.

### Disadvantages

- Can reduce the available space for road users and VRUs. As shown in the image above, it is vital to maintain a safe space for cycling – if the cones were up to the lane line, this would force cyclists into the other lane with motor vehicles, creating potentially unsafe interactions.

### Dimension Requirements

Dimensions are context-specific, often determined by the potential hazard's nature and the environment.

### Risks that this control may introduce

Poorly placed or arranged exclusion zones can encourage using those spaces for walking or cycling (defeating their purpose). Exclusion zones can inflame other hazards, with users being more cramped and more prone to incidents or constraining working room, resulting in amplified risk of working space incidents.

### Maintenance Requirements

Regular checks to ensure exclusion zones remain clear, empty and visible, with prompt adjustments as needed to maintain the integrity and effectiveness of the exclusion zone.

## *Fencing*

Fencing in TTM is implemented to delineate work zones, guiding and protecting both VRUs and workers by deterring unauthorised access to hazardous areas.

Fences are employed around construction sites, excavation areas, or any place where interaction with the public occurs. They are critical for channelling pedestrians safely around or through a TTM setup and ensuring that work zones are marked and secured.

For disabled individuals, fences must include detectable guidance features like bottom and top rails and be constructed to prevent tripping or impeding mobility aids.


*Fencing is particularly important on longer-term worksites, and where heavy machinery is used. Image Credit lxxxvi: Wikimedia Commons.*

### Specific Requirements

Fencing must be continuous, securely linked, and have supportive top and bottom rails to form a barrier around hazards. The bottom rail should not exceed 100mm above the ground level to prevent tripping, and the top rail must be at a minimum height of 1.2m to prevent climbing, roll-over, and ensure visibility.

### Control Measure Variations

Variations in fencing include different materials like polyethylene or metal, heights, and additional safety features like reflective surfaces or warning lamps for night use.

### Advantages

- Clearly demarcates hazardous areas.
- Offers visual and physical guidance for VRUs.
- Prevents unauthorized access.

### Disadvantages

- Requires maintenance to ensure integrity.
- Can be cumbersome to install and remove for shorter activities.
- Could obstruct views if not designed with visibility in mind.
- Is less flexible with more dynamic worksites.

### Dimension Requirements

Fencing should be at least 1.2m high and have detectible bottom edging at 100mm from the ground.

### Installation and Removal Considerations

Installation and removal of fencing can be challenging and a phase of the work itself –transporting, placing, and installing the fencing. This should be accounted for in the TTM and activity planning. Installation can also be intrusive to the environment by carrying fencing across pathways and parking unloading vehicles close by; these hazards introduce a new layer of risk to VRUs.

*Fencing should be selected based on having the least amount of introduced risk. This example shows non-trip feet. Image Credit lxxxvii: Oxford Plastics LLC.*

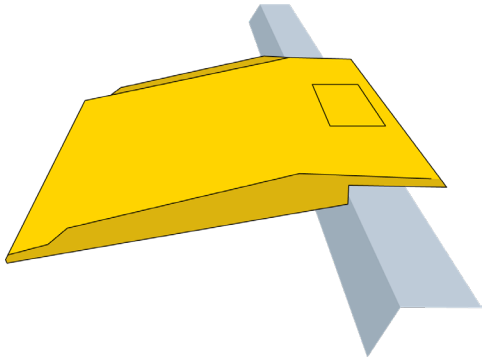
### Risks that this control may introduce

If not installed correctly, fencing could create tripping hazards, obstruct visibility, or become a projectile in strong winds. If not installed correctly, fencing could create tripping hazards, obstruct visibility, or become a projectile in strong winds.

### Maintenance Requirements

Regular inspection ensures fences remain in good condition, appropriately anchored, and visible.

## *Kerb Ramps*



- When regular footpath levels are altered, Kerb ramps are integral in maintaining pedestrian access and safety.
- They aim to bridge vertical gaps between the footpath and the road, thus enabling continuous, unimpeded pedestrian flow.
- These ramps are strategically placed where pedestrians need to ascend or descend from the footpath level. For example, when a footpath is closed for work, a kerb ramp will allow pedestrians to safely detour onto the road (into a separated space) and then back onto the footpath beyond the obstruction.
- Kerb ramps are vital for inclusivity, allowing wheelchair users, the visually impaired, or those with pushchairs to navigate elevation changes that would otherwise be inaccessible. They remove the barrier that a kerb presents.

### Specific Requirements

Kerb ramps should have a gentle incline, no steeper than a 1:12 gradient, which is manageable for wheelchair users without assistance. They must be constructed of durable, non-slip materials with sufficient weight capacity to handle heavy pedestrian traffic and mobility aids.

Refer to the Kerb ramps section in Appendix F of this guidance and Waka Kotahi's M23 Appendix F for more detail.

### Control Measure Variations

Variations can include portable, lightweight ramps for short-term use and more robust installations for longer-term projects. Some ramps may incorporate tactile ground surface indicators to aid visually impaired users.

*Kerb ramps should be secure and avoid edges that users can fall off (as shown in this example). Use cones or other methods to make the path clear for how to safely use the ramp. Image Credit lxxxviii: Betty Mitrova.*

### Advantages

- Provides access across kerbs and elevation changes.
- Supports compliance with accessibility requirements.
- Generally quick to deploy and adaptable to various environments.

### Disadvantages

- May become obstructive if not positioned correctly.
- Temporary solutions require regular maintenance.

### Dimension Requirements

Ramps should have a minimum clear width—1.2 metres—to accommodate a wide range of users, including those with service animals or wide mobility devices. Further dimension requirements are explored in the kerb ramp section of Appendix F of this guidance.

## Installation and Removal Considerations

Installation should factor in the ramp's stability and its capacity to withstand pedestrian traffic without shifting.

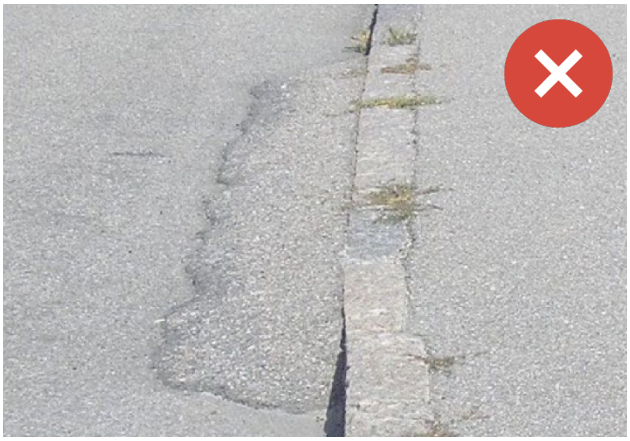


*Image Credit lxxxix: Asphalt Kerb ramps are also possible, however effective drainage is a consideration, as well as visibility of the ramp for visually impaired users.*

## Risks that this control may introduce

If not properly designed or maintained, ramps can introduce risks such as slipping, tripping, or the ramp becoming a navigational hazard.

## Maintenance Requirements

Regular inspections are necessary to ensure that kerb ramps maintain their structural integrity, surface traction, and that any temporary fixings remain secure. Any wear or damage should be promptly addressed to prevent accidents.

*Kerb ramps can be useful for changes in elevation in other places, not just kerbs. Image Credit xc: Steve Murphy.*

When selecting a kerb ramp, prioritise one with a high-traction surface and bevelled edges to reduce trip hazards.

Ensure that the ramp placement does not inadvertently create new hazards, such as creating a pinch point with street furniture or impeding drainage, which could lead to water pooling and increased slip risk.

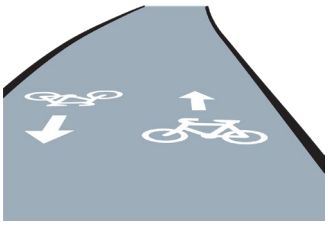
It is also essential to consider the end-users; for instance, ramps with high-contrast colours can assist people who are blind or with low vision identify the ramp's location and boundaries.

Additionally, during installation, ensure ramps are securely anchored to prevent movement or displacement and check that the transition between the ramp and the existing footpath is smooth to prevent tripping.

Proper signage should also be installed to guide pedestrians to and from the ramp, ensuring visibility and that users know the alternate route.

*Pedestrian kerb ramps come in many forms, including more robustly constructed types such as this one. Kerb ramps that are fit for purpose based on the situation, duration, and risk for the site should be selected. Image Credit xci: Oregon Department of Transportation.*

## *Markings (Temporary Marking, Road Marking)*



- The primary purpose of road markings is to guide vulnerable road users (VRUs) safely through or around temporary traffic management (TTM) areas, delineating safe paths and alerting them to hazards.
- In practice, markings are used to create temporary crosswalks, segregate cyclist lanes, or outline safe zones for pedestrians, offering visual cues to guide VRUs along designated safe paths.
- High-contrast and coloured markings can enhance visibility for those with visual impairments but may not provide utility for long-cane users who rely on tactile feedback.

### Specific Requirements

Markings should be applied to meet -visibility standards following Waka Kotahi's Manual of Traffic Signs and Markings (MOTSAM) Part 2, using colours and contrasts that stand out from the surrounding pavement.

### Control Measure Variations

Variants include different colours, materials (paint, tape, thermoplastics), and reflective properties adapted to various lighting conditions and road surfaces.


*Markings can be used to help give clear guidance of separation of users. Using colours is also valuable for those with visual impairments. Image Credit xcii: Bike Portland.*

### Advantages

- Increases visibility of pathways for VRUs.
- Can be quickly applied and adapted to changing TTM scenarios.

### Disadvantages

- Temporary markings may wear off more quickly than permanent ones.
- May not be effective for all users, particularly those who are visually impaired.
- Do not provide physical controls to direct behaviour
- May be challenging to remove and confuse if left in place when no longer applicable.

### Dimension Requirements

Dimensions should mimic standard road markings, maintaining consistent widths and patterns to avoid confusing VRUs.

### Installation and Removal Considerations

The application should consider the surface condition and weather for adherence. Installation (and removal) of road marking requires activity- and environment-specific TTM considerations on their own.

### Risks that this control may introduce

Inadequately applied markings may lead to misinterpretation of safe paths, potentially guiding VRUs into hazardous areas.

### Maintenance Requirements

Markings require regular inspection to remain visible and intact; faded or damaged markings should be restored promptly.


*In many cases, VRUs look down – so marking can be a valuable way to provide guidance that supports signs and places informaiton exactly where they are looking. Image Credit xciii: Parallaxx.*

## *Signs (Directional Signs, Regulatory Signs)*


*Signs can be informative, to help with naivigation or even local businesses. Image Credit xciv: Parallaxx.*

Signage in temporary traffic management informs and directs all road users, including VRUs, ensuring their safe navigation through or around worksites and other alterations to the usual traffic environment.

Signs are utilised to communicate various messages, from directional instructions and regulatory requirements to warnings about upcoming conditions, enabling road users to make informed decisions and take appropriate actions.

Signage design must consider visibility for all users, including those with visual impairments. Reflectivity standards and sign placement are critical to ensure that VRUs, such as cyclists who may not have powerful lights, can see the signs clearly.


*Image Credit xcv: Parallaxx*

### Specific Requirements

Signs must comply with the Land Transport Rule Traffic Control Devices 2004 and NZTA M25 specifications, ensuring retro-reflectivity and adherence to prescribed dimensions and materials.

### Control Measure Variations

Variations in signage include differences in size, colour, and reflectivity, depending on the road level and expected traffic volume. Temporary signs may have custom wording approved by the road controlling authority to address specific scenarios[32].

### Advantages

- Provides clear instructions, reducing confusion.
- Supports good decision-making from VRUs

### Disadvantages

- Poorly designed or placed signs may lead to misinterpretation.
- An overabundance of signs can cause confusion or ignorance.

### Dimension Requirements

The dimensions for signs vary based on road classification, with specific minimum sizes required for visibility and comprehension from appropriate distances. Refer to Waka Kotahi's M23 Appendix F and Land Transport Rule Traffic Control Devices 2004.


*Sign placement is a key consideration. Signs can increase risk when they block or obstruct VRU paths. Image Credit xcvi: UltimeciaNZ via Twitter.*

### Installation and Removal Considerations

Installation should ensure signs are secure and visible in all conditions and not presenting any trip hazards for users.

### Risks that this control may introduce

Any signs introduced into the environment carry risks as they take up space and add a hazard. All signs must add value and contribute to overall risk management onsite.

Any signs that are no longer serving this purpose should be removed.

Also, signs may become obscured if not maintained or correctly positioned, leading to miscommunication and potential hazards for VRUs.

### Maintenance Requirements

Signs require regular checks to ensure they serve a purpose, are visible and clean and do not impede users.

## *Temporary Bus Stops*


- The primary purpose of temporary bus stops is to maintain public transport service continuity when regular bus stops are impacted by temporary traffic management activities such as roadworks or events.
- Temporary bus stops ensure that passengers can continue to access bus services when their usual stops are unusable. They provide interim solutions to facilitate public transport during disruptions, providing an alternative location for boarding and alighting from buses.
- The establishment of temporary bus stops can have significant impacts on individuals with disabilities. Ensuring these stops are accessible is crucial, involving step-free access, clear signage, and proximity to safe road crossings.

### Specific Requirements

Temporary bus stops need to be within a certain proximity to the original stop, provide safe access, and meet legal requirements such as clear visibility and no obstruction from driveways or 'no stopping' zones. Waka Kotahi's guidance on Temporary Bus Stops in TTM environments contains further considerations.

### Control Measure Variations

Variations of temporary bus stops may include those with or without shelters, varying lengths to accommodate different bus sizes, and differing proximity to the original bus stop, depending on site-specific conditions.

### Advantages

- Ensures continuity of bus services
- Provides flexibility in public transport management
- Can be tailored to meet specific site requirements

### Disadvantages

- Potential confusion for passengers
- May not offer all the amenities of a permanent stop

### Dimension Requirements

Key dimensions for temporary bus stops include adequate space for bus manoeuvres (entry and exit), vertical and horizontal clearance for the bus, and safe pedestrian access. Some basic dimension requirements can be found in **Appendix F of this guidance.**

### Installation and Removal Considerations

Installation should consider the timing of works, the need for consultation with authorities, and the provision of clear communication to the public.

### Risks that this control may introduce

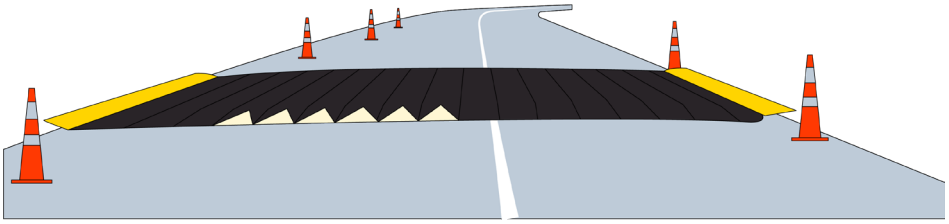
Temporary bus stops can introduce risks such as decreased visibility of the stop, confusion leading to unsafe pedestrian behaviours, and potential impacts on traffic flow.

### Maintenance Requirements

Maintenance of temporary bus stops includes ensuring signage is clear, the stop remains accessible, and any temporary materials are kept in good condition. Regular inspections should be conducted to address any emerging issues.

*In some cases, temporary bus stops will require temporary shelters as well. Image Credit xcvii: photobucket.com.*

## *Temporary Crossings*



Temporary crossings facilitate safe pedestrian passage across roadways when usual routes are inaccessible or unsafe.

A temporary crossing is implemented when there is a disruption to the standard pedestrian network, providing a clearly defined path for individuals to cross from one side of a street to the other.

The design of temporary crossings has a profound impact on accessibility. Features like tactile pavers are crucial; they guide visually impaired pedestrians and should be included in temporary setups wherever feasible.


*When selecting crossing points, using existing permanent infrastructure (including median refuges) is preferred. Image Credit xcviii: Danny Wood.*

### Specific Requirements

Temporary crossings must be designed with user safety as the priority. This includes continuous fencing to guide pedestrians and using pedestrian refuges for crossings exceeding 10 metres across, providing a safe mid-point standing area. Tactile pavers should meet Waka Kotahi's RTS14 guidelines.

### Control Measure Variations

Different scenarios may call for various temporary crossings, ranging from informal signposted crossings to those with tactile ground surface indicators to signalised crossings with audible cues and adjusted timings for slower walking speeds.

### Dimension Requirements

Temporary crossing widths should be at least 1.8m, with specific visibility requirements explored in the **Temporary Crossings portion of Appendix F**. The height and arrangement of any installed push buttons should meet the specifications of NZS 4121:2001.

### Risks that this control may introduce

**Introducing a directive for pedestrians to cross live traffic lanes generates significant additional risk and must mitigate more risk that is introduced.**

### Maintenance Requirements

Ongoing maintenance is critical to ensure temporary crossings remain navigable and hazard-free. This includes monitoring the integrity of tactile guiding systems if used, ensuring signage visibility, and maintaining the functionality of push-button signals if the crossing is signalised.

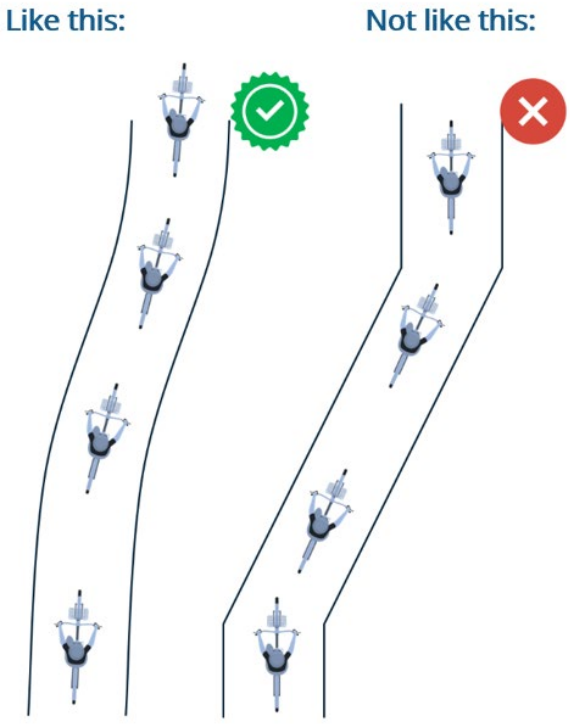
*Tactile ground surface indicators can be installed easily and quickly. Image Credit xcix: Parallaxx*

*Tactile Ground Surface Indicators are an important measure for the safety of pedestrians, even at temporary crossing points. They should be considered in accordance with best local practice. Image Credit c: UW-TOPS Lab.*

## *Temporary Cycleways*

- Temporary cycleways are a control measure to safely redirect cyclists around construction zones or roadworks without significantly altering their route. These pathways are designed to maintain connectivity and safety for cyclists during temporary changes in their usual environment.
- When usual cycle routes are obstructed, temporary cycleways provide an alternative that minimises disruption to cyclists' journeys. They guide cyclists along a secure and defined path, ensuring continuity in their travel while keeping them segregated from vehicular traffic and pedestrian walkways.
- As a control measure, temporary cycleways should be accessible to all cyclists, including those with disabilities. The physical attributes of the path, such as surface smoothness and width, play a crucial role in its usability by cyclists of varying abilities.

*Delineation between cycle paths and live traffic is vital for ensuring safe separation. Image Credit ci: Bike Auckland.*




### Specific Requirements

Fencing, when used to delineate the cycleway, must be continuous and linked to prevent cyclists from entering vehicular traffic and to guide them along the intended path. Signage should be clear, informing cyclists of the temporary cycleway and its direction.

When altering the route of cyclists – do not use sharp movements. Like motor vehicles, people who cycle need to change their direction over distance. **Use smooth curves with cyclists.**

### Control Measure Variations

Temporary cycleways can vary from simple demarcated lanes to fully separated paths with physical barriers. The chosen variant typically depends on the expected cycle traffic volume, the complexity of the surrounding roadworks, and the work duration.

### Advantages

- Maintains cyclist route continuity during disruptions.
- Enhances safety by segregating cyclists from other traffic.
- Encourages ongoing cycling, supporting sustainable transport.

### Disadvantages

- Requires significant space and resources to implement.
- May confuse if markedly different from regular routes.
- Possibility of introducing new hazards if not well-managed.

## Dimension Requirements

Further extensive dimensional details for temporary cycleways can be found in **Appendix F of this guidance.**

*Even when there are no formed or marked cycle paths, cyclists are often present. Providing sufficient space for them to safely move through a TTM site is important as space can often be constrained and given to vehicles as a priority first. Do the opposite – give space first to cyclists, then vehicles. Image Credit cii: Chris Harmer.*

## Installation and Removal Considerations

- Before installing the temporary cycleway, ensure a safe diversion of motor vehicle traffic away from the installation area. This may require phased traffic control measures to shift traffic patterns gradually.
- Cyclist Transition: Sequence the shift of cyclists onto their temporary path carefully. This should be done in stages to minimize disruption and confusion, ensuring clear signage and communication.
- Work Vehicle Coordination: Plan the entry and exit of work vehicles to minimize crossings with the cyclist path. This may involve scheduling work vehicle movements during lower cycle traffic periods or using designated crossing points with clear visibility and signage.

*If pushing cyclists close to the edge of the road, consider the safety of drainage infrastructure. Image Credit ciii: seattlepi.com/local/transportation/article/Cyclists-want-action-on-dangerous-storm-drains-1261495.*

## Risks that this control may introduce

Improperly installed or maintained cycleways can lead to risks such as collisions if cyclists are forced into close proximity with pedestrians or vehicles. Additionally, temporary paths may introduce hazards if they are not clear of obstructions or lead cyclists through high-risk areas.

## Maintenance Requirements

Maintaining a temporary cycleway involves regular checks to ensure visible signage, surfaces are intact, and fencing and delineation remain effective.

*Providing good signage aligning with temporary cycle paths ensure that users navigate the space safely and don't take less safe routes through the site. Image Credit civ: Glen Koorey.*

## *Temporary Footpaths*

- Temporary walkways serve to maintain safe, accessible pedestrian routes when standard pathways are obstructed or unavailable.
- Temporary walkways are alternate footpaths provided when usual walking routes are disrupted, for instance, due to construction or maintenance work. They ensure pedestrians can continue their journey safely.
- Temporary walkways must consider those with disabilities. This includes ensuring surfaces are firm, stable, and slip-resistant and that gradients (cross-slopes) **do not exceed 2%**. Regular passing spaces if the walkway width is less than 1.8m are essential for accommodating mobility aids.

*A well-formed temporary walkway is well marked, straight and clear, and separated from other hazards like work activity and live traffic. Image Credit cv: Parallaxx.*

## Specific Requirements

These walkways should maintain a continuous fence (or similar) to prevent access to live traffic, the worksite hazards, and directional clarity. The quality of the walking surface is paramount, and it should be kept free from hazards such as debris or uneven surfaces.

## Control Measure Variations

Variations in temporary walkways can include differences in surface materials, widths, and barrier types. A diverted walkway varies based on the chosen route, with a move away from traffic being preferred, followed by moving towards traffic, and lastly, into the roadway (into a separate space) if there is no other option.

*Any footpath (temporary or not) has risk of trips where there are level differences in the surface. Any step thicker than a pencil is a potential trip hazard and should be addressed by fixing the path (preferred), and if not reasonably practicable, delineating and marking the hazard so it is clearly visible. Image Credit cvi: Wikimedia Commons.*

## Advantages

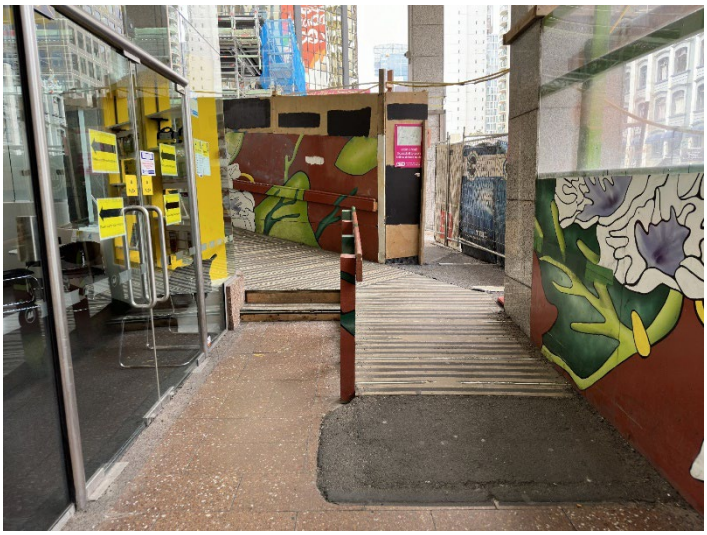
- Ensures pedestrian safety and continuity of access during disruptions.
- Accommodates a diverse range of users, including those with disabilities.

## Disadvantages

- Can occupy significant space, impacting other road users.
- Requires resources for installation, maintenance, and eventual removal.
- Can disrupt property or business access.

## Dimension Requirements

The desired width for temporary walkways is 1.8 metres, accommodating comfortable passage for pedestrians, including those with disabilities. Further detailed dimensional guidance is available in the **temporary walkways section of Appendix F.**



*Temporary walkways should always provide accessible routes for those with mobility impairments. In this case, while there are steps – there is a clear and well-formed safe ramp available. Image Credit cvii: Parallaxx.*

## Installation and Removal Considerations

- Carefully plan the installation to cause minimal disruption to existing pedestrian flow.
- Clearly signpost alternative routes and provide adequate lighting, especially in areas with high foot traffic or complex navigation.
- Prioritize safety and accessibility during installation, ensuring no new hazards are introduced.
- During removal, progressively reintegrate pedestrians back to their original pathways, ensuring any temporary signage or fencing is entirely removed promptly and not left as hazards anywhere onsite.

## Risks that this control may introduce

Risks include potential tripping hazards, insufficient space for mobility aids, or inadequate separation from vehicular traffic, which could lead to accidents.

## Maintenance Requirements

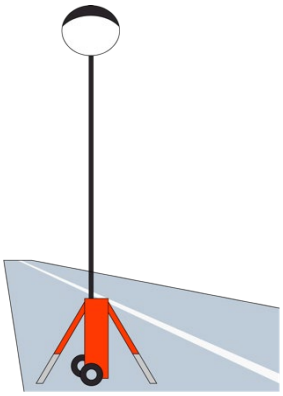
Regular inspection and maintenance ensure the walkway remains safe and navigable.

This includes monitoring surface conditions, fencing integrity, and signage clarity.

*Temporary walkways should be safe, obvious, and smooth and stable. In this case the path narrows considerably, the sign is obscured, there is an unsafe kerb drop off, and many trip hazards. Image Credit cviii: Parallaxx.*

## *Temporary Lighting*

*A key risk of temporary lighting is the glare for road users from their installation. Lighting should be selected to minimise glare (i.e. balloon lighting) and be directed away and down from approaching users. Image Credit cix: IRF Webinar - Pedestrian Safety in Work Zones.*



- Temporary lighting in (TTM enhances safety and navigation for VRUs through well-lit, visible environments, particularly during low-light conditions or at night.
- Temporary lighting is deployed in areas where regular lighting is insufficient or absent, such as construction zones, detours, or areas with heavy machinery. It helps VRUs and drivers navigate safely by providing clear visibility.
- Good lighting can significantly aid those with visual impairments, ensuring safer navigation through TTM areas. However, improperly placed or overly bright lights can cause glare, posing challenges for all road users, especially those with certain visual disabilities.

### Specific Requirements

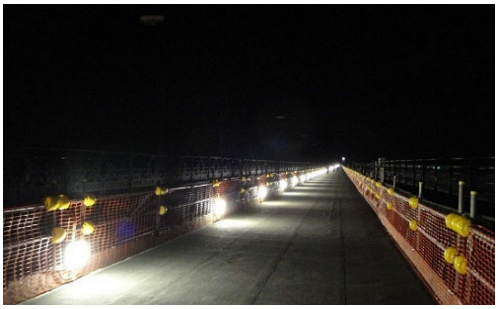
Temporary lighting should provide ample lighting without glare or distraction. Road lighting design requirements can be found in Waka Kotahi's M30 specification.

### Control Measure Variations

Standard temporary lighting includes portable light towers, often used in work zones. Balloon lighting is increasingly popular for its diffuse, glare-free illumination, suitable for complex or sensitive areas. Solar-powered lighting can provide reliable light without electrical connections. LED lighting is a common choice due to its energy efficiency and long lifespan.

### Installation and Removal Considerations

- Lighting should be strategically placed to illuminate paths, crossings, and work zones effectively.
- Careful planning is required to ensure that lighting does not create new hazards, like glare or shadows.
- Installation timing should account for minimal disruption to traffic and VRU flow.
- Removal should be coordinated to ensure areas are not left without adequate lighting, potentially increasing risk.



*Temporary lighting for VRU paths can be placed low, to reduce glare for drivers but serve the purpose of lighting the path. Image Credit cx: Wikimedia Commons.*

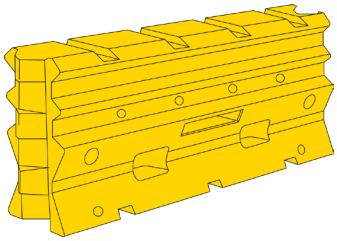
### Risks that this control may introduce

- Glare from poorly positioned or overly bright lights can lead to visibility issues for VRUs and drivers.
- Inadequately secured lighting equipment could pose tripping hazards or become dislodged, causing accidents.
- Electrical hazards associated with temporary lighting installation, particularly in wet conditions.

### Maintenance Requirements

Regular checks to ensure all lights are functioning correctly, securely fastened, and orientated correctly.

## *Temporary Road Safety Barrier Systems (TRSBS)*



- Temporary Road Safety Barrier Systems (TRSBS) are engineered to redirect or absorb the impact of errant motor vehicles, thereby reducing the severity of crashes and protecting road users, including pedestrians, cyclists, and workers in TTM zones.
- TRSBS are deployed in areas with a risk of motor vehicles deviating from their path, particularly near work zones or traffic diversions. They act as a physical barrier, safeguarding VRUs and workers by preventing motor vehicles from entering pedestrian or work areas.

### Specific Requirements

- TRSBS must be installed with an adequate deflection zone behind the barrier, as specified by the manufacturer or relevant standards.
- The barrier system should be continuous, without gaps that could permit motor vehicle intrusion.
- Proper anchoring and end treatments are crucial for the effective functioning of TRSBS.

*Pedestrians should not be put into the deflection zone of a barrier system. Image Credit cxi: Parallaxx.*

### Control Measure Variations

- Concrete barriers are durable and offer high-level crash protection but are less flexible for quick repositioning.
- Water-filled barriers are more versatile for quick deployment and adjustments.
- Steel barriers provide substantial protection and can be adapted to various road configurations.

### Advantages

- Provides a robust physical barrier between motor vehicles and VRUs.
- Helps to absorb and redirect crash energy, enhancing safety in TTM zones.

### Disadvantages

- Can occupy significant space, potentially impacting traffic flow and pedestrian movement.
- Requires careful planning and installation to ensure effectiveness and safety.

### Dimension Requirements

Adequate deflection space must be maintained behind the barrier per the manufacturer's system specifications.

### Installation and Removal Considerations

TRSBS require significant installation coordination and a specifically dedicated planned operation for installation and removal.

### Risks that this control may introduce

If not correctly installed, barriers can become hazards, especially if they intrude into pedestrian or motor vehicle pathways.

Inadequate deflection space can lead to barrier failure in the event of a motor vehicle impact.

*Temporary Road Safety Barriers can serve as channelisation devices too – giving clear path for where cyclists should travel. Neither cyclists nor pedestrians should be permitted to travel in the deflection zone of the barrier. Image Credit cxii: New York Department of Transport.*

### Maintenance Requirements

Regular inspections to ensure the TRSBS remains installed as per manufacturers' requirements.

## *Temporary Speed Limits*


- Temporary Speed Limits (TSLs) are a **critical control measure in TTM environments aimed at reducing motor vehicle speeds to ensure the safety of all road users, especially VRUs in proximity to vehicular traffic.**
- TSLs are implemented in areas where road conditions, such as construction work or road layout changes, necessitate a slower vehicular speed to maintain safety. By legally mandating lower speeds, TSLs help in reducing the risk of accidents and the severity of any potential incidents, particularly in zones where VRUs and motor vehicles are nearby or sharing space.

### Specific Requirements

- TSLs must comply with the Land Transport Rule: Setting of Speed Limits 2022.
- Speed limits should be indicated through signage and, where applicable, supported by additional traffic control measures.

### Control Measure Variations

Whilst the construct of temporary speed limits themselves are fixed through legislative requirements, the deployment and use of a TSL can be varied by using additional traffic calming measures to illicit a more prominent speed reduction from road users. Refer to **Case Study C**, which explores this subject.

### Advantages

- Can reduce the likelihood and severity of accidents in TTM environments.
- Enhances safety for VRUs by slowing down vehicular traffic.

### Disadvantages

- May cause traffic delays and increased travel time.
- Effectiveness depends on driver compliance and enforcement.

### Installation and Removal Considerations

Signs must be installed following the approved TMP and the Land Transport Rule: Setting of Speed Limits 2022.

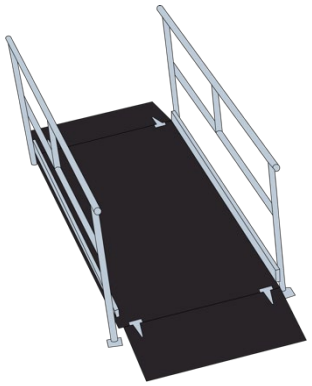
### Risks that this control may introduce

- Inadequate enforcement or non-compliance can lead to ineffective speed control.
- Overly restrictive speed limits may lead to driver frustration and non-compliance.

### Maintenance Requirements

- Regularly inspect and maintain speed limit signs and any additional traffic calming measures to ensure visibility and effectiveness.
- Monitor and review TSLs to ensure they meet the TTM environment's safety requirements, which is still necessary, especially in dynamic work zones.

## *Temporary Walkway Bridges*



- Temporary walkway bridges provide a safe, continuous path for pedestrians and cyclists over obstacles like trenches, excavated areas, or other hazardous work zones, ensuring minimal disruption to their travel routes.
- These bridges are deployed when the direct pedestrian path is obstructed, offering a safe alternative to ground-level detours. They are especially useful in high-traffic areas or where detours would significantly extend travel time or reduce compliance with alternative routes.
- It is essential to include wheelchair-accessible ramps at entrances and exits.
- Bridges should also accommodate various mobility aids.

### Specific Requirements

- Need to be robust and stable, free from structural defects such as cracks or holes.
- Should adhere to minimum width requirements for safe passage of pedestrians and cyclists (refer to Appendix F).

### Control Measure Variations

- Widths vary based on pedestrian volume: standard widths range from 1.20m to 1.50m, with up to 2.50m for high-traffic areas.
- Material and design may vary, with some bridges designed for lightweight portability and others for heavier traffic.

### Dimension Requirements

- Refer to the Temporary Walkway Bridges section within Appendix F of this guidance.

### Installation and Removal Considerations

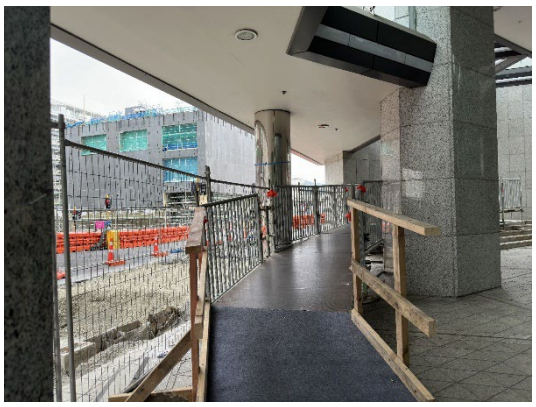
- Planning must account for the space required for ramps and the bridge itself.
- Coordination with other TTM elements is crucial to ensure safe and efficient installation and removal.

### Risks that this control may introduce

- Potential tripping hazards at entry and exit points if ramps are not appropriately designed.
- Risk of structural instability if not properly installed or maintained.

### Maintenance Requirements

- Regular inspections for structural integrity, especially under high-usage



*Purpose build bridges can be useful where the geometry and arrangement of pathways is unique and bespoke. Image Credit cxiii: Parallaxx.*

*Temporary bridges should be stable and embedded into the pathways either side so there are no trip hazards for users at either end. Image Credit cxiv: Oregon Department of Transport.*

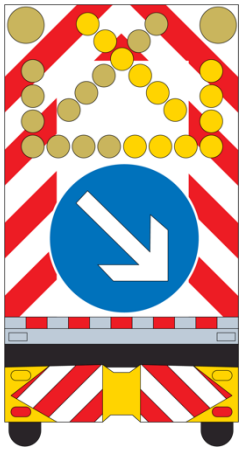
### Advantages

- Maintains direct pedestrian routes, avoiding lengthy detours.
- Ensures safety over hazardous or uneven surfaces.

### Disadvantages

- Can be costly and time-consuming to install.
- Requires significant space for installation and ramps.

## *Vehicle fitted with a Truck Mounted Attenuator (TMA)*



- A truck-mounted attenuator (TMA) vehicle serves dual purposes in TTM. Firstly, the vehicle acts as a protective barrier for people on foot, such as when footpaths are diverted into the carriageway. Secondly, the TMA minimises the impact severity if a road user collides with the protective vehicle.
- The vehicle is strategically placed to shield pedestrians from traffic, particularly in areas where footpaths merge with or are close to vehicular lanes. The TMA, attached to the vehicle's rear, absorbs collision energy, reducing injury risk to the errant driver and protecting workers and VRUs nearby.
- The vehicle placement should not impede visual or physical accessibility features of the walkway.

### Specific Requirements

- The vehicle should be of the required weight to be fitted with the TMA.
- The TMA must be approved for use on New Zealand's roads through Waka Kotahi's M23 Appendix C.

### Control Measure Variations

- Variations in TMA designs, based on impact rating and size.
- Different vehicle types, depending on the required level of protection and site-specific conditions.

### Advantages

- Provides physical barrier protection for pedestrians.
- Reduces impact severity in case of vehicular collision.

### Disadvantages

- Requires significant road space.
- Potential visual obstruction for drivers and pedestrians.

### Installation and Removal Considerations

- Strategic positioning is crucial to maximise protection without causing undue road or pedestrian obstruction.
- Coordination with other TTM elements, ensuring the vehicle does not impede traffic flow or pedestrian movement.
- Consider quick and safe removal in case of emergency or completion of work.

*TMA vehicles, when positioned to protect something, need to ensure there is sufficient space in front of them to accommodate room to roll ahead if struck. Image Credit cxv: Parallaxx.*

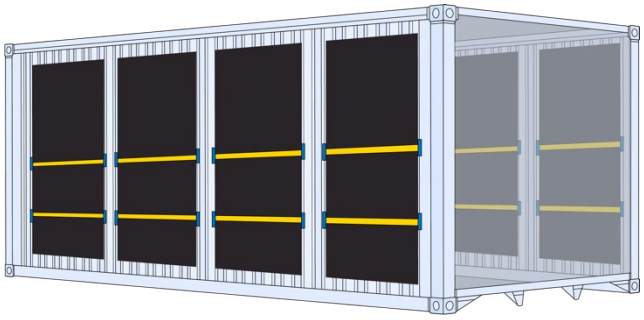
### Risks that this control may introduce

Potential for creating blind spots for both drivers and pedestrians.

Risk of pedestrian or vehicle collision if improperly positioned.

Sufficient **roll-ahead distance** must be accommodated to ensure there is room for the vehicle to move forward if struck.

## *Walkway Covering*



- Walkway covering protects pedestrians and cyclists from hazards such as falling objects, particularly in areas where overhead work is being conducted.
- These coverings are installed over existing or temporary walkways and bikeways, ensuring a safe passage for VRUs underneath construction or maintenance areas. They are particularly useful in urban environments where rerouting pedestrian traffic is impractical or unsafe.
- Must be designed to accommodate wheelchairs and other mobility aids.
- Requires clear signage and, where appropriate, tactile ground surface indicators for visually impaired users.

### Specific Requirements

- Must meet minimum height and width standards to ensure safe and comfortable passage (refer to the relevant section in Appendix F of this guidance).
- Materials used should be durable, weather-resistant, and capable of withstanding anticipated loads.

### Control Measure Variations

- Variations in materials (e.g., solid materials, transparent panels for natural light).
- Different designs for integration with surrounding urban aesthetics.

### Advantages

- Protects pedestrians and cyclists from overhead hazards.
- Enables continuous access along existing routes, minimising disruption.

### Disadvantages

- Can be costly and time-consuming to install and maintain.
- May create visual and physical barriers in the streetscape.

### Dimension Requirements

Minimum width of 1.8m (2.5m or more in CBD environments) and minimum height clearance of 2.5m.

### Installation and Removal Considerations

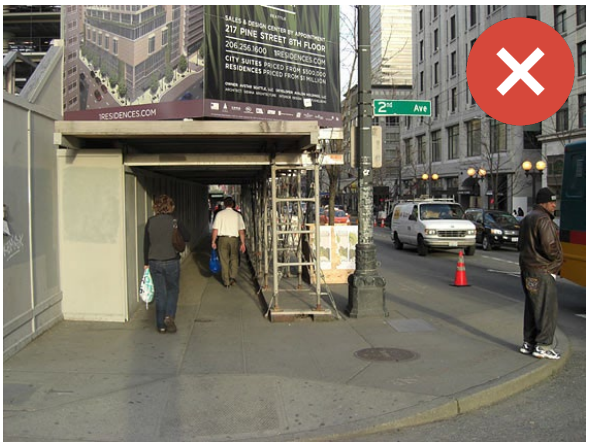
- Installation should minimise disruption to pedestrian and vehicle traffic.
- Structural stability and secure anchoring are crucial.

### Risks that this control may introduce

- Potential tripping hazards if not installed correctly.
- Reduced visibility for pedestrians and cyclists, especially at corners and intersections.

### Maintenance Requirements

- Regular inspection for structural integrity and damage.
- Cleaning and clearing of debris to ensure visibility and safety.




*A key risk of covered walkways is darkness and constrained space. A suitable height to the covered walkway allows for the installation of temporary lighting and a reduced feeling of claustrophobia by users. Image Credit cxvi: City of Seattle.*

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