

# Prioritising future level crossing removals: Site prioritisation framework

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# 1 Introduction

## 1.1 Background

Level crossings place a significant burden on Victoria’s transport network, the community and business. With unprecedented population growth forecast to continue in Victoria, the impact of boom gate closures will increasingly affect movements across the network, access for local communities and safety. Removing level crossings reduces congestion, creates better connected and liveable communities and saves lives – creating thousands of jobs along the way.

The Level Crossing Removal Authority (LXRA) was established in 2015 by the Victorian Government to oversee one of the largest rail infrastructure projects in the state’s history – the Level Crossing Removal Project (LXRP). LXRP will eliminate 50 dangerous and congested level crossings across metropolitan Melbourne by 2022. Concurrently, LXRA is delivering a Metropolitan Network Modernisation Program which includes new train stations, improved public transport access, and improved pedestrian and cycling routes.

LXRP has made significant progress in addressing level crossings that disrupt Melbourne’s transport network and local communities. Over the past two and a half years, 29 level crossings have been removed and 15 train stations have been rebuilt.

While LXRP is delivering great benefit to the community and business, there is still much work to be done. After completion of the LXRP there will be more than 120 level crossings remaining on Melbourne’s electrified rail network, and many more across Victoria.

## 1.2 Purpose of this document

Prioritising level crossings for removal is a complex task, with no simple answer. This is because there are a range of different factors which may warrant removal of a level crossing. Victoria is also in an unprecedented transport construction boom with \$38 billion of projects in delivery, so selection of future level crossings must seek to realise investment efficiencies and minimise disruption impacts by leveraging concurrent projects across the network. Over the past 18 months, LXRA and Transport for Victoria have worked to develop and apply a framework to prioritise future level crossing removals. This document sets out the framework, which transparently and logically navigates the complexity of the prioritisation task.

## 1.3 Framework overview

The site prioritisation framework, and key steps, is summarised in Figure 1 below.

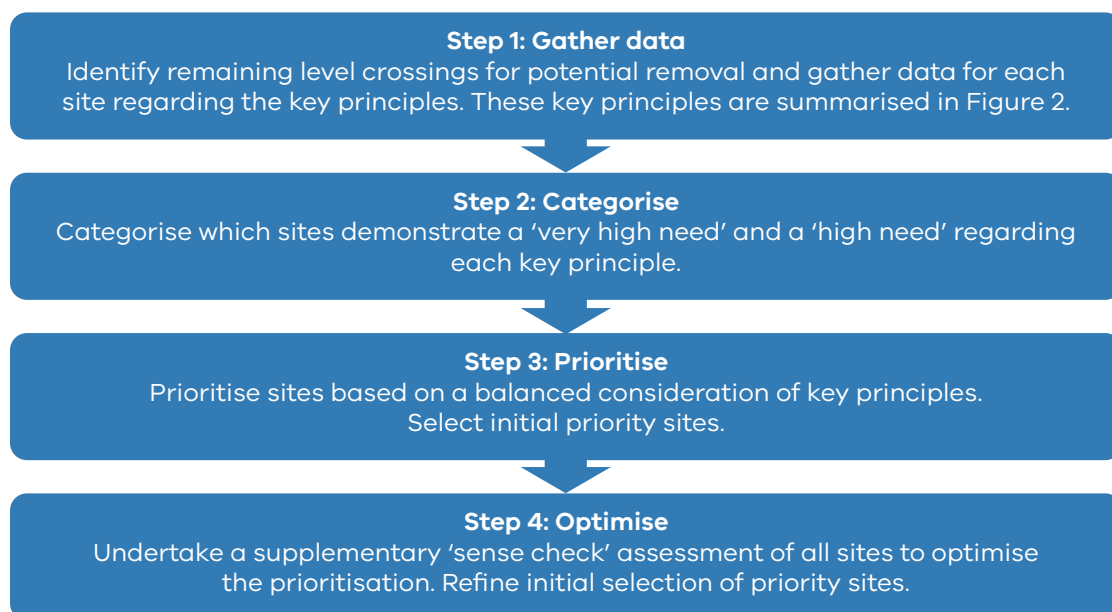


Figure 1: Overview of framework

## 1.4 Key principles that underpin the framework

Underpinning this framework are the key principles summarised in Figure 2. These key principles are used throughout the framework and inform the identification of priority future sites for removal.

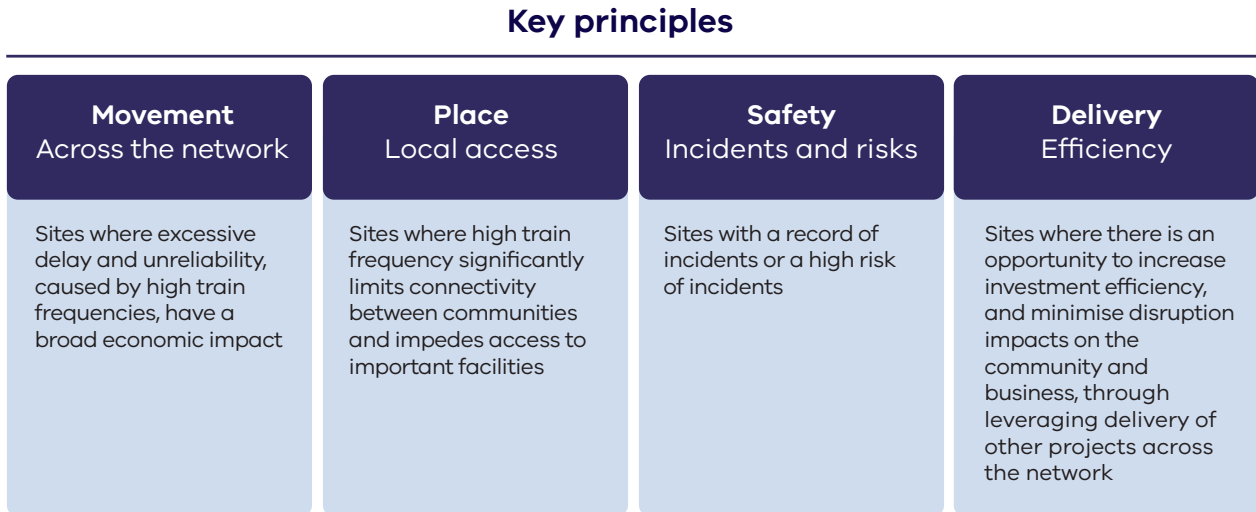


Figure 2: Key principles

## 2 Context

### 2.1 Victoria's Big Build

Victoria is currently in a transport construction boom with \$38 billion of transport projects currently in construction, putting more than 12,000 people in jobs. Further, there is significant planning underway for a number of projects that are set to transform the way Victorians travel. Highlights of Victoria's Big Build include:

- Victoria's biggest ever commitment to remove level crossings, the LXRP
- a second underground railway, the Metro Tunnel
- \$1.7 billion Regional Rail Revival package
- a second major road connection from the west, the West Gate Tunnel
- Victoria's biggest road tunnel and project, the North-East Link
- major upgrades to some of our busiest freeways including the M80, CityLink, Tullamarine and Monash
- the Mernda Rail Extension project, bringing trains to growing outer suburbs in Melbourne's north.

### 2.2 Strategic context

This framework builds on and responds to previously completed studies and existing strategies, including those summarised in Table 1.

*Table 1: Studies and strategies relevant to the development of the Framework*

#### **Victoria's 30-year Infrastructure Strategy (2016) - Infrastructure Victoria**

Infrastructure Victoria (IV) prepared a 30-year strategy that supported continuing investment in additional level crossing removals. IV recommended the development of a transparent prioritisation process within 0-5 years for targeted removal of level crossings beyond current commitments made by Government.

Government's response to IV's 30-year strategy has been released in the Victoria Infrastructure Plan and is supportive of a prioritisation framework that considers updated data, including land use, to inform any future decisions to expand the level crossing removals program.

#### **Plan Melbourne (2017 - 2050) - Department of Environment, Land, Water and Planning (DELWP)**

Plan Melbourne sets out the strategy for supporting jobs and growth, while building on Melbourne's legacy of distinctiveness, liveability and sustainability. The plan, along with other relevant government policy, requires a coordinated and cohesive approach to level crossing removals.

## 2.3 Victorian Auditor General's (VAGO) recommendations

VAGO's report, titled *Managing the Level Crossing Removal Program* (December 2017), recommended the development of a transparent selection and prioritisation process for targeted removal of level crossings beyond current commitments made by Government.

## 2.4 The need for further level crossing removals

A well-connected and efficient transport network is critical to Melbourne's liveability, but also to its economic activity, productivity and competitiveness. While significant work has been done and much achieved to date under the current LXR, without further action being taken to remove additional level crossings, the transport network's connectivity and accessibility remains at risk.

If we do not remove additional level crossings:

- journey times and the variability of journey times for private, business and freight vehicles across Melbourne's road network will increase
- vehicle operating costs will increase
- collision costs will increase
- higher rail service frequencies will be unable to operate in peak periods without extending boom gate closures even further and creating more delays for road users
- public transport users will experience longer travel times on road-based public transport (buses and trams), overcrowded trains, reduced station amenity and delays to train services
- public transport becomes a less attractive travel option (especially for commuting), with flow-on impacts for the city's road network
- community amenity and local accessibility will not improve
- the connectivity and accessibility of Melbourne's transport network will reduce, eroding the city's liveability
- opportunities for economic development, higher productivity and jobs growth will be limited.

## 2.5 Benefits of removing level crossings

Removing additional level crossings provides significant benefits to the community and business, including:

- delivering significant safety improvements for drivers and pedestrians
- improving travel around Melbourne – whether you are a train user, pedestrian, cyclist or driver
- making our roads more reliable, enabling people to better predict their travel times
- stimulating economic growth by creating thousands of jobs during construction
- revitalising local communities, with many areas benefiting from station rebuilds
- enabling more trains to run more often and on time.

## 2.6 Alignment with LXRP business case

Figure 3 illustrates how the key principles of movement, place, safety and delivery efficiency relate to the LXRP investment logic.

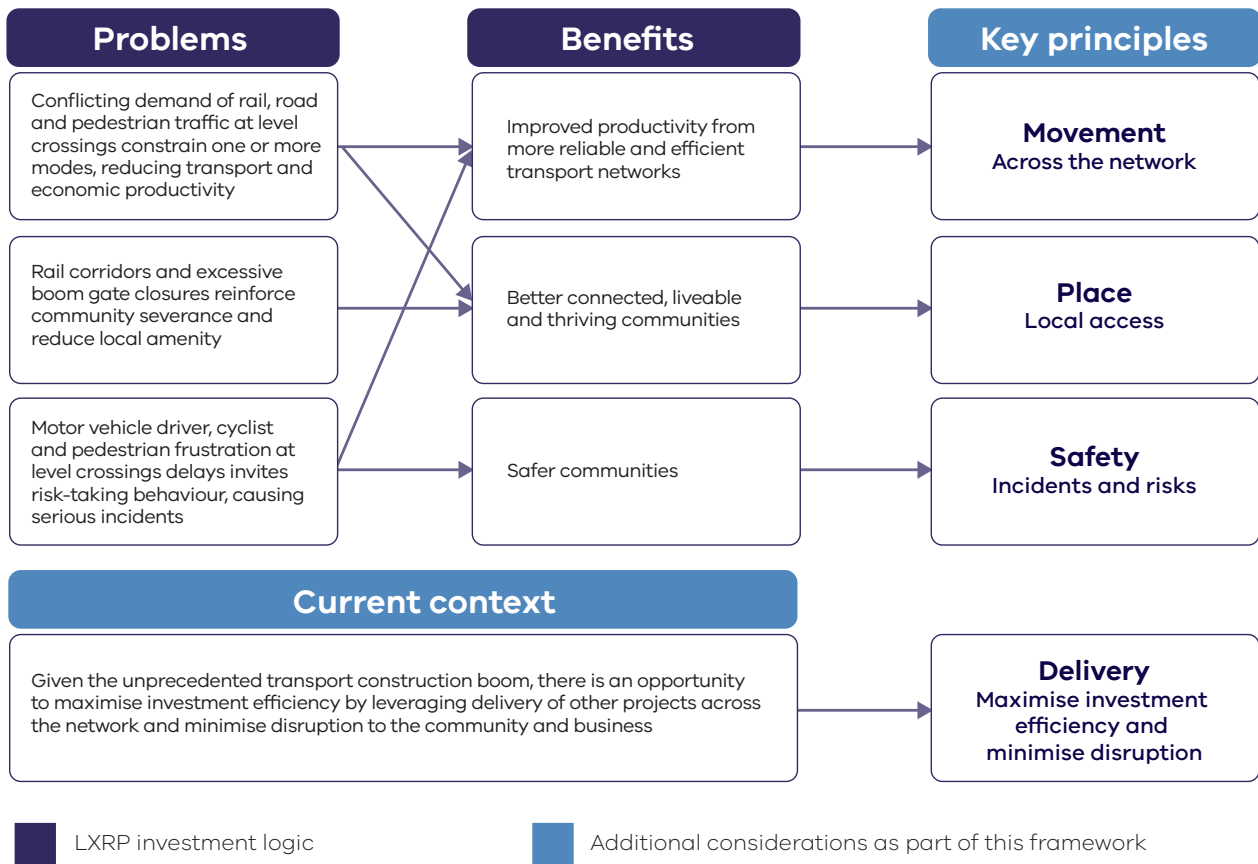


Figure 3: Relationship to LXRP investment logic matrix



### 3 Framework: Key principles explained

This section explains the key principles and underpinning factors that form the prioritisation framework.

#### Key principles and underpinning factors



Figure 4: Key principles and underpinning factors

## 3.1 Movement

Movement (across the network) considers sites where excessive delay and unreliability, caused by high train frequencies, have a broad economic impact.

### 3.1.1 Level crossings restrict movement across the network

Melbourne is Australia's fastest growing city, heading towards a population of six million by 2031 and more than 7.8 million by 2051. As the city grows, reliable and highly efficient transport networks are essential to moving more people and goods around the city, attracting new businesses, residents and jobs, and maintaining Melbourne's liveability and amenity. Conflicting demands of rail, road and pedestrian traffic at level crossings necessarily constrain movement of one or more modes.

With more train services required to accommodate Victoria's ever-growing population, more and longer boom gate closures will occur. Boom gates closing more often and for longer periods creates significant delays and congestion on the road network. As traffic and train volumes continue to increase, travel speeds around level crossings will decrease, delays will increase, and trips will take longer.

Variable and unpredictable boom gate closures make travel time on the road network less reliable, causing frustration and inconvenience for road users, as well as creating additional personal and business costs. Reliable and efficient connections to key freight hubs are critical to sustaining the productivity and competitiveness of many industries, especially those engaged in exporting.

### 3.1.2 Assessing a level crossing's impact on network movement

A level crossing's impact on movement across the network, specifically congestion, is driven by two key factors as set out in Table 2.

Table 2: Movement (congestion) factors

Factors	Description
Number of trains	<p>The amount of trains per hour, in the peak direction, expected to be passing through the level crossing in the morning peak by 2026.</p> <p>This reflects the duration of boom gate closures during the peak period.</p> <p>The impacts of network congestion and delay are likely to be greatest during this period.</p>
Amount of traffic	<p>The amount of traffic, per lane, expected to be using a level crossing by 2026.</p> <p>This indicates the number of road users impacted by boom gate closures during an average day, and the capacity of the road.</p>

The interaction of these principles determines the extent to which a level crossing is likely to cause congestion. Specifically, the number of trains reflects the degree of boom gate closures and, together with the amount of traffic, reflects the level of congestion, exposure and delay on the roads.

Significant delay can result from relatively short durations of boom gate closures when traffic volumes are high. Conversely, significant delay can also occur when traffic volumes are lower, but a high frequency of train services causes long durations of boom gate closures. Even at frequencies of 10 trains per hour (in the peak direction), capacity through signalised intersections near level crossings can be reduced by more than a third.

## 3.2 Place

Place (local access) considers sites where high train frequency significantly limits connectivity between communities and impedes access to important facilities.

### 3.2.1 Level crossings reinforce community severance and reduce local amenity

Level crossings can exacerbate the community severance caused by rail corridors, dividing communities and limiting their ability to access local services, jobs, and education. Level crossings can have a significant impact on local communities and can constrain land use, development and urban renewal.

### 3.2.2 Assessing a level crossing's impact on place

A level crossing's impact on place is driven by two key factors as set out in Table 3.

Table 3: Place factors

Factors	Description
Number of trains	The amount of trains per hour, in the peak direction, expected to be passing through the level crossing in the morning peak by 2026. This reflects the duration of boom gate closures during the peak period. The impacts on place are likely to be greatest during this period.
Importance for local access	Considers the role the level crossing plays in facilitating local access for: nearby community facilities (emergency services and schools), major activity/ shopping areas, pedestrians, and cyclists.

The interaction of these factors determines the extent to which a level crossing is likely to impede access to local communities.

At medium frequencies of 11–16 trains per hour (in the peak direction) boom gate closure can severely limit a community's access to schools, shopping areas, and even the ability to reach station platforms. At high frequencies of 17 or more trains per hour (in the peak direction) boom gates will rarely open during peak times. In such circumstances, and without alternative grade separated rail crossings, communities are essentially disconnected.

An example of the relevance of these key principles is shown in Figure 5, which illustrates how a level crossing can restrict local access to important community facilities. Residents to the west of the railway line rely on the level crossing to access schools, the shopping centre, and other facilities located east of the crossing.

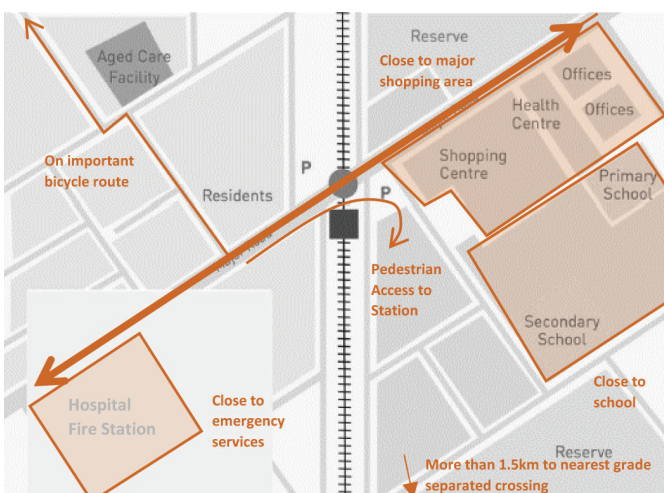


Figure 5: Level crossings and local access

### 3.3 Safety

Safety (incidents and risks) considers sites with a record of incidents or a high risk of incidents.

#### 3.3.1 Frustration at level crossing delays induces risk-taking behaviour, causing serious incidents

A primary benefit in removing level crossing sites is in improving pedestrian and vehicle safety. The degree of danger varies from crossing to crossing and can be based on the history of incidents or the risk associated with specific characteristics observed at a level crossing.

Collisions at level crossings in Victoria account for around one third of level crossing collisions between trains and road vehicles, and over half of all collisions between trains and pedestrians, across Australia.

#### 3.3.2 Assessing a level crossing's impact on safety

A combination of safety record and safety risk should be considered when identifying dangerous level crossings that should be removed as described in Table 4.

Table 4: Safety factors

Factors	Description
<b>Safety risk</b>	<p>Representative of the probability of an incident resulting in a fatality or serious injury at a given level crossing.</p> <p>Safety risk scores are sourced from the Australian Level Crossing Assessment Model (ALCAM), which is universally accepted across Australia and New Zealand as a suitable method to identify the inherent risk at a specific level crossing. The risk is influenced by a multitude of factors including existing level crossing infrastructure, road volumes, and train speed and frequency.</p>
<b>Incident history: near misses</b>	<p>The number of recorded incidents at level crossings, from 2012 to June 2017 based on records from the Office of the National Rail Safety Regulator (ONRSR) and Transport Safety Victoria (TSV) data.</p> <p>A near miss is defined as an incident causing the train driver to engage the emergency brakes.</p>
<b>Incident history: fatality/ serious injury collisions</b>	<p>The number of recorded incidents at level crossings that resulted in fatalities or serious injuries, from 2005 to June 2017, based on records from ONRSR.</p>

### 3.4 Delivery

Delivery (efficiency) considers sites where there is an opportunity to minimise disruption impacts on the community and business, or increase investment efficiency, through leveraging delivery of other projects across the network.

Efficient delivery can be realised by combining additional level crossing removals with other projects in two key ways as summarised in Table 5.

Table 5: Delivery efficiency factors

Factors	Description
<p><b>Increased investment efficiency</b></p>	<p>Delivery efficiencies can be achieved by removing level crossings together with other removals or an interfacing project, rather than removing them independently at some point in the future.</p> <p>For example, efficiencies can be achieved through:</p> <ul style="list-style-type: none"> <li>• streamlined project management and overhead costs</li> <li>• strengthened purchasing power</li> <li>• greater scheduling coordination</li> <li>• reduced interface risk.</li> </ul> <p>This may also be achieved where works physically overlap, and there is an efficiency in avoiding rework.</p>
<p><b>Reduced disruption</b></p>	<p>Delivery efficiencies can be achieved by removing level crossings concurrently with other planned rail occupations. A rail occupation may be required for another level crossing removal or any other project that interfaces with the existing rail network.</p> <p>Not only does the occupation of rail corridors cause major disruption for the community, it also requires considerable resources for operators to plan and manage. Bus replacement services are disruptive for public transport users and result in a cost to the state.</p> <p>It is desirable to minimise the number of times a rail corridor is occupied by taking the opportunity to complete additional level crossing removals, where appropriate, during a single rail occupation.</p>

## 4 Framework: Step 1 (Gather data)

This step involves identifying remaining Victorian level crossings for potential removal and gathering data for each of those sites in respect of the key principles to inform an evidence-based decision. Step 1 is summarised in Figure 6.

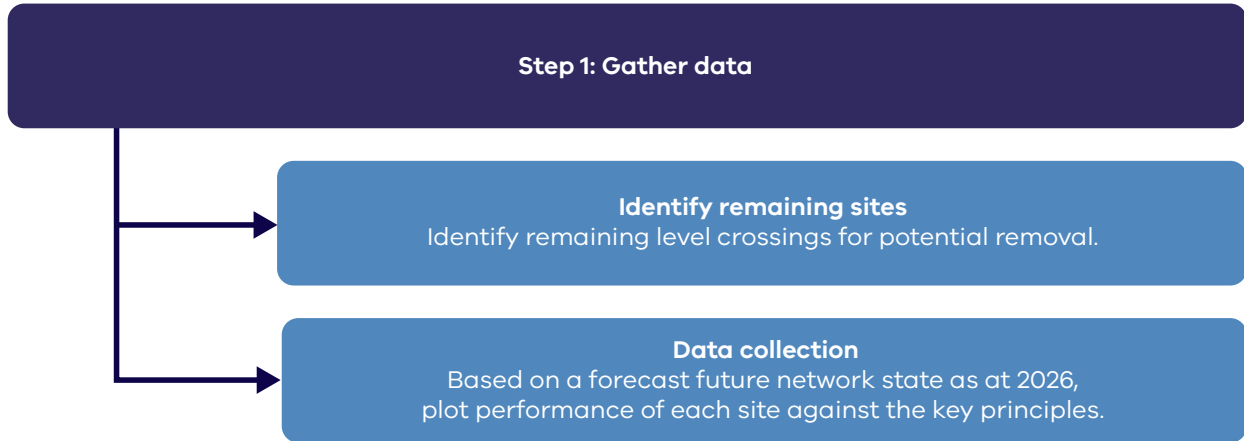


Figure 6: Step 1 (Gathering data)

### 4.1 Identify remaining sites

Following delivery of the initial 50 level crossing removals, there will be a further 276 remaining level crossings across metropolitan Melbourne and in regional Victoria that fall into the following categories:

- road-rail level crossings on the Melbourne electrified metropolitan rail network
- road-rail level crossings on the regional commuter rail network with at least three trains per hour in the peak direction
- road-rail level crossings on freight rail lines within the Melbourne metropolitan area.

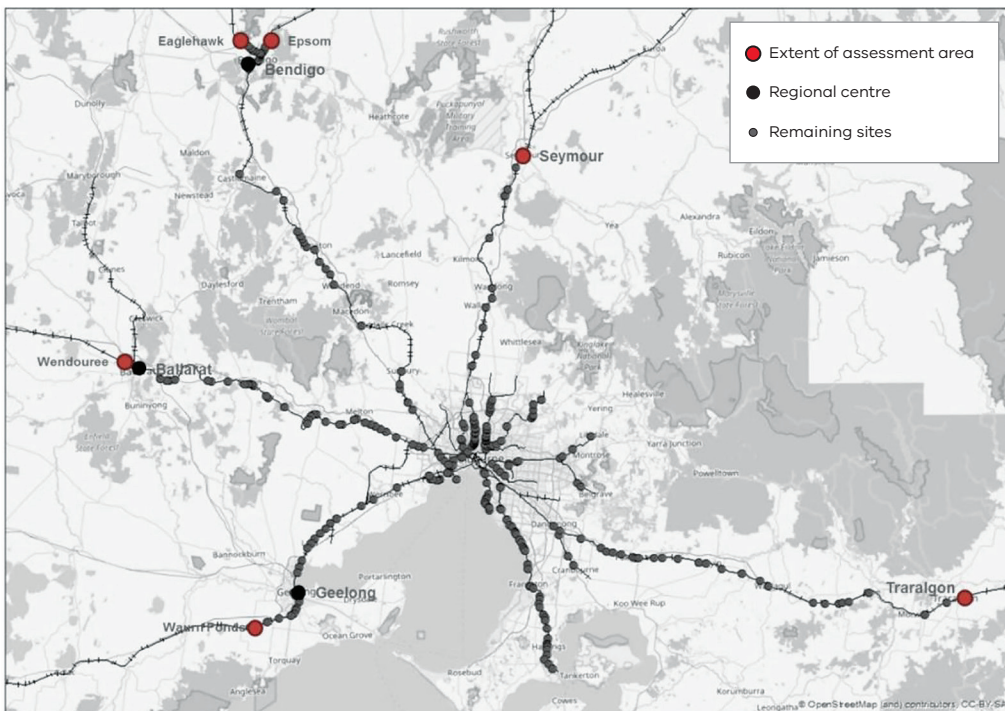


Figure 7: Remaining sites

## 4.2 Data collection

This framework considers sites in the context of a future network state at 2026. The number of train services operating has been forecast based on service projections made by Transport for Victoria (TfV). This reflects projected service increases enabled by the Metro Tunnel Project and associated works. It also accounts for services increases to meet forecast demand and considers several major line upgrades.

Other data underpinning the assessment includes:

- observed traffic data
- traffic and patronage growth projected
- road user hierarchy and classification
- Plan Melbourne land use designations
- Public Transport Victoria (PTV) rail asset information
- inspection of aerial imagery for individual level crossing sites.

## 4.3 Boom gate closures

While increasing numbers of trains will increase boom gate closure durations, estimating the exact timing of boom gate closures is complex, due to a range of variable factors including:

- the proximity of train stations to the level crossing. Boom gates will stay down while trains are dwelling at the station platform
- passenger boarding times at nearby stations. Busier stations will require more time needed for passengers to board and alight, which can vary each day
- the likelihood that a counter-peak train will pass the level crossing at the same time as a peak direction train. Where this does not occur, boom gate closure times are longer, because separate closure events are triggered
- the speed at which trains pass the level crossing, such as trains passing along tight curves. Additionally, the presence of tram squares reduces the speed at which trains can pass through a level crossing. Slower train movements can also occur for movements into nearby stabling yards
- presence of additional express tracks
- longer freight trains that will take longer to pass through a level crossing.

Given these factors, trains per hour has been used to assess the impact on congestion due to the boom gates being down, instead of estimated boom gate down time.

## 4.4 Adjacency sites

Adjacent sites are those that cannot be removed independently of another site because of their proximity, or the requirement to manage a risk.

As such, any site identified for removal and their associated adjacent sites must be removed together. Adjacency between sites has been identified as part of this framework.

## 5 Framework: Step 2 (Categorise)

Having gathered data for all sites, this step categorises relative performance of each site against the key principles. Specifically, it identifies which sites demonstrate a 'very high need' and a 'high need' in respect of the movement, place and safety key principles. Step 2 is summarised in Figure 8 below.

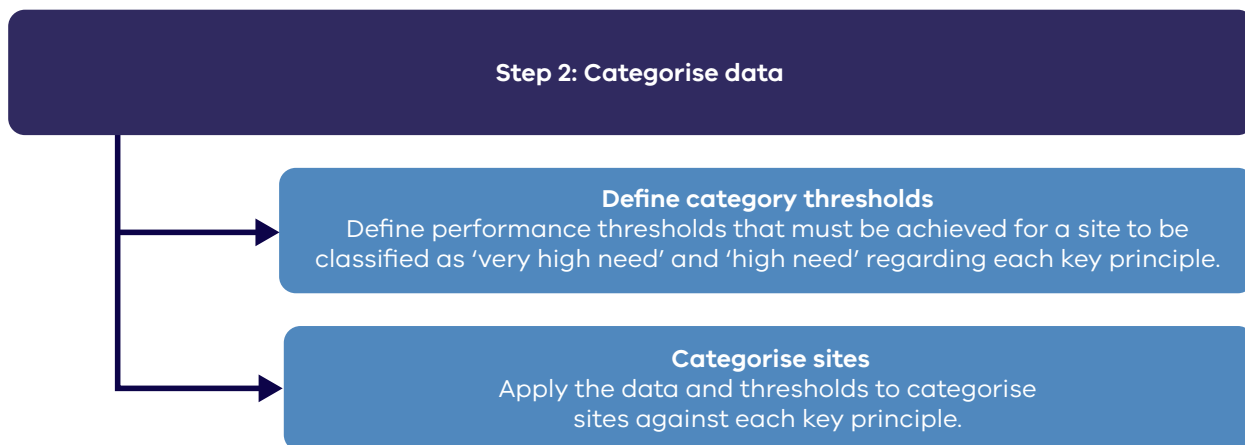


Figure 8: Step 2 (Categorise data)

### 5.1 Define categories

#### 5.1.1 Movement

Set out below in Figure 9 is a diagram illustrating the categories of 'very high need' and 'high need' in respect of movement.

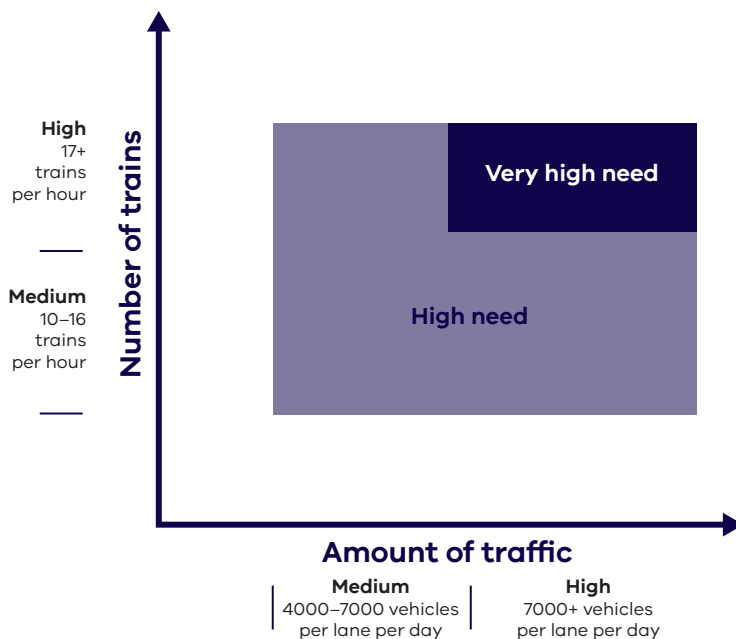


Figure 9: Thresholds - movement



Level crossings with:

- over 7000 vehicles per lane per day, and over 17 trains per hour, represent major congestion points. These level crossings are categorised as very high need
- over 4000 vehicles per day, and over 10 trains per hour, will have issues in varying degrees. These sites are high need.

These categories have been developed, taking the following into account:

- in respect of the number of trains per hour in the peak direction:
  - between 10 and 16 trains per hour, boom gate closure durations are typically expected to range from 25% to 60%. VicRoads analysis suggests that traffic capacity of signalised intersections close to level crossings will be reduced by up to half
  - above 17 trains per hour, boom gate closure durations are typically expected to exceed 50%. VicRoads analysis suggests that traffic movements around level crossings will become highly restricted.
- in respect of amount of traffic per lane per day:
  - below 4000 vehicles per lane per day, traffic flow is relatively free flowing, and there is capacity to deal with congestion
  - between 4000 to 7000 vehicles per lane per day, traffic flow becomes more constrained and there is less capacity to deal with congestion
  - above 7000 vehicles per lane per day, traffic flow is highly constrained and there is very little capacity to deal with congestion.

## 5.1.2 Place

Set out below in Figure 10 is a diagram illustrating the categories of a 'very high need' and 'high need' in respect of place.

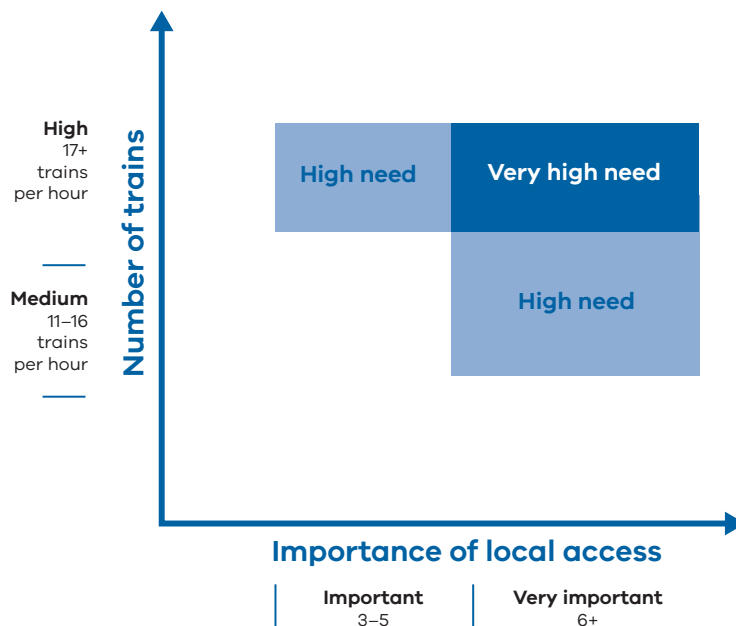


Figure 10: Thresholds - place

The local community's reliance upon access via a level crossing is assessed through an importance for local access score.

This score uses metrics that reflect site-specific characteristics, which include an observation of community facilities around the crossing, the crossing's role in facilitating pedestrian and bicycle movements, as well as the distance to alternative grade separated crossings.

Table 6: Importance for local access scoring metrics

Is the level crossing located...		Importance weighting	Score
<b>Emergency services</b>	Close to a hospital, police station, ambulance station or fire station?	High	4
<b>Schools</b>	Close to a primary or secondary school?	High	3
<b>Shopping/ activity areas</b>	In a major shopping/ activity area?	High	3
	In a local shopping area?	Medium	2
<b>Traffic access</b>	In an urban area, and more than 1.5 kilometres from the next nearest grade-separated crossing?	Medium	2
<b>Pedestrian access</b>	On the main pedestrian access route to a station (no nearby underpass or overpass)?	Medium	1
<b>Cycling access</b>	On an important bicycle route?	Medium	1

Level crossings that:

- are very important for local access, with over 17 trains per hour, represent major issues for local community connectivity. These level crossings are categorised as very high need.
- are important for local access, with over 11 trains per hour, will have issues in varying degrees. These sites are identified as high need.

These categories have been developed, taking the following into account:

- in respect of the number of trains per hour in the peak direction:
  - between 11 and 17 trains per hour, boom gate closure durations typically range from 30% to 60%. This can limit a community's access to schools and shopping areas
  - above 17 trains per hour, boom gate closure durations typically exceed 50%. In such circumstances, and without alternative grade separated rail crossings, communities become increasingly disconnected.
- in respect of the importance for local access:
  - sites that are important for local access (3-5) will typically have one or two types of nearby community facilities, such as a school or a shopping area, or a cycling route
  - sites that are very important for local access (6+) will typically have several types of community facilities nearby, such as emergency services, schools and shopping areas.

### 5.1.3 Safety

Set out below in Figure 11 is a diagram illustrating the categories of a 'very high need' and 'high need' in respect of safety.

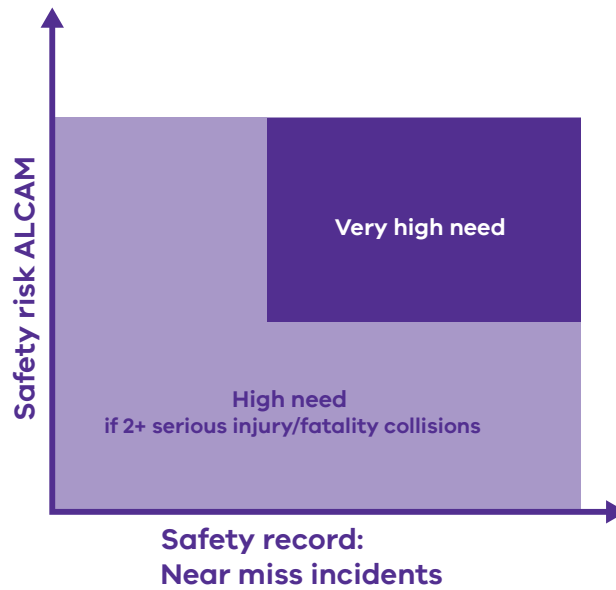


Figure 11: Thresholds - safety

Level crossings with both a high safety risk and a high near-miss incident record, are strongly indicative of an underlying safety issue, and are identified as very high need.

The number of collisions occurring at level crossings, while infrequent, has a very large impact. Therefore, any sites with two or more serious-injury/fatality crashes are identified as high need, irrespective of safety risk and near-miss incident record.

## 5.2 Categorise sites

Having defined the categories, the next task is to identify sites that meet the thresholds for a 'very high need' or 'high need' in each of the key principles.

## 6 Framework: Step 3 (Prioritise)

Given the significant burden that level crossings place on Victoria’s transport network, it is important to identify priority sites for removal that deliver the greatest benefits to the community. Figure 12 illustrates the assessment process which is designed to initially prioritise sites based on a balanced consideration of each of the key principles.



Figure 12: Prioritisation process

### 6.1 Defining the priorities

Set out in Figure 13 are two requirements that are used to identify an initial priority list. Where a site is adjacent to a site that meets either requirement, this adjacent site is also identified as an initial priority given the sites cannot be removed independently.

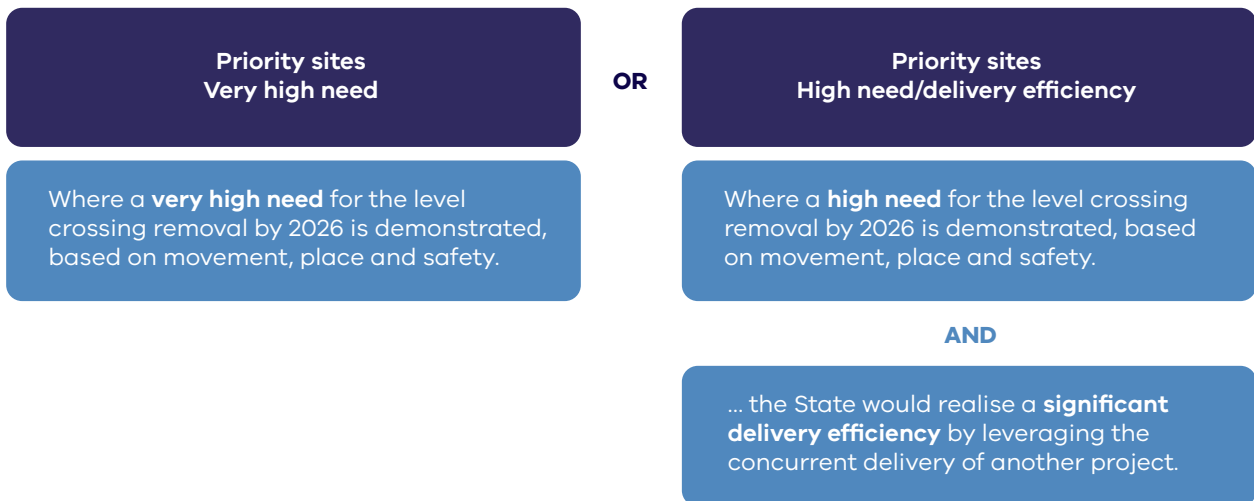


Figure 13: Priority definition

### 6.2 Identifying initial priority sites

The next task is to determine a list of initial priority sites by applying the requirements defined in section 6.1.

## 7 Framework: Step 4 (Optimise)

Acknowledging the complexity of this task, a supplementary, sense-check, assessment of all sites is undertaken to identify any unique characteristics that should elevate or reduce a site's priority for removal. An overview of Step 4 (Optimise) is set out in Figure 14.

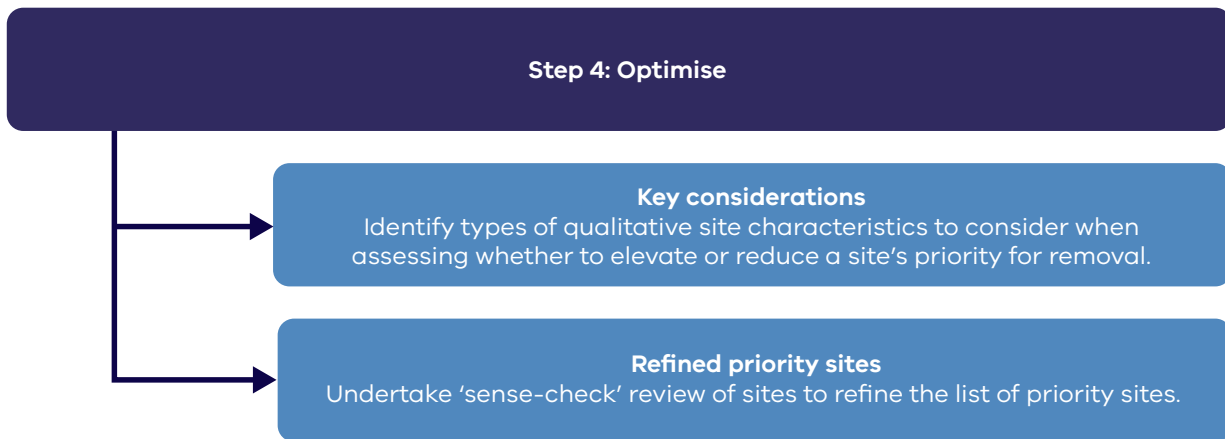


Figure 14: Sense check assessment

### 7.1 Key considerations

All site characteristics should be considered in this optimise step. However, key considerations should include those set out below in Table 7. Particular consideration should also be given to sites where they either marginally exceed or fail to meet the thresholds defined in Step 2.

Table 7: Key considerations

Consideration	Summary
Future need	Is the level crossing likely to need removal in the medium to long-term (beyond 2026) from a movement, place or safety perspective?
Corridor completion	Would removal of two or fewer level crossings enable the grade separation of an entire rail corridor section?
Land use opportunity	Would removal of the level crossing lead to other land use and transport benefits, such as significant precinct or urban renewal?
Network importance	Based on the network importance consideration, sites may either be added or removed from the initial priority list.  Would removal of the level crossing provide a significant improvement to network performance? Typically, these sites include preferred traffic routes, tram routes and high frequency SmartBus routes, or sites with a particular large number of combined features. This consideration is explained further below and a scale for weighting importance for network is set out in Table 8.

The network importance consideration indicates the role the route plays in accommodating the movement of people and goods across the network and, by extension, its economic significance.

This is largely informed by the VicRoads' SmartRoads hierarchy, which captures both the type of users impacted by a level crossing, and the potential impact of the crossing on the performance of the transport network. Within this context, the higher the importance given to an individual road, the greater the economic impact of congestion and road user delay.

Table 8: Network importance weighting

Is the level crossing located on...		Importance weighting
Road function	A preferred traffic route?	Very high
	Any other arterial road?	Medium
	On a local road, and within 50 metres of a preferred traffic route?	Medium
Freight	A route that is important for the distribution of freight?	Medium
Trams	A tram route?	Very high
Buses	A SmartBus bus route?	High
	On a high frequency bus route?	High
	On a low frequency bus route?	Medium
Employment	A key access route to an important employment area?	Medium

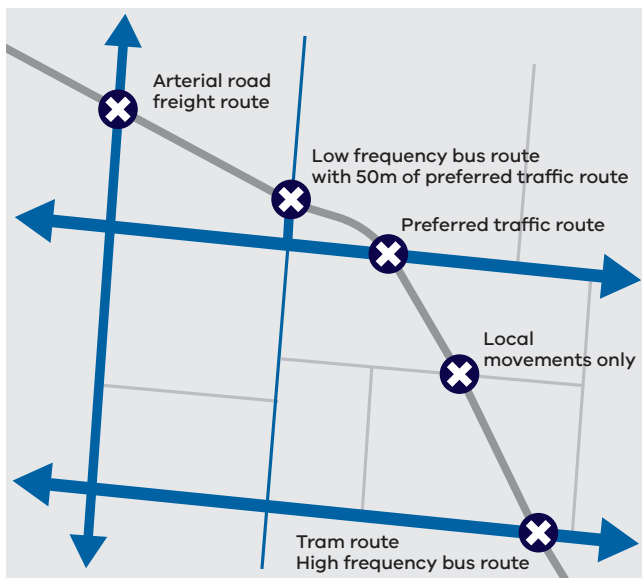


Figure 15: Importance for network route considerations

## 7.2 Refined priority sites

The next task is to identify whether to elevate or reduce a site's priority for removal and add it or subtract it from the initial priority list.



