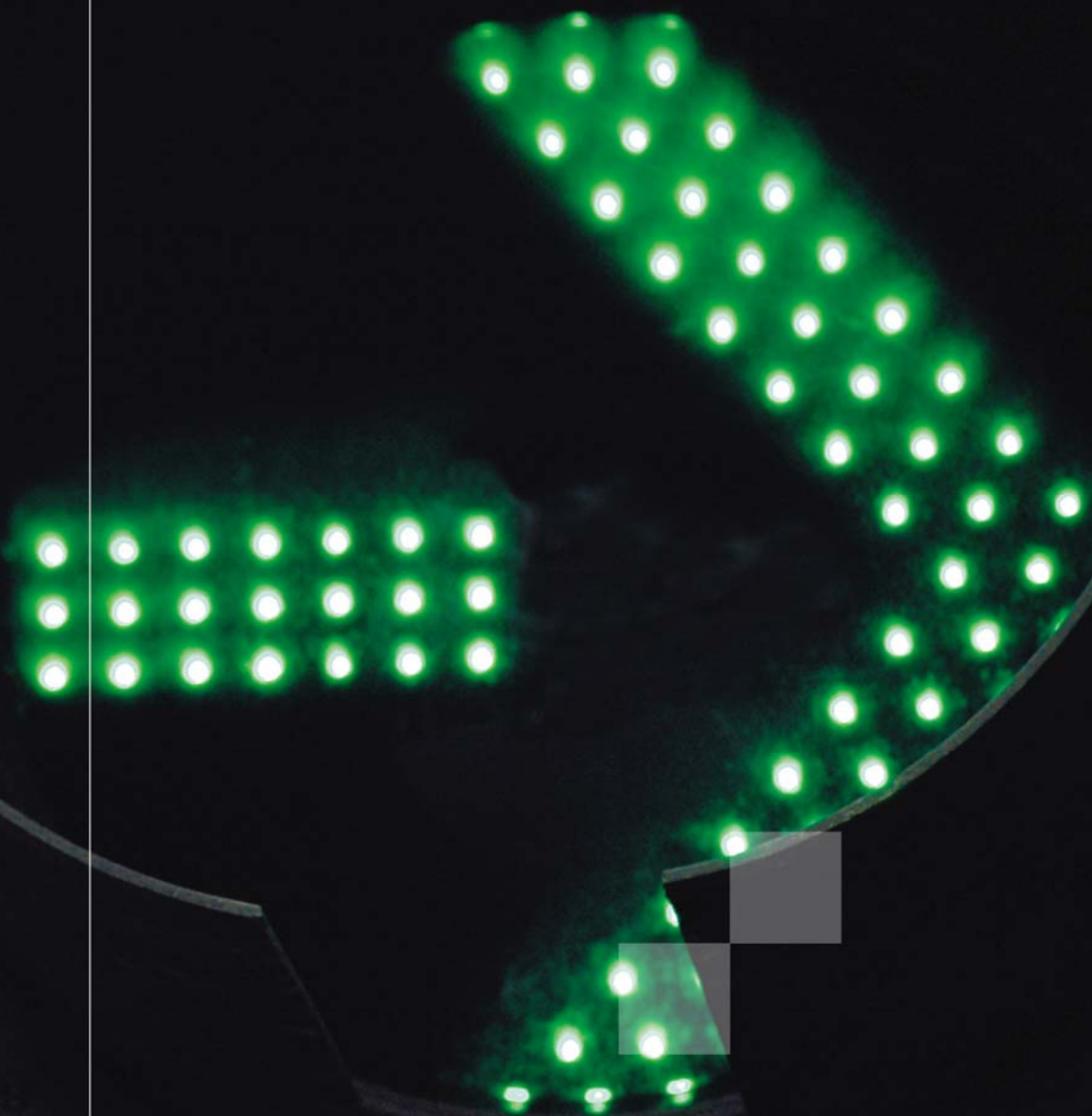




Traffic signal design

Section 2 - Warrants



The traffic signal design guidelines have been developed to assist in designing traffic control signals.

The guidelines are to comprise 16 sections and 5 appendices. These are initially being released individually and in no specific order. The sections which are to be released are as follows:

Part	Title
Section 1	Investigation
Section 2	Warrants
Section 3	Design Process
Section 4	Plan Requirements
Section 5	Geometry
Section 6	Pavement Marking
Section 7	Phasing and Signal Group Display Sequence
Section 8	Lanterns
Section 9	Posts
Section 10	Signs
Section 11	Detectors
Section 12	Controller
Section 13	Provision for Future Facilities
Section 14	Signalised Mid-block Marked Footcrossings
Section 15	Special Situations
Section 16	References
Appendix A	Design Plan Checklist
Appendix B	Traffic Signal Symbols
Appendix C	Location and Function of Lanterns
Appendix D	Location and Dimensions of Components
Appendix E	Left Turn on Red

To determine which sections are currently available go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/trafficsignaldesign_dll.html

The information contained in the various parts is intended to be used as a guide to good practice. Discretion and judgement should be exercised in the light of the many factors that may influence the design of traffic signals at any particular site. The guidelines make reference, where relevant, to current Australian Standards and are intended to supplement and otherwise assist in their interpretation and application.

Traffic Signal Design

Section 2

WARRANTS





Roads and Traffic Authority

www.nsw.rta.gov.au

VERSION: 1.2
ISSUED: May 2009

APPROVED BY:

SIGNED

Phil Margison
General Manager
Traffic Management

SIGNED

Steve Levett
A/General Manager
Safer Roads

AUTHORISED FOR USE BY:

SIGNED

Michael Bushby
Director
Network Management

© 2008 Roads and Traffic Authority NSW

Extracts from these guidelines may be reproduced providing the subject is kept in context and the source is acknowledged.

Every effort has been made to supply complete and accurate information. However RTA, NSW assumes no responsibility for its use.

All trade name references herein are either trademarks or registered trademarks of their respective companies.

For policy and technical enquiries regarding these guidelines please contact:

Traffic Management Branch
Email: technical_directions_publication@rta.nsw.gov.au
Phone: (02) 9218 6287
Fax: (02) 9218 6693

To access electronic copies of these and other guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/technicalmanuals_dll.html

For the latest amendments (if any) to these guidelines go to:

www.rta.nsw.gov.au/doingbusinesswithus/downloads/technicalmanuals/trafficsignaldesign_dll.html

ISBN 978-1-921242-95-3 (Electronic only)
RTA/Pub. 08.092



Contents

2.1 INTRODUCTION	2-1
2.2 FACTORS INFLUENCING THE PROVISION OF TRAFFIC SIGNALS	2-1
2.3 SIGNALISED INTERSECTIONS	2-1
2.4 SIGNALISED MARKED FOOT CROSSINGS AT INTERSECTIONS.....	2-2
2.4.1 Flashing yellow arrows at signalised marked foot crossings	2-3
2.4.2 Conversion from pedestrian crossing to signalised marked foot crossing.....	2-4
2.5 SIGNALISED MID-BLOCK MARKED FOOT CROSSINGS	2-5
2.6 SIGNALISED SCRAMBLE CROSSING AT INTERSECTIONS	2-6
2.7 SIGNALISED ENTRIES TO PRIVATE DEVELOPMENTS	2-7

Amendment record

Please note that the following updates have been made to this document.

Version Number	Page	Description	Issued
1.1	2-4	Fig 2.1 amended to reflect new marked foot crossing markings	August 2008
1.2	2-3	Two-stage (offset) crossing note added to Section 2.4	May 2009

2.1 INTRODUCTION

This section describes the general warrants for the installation of traffic signals. It must be emphasised that these are only a guide. If a site satisfies the warrants, it does not necessarily mean that traffic signals are the best solution. All traffic data should be analysed and alternative treatments considered to determine the optimum solution (see Section 4 of the *Road Design Guide*). Traffic signals are sometimes installed due to public pressure or an administrative directive irrespective of the general warrants.

2.2 FACTORS INFLUENCING THE PROVISION OF TRAFFIC SIGNALS

Traffic signals are usually installed at an intersection:

- to provide traffic control at a site with a traffic capacity or road safety problem
- to control conflicting movements with high traffic flows
- to facilitate access to and from local areas in a major/minor road system, including pedestrian movements
- as part of an area wide system of traffic management

A side effect of signalisation is that the traffic flow on a major road is broken up into platoons. This assists nearby pedestrians to cross the major road and vehicles in nearby side streets to cross or enter the major road.

Factors influencing the provision of traffic signals include:

- traffic flows
- traffic conflicts
- traffic accident statistics
- pedestrian requirements
- access to major roads
- cost of installation
- availability of funds
- maintenance costs
- practicality
- feasibility
- the signposted speed limit is not more than 80km/h

General warrants are given in the following sub-sections. The figures stated should only be used as a guide and each intersection should be considered in more detail before being accepted for signal design.

2.3 SIGNALISED INTERSECTIONS

As a guide, a signalised intersection may be considered if one of the following warrants is met.

(a) Traffic demand:

For each of four one-hour periods of an average day:

- (i) the major road flow exceeds 600 vehicles/hour in each direction; and
- (ii) the minor road flow exceeds 200 vehicles/hour in one direction.

OR

(b) Continuous traffic:

For each of four one-hour periods of an average day:

- (i) the major road flow exceeds 900 vehicles/hour in each direction; and
- (ii) the minor road flow exceeds 100 vehicles/hour in one direction; and
- (iii) the speed of traffic on the major road or limited sight distance from the minor road causes undue delay or hazard to the minor road vehicles; and
- (iv) there is no other nearby traffic signal site easily accessible to the minor road vehicles.

OR

(c) Pedestrian safety:

For each of four one-hour periods of an average day:

- (i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and
- (ii) the major road flow exceeds 600 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 1000 vehicles/hour in each direction.

OR

(d) Pedestrian safety – high speed road:

For each of four one-hour periods of an average day:

- (i) the pedestrian flow crossing the major road exceeds 150 persons/hour; and
- (ii) the major road flow exceeds 450 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 750 vehicles/hour in each direction; and
- (iii) the 85th percentile speed on the major road exceeds 75 km/h.

OR

(e) Crashes:

- (i) The intersection has been the site of an average of three or more reported tow-away or casualty traffic accidents per year over a three year period, where the traffic accidents could have been prevented by traffic signals; and
- (ii) the traffic flows are at least 80% of the appropriate flow warrants.

2.4 SIGNALISED MARKED FOOT CROSSINGS AT INTERSECTIONS

A signalised marked foot crossing must be provided on each leg of a signalised intersection (including T Junctions), in a built-up area, except in the following circumstances:

- (a) There are significant road safety implications:
 - (i) there is insufficient sight distance (see Section 4 of the *Road Design Guide*); or
 - (ii) there is adverse road geometry (see Section 4 of the *Road Design Guide*); or
 - (iii) there is a posted speed limit of more than 80 km/h; or
- (b) There are significant adverse transport efficiency implications
 - (i) there is an unacceptable increase in delay and degree of saturation which must be substantiated by intersection modelling; or

- (c) There are parallel grade separated pedestrian facilities provided; or
- (d) There is an un-signalised approach (eg. slip lane) where a pedestrian crossing may be used (see Figure 2.1); or
- (e) The crossing would terminate in an area that is not possible for pedestrians to access (e.g. a wall or cliff face); or
- (f) The crossing is associated with a raised pavement or threshold.

The lack of adequate connecting facilities for pedestrian access (eg. no footpath or no pedestrian traffic) is not, in itself, grounds for exception.

The Manager Network Operations, Transport Management Centre, must approve all exceptions as described above.

Where an exception is granted, provision must be made in the cabling and traffic signal post locations to allow the exempted marked foot crossing to be easily provided should the exceptional conditions be removed.

Kerb ramps must be provided at each end of a signalised marked foot crossing or pedestrian crossing located at a signalised intersection (see Section 5.7 in [Geometry](#)).

Pedestrian clearance times are based on the 85th percentile walking speed of 1.2 m/s. If a site is frequently used by "slow walkers", such as the elderly or people with disabilities, different walking speeds may be chosen, in the range 0.8m/s to 1.2m/s, as considered appropriate for the situation.

If a two-stage (offset) crossing is included at a signalised intersection, it is to be provided in accordance with Section 14.3 in [Signalised Mid-block Marked Foot Crossings](#).

2.4.1 Flashing yellow arrows at signalised marked foot crossings

The flashing yellow arrow may be considered to enhance pedestrian protection at signalised intersections.

The flashing yellow arrow is intended to remind drivers of their obligation to 'give way' to pedestrians while they are completing their crossing during the flashing red 'Don't Walk' clearance period of the traffic signals.

Flashing yellow arrow pedestrian protection shall only be used in conjunction with and following red arrow protection. The red arrow protection shall not be less than for the "Walk" period, but it can be greater than it. Following the red arrow protection the flashing yellow arrow shall be displayed for the remainder of clearance 1, but not less than 2 seconds.

Flashing yellow arrow pedestrian protection is not used where there is full protection of the pedestrian phase provided by a red arrow hold, i.e. throughout the "Walk" and "Don't Walk" period.

The flashing yellow arrow may be installed at sites where one or more of the following criteria is satisfied:

- 1 or more pedestrian casualty crashes involving left turn or right turn vehicles in the last 3 years;

- heavy vehicle demand on left and/or right turn through the marked foot crossing – more than 5 vehicles per phase in any one hour period on an average day;
- high speed turning traffic – greater than 30km/h;
- high proportion of children, the elderly or people with disabilities – greater than 15% during any one hour period on an average day;
- high volume of pedestrians – greater than 250 pedestrians in any 1 hour period of an average day on the crossing applicable to the flashing yellow arrow;
- there are 2 or more lanes of traffic turning left through the marked foot crossing.

Flashing yellow arrows can be used for single or dual left turns. In either case, an opposing right turn should be held by a red arrow during the flashing yellow phase.

Flashing yellow arrows can be used for right turns at a cross intersection and from the stem of a T intersection with restrictions as follows:

The flashing yellow arrow **must not** be installed where:

- there is a conflicting opposing through movement. An opposing through movement can be eliminated by adopting a split approach phasing and thus allow the installation of flashing yellow arrows for the right turn movement;
- there are 2 or more lanes of traffic turning right through the marked foot crossing. Dual right turns must have full control;
- the 85th percentile speed of traffic is higher than 75km/h.

The red arrow hold should never be reduced by substitution with the flashing yellow arrow. The flashing yellow arrow is additional to the red arrow hold, **not** a substitute (see Section 7.10.1 in [Phasing & Signal Group Display Sequence](#)).

2.4.2 Conversion from pedestrian crossing to signalised marked foot crossing

Where a pedestrian crossing such as that shown in Figure 2.1 is used, the same warrants that apply to a signalised mid block marked foot crossing should also be considered to apply when converting from a pedestrian crossing to a signalised marked foot crossing.

If a dedicated bicycle path has been installed on the approach to the pedestrian crossing, and bicycle paths have been provided throughout the rest of the intersection, then regardless of other warrants, the pedestrian crossing should be converted to a signalised marked foot crossing to maintain continuity of the bicycle paths.

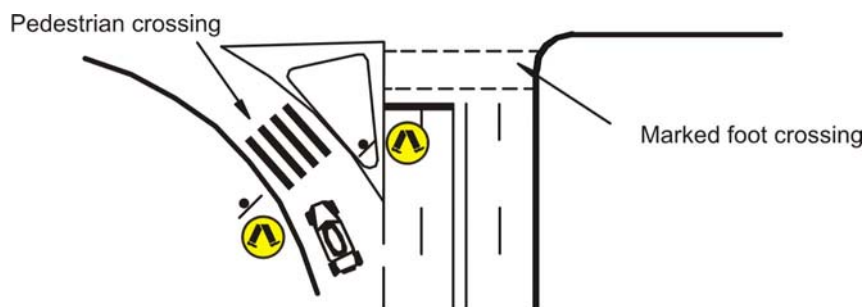


Figure 2.1 Unsignalised Approach (eg: Slip Lane etc) at the site.

2.5 SIGNALISED MID-BLOCK MARKED FOOT CROSSINGS

The need for a signalised mid-block marked foot crossing is a function of the probability of a pedestrian being able to find a suitable gap in vehicular traffic. Finding such a gap depends on the speed, concentration and flow of vehicles, not just the flow of pedestrians. Hence, factors such as randomness, number of lanes and upstream influences need to be taken into account as well as the proportion of children, the elderly or people with disabilities, pedestrian desire lines, impact of future development and so on (see Section 14 [Signalised Mid-block Marked Footcrossings](#)).

When considering a signalised mid-block marked foot crossing, remember that provision of this facility may attract extra pedestrians to the site. Therefore justification for the provision of a signalised mid-block marked foot crossing should be based on the potential pedestrian flow rather than the existing or actual flow. Signalised marked foot crossings, mid-block or otherwise, must not be used in association with raised pavement or thresholds.

The provision of a signalised mid-block marked foot crossing must be avoided within 130 m of an adjacent signalised intersection. This is to avoid unintended and possibly misinterpreted sighting of the adjacent intersection signals. It is also to keep the total number of signal sites to a manageable level and avoid unnecessary impact on the overall network performance. It is expected that pedestrians will not consider it too onerous to walk 130m to a signalised intersection.

Additionally, signalised mid-block marked foot crossings must be located a minimum of 30 m from any side streets. This is to avoid side-street traffic misinterpreting the traffic signals as controlling their movement. It also prevents the situation where a vehicle enters the main road just as the signals change to the pedestrian phase and the driver of the entering vehicle is unaware of the change or unable to react in time.

Exceptions to these requirements may be granted by the Manager Network Operations, Transport Management Centre.

As a guide, a signalised mid-block marked foot crossing may be considered if one of the following warrants is met.

- (a) For each of four one-hour periods of an average day:
 - (i) the pedestrian flow crossing the road exceeds 250 persons/hour; and
 - (ii) the vehicular flow exceeds 600 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 1000 vehicles/hour in each direction.

OR

- (b) For each of eight one-hour periods of an average day:
 - (i) the pedestrian flow exceeds 175 persons/hour; and
 - (ii) the vehicular flow exceeds 600 vehicles/hour in each direction or, where there is a central median of at least 1.2 m wide, 1000 vehicles/hour in each direction; and
 - (iii) there is no other pedestrian crossing or signalised marked foot crossing within a reasonable distance.

The warrants may be reduced if a site is used predominantly by children, the elderly or people with disabilities. In this case, a signalised mid-block marked foot crossing may be considered if one of the following warrants is met:

- (a) The crossing is used predominantly by children and for each of two one-hour periods of an average day:
- (i) the pedestrian flow exceeds 50 persons/hour; and
 - (ii) the vehicular flow exceeds 600 vehicles/hour in each direction.

OR

- (b) At least 50% of pedestrians using the crossing are elderly or people with disabilities and for each of two one-hour periods of an average day:
- (i) the pedestrian flow exceeds 50 persons/hour; and
 - (ii) the vehicular flow exceeds 600 vehicles/hour in each direction.

A signalised mid-block marked foot crossing may also be considered in certain special situations if one of the following warrants is met:

- a) The flow warrant for a pedestrian crossing is realised but its provision could cause a hazard to pedestrians because of the width of the carriageway, insufficient sight distance to the crossing, or the speed or number of vehicles.

OR

- (b) There is a large seasonal variation in the traffic flow (such as at a holiday resort) and it can be shown to meet the general criterion during the busy season, even if during the rest of the year the general criterion is not met.

OR

- (c) The location has been the site of two or more pedestrian casualties over a three year period that could have been prevented by traffic signals.

OR

- (d) The site meets the warrants for a pedestrian crossing, but a signalised marked foot crossing would improve traffic flow by enabling it to be coordinated with another site, or sites.

The warrants for PELICAN crossings are the same as those for conventional signalised mid-block marked foot crossings, and can only be used at one stage crossings of 4 lanes or less. They must not be installed at very wide roads with approaches of 3 lanes in each direction or very wide medians, two-stage crossings, or sites used predominantly by children, the elderly or people with disabilities. The site should also benefit from reduced vehicle delays and be in an area where the 85th percentile speeds are 80 km/h or less (see Section 14.4 in [Signalised Mid-block Marked Footcrossings](#)).

2.6 SIGNALISED SCRAMBLE CROSSING AT INTERSECTIONS

A scramble crossing is a specific type of exclusive pedestrian phase at a signalised intersection. During the scramble crossing all pedestrian movements, including diagonal movements, operate simultaneously within the marked limits of the crossing (see Section 6.4 in [Pavement Marking](#), Section 7.9.2 in [Phasing & Signal Group Display Sequence](#) and Section 10.6 in [Signs](#)).

Scramble crossings must operate full-time. Part-time scramble crossings must **not** be installed under any circumstances.

A scramble crossing may be installed where there is a demonstrated need for pedestrians to cross diagonally and where heavy, continuous pedestrian movements (>360 pedestrians per hour) could result in excessive congestion, conflicts and delay to pedestrians and turning traffic.

In general, scramble crossings should not be installed at T-or Y intersections. In such cases, if there is a need to cater for a large pedestrian demand, it would be more beneficial to introduce an exclusive pedestrian phase.

A scramble crossing must **not** be installed at a signalised intersection in the following circumstances:

- where there are parallel grade separated pedestrian facilities provided, or
- there is adverse road geometry, or
- there would be significant increase in delay to vehicle traffic and degree of saturation (must be substantiated by intersection modelling) particularly if this would have a substantial impact on bus services, or
- where the intersection would result in a diagonal crossing distance greater than 36 metres, or
- where the intersection is severely angled or has more than five legs, or
- where a high number of pedestrians with vision impairment is likely, or
- where the intersection has special phasing for emergency services or is at a railway crossing, or
- where the intersection has an un-signalised approach (e.g. slip lane, seagull islands, corner islands), where a pedestrian crossing as shown in Figure 2.1 is used.

2.7 SIGNALISED ENTRIES TO PRIVATE DEVELOPMENTS

The same warrants that apply to signalised mid block marked foot crossings should also be considered to apply to signalised entries to private developments (see Section 15.11 in [Special Situations](#)).

For further enquiries

www.rta.nsw.gov.au

13 22 13

Roads and Traffic Authority

March 2008

RTA/Pub. 08.092