WAKA KOTAHI
NZ TRANSPORT AGENCY

REQUIREMENTS FOR INTELLIGENT TRANSPORT SYSTEMS

ITS Core Requirements Guideline

23 FEBRUARY 2023
VERSION 0.18

New Zealand Government

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More information
If you have further queries, contact the Intelligent Transport Systems Standards and Specifications (ITS S&S) team via email: itsspec@nzta.govt.nz

More information about intelligent transport systems (ITS) is available on the Waka Kotahi website at https://www.nzta.govt.nz/its

This document is available on the Waka Kotahi website at https://www.nzta.govt.nz/itsspecs

Template version
1.8, 03/11/2021

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1 DOCUMENT CONTROL

1.1 Document information

Document number	ITS-STND-RITS-202302
Previous document number/s (if applicable)	
Document status	Draft
[IF RETIRED] New document details	
Online ISBN	978-1-99-106813-2
Document availability	The controlled version of this document can be accessed from https://www.nzta.govt.nz/resources/intelligent-transport-systems/its-standards-and-specifications/

1.2 Document owner

Role ITS S&S Steering Committee

Organisation NZTA

1.3 Document approvers

This table shows a record of the approvers for this document.

Approval date	Approver	Role	Organisation

2 TERMINOLOGY USED IN THIS DOCUMENT

Term	Definition
DRAFT	The document is being written and cannot be used outside of Waka Kotahi.
PENDING	The document has been finalised and is pending approval and ratification by Waka Kotahi. It can be used for procurement at this status.
RATIFIED	The document is an official Waka Kotahi document. Road controlling authorities are obliged to follow a document with this status.
RETIRED	The document is obsolete, and/or superseded.
100% coverage	CCTV distribution that provides visibility of all lanes of a corridor at all times
AWS	Advanced warning sign
CCTV	Closed-circuit television
CMS	Changeable message sign. A type of variable message sign (VMS) usually with a limited number of signs able to be displayed. These are often mechanical signs with two to three messages being displayed on a rotating sign face.
EJT	Estimated journey time
GPS	Government Policy Statement
HOV	High-occupancy vehicle
ITS	Intelligent transport systems
LCS	Lane and carriageway sign
LiDAR	Light detection and ranging
ONF	One Network Framework
ONRC	One Network Road Classification
RCA	Road controlling authority
RMS	Ramp metering system
TOC	Traffic operations centre
UPS	Uninterruptable power supply
VMS	Variable message sign. An electronic sign where the information shown can be changed or switched on or off as required. The information can be text or symbols.

3 OVERVIEW AND OUTCOMES

This section defines the core requirements to support operational outcomes for ITS with respect to the transport network.

3.1 Purpose

The purpose of this document is to establish the ITS requirements for a given road classification for a new capital project. The target application of this document is SM031 – State Highway construction contract proforma manual.

This standard is intended for use by all planners, project managers and consultants undertaking projects to provide new infrastructure on the national road transport network. It is primarily for Waka Kotahi projects; however, it can be used for any transport infrastructure projects.

It follows the One Network Framework (ONF), which is the new national classification system that supersedes the One Network Road Classification (ONRC). The ONF is aligned to the Government Policy Statement (GPS).

This document serves as the entry point into the ITS standards and specifications framework. This document is a standard that lays the general requirements for ITS design. Specific ITS information can be found on the Waka Kotahi ITS delivery specifications and design standards website, referenced in section 9.2.1 ‘Standards and specifications’.

This document will be reviewed when necessary to address interoperability as we move towards future automation.

3.2 Overview

A core standard is a set of global requirements for all ITS design standards and delivery specifications, which are universally applicable unless otherwise stated.

3.2.1 Waka Kotahi ITS class

000 Core requirements. Information common to more than one standard or specification in order to manage quality.

Class definitions

3.3 Scope

This document is used to establish the principal’s requirements and/or minimum requirements for ITS to be delivered for any transport project on the Waka Kotahi network.

These requirements are inputs into establishing the capital costs for ITS during the business case phase of transport network projects.

In addition to these requirements, additional ITS equipment and systems may be required to ensure Waka Kotahi operational outcomes and service levels are met. It is expected that the project's concept of operations shall cover these additional ITS requirements.

3.4 Outcomes

The following list outlines the outcomes of this core requirements standard.

- Principal's requirements and minimum requirements (part of a contract) for ITS are aligned to the operational requirements for the road classification.
- Business cases cover ITS costings.
- Network operators have the necessary ITS to meet their operational requirements.

3.4.1 Operational

The operational requirements for ITS equipment should be well understood throughout the project delivery lifecycle, from business case to implementation, enabling the road to be operated as intended.

Network operators should be engaged as early possible in the project's detailed design phase to understand their operational needs. It is assumed that a concept of operations is in place prior to the detailed design phase. While this core requirements standard outlines the requirements, engaging with network operators will provide crucial insights for a particular corridor that will establish the need for additional ITS and bespoke ITS solutions over and above the requirements.

Early engagement will enable the planner, project manager or consultant to feed these requirements and needs into the planning, design and construction stages of the project.

Contact with the Network Operations teams shall be made through the Waka Kotahi Transport Services Project Manager, whose responsibility is to see that:

- the design is fit for purpose
- the concept of operations is updated with the detailed design requirements.

3.4.2 For users of the Waka Kotahi transport network

Consistent customer levels of service are delivered and maintained for the user across the Waka Kotahi network.

3.4.3 For road controlling authorities and transport operations centres

This standard can be used as guidance for road controlling authorities (RCAs) and traffic operations centres (TOCs) to deliver and maintain the customer levels of service.

4 DESIGN FOR OPERATION

This section defines the process to deliver core functionality required for a successful intelligent transport system.

4.1 Commissioning and handover

The Contractor is responsible for handover of ITS solutions to Waka Kotahi transport and technology operations. See the latest version of ITS core requirements standard: Commissioning and handover requirements.

4.1.1 Early engagement

4.1.1.1 Strategic/planning

The Designer must consult with the Waka Kotahi Technology team, network operators (such as TOCs) and maintenance organisations at the initial conception of a project.

A concept of operations shall be drafted by the Designer and be approved by Waka Kotahi before the design process is started. The concept of operations requires approval from Waka Kotahi Transport Services. This is a critical document required to outline the operational requirements and inform the ITS design.

All projects must use the ITS communications network vendor contracted by Waka Kotahi and must follow the approved Waka Kotahi network architecture.

The Designer must consult with the Waka Kotahi Technology team. They can be contacted via email: itsspec@nzta.govt.nz

4.1.1.2 Construction phase

When starting and during work on-site, the Contractor must engage with network operators and maintainers for ITS delivery. This communication must be ongoing during the works. This will ensure network operators are aware when ITS in the construction area will be offline, relocated or disrupted.

The criticality and therefore acceptable downtimes, if any, for existing ITS equipment (eg loops, closed-circuit television [CCTV] cameras) should be determined by the TOCs and operators on a site-by-site basis. Importance should be given to detector loops, which are often damaged or not reinstated in a timely fashion during works.

There will also be newly installed ITS that will need to come online and be incorporated with the network operating systems.

4.1.2 Waka Kotahi access to ITS operated by an external party

For projects involving ITS on state highways, the ITS backbone infrastructure, power and communications systems, and any ITS devices that can be utilised for wider strategic operations must be made available and accessible to Waka Kotahi. This applies for all projects in which any ITS on the Waka Kotahi network is operated or outsourced to an external party.

Any subsequent agreements or arrangements are not to restrict the ability of Waka Kotahi to communicate with devices beyond the given project area or prohibit them from making ITS improvements outside their project extents.

All projects must use the ITS communications network vendor contracted by Waka Kotahi and follow the approved Waka Kotahi network architecture.

If a link is required to the local authority communications network, then this will be provided from the approved Waka Kotahi backbone network.

The Designer must consult with the Waka Kotahi Technology team to identify the correct processes and procedures to assist with this.

4.2 One Network Framework

The ONF is the new national classification system for the New Zealand land transport system. It evolves the ONRC to a two-dimensional classification focused on both movement and place. The ONF also introduces classifications for different modes of transport, recognising that our roads and streets have different functions for different modes.

Acknowledging the 'place' function within the transport network reflects that roads and streets are destinations for people, as well as transport corridors. Movement considers both people and goods, rather than the number of cars using a corridor. This approach also better recognises the contribution of other modes, such as walking, cycling and public transport, to the classification of overall movement.

For further information on the ONF refer to the ONF website using the link provided in section 9.2.2 'Resources'.

4.3 ITS requirements

4.3.1 Core ITS requirements for all roads

This section covers requirements that should be standard across all ITS projects, regardless of the road classification. A core requirement is that all ITS equipment installed on the road requires power and communications (see the latest versions of ITS core requirements specification: General electrical requirements, and ITS design standard: Optical fibre).

4.3.1.1 Existing ITS assets and services

An audit of existing ITS assets and services is a requirement for a road that is due for an upgrade or realignment. These existing ITS assets and services must be restored to the current ITS design standard or delivery specification. A request for departure is required if this cannot be accomplished or is not considered appropriate.

4.3.1.2 Power supply

All ITS require a power supply so that the ITS equipment can work effectively, and information can be transferred to the network operators. Reticulated mains (230V AC) is the default standard for all ITS equipment. Alternatively, solar and wind energy can also be used with extra-low voltage to power the asset. However, these stand-alone systems must be sized to suit the specific devices and maintain operational integrity. A request for departure is also required if the ITS device cannot be powered by the reticulated mains.

All uninterruptable power supplies (UPSs) must have a network interface and be capable of being remotely monitored.

Each high-criticality site must have a UPS large enough to power a communications device and the connected ITS equipment. For specific requirements for power supply for individual ITS equipment and designs, see the latest version of ITS core requirements specification: General electrical requirements.

4.3.1.3 Communications infrastructure

ITS assets, tools and infrastructure must have a communications link in place so that information can be transferred to and from devices, network operators and data centres. This can be achieved through fibre, Wi-Fi and other methods. Fibre-optic cable is the preferred transmission medium as a communications link (see the latest version of ITS design standard: Optical fibre).

Appropriate ducts and pits are an ITS requirement for all roads, with the exception of main streets and activity streets (see the latest version of ITS design standard and delivery specification: Duct supply and installation). This holds even if there is no ITS currently planned for installation.

Waka Kotahi also requires access to all communications infrastructure, such as fibre and ducting where installed, for seamless network operations on its state highways. This applies even if the infrastructure is operated by an external party. For more details, see section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

4.3.1.3.1 Communications for urban roads

Fibre communications are a requirement for transit corridors and urban connectors. While fibre communications are not a requirement for main streets and activity streets, it is still preferred.

4.3.1.3.2 Mobile phone coverage

Telecommunications companies must be engaged for transport infrastructure projects at the planning stage. It is particularly relevant for sections where there is either no or very limited mobile phone coverage. This is to identify if there are any opportunities for them to provide coverage that will benefit transport network users.

4.3.1.4 Interfacing capability

All new and upgraded ITS assets, tools and systems must be compatible with, and integrated to, current Waka Kotahi systems. This allows Waka Kotahi network operators to manage the entire network.

Planners, project managers and consultants must consult with the Waka Kotahi Technology team. They can be contacted via email: itsspec@nzta.govt.nz

4.3.2 Tunnels, bridges and multi-modal infrastructure

For an upgrade or new development there may be unique scenarios that pose a risk to road users or the surrounding environment. It might form a potential hazard, impact safety or disrupt traffic flows. If it is not feasible to design out these issues, then some additional form of ITS may be required.

This includes tunnels, bridges and multi-modal infrastructure.

In these cases, a specific ITS design needs to be carried out based on the concept of operations and the safety risks associated with the structure. The concept of operations should consider aspects such as volume of traffic, criticality of the route, emergency response and operational requirements.

4.3.3 Active modes infrastructure

For shared-use paths and cycling routes that cater to active modes, requirements are set out below.

4.3.3.1 Count data

Collecting count data is a requirement for all shared-use paths and cycling routes.

- A permanent continuous counter that detects and classifies pedestrians, cyclists and different forms of micro-mobility is a requirement for shared paths.
- A permanent continuous counter that detects and classifies cyclists and different forms of micro-mobility is a requirement for separated cycleways and cycle lanes.

This can be achieved using sensor devices such as inductive loops, infrared sensors, light detection and ranging (LiDAR), cameras and video analytics. This data can be used for traffic operations, performance analysis and benefits reporting.

4.3.3.2 Operational visibility in urban areas

Shared-use paths and cycling routes require operational visibility at underpasses and other high-risk areas. Full operational visibility (100% coverage) through underpasses and of other high-risk areas is to be provided. Cameras can be used to facilitate remote visibility of these locations.

4.3.4 ITS requirements for each road classification

The following sections detail the ITS requirements for each ONF road classification. Each has a summary table of the requirements. Each feature of the summary table is then further explained if necessary. A summary table with requirements for all ONF road classifications can be found in appendix A – 'ITS requirements summary table'.

Note that there are currently no ITS requirements for rural roads, city hubs, local streets and civic spaces as there are no state highway sections that currently fall under these ONF classifications. This may change in the future if a section of the state highway is reclassified as one of these classifications.

4.3.4.1 Transit corridors

4.3.4.1.1 Summary of ITS requirements for a transit corridor

Features	ITS requirements
Civil infrastructure	• Allow space for gantries. • Install foundations for gantries where planned as per concept of operations or operational requirements. • Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• Full operational visibility of the carriageway surface, including all on-ramps and off-ramps. • CCTV cameras enabling 100% coverage of the corridor must be used.
Communications	• Fibre-optic cable must be installed along the entire corridor.
Road-user information	• Inform road users in advance of every interchange and on-ramp. • Variable message signs (VMS) and estimated journey time (EJT) signs must be used. Changeable message signs (CMS) must be used where the concept of operations requires it.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, on-ramps, off-ramps and motorway lanes must be managed. • Ramp metering systems (RMS) and lane and carriageway signs (LCS) must be used.
Incident detection and management	• Detection systems are required across the entire corridor. • ITS tools are required to manage the incident. • CCTV cameras, LCS, VMS, EJT signs, and sensor devices must be used.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 1. Summary of ITS requirements for a transit corridor

4.3.4.1.2 Gantries

For transit corridors, it is a requirement to allow space for gantries. Consideration should also be given to whether the foundations can be installed, depending on confidence in the locations. The locations of gantries and the associated attached devices are to be determined in the concept of operations or operational requirements.

As with ducts and pits in section 4.3.1.3 ‘Communications infrastructure’, this holds even if there are no gantries currently planned in the design. Saving this space allows for futureproofing if gantries and the associated ITS are later required.

4.3.4.1.3 Operational visibility

Full operational visibility of the carriageway surface (as defined in the concept of operations or operational requirements), including all on-ramps and off-ramps, is required for the network operators to be able to view:

- all possible incidents or unusual circumstances and respond accordingly
- traffic congestion and identify potential needs for demand management.

Different types of cameras can be used to facilitate remote visibility of transit corridors. CCTV cameras enabling 100% coverage (full visibility of the corridor) must be used. In the event of a single CCTV camera failure, 100% coverage (full visibility) must still be maintained.

4.3.4.1.4 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party.

For transit corridors, high-speed communication links are a necessity so that network operators can see real-time footage, make changes and respond remotely in a timely manner from the operating centres. Fibre-optic cable is required, along with the appropriate ducts and pits.

4.3.4.1.5 Road-user information

The ability to inform road users in advance of every interchange and on-ramp (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and advanced warning of events/conditions ahead to inform their travel decisions.

ITS that provide road-user information, such as VMS on the mainline and EJT signs on the side-road approaches, must be used (see the latest versions of ITS design standard: Variable message signs – fixed, and ITS delivery specification: Variable message signs – fixed). Depending on operational analysis, additional VMS may be required and/or CMS.

4.3.4.1.6 Demand and corridor management

Demand management systems are required to:

- maximise the throughput across all possible traffic scenarios, reduce congestion and improve the journeys of road users
- improve equity across all road users, regardless of their route.

Where analysis shows that flow breakdown or congestion is likely to occur, on-ramps and corridor lanes must be managed so that during peak times, disruption to the mainline flow can be minimised. This can be achieved using various types of ITS equipment, such as RMS (see the latest version of ITS design standard: Ramp meter systems) and LCS (see the latest version of ITS delivery specification: Lane and carriageway signs (LCS), and should be as defined in the concept of operations or operational requirements.

4.3.4.1.7 Incident detection and management

Transit corridors are required to have incident detection systems across the corridor, as defined in the concept of operations. This allows for:

- emergency services to respond quickly and tend to those involved in an incident

- traffic management interventions (such as temporary speed limits or diversions) to be taken for safety and traffic-flow purposes
- an incident site to be cleared quickly to restore normal flows.

It may be necessary to install wrong-way detection on motorway off-ramps to alert operators and users of vehicles entering the corridor in the wrong direction. Advice should be sought from the Safety team at Waka Kotahi on a location-by-location basis regarding whether installation of these systems is required.

Network operators can respond effectively to incidents where ITS capable of incident detection are coupled with ITS that provide visibility of the corridor, resulting in live information being available to TOCs.

4.3.4.1.8 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis
- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane separately, as well as each on-ramp and off-ramp. This includes bus lanes and high-occupancy vehicle (HOV) lanes. This should be as defined in the concept of operations or operational requirements.

For transit corridors, additional data is required to assist network operators with real-time operations (eg demand management and traveller information purposes).

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.2 Interregional connectors

4.3.4.2.1 Summary of ITS requirements for an interregional connector

Features	ITS requirements
Civil infrastructure	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• For major intersections and high-risk areas, CCTV cameras must be used to enable full operational visibility.
Communications	• Where an ITS is planned to be installed, fibre is preferred.
Road-user information	• Inform road users in advance of every major intersection and key decision point. • VMS and EJT signs must be used.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections must be considered.
Incident detection and management	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras, VMS and EJT signs must be used.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 2. Summary of ITS requirements for an interregional connector

4.3.4.2.2 Operational visibility

Full operational visibility of major intersections and high-risk areas (as defined by the concept of operations or operational requirements) is required for interregional connectors, for the network operators to be able to view:

- the majority of possible incidents or unusual circumstances and respond accordingly (incidents are more likely to occur at major intersections and high-risk areas)
- traffic in real time and execute demand management.

Different types of cameras can be used to facilitate remote visibility of interregional connectors.

4.3.4.2.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For interregional connectors, ducts and pits are a requirement, regardless of whether any ITS is currently planned along the route. This is to allow for ITS to be installed at a later stage (eg installing an advanced warning sign (AWS) at a high-risk bend).

Where an ITS is planned to be installed, fibre is preferred. A request for departure is required if a fibre network can't be provided and the device needs to access other fibre through other networks, such as telecommunications.

4.3.4.2.4 Road-user information

The ability to inform road users in advance of every major intersection and key decision point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and advanced warning of events/conditions ahead to inform their travel decisions.

ITS that provide road-user information, such as VMS on the mainline and EJT signs on the side-road approaches to key decision points, must be used. Depending on operational analysis, additional VMS may be required. The geometric layout of the road should influence the type of sign used (eg side-mounted VMS versus overhead gantry mounted).

4.3.4.2.5 Demand and corridor management

Demand management systems are required to:

- maximise the throughput across all possible traffic scenarios, reduce congestion and improve the journeys of road users
- improve equity across all road users, regardless of their route.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed.

Demand management can be achieved using various types of ITS equipment, such as LCS, roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

4.3.4.2.6 Incident detection and management

Interregional corridors are required to have incident detection systems at major interchanges and high-risk areas, as defined in the concept of operations or operational requirements. This allows for:

- emergency services to respond quickly and tend to those involved in an incident
- traffic management interventions (such as temporary speed limits or diversions) to be taken for safety and traffic-flow purposes
- an incident site to be cleared quickly to restore normal flows.

Network operators can respond effectively to incidents where ITS capable of incident detection are coupled with ITS that provide visibility of the corridor, resulting in live information being available to TOCs.

4.3.4.2.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis
- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations. This includes bus lanes and HOV lanes. Strategic locations would be before and after key interchanges with significant volumes. This should be as defined in the concept of operations or operational requirements.

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.3 Urban connectors

4.3.4.3.1 Summary of ITS requirements for an urban connector

Features	ITS requirements
Civil infrastructure	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• For major intersections and high-risk areas, CCTV cameras must be used to enable full operational visibility.
Communications	• Fibre-optic cable must be installed along the entire corridor.
Road-user information	• Inform road users in advance of every key decision and congestion point. • VMS and EJT signs must be used.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.
Incident detection and management	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras and VMS must be used.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 3. Summary of ITS requirements for an urban connector

4.3.4.3.2 Operational visibility

Full operational visibility of major intersections and high-risk areas (as defined by the concept of operations or operational requirements) is required for urban connectors, for the network operators to be able to view:

- incidents and respond accordingly
- traffic in real time and execute demand management.

Full operational visibility at major intersections includes visibility of potential queues. Different types of cameras can be used to facilitate remote visibility of urban connectors.

4.3.4.3.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For urban connectors, high-speed communication links are a necessity so that network operators can see real-time footage, make changes and respond remotely in a timely manner from the operating centres. Fibre-optic cable is required, along with the appropriate ducts and pits.

4.3.4.3.4 Road-user information

The ability to inform road users in advance of every key decision and congestion point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and inform their travel decisions.

VMS must be used on the mainline, and EJT signs must be used on the side-road approaches to key decision points. Depending on operational analysis, additional VMS may be required.

4.3.4.3.5 Demand and corridor management

Demand management systems are preferred on urban connectors to:

- maximise the throughput of the urban connectors across all possible traffic scenarios, reduce congestion and improve the journeys of road users
- improve equity across all road users, regardless of their route.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. This should only be for incoming flows that can have a significant impact on the throughput of an urban connector.

Demand management can be achieved using various types of ITS, such as roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

4.3.4.3.6 Incident detection and management

For incident detection and management, urban connectors require visibility at major intersections and high-risk areas, as defined in the concept of operations or operational requirements. This allows for:

- emergency services to respond quickly and tend to those involved in an incident
- traffic management interventions (such as temporary speed limits or diversions) to be taken for safety and traffic-flow purposes
- an incident site to be cleared quickly to restore normal flows.

Different types of cameras can be used to facilitate remote visibility of urban connectors. This will be dependent on the requirements for visibility.

4.3.4.3.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis

- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations, such as before and after intersections. This should be as defined in the concept of operations or operational requirements.

For urban connectors, additional data is required to assist network operators with real-time operations (eg demand management).

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.4 Main streets

4.3.4.4.1 Summary of ITS requirements for a main street

Features	ITS requirements
Civil infrastructure	• Should have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• Any signalised intersections/crossings or adjustable traffic management devices must have CCTV coverage.
Communications	• Fibre-optic cable is preferred, but not a requirement.
Road-user information	• Inform road users in advance of every key decision and congestion point. • EJT signs must be used.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.
Incident detection and management	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras must be used.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 4. Summary of ITS requirements for a main street

4.3.4.4.2 Operational visibility

Any signalised intersections/crossings or adjustable traffic management devices must have CCTV coverage. This is required for network operators to manage the corridor effectively.

CCTV coverage includes visibility of potential queues. Different types of cameras can be used to facilitate remote visibility.

4.3.4.4.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For main streets, fibre-optic cable is preferred.

4.3.4.4.4 Road-user information

The ability to inform road users in advance of every key decision and congestion point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and inform their travel decisions. EJT signs must be used.

4.3.4.4.5 Demand and corridor management

Demand management systems are preferred on main streets to manage the priorities sought in the concept of operations.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. This should only be for incoming flows that can have a significant impact on the throughput of a main street.

Demand management can be achieved using various types of signalling ITS, such as roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

4.3.4.4.6 Incident detection and management

For incident detection and management, main streets require visibility at major intersections and high-risk areas, as defined in the concept of operations or operational requirements. This allows for:

- emergency services to respond quickly and tend to those involved in an incident
- traffic management interventions (such as temporary speed limits or diversions) to be taken for safety and traffic-flow purposes
- an incident site to be cleared quickly to restore normal flows.

Different types of cameras can be used to facilitate remote visibility of main streets. This will be dependent on the requirements for visibility.

4.3.4.4.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis
- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations, such as before and after intersections. This should be as defined in the concept of operations or operational requirements.

For main streets, additional data is required to assist network operators with real-time operations (eg demand management).

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.5 Activity streets

4.3.4.5.1 Summary of ITS requirements for an activity street

Features	ITS requirements
Civil infrastructure	• Should have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• Any signalised intersections/crossings or adjustable traffic management devices must have CCTV coverage.
Communications	• Fibre-optic cable is preferred, but not a requirement.
Road-user information	• Inform road users in advance of every key decision and congestion point. • EJT signs must be used.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.
Incident detection and management	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras must be used.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 5. Summary of ITS requirements for an activity street

4.3.4.5.2 Operational visibility

Any signalised intersections/crossings or adjustable traffic management devices must have CCTV coverage. This is required for network operators to manage the corridor effectively.

CCTV coverage includes visibility of potential queues. Different types of cameras can be used to facilitate remote visibility.

4.3.4.5.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For activity streets, fibre-optic cable is preferred.

4.3.4.5.4 Road-user information

The ability to inform road users in advance of every key decision and congestion point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and inform their travel decisions. EJT signs must be used.

4.3.4.5.5 Demand and corridor management

Demand management systems are preferred on activity streets to manage the priorities sought in the concept of operations.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. This should only be for incoming flows that can have a significant impact on the throughput of an activity street.

Demand management can be achieved using various types of signalling ITS, such as roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

4.3.4.5.6 Incident detection and management

For incident detection and management, activity streets require visibility at major intersections and high-risk areas, as defined in the concept of operations or operational requirements. This allows for:

- emergency services to respond quickly and tend to those involved in an incident
- traffic management interventions (such as temporary speed limits or diversions) to be taken for safety and traffic-flow purposes
- an incident site to be cleared quickly to restore normal flows.

Different types of cameras can be used to facilitate remote visibility of activity streets. This will be dependent on the requirements for visibility.

4.3.4.5.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis
- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations, such as before and after intersections. This should be as defined in the concept of operations or operational requirements.

For activity streets, additional data is required to assist network operators with real-time operations (eg demand management).

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.6 Peri-urban roads

4.3.4.6.1 Summary of ITS requirements for a peri-urban road

Features	ITS requirements
Civil infrastructure	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• For major intersections and high-risk areas, CCTV cameras must be used to enable operational visibility.
Communications	• Where an ITS is planned to be installed, fibre is preferred.
Road-user information	• Inform road users in advance of every key decision and congestion point. • VMS and EJT signs should be considered.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.
Incident detection and management	• Will be dependent on level of visibility.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 6. Summary of ITS requirements for a peri-urban road

4.3.4.6.2 Operational visibility

Full operational visibility of major intersections and high-risk areas (as defined by the concept of operations or operational requirements) is required for peri-urban roads, for the network operators to be able to view:

- the majority of possible incidents or unusual circumstances and respond accordingly (incidents are more likely to occur at major intersections and high-risk areas)
- traffic in real time and execute demand management.

Different types of cameras can be used to facilitate remote visibility of peri-urban roads.

4.3.4.6.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For peri-urban roads, ducts and pits are a requirement, regardless of whether any ITS is currently planned along the route. This is to allow for ITS to be installed at a later stage (eg installing an AWS at a high-risk bend).

Where an ITS is planned to be installed, fibre is preferred. A request for departure is required if a fibre network can’t be provided and the device needs to access other fibre through other networks, such as telecommunications.

4.3.4.6.4 Road-user information

The ability to inform road users in advance of every key decision and congestion point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and inform their travel decisions. VMS and EJT signs should be considered.

4.3.4.6.5 Demand and corridor management

Demand management systems are preferred on peri-urban roads to:

- maximise the throughput of the peri-urban roads across all possible traffic scenarios, reduce congestion and improve the journeys of road users
- improve equity across all road users, regardless of their route.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed.

Demand management can be achieved using various types of signalling ITS, such as roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

Where there is a speed differential/safety hazard, intersection speed zones should be used with guidance from the concept of operations.

4.3.4.6.6 Incident detection and management

Incident detection and management on peri-urban roads will depend on the level of visibility at major intersections or high-risk areas, as defined in the concept of operations or operational requirements.

Different types of cameras can be used to facilitate remote visibility of peri-urban roads. This will be dependent on the requirements for visibility.

4.3.4.6.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis

- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management or future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations, such as before and after intersections. This should be as defined in the concept of operations or operational requirements.

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.7 Rural connectors

4.3.4.7.1 Summary of ITS requirements for a rural connector

Features	ITS requirements
Civil infrastructure	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.
Operational visibility	• For major intersections and high-risk areas, CCTV cameras must be used to enable operational visibility.
Communications	• Where an ITS is planned to be installed, fibre is preferred.
Road-user information	• Inform road users in advance of every key decision and congestion point. • VMS should be considered.
Demand and corridor management	• Where flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.
Incident detection and management	• Will be dependent on level of visibility.
Optimisation and analysis	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Table 7. Summary of ITS requirements for a rural connector

4.3.4.7.2 Operational visibility

Full operational visibility of major intersections and high-risk areas (as defined by the concept of operations or operational requirements) is required for rural connectors, for the network operators to be able to view:

- intersections and respond accordingly
- traffic in real time and execute demand management.

Depending on operational requirements, visibility at passing lanes, cycleways etc may be required. Different types of cameras can be used to facilitate remote visibility of rural connectors.

4.3.4.7.3 Communications

Reliable and efficient communication links are required for Waka Kotahi network operators. This applies even if the corridor is operated by an external party, as covered in section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

For rural connectors, ducts and pits are a requirement, regardless of whether any ITS is currently planned along the route. This is to allow for ITS to be installed at a later stage (eg installing an AWS at a high-risk bend).

Where an ITS is planned to be installed, fibre is preferred. A request for departure is required if a fibre network can’t be provided and the device needs to access other fibre through other networks, such as telecommunications.

4.3.4.7.4 Road-user information

The ability to inform road users in advance of every key decision and congestion point (as defined by the concept of operations or operational requirements) is a requirement. This is to provide directions and inform their travel decisions. VMS should be considered.

4.3.4.7.5 Demand and corridor management

Demand management systems are preferred on rural connectors to:

- maximise the throughput of the rural connectors across all possible traffic scenarios, reduce congestion and improve the journeys of road users
- improve equity across all road users, regardless of their route.

Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed.

Demand management can be achieved using various types of signalling ITS, such as roundabout metering and signalised intersections. This should be as defined in the concept of operations or operational requirements.

4.3.4.7.6 Incident detection and management

Incident detection and management on rural connectors will depend on the level of visibility at major intersections or high-risk areas, as defined in the concept of operations or operational requirements.

Different types of cameras can be used to facilitate remote visibility of rural connectors. This will be dependent on the requirements for visibility.

4.3.4.7.7 Data collection for optimisation and analysis

Data is collected for three main functions:

- real-time optimisation
- future analysis
- to better inform customers of the current state of the state highway network.

Volume, speed and classification data must be collected for routine management of the road or for future planning of the road infrastructure. Equipment must be available to collect data for each mid-block lane at strategic locations. This should be as defined in the concept of operations or operational requirements.

Data can be collected using a variety of detector types. Inductive loops are generally used, but other technology like radar sensors can also be effective.

4.3.4.8 Stopping places

Due to the variety in stopping places, the requirements are as follows.

4.3.4.8.1 Summary of ITS requirements for a stopping place

Features	ITS requirements
Civil infrastructure	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.

Table 8. Summary of ITS requirements for a stopping place

For stopping places, a specific ITS design needs to be carried out. It should be guided by the concept of operations and any additional safety risks associated with the location.

5 DESIGN FOR SAFETY

This section defines the core requirements to ensure the ITS can be operated and serviced safely.

5.1 Health and safety

All ITS equipment must be designed to ensure installation and maintenance can be carried out in accordance with the Health and Safety at Work Act 2015.

The following publications consider health and safety throughout the project life cycle including design, construction, operation and maintenance:

- *Health and safety in design minimum standard*
- *Contractor health and safety expectations: Guidance for supply chain partners*
- *Te Ara ki te Ora – Road to Zero.*

Specific requirements for safety conditions and obligations for individual ITS equipment and designs will be made available in future health and safety requirements.

5.2 Key safety outcomes

So that ITS can be operated and serviced safely, Waka Kotahi requires the following key safety outcomes to be met:

- Safety is included and maintained in the design.
- Safe access for maintenance is provided.

6 DESIGN FOR MAINTAINABILITY

This section defines the core requirements to ensure the ITS can be maintained.

6.1 Maintenance conditions and obligations

For specific requirements for maintenance conditions and obligations for individual ITS assets, refer to the corresponding Waka Kotahi ITS design standards and delivery specifications.

6.1.1 Commissioning and handover

The project contractor has a liability to ensure handover of ITS solutions into Waka Kotahi maintenance. See the latest version of ITS core requirements standard: Commissioning and handover requirements.

6.1.2 Asset numbering

All ITS assets must be numbered in accordance with the Waka Kotahi ITS numbering system. See the latest version of ITS core requirements standard: General requirements.

Once ITS assets have been numbered, they must be recorded appropriately in the Waka Kotahi ITS asset database, along with location, status and condition data etc.

6.1.3 ITS site location

The following maintenance-related measures must be considered when deciding on the location of an ITS site:

- ITS assets are to be maintainable without the need for temporary traffic management, lane closures or shoulder closures.
- ITS equipment is to be clear of swales and drains.

6.1.4 Vegetation

The following maintenance-related measures must be considered to minimise the adverse effects of vegetation on ITS sites:

- ITS assets (eg pits) shall be clear of vegetation, allowing maintenance to be unobstructed.
- Vegetation shall not obstruct ITS assets or impede their functionality.
- Concrete aprons or surroundings shall be provisioned for ITS assets, such as pits and cabinets, to allow for easy mowing.

6.1.5 Doors

The following maintenance-related measures must be considered for the design of ITS asset doors:

- Maintenance personnel must be able to undertake work at or on the asset in a safe manner and have both hands free to complete a task (eg door retention mechanisms and courtesy lights).
- An open door must not become a hazard to any other personnel or members of the public.

6.1.6 Accessibility for unit replacement

The following maintenance-related measures must be considered for the safe and easy replacement of units as required:

- Raising and lowering systems shall be provided (where practically possible) for maintenance access purposes.
- Where lowering systems are not practical, safe access to the ITS assets must be provided (eg platforms or ladders that are suitable for working at heights).
- The design should allow for a unit replacement rather than a repair onsite where practical.

7 DESIGN FOR SECURITY

This section defines the core requirements to ensure the ITS can be secured and maintain integrity.

7.1 Security conditions and obligations

Specific requirements for security conditions and obligations for individual ITS assets will be available in future Waka Kotahi ITS design standards and delivery specifications.

7.1.1 General security

All ITS assets are to be tamper-proofed and graffiti-proofed.

7.1.2 Access

The following security-related measures must be considered for ITS asset physical access:

- Assets are to only be accessible to approved users, maintainers and operators. All accesses and gates are to be locked.
- Access doors and panels are to be fitted with locks designed for outdoor conditions, with identical keys.
- Assets are to have measures preventing the general public from climbing them.

7.1.3 Power and communications

The following security-related measures must be considered for ITS power and communications systems:

- ITS assets should have power back-ups if identified as a critical asset.
- A high level of redundancy is to be built into all ITS backbone communications infrastructure so that if one link or route fails, communication between sites can occur via an alternative route with an appropriate transmission capability.
- Data transfer across all backbone communications infrastructure for ITS sites must be protected by measures like firewalls, which prevent unauthorised access to or from the private ITS network. If the corridor is operated by an external party, it must meet Waka Kotahi security requirements. Refer to section 4.1.2 ‘Waka Kotahi access to ITS operated by an external party’.

7.1.4 Information technology security

Project designers and planners must consult with the Waka Kotahi Technology Product Management team regarding technology security. The following security design principles must be considered for ITS information technology security:

- Physical segmentation of the ITS network from the Waka Kotahi corporate network and any third-party environments must be implemented to ensure isolation is maintained between environments that require different levels of protection and to enable rapid containment of any unauthorised breach.
- Security domains and subcomponent security zones must be implemented to ensure logical separation between ITS network components requiring different protection profiles according to risk and service criticality.
- Any systems not under the control of Waka Kotahi Technology teams (or their delegated integration partners) are considered untrusted. This includes any third-party networks and the Internet.
- Security governance over third-party vendors must be maintained by Waka Kotahi personnel to provide independent assurance.

8 APPENDIX A – ITS REQUIREMENTS SUMMARY TABLE

Features	Civil infrastructure	Operational visibility	Communications	Road-user information	Demand and corridor management	Incident detection and management	Data collection for optimisation and analysis
Transit corridors	• Allow space for gantries. • Install foundations for gantries where planned as per concept of operations or operational requirements. • Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• Full operational visibility of the carriageway surface, including all on-ramps and off-ramps. • CCTV cameras enabling 100% coverage of the corridor must be used.	• Fibre-optic cable must be installed along the entire corridor.	• Inform road users in advance of every interchange and on-ramp. • VMS and EJT signs must be used. CMS to be used where appropriate.	• Where analysis shows that flow breakdown or congestion is likely to occur, on-ramps, off-ramps and motorway lanes must be managed. • RMS and LCS must be used.	• Detection systems are required across the entire corridor. • ITS tools are required to manage the incident. • CCTV cameras, LCS, VMS, EJT signs, and sensor devices must be used.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.
Interregional connectors	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• For major intersections and high-risk areas, CCTV cameras must be used to enable full operational visibility.	• Where an ITS is planned to be installed, fibre is preferred.	• Inform road users in advance of every major intersection and key decision point. • VMS and EJT signs must be used.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections must be considered.	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras, VMS and EJT signs must be used.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Features	Civil infrastructure	Operational visibility	Communications	Road-user information	Demand and corridor management	Incident detection and management	Data collection for optimisation and analysis
Urban connectors	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• For major intersections and high-risk areas, CCTV cameras must be used to enable full operational visibility.	• Fibre-optic cable must be installed along the entire corridor.	• Inform road users in advance of every key decision and congestion point. • VMS and EJT signs must be used.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras and VMS must be used.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.
Main streets	• Should have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• Any signalised intersections/ crossings or adjustable traffic management devices must have CCTV coverage.	• Fibre-optic cable is preferred, but not a requirement.	• Inform road users in advance of every key decision and congestion point. • EJT signs must be used.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras must be used.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Features	Civil infrastructure	Operational visibility	Communications	Road-user information	Demand and corridor management	Incident detection and management	Data collection for optimisation and analysis
Activity streets	• Should have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• Any signalised intersections/ crossings or adjustable traffic management devices must have CCTV coverage.	• Fibre-optic cable is preferred, but not a requirement.	• Inform road users in advance of every key decision and congestion point. • EJT signs must be used.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections can be used with guidance from the concept of operations or operational requirements.	• Detection systems are required at key interchanges and high-risk areas. • ITS tools are required to manage the incident. • CCTV cameras must be used.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.
Rural connectors	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• For major intersections and high-risk areas, CCTV cameras must be used to enable operational visibility.	• Where an ITS is planned to be installed, fibre is preferred.	• Inform road users in advance of every key decision and congestion point. • VMS should be considered.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections should be considered.	• Will be dependent on level of visibility.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

Features	Civil infrastructure	Operational visibility	Communications	Road-user information	Demand and corridor management	Incident detection and management	Data collection for optimisation and analysis
Peri-urban roads	• Must have ducts, pits and cabinets along the entire corridor. • For cabinets, the exception is when the unit is self-contained, meaning there is no physical external connection. • All ITS must have a power supply.	• For major intersections and high-risk areas, CCTV cameras must be used to enable operational visibility.	• Where an ITS is planned to be installed, fibre is preferred.	• Inform road users in advance of every key decision and congestion point. • VMS and EJT signs should be considered.	• Where analysis shows that flow breakdown or congestion is likely to occur, mainline and significant incoming or exiting flows must be managed. • Roundabout metering and signalised intersections should be considered. • Where there is a speed differential/safety hazard, intersection speed zones should be used with guidance from the concept of operations.	• Will be dependent on level of visibility.	• Equipment must be available to collect data for optimisation and future analysis. • Appropriate sensor devices must be used.

9 REFERENCES

This section lists all external and Waka Kotahi references included in this document.

9.1 Industry standards

Standard number/name	Source	Licence type and conditions
Health and Safety at Work Act 2015	NZ Legislation website	Publicly available

9.2 Waka Kotahi standards, specifications and resources

9.2.1 Standards and specifications

See the Waka Kotahi website for the latest versions of the ITS design standards, delivery specifications and core requirements.

Code	Document name	Waka Kotahi website link
ITS-01-03	ITS core requirements specification: General electrical requirements	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-01-03-general-electrical-requirements.pdf
ITS-10-01	ITS core requirements standard: Commissioning and handover requirements	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-10-01-commissioning-and-handover-process.pdf
ITS-01-01	ITS core requirements standard: General requirements	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-01-01-general-requirements.pdf
ITS-02-003-202110-SPEC-LCS-Interim	ITS delivery specification: Lane and carriageway signs (LCS)	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-02-003-202110-SPEC-LCS-Interim.pdf
ITS-02-001-202211-SPEC-VMS-FIXED	ITS delivery specification: Variable message signs – fixed	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-02-001-202211-SPEC-VMS-FIXED-v4.2.pdf
ITS-02-01	ITS design standard and delivery specification: Duct supply and installation	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-02-01-duct-supply-and-installation.pdf
ITS-01-008-202006-STD-CABLE-FIBRE	ITS design standard: Optical fibre	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-01-008-202006-STD-CABLE-FIBRE.pdf

Code	Document name	Waka Kotahi website link
ITS-01-003-202008-STD-RMS	ITS design standard: Ramp meter systems	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-01-003-202008-STD-RMS.pdf
ITS-01-001-202105-STD-VMS-FIXED	ITS design standard: Variable message signs – fixed	https://www.nzta.govt.nz/assets/resources/intelligent-transport-systems/specifications/ITS-01-001-202105-STD-VMS-FIXED.pdf

9.2.2 Resources

Document name/code	Waka Kotahi website link
Te Ara ki te Ora – Road to Zero	https://www.transport.govt.nz/area-of-interest/safety/road-to-zero/
One Network Framework	https://www.nzta.govt.nz/planning-and-investment/planning/one-network-framework/
Fit for purpose customer levels of service (CLoS) outcomes (provisional)	https://www.nzta.govt.nz/assets/Road-Efficiency-Group-2/docs/customer-levels-of-service.pdf
Contractor health and safety expectations: Guidance for supply chain partners	https://www.nzta.govt.nz/resources/contractor-health-and-safety-expectations/
Health and safety in design minimum standard	https://www.nzta.govt.nz/assets/resources/contractor-health-and-safety-expectations/ZHMS-01-Health-and-safety-in-design-minimum-standard.pdf

9.3 Drawings

See the Waka Kotahi website for the latest versions of the ITS standard drawings listed below.

Drawing number

10 CONTENT TO BE REDIRECTED

This section records any circumstances where content from this document will be reclassified and moved into future documents. This table is then updated with a reference to the new location.

Section reference	Section name	Future document	Class

11 FULL VERSION HISTORY

This table shows the full history of changes made to this document, both minor and major, in chronological order, since the document was first authored.

Minor versions are numbered 0.1, 0.2 etc until such point as the document is approved and published, then it becomes 1.0 (major version). Subsequent edited versions become 1.1, 1.2 etc, or if it's a major update 2.0, and so on.

Version	Date	Author	Role and organisation	Reason
0.1	04/09/2020	ITS Working Group	Waka Kotahi	Some sections pre-populated prior to authoring
0.2	13/11/2020	Minimum ITS Requirements Team	Aurecon	First draft for review
0.3	18/11/2020	ITS Working Group	Waka Kotahi	Review of the first draft by Russell Pinchen and Ian Leach
0.4	27/11/2020	Minimum ITS Requirements Team	Aurecon	Second draft for review
0.4.1	30/11/2020	Minimum ITS Requirements Team	Aurecon	Minor updates after second draft review by Russell Pinchen and Ian Leach, before review by expert panel
0.5	30/11/2020	ITS Working Group	Waka Kotahi	Draft sent for review by expert panel
0.6	22/12/2020	Minimum ITS Requirements Team	Aurecon	Issue for Waka Kotahi internal review
0.7	18/01/2021	ITS Working Group	Waka Kotahi	Review after proofreading
0.8	18/01/2021	Minimum ITS Requirements Team	Aurecon	Updates after industry feedback
0.9	11/03/2021	Final Word	Editorial services	Tidy up after Aurecon updates
0.10	12/03/2021	ITS Working Group	Waka Kotahi	Updates after industry feedback
0.11	24/03/2021	ITS Working Group Minimum ITS Requirements team	Waka Kotahi Aurecon	Final review of updates after industry feedback
0.12	29/03/2021	Final Word	Editorial services	Proofread document prior to publishing major version 1.0

Version	Date	Author	Role and organisation	Reason
0.13	01/11/2021	Minimum ITS Requirements team	Aurecon	Added wording in section 3.1 Purpose, to: • reference to the existing policy (ONRC, which is aligned to the GPS) • clarify that the intended audience of the standard includes planners, performance measures and consultants • clarify that this standard is primarily for Waka Kotahi projects Removed the ITS background information section Removed ONF sections Removed references to specific ITS standards and specifications Referred to micro-mobility rather than just pedestrians and cyclists in section 4.4.4.1 Minor heading change to 'Data collection' from 'Optimisation and analysis'
0.14	15/08/2022	ITS Requirements team	Aurecon	Updated document with comments from ratification group, RCAs, future transport team and urban mobility team
0.15	11/11/2022	ITS Requirements team	Aurecon	Updated document to address feedback received from Technical Committee
0.16	15/11/2022	Document Manager	Waka Kotahi	Updated document to address feedback received from the Technical Committee
0.17	19/12/2022	Clear Edit NZ	Editorial services	Proofread
0.18	23/02/2022	Document Manager	Waka Kotahi	Updated document to address feedback received from the Ratification Group.