Guideline

Smart pedestrian crossings

November 2023

Queensland Government

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1 Introduction

This guideline provides guidance on smart pedestrian crossings in Queensland. It includes a general description of the function and benefits and provides guidance on the design of smart pedestrian crossings.

This guideline is issued under the authority of Section 166 of the *Transport Operations (Road Use Management) Act* 1995. The contents of this guideline are issued as an 'approved notice' under Section 166(2) of said Act.

Providing safe and accessible pedestrian facilities are a key component of implementing Transport and Main Roads' strategic plan of creating a single integrated transport network accessible to everyone. Pedestrian facilities are to be provided across all approaches to an intersection unless justification is documented in a design exception or planning report. The facility provided should consider the types of pedestrians (in terms of age and ability), particularly where there is a high proportion of school children, elderly pedestrians or pedestrians who have a vision, mobility or hearing impairment.

Traditionally, signalised pedestrian crossings used a fixed timing and signal sequence. This can result in:

- insufficient time for slower pedestrians (who commence walking at the end of the WALK display) to clear the crossing
- unnecessary delay to traffic held on a red signal, after pedestrians have cleared the crossing, and/or
- unnecessary delay to traffic when a pedestrian crosses the road before the pedestrian signals go green or chooses not to cross after pushing the pedestrian push-button.

Smart pedestrian crossings use carriageway pedestrian detectors to control the pedestrian flashing DON'T WALK time and footpath detectors to cancel the pedestrian demand when no longer required. These additional detector systems improve the operational efficiency and safety of the crossing. Smart crossings use standard traffic signal displays and sequencing.

Other changes to signal timings to reduce pedestrian delay are possible but are out of scope for this document.

The pedestrian detector systems that can be used by smart crossings are:

- **Footpath detectors:**

  Detectors that monitor pedestrians on the footpath adjacent to the push-button. The intent is to ensure that traffic is not stopped if the pedestrians cross the road or leave the waiting area before the pedestrian phase is initiated.

- **Carriageway detectors:**

  Detectors that monitor pedestrians on the carriageway. They can either reduce traffic delay, by starting the traffic as soon as pedestrians are clear of the crossing or enhance safety by increasing the flashing DON’T WALK time when pedestrians have not cleared the crossing.

Footpath detectors and carriageway detectors can be installed and operated independently.

Only pedestrian detectors that have been type approved by the department for use as footpaths or carriageway pedestrian detection shall be used.

To ensure that the zone of detection of carriageway detectors is adequate:

- the designer must check the manufacturer's specification for the selected detector type and model and confirm the guaranteed zone of detection for the design pedestrian meets the requirements for the minimum zone of detection given in this guideline, and
- the commissioning procedure specified in Appendix B must be followed.

1.1 Definitions

The definitions given in Austroads *Glossary of terms* AP-C87-15 apply, plus those given in Table 1.1.

Table 1.1 – Definitions

Term	Definition
TGSI (Tactile Ground Surface Indicator)	Truncated cones and/or bars installed on the ground or floor surface designed to assist vision-impaired pedestrians to locate a crossing or pushbutton.
Far side pedestrian lantern	A lantern which is intended for the control of pedestrian traffic located on the other side of crossing. A far side lantern is in view for pedestrians throughout the crossing movement.
Nearside pedestrian lantern	A lantern which is intended for the control of pedestrian traffic located on the near side of crossing. A nearside lantern is in view for pedestrians at the kerbside, but not in view during the crossing movement.
Design pedestrian	The 'design pedestrian' is cloth-covered 1 metre high by 0.5 metre wide by 0.2 metre deep with a mass of 20 kg, representing a 5 – 6-year-old child.
Radar	Radar is a detection system that uses radio waves to determine the range, angle, or velocity of objects.
Doppler radar	The Doppler effect (or the Doppler shift) is the change in frequency of a wave in relation to an observer who is moving relative to the wave source. It is named after the Austrian physicist Christian Doppler, who described the phenomenon in 1842.
FMCW doppler radar (Frequency Modulated Continuous Wave)	Technique used to allow doppler radars to assess the distance a target is away from the radar.
3D FMCW radar	The return signal from multiple radar beams is processed to identify the position of an object in three dimensions.

2 Background

The concept of smart pedestrian crossings is similar to the U.K. Puffin crossing.

The Puffin crossing (Pedestrian User-Friendly Intelligent crossing) is a U.K. specification for pedestrian crossings that uses pedestrian detectors and nearside pedestrian lanterns. Nearside pedestrian lanterns are not used in Queensland. Queensland has chosen to use the term 'smart crossing' rather than Puffin as the full UK specification is not used.

3 Benefits of smart pedestrian crossing

The major benefits of smart pedestrian crossings are improved safety and a reduction in traffic delays.

3.1 Safety improvement

Pedestrian safety is enhanced at smart crossing by:

- the provision of additional flashing don't walk time to allow slow-moving pedestrians to clear the road
- shorter cycle times being possible, and
- better compliance by drivers due to reduction in unnecessary delay.

Pedestrian footpath detectors can alleviate driver frustration caused by pedestrians crossing in a gap against the 'red man' display or choosing not to cross. Carriageway pedestrian detectors also reduce unnecessary delay by ensuring the flashing DON'T WALK period is minimised when no-one is on the crossing.

In addition, smart crossing carriageway detectors may be used to delay the start of turning traffic (by holding on left or right turn red arrow lanterns), to protect pedestrians from turning vehicles (see Section 5.6 following).

3.2 Reducing vehicle delay

Trials undertaken at mid-block pedestrian crossings show unnecessary delays can typically be:

- over 10 seconds when pedestrians cross at a brisk walking pace
- 2~3 seconds when many pedestrians cross the road, with some pedestrians leaving the footpath at (or just past) the end of the WALK time, and
- over 20 seconds when pedestrians cross before the WALK time or do not cross at all.

Similar benefits can be achieved by using smart crossings at intersections. They can improve traffic efficiency by reducing the time required for pedestrian movements. They can also potentially improve traffic signal coordination by reducing the time for pedestrian movements that conflict with major traffic flows. The flashing don't walk period will be cut short when fast moving or early starting pedestrians.

3.3 Other benefits

In addition to reducing traffic delays and improving safety, smart pedestrian crossings:

- provide environmental benefits, such as fuel saving, by reducing unnecessary start–stop or running time of motor vehicles, and
- improve mobility and comfort for slow-moving pedestrians including pedestrians with disabilities or impaired mobility.

4 Smart crossing facilities

Smart pedestrian crossings may include some or all of the following components:

- carriageway detectors
- footpath detectors
- pedestrian pushbuttons with demand-indicator
- 'Cross with Care' adhesive label (TC1471)
- pavement marking, and/or
- Tactile Ground Surface Indicators (TGSI).

Testing and commissioning procedures for pedestrian detectors and smart crossing personalities (or configuration files) are detailed in Appendix B following.

4.1 Carriageway detector

Carriageway detectors are the essential components of smart crossings. There are different technologies that can be used for carriageway detectors including Doppler radar, video and thermal detectors. The designer must ensure that the technology selected is suitable for the application and that the make and model of the detector has been type approved for the specific application.

The zone of detection of a carriageway detector is based on many factors, including the technology used, the mounting height of the detector, the vertical and horizontal mounting angle, the antennae or lenses used in the detector and the software processing that is applied to the raw output from the sensor. Detailed information should be sought from suppliers regarding the recommended mounting height and the detection zone that can be achieved with the detectors being used. Pedestrians outside the detection zone will not be detected and the pedestrian flashing DON'T WALK period may be terminated early.

The designer must check the zone of detection provided by the make and model of the detectors and allow for any additional detectors required to guarantee the required zone of detection (see Section 5 following).

Landscaping or appropriate fencing may be used to encourage pedestrians to cross within the zone of detection.

At the time of writing of this guideline, the only detectors type approved for carriageway pedestrian detectors are radar detectors. Much of this guideline is directed at the correct use of these detectors. If other technologies are used, the manufacturers' recommendations should be followed.

Some commentary on radar detectors

- Doppler radar only detects moving objects and, thus, care must be taken to ensure that the radar unit selected meets the required standard for the minimum speed of the design pedestrian.
- FMCW radar (an advanced form of doppler radar) allows the distance of the target from the radar to be assessed by the radar unit. 3D FMCW radars process the return signal from multiple radar beams to map the position of an object in three dimensions. This allows the user to configure the radar the length and width of the detection zone.
- Radar detectors mounted on a post at or near the edge of the kerb will not detect pedestrians directly under the post or pedestrians stepping onto the carriageway at the side of the crossing away from the post. Diagrams in Section 5 following seek to illustrate this.
- The size of the target influences the strength of the return signal from a radar detector. Appendix C of Transport and Main Roads Technical Specification MRTS204 *Vehicle Detectors* for radar detectors adopts the UK standard target representing a child aged about 5 or 6. Children younger than this may not be detected and, if they are on their own, the flashing DON'T WALK display may terminate before they reach the kerb.
- Doppler radars detect any objects moving towards and away from the radar traveling at a speed greater than the specified minimum speed, and vehicles traveling across the radar beam may be seen due to radar scatter effects. The possibility of turning traffic extending the flashing DON'T WALK time must be considered and radar detectors may not be suitable for sites where traffic filters through the pedestrian movement.

4.2 Footpath detector

Footpath detectors are optionally used to cancel the pedestrian crossing call if the pedestrian crosses before the green WALK period or walks away from the crossing. This can provide significant operational efficiency gains. The zone of detection with detectors available currently is limited to an area close to the push-button (see Figure 4.2(a) following). It has been found that, in practice, pedestrians can move outside this zone when waiting for the pedestrian movement to go green. For this reason, pedestrian detectors are currently not often used.

The hatched area in Figure 4.2(a) following gives an approximate representation of the zone of detection that is usually achievable.

Figure 4.2(a) – Typical arrangements for footpath detectors

Detailed information should be sought from suppliers regarding the detection range and mounting height. Incorrect height or mounting may cause malfunction of detectors and risk to pedestrians.

Footpath detectors shall be accompanied by:

- pedestrian push-button with demand indicators
- specific 'Cross with Care' adhesive labels, and
- specific pavement marking.

The area of detection shall correspond to the area in which pedestrians actually stand. Pavement markings encourage pedestrians to stand in the designated detection area (refer to Section 4.5). In addition to pavement markings, landscaping or road furniture (such as shade) may be used to encourage pedestrians to stay in the designated area.

Two trial sites used fences and leaning rails to make pedestrians' movement more predictable (Figure 4.2(b) and 4.2(c)).

Figure 4.2(b) – Trial site using fences

Figure 4.2(c) – Trial site using leaning rails

4.3 Pedestrian push-button with demand-indicator

Most pedestrian push-buttons in Queensland have no demand-indicator. But where footpath detectors are used, demand-indicators shall be available to give pedestrians confirmation that their demand will be serviced.

The demand will be cancelled, and the indicator switched off if the pedestrian moves outside the detection zone.

If the demand indicator goes off or does not come on, pedestrians can press the push-button to re-initiate and hold the demand.

Demand-indicators require the installation of relays and fuses in traffic signal controllers. A number of issues have been reported with older traffic controllers; therefore, only traffic signal controllers that fully comply with current standards shall be used for smart pedestrian crossings that use footpath detectors.

A pedestrian push-button with demand indicator is illustrated in Figure 4.3.

Figure 4.3 – Pedestrian push-button with demand-indicator

4.4 'Cross with Care' adhesive label (TC1471)

Where a footpath detector is used, a non-standard 'Cross with Care' adhesive label is required. It provides instruction to pedestrians for using smart pedestrian crossings.

This label is available via the MUTCD-Q and Traffic Control (TC) signs database published on the department website, searching with the number 'TC1471'.

Figure 4.4 – 'Cross with Care' adhesive label (TC1471)

4.5 Pavement markings

Pavement markings typically comprise a red rectangle, painted on footpath, that aligns with the location of the detection area of the footpath detector. Either a solid red rectangle or an outline of the red rectangle can be used (refer to Section 4.6). Given that the location of the detection area is site-specific and critical to the success of a smart crossing with footpath detectors, onsite observations should include the following:

1. preferred waiting area of pedestrians
2. the direction pedestrians are coming from
3. anything affecting pedestrians' behaviour, for example: slope, TGSI, kerb ramp, road furniture, trees and other forms of shade and so on, and
4. the detection area of the detectors being used.

Where a footpath detector is used, pavement marking or TSGI shall also be used (see Figure 4.6(a) following).

4.6 Tactile Ground Surface Indicators (TGSIs)

Where TGSIs are required, the warning TGSI shall be located in the detection area of footpath detectors. The pedestrian push-button shall be within reach by a pedestrian standing on the warning TGSI.

Where directional TGSIs are required, it is preferable to place TGSIs at the push-button side of the pavement marking (refer Figure 4.6(a)). An outline red rectangular pavement marking may be used instead of a solid red rectangular pavement marking (refer Figure 4.6(b)).

TGSI design is site-specific. For more information, please refer to Transport and Main Roads Standard Drawings 1446, 1447, KRG1, KRG2 and Australian Standard AS/NZS 1428.4.1 *Design for access and mobility, Part 4.1: Means to assist the orientation of people with vision impairment – Tactile ground surface indicators*.

Figure 4.6(a) – Example of directional tactile ground indicator and pavement marking

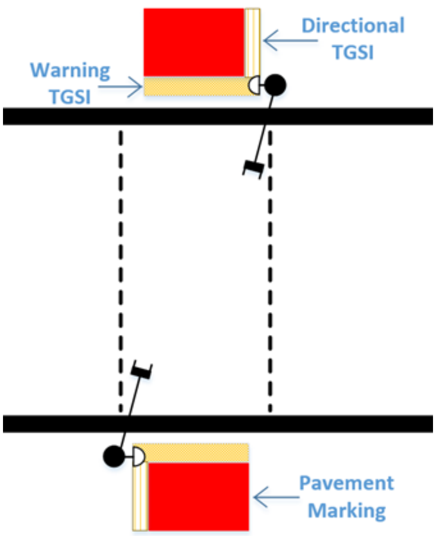


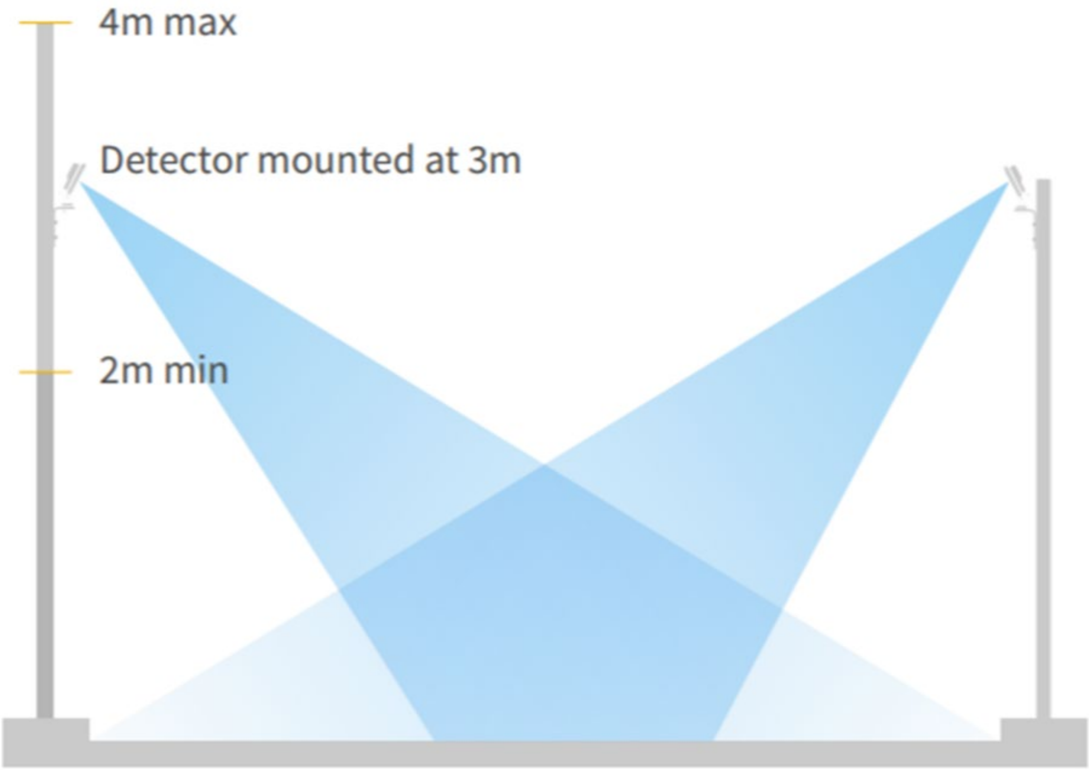
Figure 4.6(b) – Alternative outline red rectangular pavement marking

5 Carriageway detectors design considerations

5.1 Typical layout of carriageway detectors

The design must ensure that a pedestrian moving anywhere on the crossing will be detected (see following for comment on the size of the pedestrian). Figure 5(a) following shows the typical arrangement of the AGD326 24 m detector from the manufacturer's manual.

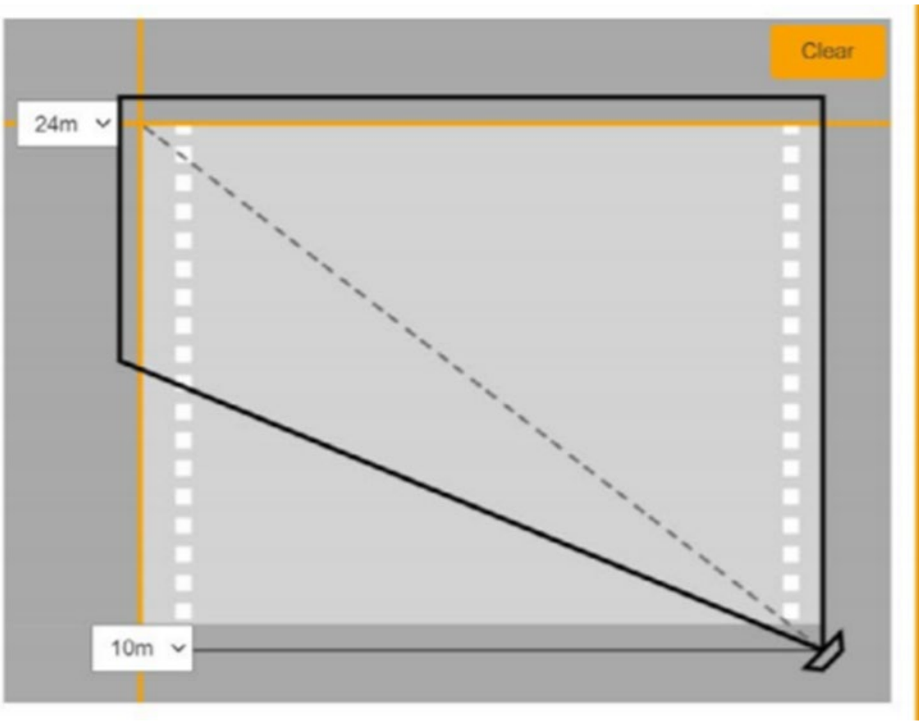
Figure 5.1(a) – Typical layout of AGD326 24 m detector from the manufacturer's manual



Two detectors per carriageway are required as the detector does not cover the area directly under the post it is mounted on. Transport and Main Roads uses the two detectors to detect misalignment of the radars that might not otherwise be detected as a fault.

The manufacturer's documentation for the specific make and model of detector to be used must be consulted to determine the zone of detection that can be achieved; for example, the AGD326 24 m detector user manual shows the maximum detection area as shown in Figure 5.1(b).

Figure 5.1(b) – AGD326 24 m zone of detection



5.2 Detection zones at a divided crossing

The designer must ensure that the crossing area, including the median area, is covered by at least one detector. This should include allowance for pedestrians that cross just outside the marked crossing, particularly at times of high pedestrian volume. Refer to Figure 5.2 following for the suggested minimum requirements for the area to be covered.

Overlapping zones of detection are not required but are inevitable with radar detectors due to the detector not being able to see the full width of the crossing at the kerb near the post it is mounted on. Appendix A gives details of how the output from multiple detectors can be used to monitor for a misaligned detector.

A typical layout using Doppler radar detectors at a divided crossing is shown in Figure 5.2 following. Table 5.2 lists the detector or detectors that cover each zone.

Figure 5.2 – Typical detector coverage of a divided crossing

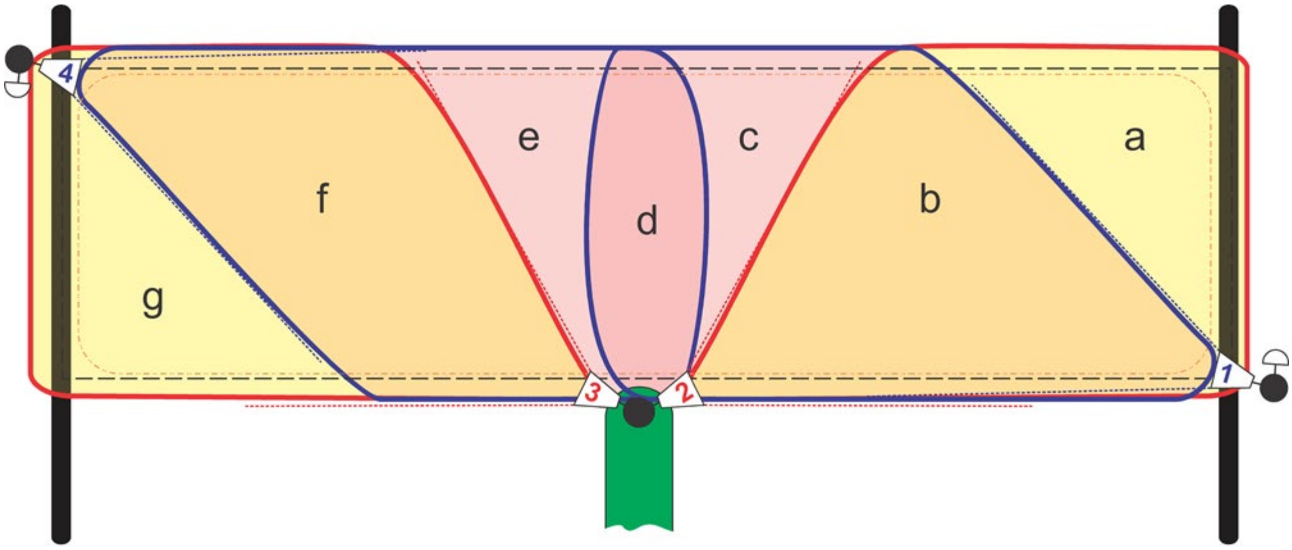


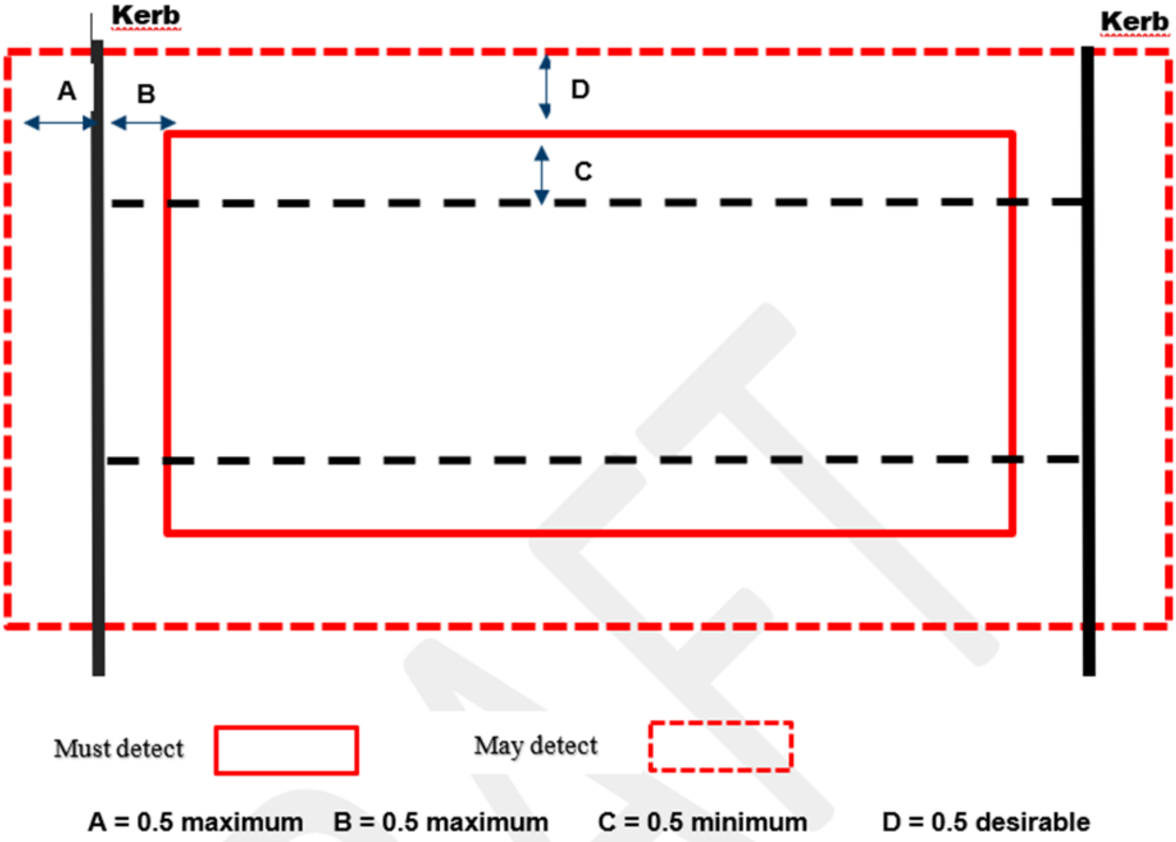
Table 5.2 – Detectors covering each zone at typical divided crossing

Detector	Area in Figure 5.1							
		g	f	e	d	c	b	a
	1				✓	✓	✓	
	2						✓	✓
	3	✓	✓					
	4		✓	✓	✓			

5.3 Minimum zone of detection for carriageway detectors

Figure 5.3 following illustrates the area to be covered in relation to the marked crossing and the kerb. Typical values for the dimensions are given in the diagram but these values are site-dependant and the area to be covered should be considered by the designer. Attention must be given to the need to detect pedestrians walking outside the crossing and the value used for 'C' increased as necessary. This would be particularly important at heavily-congested pedestrian movement in a central business district area.

Figure 5.3 – Minimum zone of detection



5.4 Additional commentary on radar detectors

The zones of detection shown previously are indicative only. Factors contributing to the size and shape of the actual zone of detection of a microwave radar detector include:

- detector horizontal and vertical beam width
- mounting height; and angle of declination of the unit
- output power of the unit, and/or
- software processing applied by the detector to the radar signals to limit the length and width of the detection zone.

In addition, the ability of a radar detector to detect a target depends on the strength of the signal reflected from the target. The strength of the reflected signal depends on the target size and composition. The minimum zone of detection required for a single carriageway site as shown previously must be achieved for the design pedestrian. This is a cloth-covered target 1 metre high by 0.5 metre wide by 0.2 metre deep with a mass of 20 kg, representing a 5–6-year-old child.

With simple microwave radar detection, there are no distinct cut-off lines. The diagrams in a manufacturer's brochure may be a simplification of the actual zone of detection from a conical radar 'beam' projected onto the road surface, or, better, a plane ~ 1 m above the road. Signal strength plots are usually based upon the -3dB contour (that is, the point where the transmitted signal is at half power). 3D microwave radar uses signal processing techniques to define the detection length and width.

The 'must detect' zone should cover the full crossing width and the full crossing distance less 0.5 m from the kerb at each side with some allowance for pedestrians that walk outside the marked crossing area.

The 'may detect' zone is shown for information only but should be minimised to avoid unnecessary extension of the flashing DON'T WALK period.

There have been concerns about the safe operation of the microwave units in heavy rain. It has been observed that detectors are actuated by heavy rainfall, presumably by 'scatter'. This is not a major problem, as this only results in some unnecessary delays to vehicles during heavy rainfall events and where there is a pedestrian demand. For light rain, the microwave signal may be attenuated.

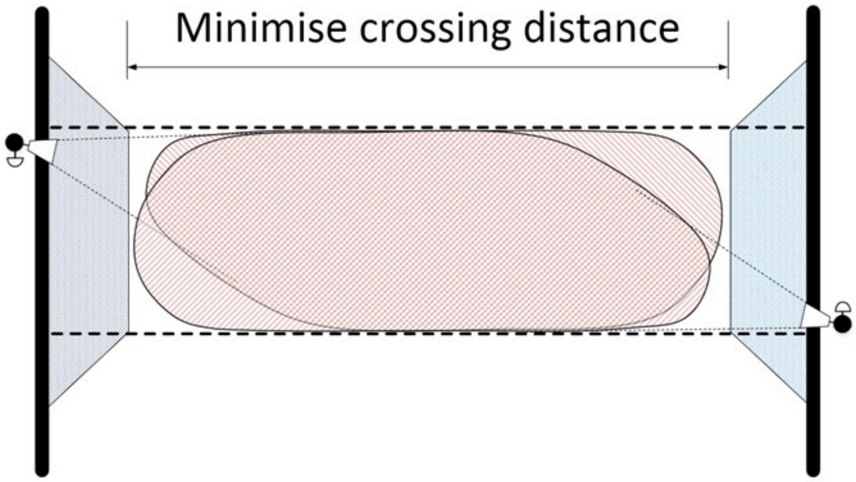
5.5 Crossing distance

Recommendations to reduce crossing distances are outlined in Austroads *Guide to Road Design Part 4 Intersections and Crossings – General*. Reducing the crossing distance may have the following benefits:

1. greater travel time savings for pedestrians
2. improved pedestrian safety, through reducing their exposure to traffic
3. better coverage and larger common zone for carriageway detectors (refer to Section 5.1), and/or
4. reduction in required number of carriageway detector units.

Minimising the crossing distance can be achieved by building out the kerbs and narrowing traffic lanes. Pedestrian refuges shall not be used at smart crossings unless the crossing can be staggered and operated as two separate crossings.

Figure 5.5 – Example of kerb extensions used to minimise the crossing distance



5.6 Pedestrian protection

In line with Transport and Main Roads' *Road Safety Policy* where turning vehicles can conflict with a pedestrian movement, pedestrian protection shall be provided by delaying the start of the vehicle movements.

Where carriageway pedestrian detectors are used, consideration can be given to introducing or extending the pedestrian protection period until the carriageway detectors indicate that all pedestrians have cleared the crossing.

5.7 Slip lanes

There is no reason why pedestrian detectors should not be used at 2 or 3 aspect-controlled slip lanes to provide longer pedestrian clearance (flashing DON'T WALK) times when needed. However, the benefits might be small as the crossing distance is usually short. The effect on efficiency would probably also be small unless the left turn is a major movement. Thus the reduction of unnecessary delay to left-turning traffic should not be a driving factor for the installation of pedestrian detectors on a slip lane as the cost of small delays to general purpose traffic is debatable.

Appendix A – Traffic signal controller operation

This section provides some general information on the operation of a smart crossing for traffic engineers and intersection designers. **It does not seek to give detailed guidance on how the smart crossing functionality is achieved in the traffic signal controller.**

A.1 Signal display sequence

Smart crossings use the same traffic signal display sequence as standard signalised pedestrian crossings. The time settings and control sequence are similar to those of a standard crossing, except:

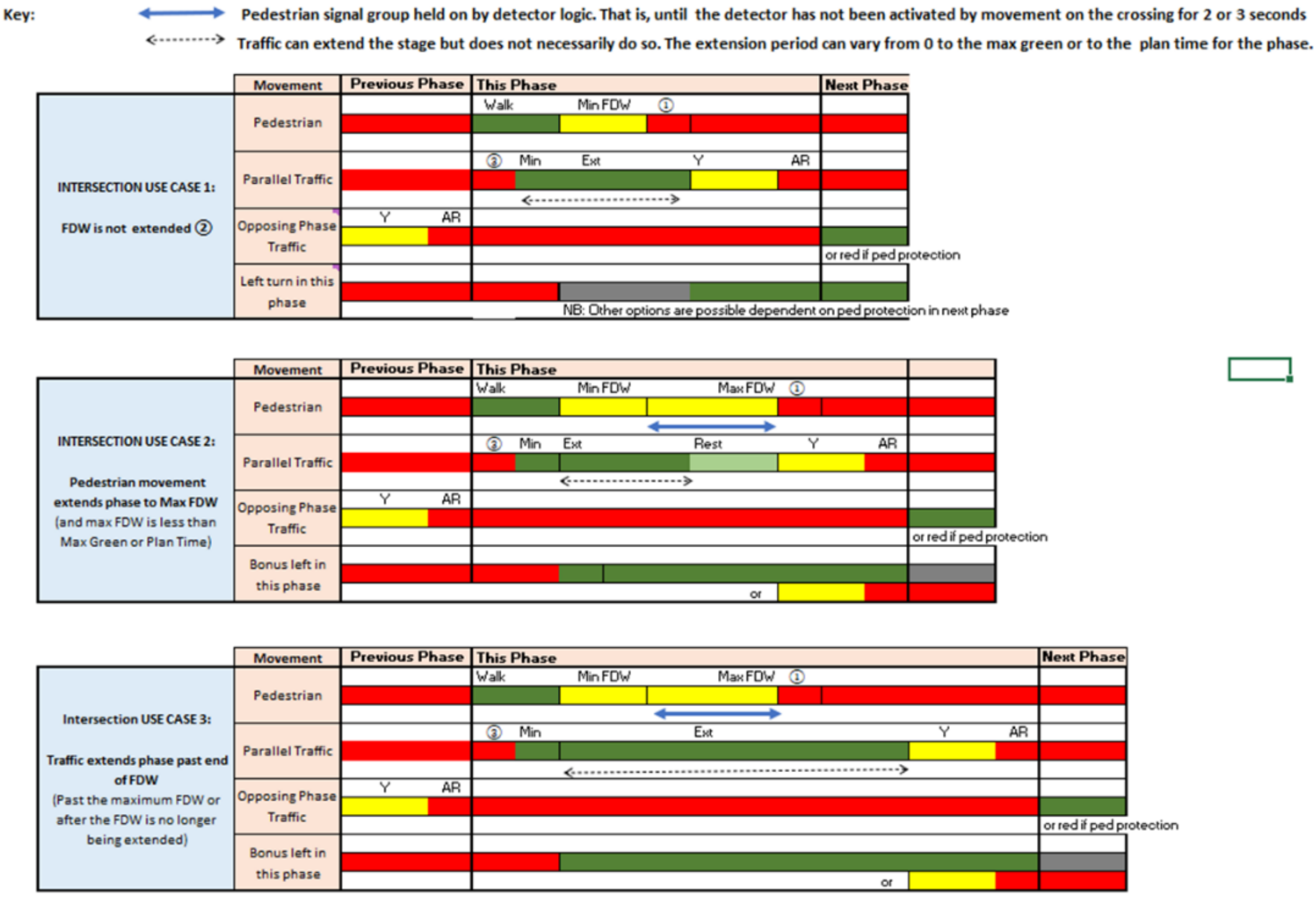
a) The flashing DON'T WALK time at a smart crossing can be longer than the standard, fixed, flashing DON'T WALK time when necessary; that is, when pedestrians on the crossing extend the flashing DON'T WALK time. The maximum flashing DON'T WALK time is configured in the controller to a value that allows slow-walking pedestrians that step off the kerb at the end of the walk to safely cross before opposing traffic starts (see Section A.2.3 following).

b) A minimum flashing DON'T WALK time is specified to ensure pedestrians who start to cross after the green walk period, but during this minimum flashing DON'T WALK period, will extend the flashing DON'T WALK period until they clear the road (or until the maximum flashing DON'T WALK time is reached).

c) Footpath detectors, if present, can cancel the pedestrian demand before it starts.

d) The Clearance 2 period in a TSC4 controller is not used at smart crossings. Figures A.1(a) and A.1(b) following demonstrate the operation of the crossing.

Figure A1(a) – Smart crossing operation at an intersection



① Solid DON'T WALK. In a TSC4 controller, this period can be the yellow time for the pedestrian movement (that must exist in the TRAFF software) plus the minimum all red time that can be set (0.1 s) and is, thus, 3.1 s.

② The flashing DON'T WALK time was not extended as either there were no pedestrians detected or the pedestrian detection cleared before minimum flashing DON'T WALK time.

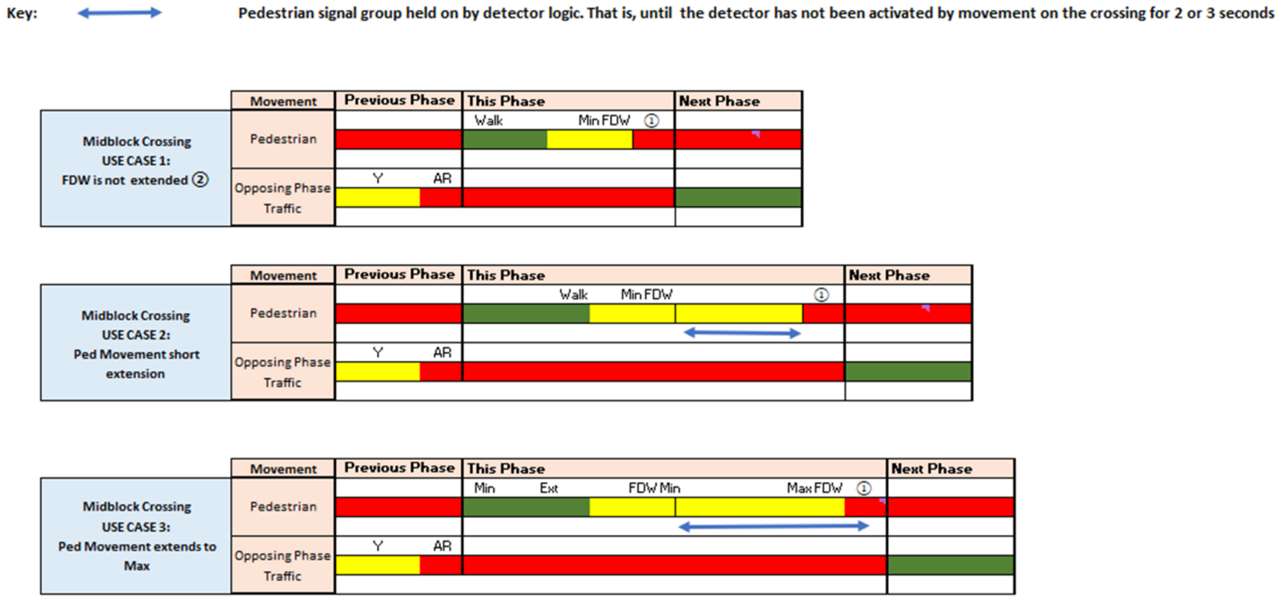
③ Pedestrian protection period can vary from 4 s to the end of the flashing DON'T WALK period. For smart crossings, consider protecting to end of flashing DON'T WALK time using pedestrian detector.

Note:

1. The pedestrian movement timing periods are as described in the *Traffic and Road Use Management* (TRUM) manual – traffic movement timing periods are for TRAFF controller.
2. The next phase is shown starting at the end of the yellow and all red periods as per the TRAFF controller.

   For ITC controllers, the next phase starts at the end of the last green in the stage.
3. These diagrams are designed to show the basic operation of a smart crossing in several simple scenarios. They are not comprehensive and do not show all options for pedestrian protection.

Figure A.1(b) – Smart crossing operation at a mid-block crossing



① Solid DON'T WALK. In a TSC4 controller, this period can be the yellow time for the pedestrian movement (that must exist in the TRAFF software), plus the minimum all red time that can be set (0.1 s) and is thus 3.1 s.

② The flashing DON'T WALK time was not extended as either there were no pedestrians detected or the pedestrian detection cleared before minimum flashing DON'T WALK time.

Note:

1. The pedestrian movement timing periods are as described in the *Traffic and Road Use Management* (TRUM) manual – traffic movement timing periods are for TRAFF controller.
2. The next phase is shown starting at the end of the yellow and all red periods as per the TRAFF controller.

   For ITC controllers the next phase starts at the end of the last green in the stage.
3. These diagrams are designed to show the basic operation of a smart crossing in several simple scenarios. They are not comprehensive and do not show all options for pedestrian protection.

A.2 Time settings

The following times should be specified by the Traffic Engineer certifying the design.

A.2.1 Demand cancel time

This time setting is required for smart crossings with **footpath detectors**. The demand cancel timer operates similarly to a gap timer for a traffic movement. If the footpath detector does not detect anyone in the waiting area for the defined 'demand cancel time', the pedestrian demand is cancelled. The demand timer is set to the demand cancel time when the controller starts. The timer starts to count down if, at any time after the button is pressed, the detectors cannot detect anyone waiting to cross. If the timer reaches zero, the pedestrian demand is cancelled. If the pedestrian detector or the push-button is activated again in the same cycle, the pedestrian demand is reinstated and the demand timer set to the demand time.

The demand cancel time should nominally be set to three seconds but can be adjusted to make the crossing more or less responsive to pedestrians leaving the zone of detection of the detector. If the detector used has an inbuilt demand cancel time, the controller setting can be reduced by an equivalent time (the AGD326 detector has an inbuilt demand cancel time of 0.8 seconds so the controller demand cancel time should be two seconds).

A.2.2 Minimum flashing DON'T WALK time

This time setting is required for smart crossings with **pedestrian carriageway detectors**.

A minimum flashing DON'T WALK time is specified to ensure pedestrians who start to cross after the green WALK period but during this minimum flashing DON'T WALK period, will extend the flashing DON'T WALK period until they clear the road (or until the maximum flashing DON'T WALK time is reached).

The total minimum flashing DON'T WALK time should be specified by the Traffic Engineer but should be a minimum of four seconds.

If a longer time is specified, it should be a balance between catering for errant pedestrians (stepping off the kerb after the flashing DON'T WALK time has started) and the possibility that a longer flashing DON'T WALK time encourages pedestrians to start to cross during the flashing DON'T WALK time as they learn that the flashing DON'T WALK time will be extended until they clear the crossing.

A.2.3 Maximum flashing DON'T WALK time

This time setting is required for smart crossings with **pedestrian carriageway detectors**. While pedestrians are detected on the carriageway, the traffic signal controller can extend the flashing DON'T WALK period up to the maximum flashing DON'T WALK time. The maximum flashing DON'T WALK time is set to the total time required to allow a pedestrian stepping off the kerb at the end of the green period to fully cross the road.

For Transport and Main Roads smart crossings, the maximum flashing DON'T WALK time shall be calculated using a walking speed of **either:**

- **0.8 m/s, or**
- **1.0 m/s.**

The most appropriate walking speeds at signals are typically:

- **0.8 m/s – where slow-walking pedestrians may be encountered, for example:**
  - parks and recreation areas
  - day cares or other educational facilities (except universities)
  - attractors or generators of children
  - attractors or generators of elderly (the literature indicates, to be inclusive of the needs of pedestrians aged over 65, a walking speed of 0.8 m/s should be adopted)
  - attractors or generators of people with vision, mobility or hearing impairment
  - attractors or generators of tourists
  - high volumes of path users, causing congestion, and/or
  - steep grades or other physical constraints that limit walking speeds.
- **1.0 m/s – where slow walking is not expected to be encountered**.

A.2.4 Flashing DON'T WALK gap time

This time setting is required for smart crossings with carriageway detectors. If no movement is detected on the crossing, this timer will start to count down from this time. Any movement in the zone of detection will reset the timer to its initial value. After the minimum flashing DON'T WALK time, the flashing DON'T WALK signal will be terminated when the gap timer reaches zero (or immediately if it is zero at the end of the minimum). The flashing DON'T WALK gap time should be set to three seconds.

A.3 Smart crossing modes

Smart crossings have three possible modes of operation.

1. **Smart clearance mode**

   Smart clearance mode allows the flashing DON'T WALK time to be varied between minimum and maximum values. This mode requires carriageway detectors.

2. **Smart demand mode**

   Smart demand mode allows the demand for a pedestrian movement to be cancelled if it is likely that the pedestrian movement is no longer required. This mode requires footpath detectors. Smart demand mode is optional at smart crossings.

3. **Fall-back mode**

   Fall back mode may not be necessary in a controller as the smart crossing functionality can be disabled by setting a carriageway detector on. A faulty carriageway detector will automatically cause the controller to use the maximum flashing don't walk time when the pedestrian movement is demanded.

   If fall back mode is implemented, when it is fallback mode, the controller will ignore the output of pedestrian detectors and operate with the maximum flashing DON'T WALK time. Pedestrian demands will not be affected.

If provided fall back mode can be introduced:

a) automatically by the controller if a pedestrian detector is faulty

b) by STREAMS if statistical checking of detect counts indicates a suspected faulty detector, or

c) by a Traffic Management Centre operator for operational purposes.

Note: The maximum flashing DON'T WALK time used in fall back mode SHOULD be is the same as that for smart clearance mode. See Section A.2.3 above.

A.4 Interaction with traffic management system

The traffic signal controller should:

- report pedestrian detector faults to the traffic management system (STREAMS), and
- allow the traffic management system to disable or enable the associated smart crossing modes, or set detectors on to disable smart crossing functionality.

A.5 Fault monitoring

Pedestrian detectors are designed to be fail safe; that is, they should fail in the occupied (pedestrian present) state. The system should however be designed to mitigate the impact of detector faults. The output of the carriageway and footpath detectors should be monitored by the traffic signal controller and/or the Traffic Management Centre system to detect over or under counting over a period of time.

If one or more pedestrian detector is failed permanently demanded (as it is designed to do, it has failed safe), or has failed statistical monitoring checks, the flashing don't walk timer will run to the maximum time setting. And thus smart crossing functionality will be automatically disabled.

In the unlikely event that a pedestrian detector has failed unoccupied or is not seeing pedestrians on the crossing the control log (as per the standard tables supplied by Statewide Network Operations, ITSE Technology) will automatically ensure the flashing don't walk timer will run to the maximum time setting.

To report a fault please email the team via SNO_ITS&E_Technology_Managers@tmr.qld.gov.au.

It is considered extremely unlikely that all pedestrian detectors will fail unoccupied at precisely the same moment but if both detectors are failed unoccupied the FDW will only run to the minimum don't walk time. However, TMC operators should already be aware of the first detector having failed and thus have the process of repairing the detector in hand.

A.5.1 Footpath detector fault monitoring

The major risk with using footpath detectors is incorrect cancellation of pedestrian demands.

If a footpath detector does not detect the presence of a pedestrian, the demand will be cancelled. If the pedestrians notice that the demand indicator has gone off, they can press the button to re-initiate and hold the demand. It is, however, possible that some pedestrians may decide to risk crossing without the pedestrian phase.

Similar to carriageway detectors, the health of footpath detectors should be monitored.

A.6 Clearance 2 time

The Clearance 2 time setting in a TRAFF controller is not used for smart pedestrian signal groups (if required by the controller it should be set to zero or as near zero as possible). This ensures that an opposing traffic movement can start as soon as possible when the system determines that there are no detectors on the crossing (the gap timer has expired). A safety buffer between the termination of the flashing DON'T WALK signal and a conflicting vehicle movement is provided by holding the conflicting vehicle signal red for a minimum of two seconds. Figure A.1(a) illustrates how this would operate including with a bonus left-turn movement.

Appendix B – Commissioning a smart crossing

As always when a new personality or configuration is installed, the operation of the controller must be checked on the workbench and in a test controller before it is deployed to site.

The zone of detection of all pedestrian detectors used at a smart crossing must be verified before smart mode is enabled. This should be done at the time the detectors are installed, before the personality or configuration is updated to allow smart operation.

Correct operation of the system should then be verified when the smart crossing personality or configuration is commissioned.

All testing and commissioning should be undertaken in line with Transport and Main Roads Manual for Commissioning a Smart Crossing available from Statewide Network Operations, Operational Technologies.

For any enquires please email the team via SNO_ITS&E_Technology_Managers@tmr.qld.gov.au.