File Note

Date	18 September 2007
Project No	AN00835
Subject	**Advisory Cycle Symbol Proposed Trial**

1. Outline of the Issues

Auckland City Council (ACC) has identified the need to investigate the use of advisory cycle markings in areas where there is insufficient space for an exclusive on-road or off-road cycle facility and where there is a need to raise motorists' awareness of the presence of cyclists.

It is envisaged that this symbol would be an advisory type road marking to highlight the presence of cyclists and may be used in applications such as wide kerbside or parking lanes. The current road marking cycle symbol M2-3 is not necessarily appropriate for this type of cycle facility as sufficient carriageway width is not available or current cycle volumes do not warrant the provision of a dedicated facility.

ACC is cognisant of the national reluctance to use advisory symbols in case it confuses motorists or dilutes other cycle lane efforts, however the highly constrained roading environment in Auckland requires a broader approach to cycle facilities.

ACC commissioned Sinclair Knight Merz (SKM) to undertake an investigation of advisory cycle markings, with the intention of eventually undertaking a Land Transport New Zealand (LTNZ) trial of a non-standard symbol. Subsequent to a process detailed in sections below, a possible advisory cycle symbol has now been designed and is ready to trialled, subject to LTNZ approval. This symbol is seen in Figure 1-1.

The trial would focus on on-road cycle facilities only, as there is limited opportunity for safe and continuous off-road facilities within the Auckland area. The trial would also focus on arterial or collector routes which make up the bulk of Auckland's main traffic and cycling routes, particularly those with kerbside parking, and will not include quieter residential streets where the lower traffic speed and volumes do not warrant interventions to assist cyclists. The trial would include continuous mid-block sections as well as isolated 'pinch points' and avoid roads with bus lanes (as these already cater for cyclists).

Cyclists are to be the primary beneficiaries of this scheme, which is intended to raise motorists' awareness of the presence of cyclists where no dedicated facility can be provided.

- **Figure 1-1: Proposed Advisory Cycle Symbol**

1.1 Proposed Trial Locations

A number of possible trial locations within Auckland City have been identified. These cover a range of road environments and conditions and are listed below:

- Richardson Road between New North Road and Stoddard Road (2 lanes). Some sections of this are proposed for future cycle lanes but at zebra crossing 'pinch points' there is insufficient room and the trial would test the use of an advisory symbol to assist in what would otherwise be a network gap;
- Tamaki Drive between Kelly Tarltons and Mission Bay, or between Mission Bay and St Heliers (2 lanes). This is a very busy cycle route with kerbside parking. A shared pedestrian / cycle path is currently provided on the existing footpath, but this is used primarily by recreational cyclists. On-road marking for commuter cyclists would provide additional awareness and enhance this as a key cycle route;
- New North Road between Morningside Drive and Bond Street (4 lanes). A clearway is provided along this section during morning and evening peak periods. On-street parking is permitted at off-peak times. The markings would be against the kerb and only visible during the clearway hours and then parked upon during the inter-peak period;
- Mt Albert Road between Sandringham Road and Mt Eden Road (2 lanes). This is a busy cycle route with kerbside parking. The carriageway lanes are not wide enough to provide a dedicated facility, and the advisory symbol is intended to provide additional awareness for drivers;

- Williamson Avenue (2 lanes). This is a busy arterial road with kerbside parking, which connects residential areas with the CBD. Existing carriageway lanes are wide enough for adequate clearance between cyclists and vehicles but the road is currently not a well trafficked cycle route. The advisory symbol is intended to encourage additional cycle use;
- Ladies Mile from Main Highway intersection northbound. This section of road is part of the cycle network, has a steep gradient, and is often congested. The existing carriageway width is a significant constraint to providing for dedicated on-road cycle lanes in both directions and the advisory symbol is intended to provide additional awareness of slower uphill cyclists;
- Campbell Road (2 lanes). This is part of the strategic cycle network and has indented parking; and
- Main Highway / Robert Street approach westbound (2 lanes). This is a 'pinch point' due to a narrowing lane on a bend approaching an over bridge.

1.2 Time Frames

It is thought that the trial would be commenced within four weeks of approval by LTNZ. The trial period would be for two weeks. The logic for these timeframes is discussed in the proposed trial methodology in Section 5.

2. Development Background

SKM has undertaken a review of existing legislation and standards for cycle facilities. The full review is included as Appendix A. However, the key points of this are summarised below:

- MOTSAM Part I: Signs has been updated with the signs as described in the Transit NZ Supplement to GTEP Part 14;
- The MOTSAM cycle pavement markings have not been updated and some discrepancies between this and the Transit NZ Supplement exist;
- MOTSAM currently provides adequately for the marking of legal cycle lanes. There are regulatory signs for exclusive cycle facilities which are not appropriate to use as an advisory sign. An advisory sign PW-35 is available to warn motorists of the presence of cyclists in areas with traffic speeds in excess of 50km/hr;
- There are no advisory pavement markings available for cycle lanes. The only existing cycle marking is MOTSAM Section 2.10 Figure 2.12 which is for use in a cycle lane only;
- Austroads Part 14 contains guidelines for advisory treatments such as edge line treatments of pavement symbols but the Transit NZ supplement does not support the use of these;
- The Land Transport Rule contains information on special vehicle lane markings which states that a cycle symbol pavement marking legally denotes a cycle lane; and
- The Land Transport Rule Traffic Devices 2001 and Land Transport NZ Traffic Note 10-Rev 1 contains additional information on requirements for trials.

A literature review of international practice to investigate whether other countries provide for cyclists in a non-regulatory manner has also been conducted. Four regions have been investigated as below:

- United Kingdom – London;
- Australia – Victoria;
- United States; and
- Netherlands.

The key results of this review are summarised in Table 2-1 below. The full literature review is attached as Appendix B.

- **Table 2-1: Summary Table of International Facilities**

Country	Legal Cycle Lane Definition	Advisory markings	Advisory Signage
New Zealand	Pavement symbol marking and solid white edge line	No advisory pavement markings Coloured pavement can be utilised (no legal significance)	One cycle warning sign (PW-35)
United Kingdom	Mandatory cycle lanes have solid white edge line, with use of regulatory signs and symbol at appropriate locations. A Traffic regulation order (TRO) is required to prohibit other vehicles using this lane. A mandatory lane is required to start with a taper of broken white lines and have broken white "advisory" lines at all intersections	Advisory cycle lanes are marked by broken white lines with the use of the same pavement symbol as mandatory but different advisory signs. Yellow no stopping lines/clearways to be used as appropriate Pavement cycle symbol marking can be used for advisory purposes Coloured pavement can be utilised	There is separate signage for advisory lanes and bike routes
Victoria, Australia	"Bicycle lane" sign and "bicycle lane ends" sign	Pavement cycle symbol markings Coloured pavement can be utilised (no legal significance)	No advisory signs but some warning signs available for cycle race events etc
United States	Pavement Marking Symbol (2 available), direction arrow and signage	No advisory pavement markings Coloured pavement can be utilised (no legal significance)	Bicycle route signs and some warning signs for bike routes. Not used in conjunction with pavement marking
Netherlands	Pavement Symbol Marking and solid white edge line	"Recommended cycle lanes" are permitted and these are indicated	No signs were discussed in the CROW manual. It is believed

Country	Legal Cycle Lane Definition	Advisory markings	Advisory Signage
		by a broken white line and no pavement cycle symbol	that the Netherlands use the European sign standards

It can be seen each country has a different method of legalising and treating cycle lanes. It appears that most of these countries either create an exclusive cycle facility or provide lane colouring or route signage. The UK does allow "advisory lanes" which allow occasional encroachment of vehicles however this is accompanied by pavement marking and signs so is similar to an exclusive cycle lane.

2.1 Development of Advisory Cycle Symbol

Following the review of existing legislation and standards for cycle facilities in New Zealand and an international literature review of advisory cycle markings/signage an evaluation frame work was developed to allow selection of the most appropriate symbol for trialling in New Zealand.

Six options were considered for further analysis. These were:

- Using a different colour for the existing regulatory pavement symbol (e.g. yellow instead of white);
- Designing a new advisory sign;
- Colouring the pavement;
- Introducing a broken white edge line;
- Designing a new advisory pavement symbol; and
- Introducing diagonal lines on edge of traffic lanes.

An evaluation process was undertaken to ensure that the proposal:

- Would not create any new safety or other problems;
- Is a potential solution to the identified problem;
- Addresses the relevant issues;
- Will be easily understood by road users;
- Integrates with current standards; and
- Is practical and sustainable.

The full process can be seen in Appendix C, but the final overall ranking of the six options is shown in Figure 2-2.

- **Figure 2-2 Ranking of most appropriate methods to advise of cyclist presence**

	Option					
	Different Colour for Existing Regulatory Symbol (eg yellow)	New Advisory Sign	Coloured Pavement	Broken White Edgeline	New Pavement Symbol	Diagonal Lines
Safety						
Clarity and Ease of Understanding of Advisory Status						
Economics						
Practicality						
Sustainability						
Integration						
Overall Assessment (Rank)	4	3	6	2	1	5

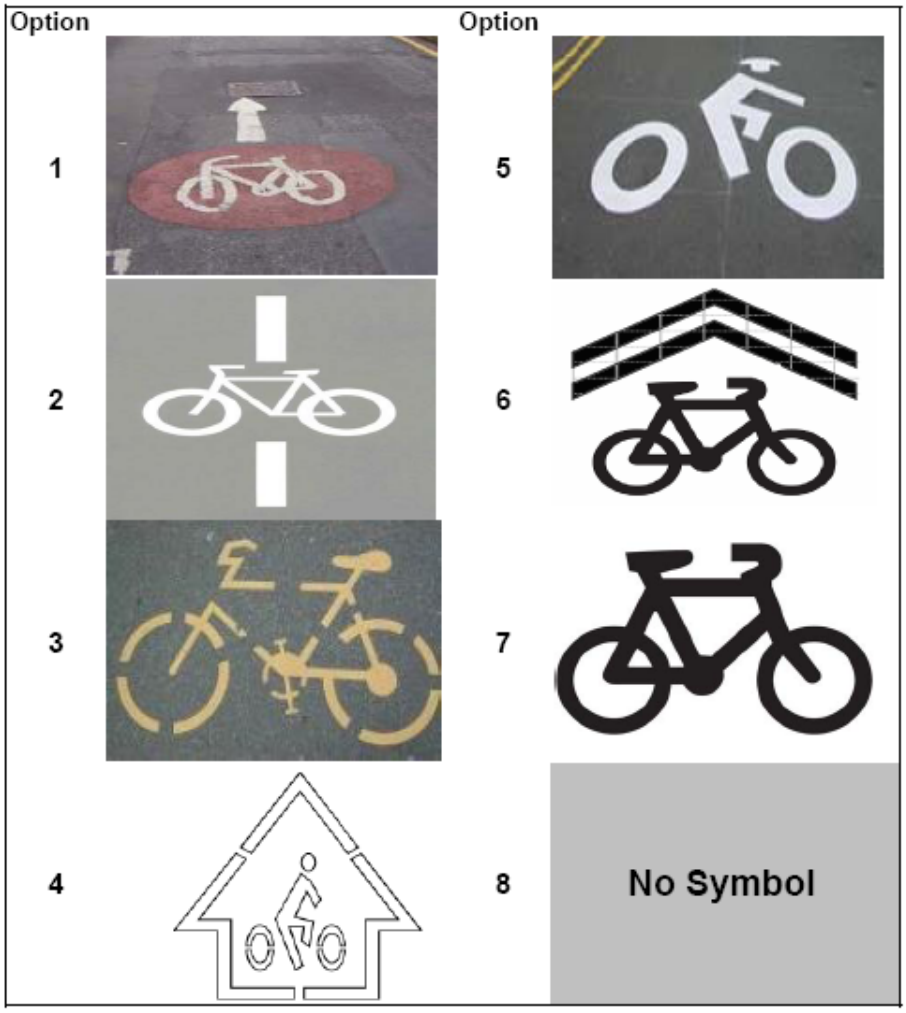
As Figure 2-2 shows, the design of a new advisory pavement symbol was determined as being the most appropriate way to provide for cyclists in a non-regulatory manner.

Following this, the eight possible pavement symbols seen in Figure 2-3 were collated and a similar evaluation framework was developed with the two key criteria being:

- Visibility; and
- Clarity and ease of understanding of status (i.e. advisory).

The symbol would need to plainly visible, and to avoid confusion with the existing regulatory symbol should be clearly different while still conveying the presence of cyclists.

- **Figure 2-3 Advisory Cycle Symbols Considered**



The full evaluation of these eight symbols can be seen in Appendix C, however the overall rankings are shown below.

- **Figure 2-4 Ranking of most appropriate advisory pavement symbols**

		Options							
		1	2	3	4	5	6	7	8
Evaluation Criteria	Weighting	Score	Score	Score	Score	Score	Score	Score	Score
Visibility	0.5	●●●	●●◗	●●	●●●	●●	●●◗	●●	●●●
Clarity and Ease of Understanding of Status (i.e. Advisory)	0.5	●●	●◗	●●◗	●●●		●◗	●●	●◗
Overall Assessment (Rank)	1.0	5	3=	2	1	4	3=	3=	7

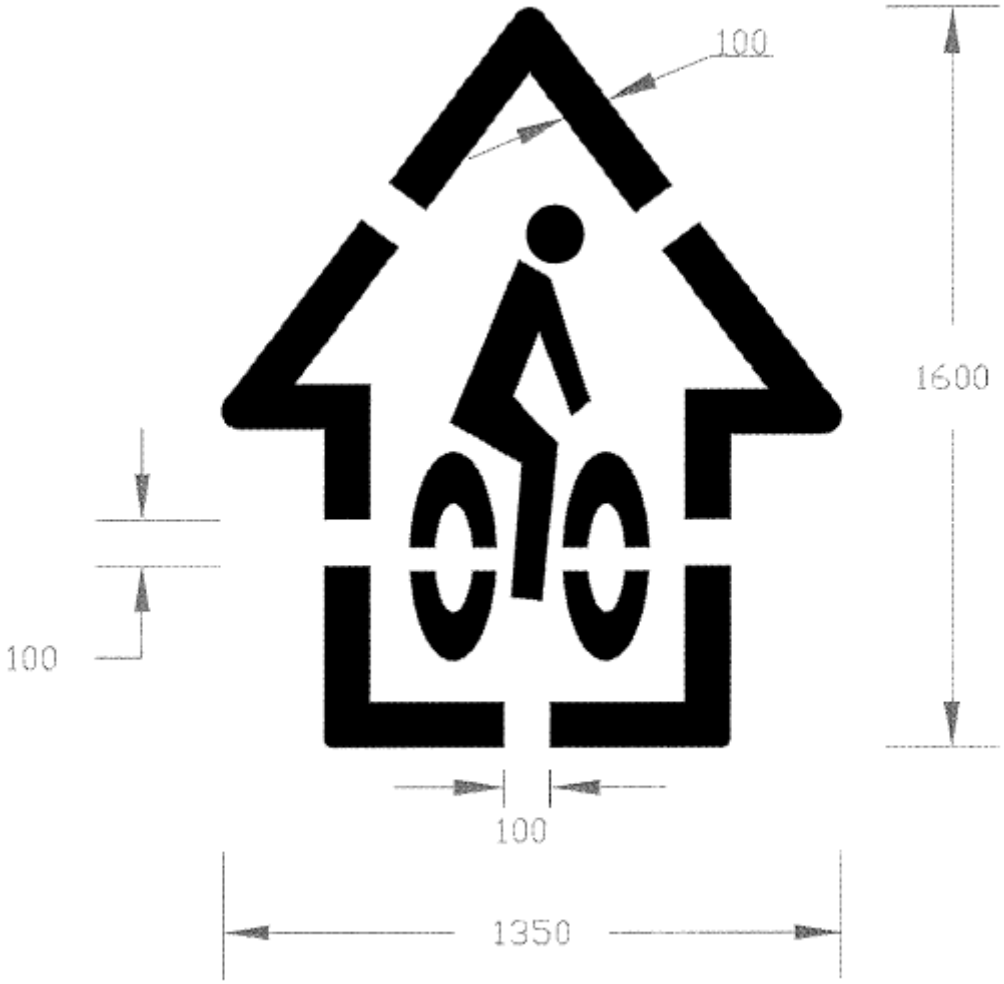
Scoring Legend
● Beneficial Impacts
● Adverse Impacts
* More symbols = larger impact

This shows that Option 4 is the most appropriate pavement symbol for an advisory marking. This design was modified slightly to maximise its effectiveness. This updated symbol can be seen in the following section.

3. Technical Analysis

For the purposes of a trial it is proposed that a stencil be made within a1600mm x 1350mm envelope with a line thickness of 100mm. Subsequent to the trial being given approval a more detailed will be developed. A fully dimensioned plan could be provided if required.

- **Figure 3-1 Proposed Advisory Cycle Symbol**



4. Consultation

The following is a list of the parties which would require consultation through letters and/or meetings to discuss the overall issue and approach:

- Land Transport New Zealand
- Auckland Regional Transport Authority
- Auckland Regional Council
- Auckland City Council
- Cycle Action Auckland
- Cycle Touring Association

5. Proposed Assessment

As part of the trial it is envisioned that there will be two key criteria used to measure its success:

- The tracking position of motor vehicles and cyclists; and
- Road users' perception of the advisory cycle symbol's effect on safety.

5.1 Motor Vehicle and Cyclist Tracking

In order to record the tracking positions of cars, it is proposed that a video camera be set up on the side of the road. Distances would be marked inconspicuously on the road so that when the video was played back, the distance between the car and the kerb could be measured. On playback, the distances would be recorded in a database along with the traffic situation at that instant. The position of cyclists within the lane will also be recorded.

It is proposed that this survey be conducted at least four times in the following manner:

- Two times prior to the advisory symbol being painted to determine the existing behaviour and positioning of motor vehicles and cyclists in the AM peak period (7:00am – 9:00am);
- Two times subsequent (a minimum of two weeks to allow time for road users to adjust) to the symbol being painted to determine the change (if any) in behaviour and positioning of motor vehicles and cyclists in the AM peak period (7:00am – 9:00am).

If there were insufficient numbers of cyclists in a particular study area, casual staff could be engaged to cycle along the road section for the duration of the survey, emulating the behaviour of a 'real' cyclist as closely as possible. Wherever possible, these cyclists would be from the local area and may be able to be sourced through Cycle Action Auckland. All cyclists would be instructed to ride at a set distance from the kerb of 400mm and wear high visibility vests. Following each survey, cyclists would also be asked to describe their comfort level.

5.2 Road Users' Perception of Effect on Safety

In order to understand road user's perceptions of the advisory cycle symbol's effect on safety ideally motorists and cyclists passing through the site would be interviewed. However, due to the difficulty/impracticality involved in stopping motorists and variable cycle numbers it is proposed that the local residents near the trial sites be interviewed as it is assumed that they would be frequent users of the section of road within the study area. It is expected that the survey would assess:

- Frequency of use and awareness of different modes of transport;
- The effect of the cycle symbol on motorists opinions about passing cyclists while driving;
- Cyclists' perception of safety; and
- Any other comments/concerns.

5.3 Site Inspection and Safety Plan

Each of the test sites would be inspected to identify the optimal location for testing. A layout plan for each site would be drawn up showing the exact location of the survey. Health and safety issues would be identified and described in site specific safety plans, and this would be given to all personnel involved.

5.4 Pilot Study

It is proposed that a 30-minute pilot study be undertaken at one of the trial locations to test the proposed methodology.

6. Summary

Auckland City Council has identified the need to investigate the use of advisory cycle markings in areas where there is insufficient space for an exclusive on-road or off-road cycle facility and where there is a need to raise motorists' awareness of the presence of cyclists.

SKM has been commissioned to develop the most appropriate marking and has conducted a review of existing legislation and standards for cycle facilities in New Zealand and an international literature review of advisory cycle markings/signage. Subsequent to this an evaluation framework was developed to allow the most appropriate marking to be selected. An advisory pavement symbol has been designed and is considered suitable to be tested in a LTNZ approved trial at a number of specified sites within Auckland City. The proposed methodology for the trial procedure has been outlined.

This file note is submitted to the members of the Land Transport New Zealand Traffic Control Devices Steering Group to gain approval for such a trial to take place.

Ashley Gray
Transportation Planner
Phone: 09 985 3818

Appendix A Review of Existing Legislation and Cycle Standards

File Note

Date	20 March 2007
Project No	AN00835
Subject	**Non-standard Cycle Markings - Review of Existing New Zealand Legislation**

1. Purpose

Auckland City Council (ACC) commissioned SKM to undertake a review of cycle markings. The intention is to undertake a Land Transport New Zealand (LTNZ) trial of non-standard symbols for areas where there is insufficient space for an exclusive on-road or off-road cycle facility and the cyclists are required to share road space. It is envisaged that this symbol may be used as an advisory type road marking to highlight the presence of cyclists and may be used in applications such as wide kerbside or parking lanes. The current road marking cycle symbol M2-3 is not necessarily appropriate for this type of cycle facility. This trial may include the use of lane colouring, signage and road marking.

This note sets out the initial review of existing legislation and standards for cycle facilities.

2. Manual of Traffic Signs and Markings (MOTSAM)

Cycle Signs are incorporated in Transit New Zealand, Land Transport Safety Authority (2004) *Manual of Traffic Signs and Markings, Part I – Signs, Edition 4: Update March 2007* and amendments.

MOTSAM has been recently updated to incorporate new signs as endorsed in the Transit NZ Supplement to Austroads Guide to Traffic Engineering Part 14

MOTSAM specifies the installation of a RG-26 "to supplement a full time cycle lane marked on a road" There are supplementary BEGINS/ENDS plates (RG-26.1 – RG-26.2) which can also be used with this sign. As this sign is a regulatory sign denoting a cycle lane it is therefore not appropriate for use as an advisory sign.

MOTSAM specifies a number of other regulatory cycle signs which identify exclusive cycle paths, shared cycle paths and an "all cycles must exit" sign which directs cyclists to use a specific path

MOTSAM also specifies the use of a PW-35 sign is a yellow diamond with a cycle symbol. This sign may be erected in areas not subject to a 50km/hr speed restriction where in the opinion of the controlling authority, a considerable volume of cycle traffic shares the carriageway with motor vehicles (i.e. is not provided with physically separated cycle lanes) and constitutes a hazard. As the advisory treatments being considered are likely to be in speed restrictions of 50km/h the use of this sign would not be strictly acceptable. However it could be used as part of a trial.

The Land Transport NZ site also contains three general advisory signs for cyclists GA8-1, GA8-2 and GA8-3 which are black and white signs for cyclists "use left shoulder", "use ramp" and "cross with care". None of these are applicable for this study.

Cycle Pavement Markings are incorporated into the Transit New Zealand, Land Transport Safety Authority (2004) *Manual of Traffic Signs and Markings, Part II – Markings, Edition 3: Update July 2004* and amendments

The following section is taken from MOTSAM and sets out the use of the cycle lane symbol and includes a figure showing the layout of the marking. The marking is intended for use with exclusive cycle lanes where road space is to be formally allocated to cyclists.

> ***2.10.04 CYCLE LANE SYMBOL***
>
> *The cycle lane symbol shall be marked as a supplement to the RG - 26 signs at the start of a cycle lane and at the re-commencement of the lane beyond each intersection or other break in the lane.*
>
> *The symbol is to repeated a minimum of every 200 m on continuous lengths of cycle lane. The distance between symbols may be reduced in situations where the road controlling authority deems it necessary.*

The symbol shall be marked as follows:

Refer to Figure 2.12

*Colour : White **

*** The cycle symbol may be reflectorised at the discretion of the road controlling authority. It is recommended that the symbol is reflectorised when the cycle lane is not physically separated from the traffic lanes.*

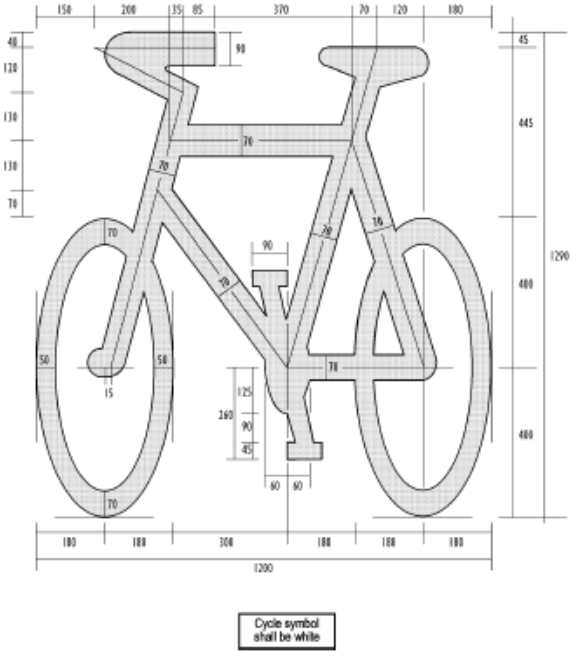


Figure2.12: Cycle Lane Symbol

MOTSAM also contains information on pavement marking in Section 2.10. Some of this information is in direct conflict with the NZ supplement. For example MOTSAM references the use of broken white lines to identify a cycle lane and the use of diagonal lines to indicate a cycle lane. Stanley Chesterfield of Transit NZ has been contacted regarding this issue and has advised that solid white edge lines are now standard practice. In relation to the diagonal markings, he advises that these would not be good within a formal cycle lane, but a road shoulder over 2m wide (or so) that is also used by cyclists probably should have them. This is because any strip of pavement 2.5m wide or more is legally a "lane" and can therefore be used by vehicles, and we want to keep vehicles out of shoulders. As this trial is directed at urban facilities with constrained road space it is unlikely that any wide shoulders will be available as this would have been used for an exclusive cycle facility in preference to advisory markings Therefore the diagonal marking will not be considered for this trial.

MOTSAM Part II does not contain any references to coloured pavement marking.

MOTSAM refers to The Traffic Regulations 1976, Part III – Rules for Cycles and Power Cycles. These regulations have been largely superseded. Refer to Section 3 below.

MOTSAM also refers to:

- AUSTROADS Guide to Traffic Engineering Practice – Part 14 : Bicycles, and
- NRB/UTC (1985) Guide to Cycle Facilities.

The Guide to Cycle Facilities or "the blue book" as it is sometimes referred is generally considered to be outdated and has not been reviewed.

3. Guide to Traffic Engineering Practice, Part 14

Austroads (1999) *Guide to Traffic Engineering Practice, Part 14: Bicycles*, Second Edition 1999, Sydney, Australia

The GTEP Part 14 has a section on the use of Advisory Treatments. Advisory treatments are considered for use to advise road users of the potential presence of cyclists and the area where they are likely to be when dedicated facilities are not provided. It discusses the use of edge lines next to parking lanes and the use of pavement symbols:

> ***"4.4.6 Advisory Treatments***
>
> *These are treatments to indicate or advise road users of the potential presence of cyclists and of the location where cyclists may be expected to ride on a road. They consist of pavement markings and otherwise only warning and guide signs, and as such have no regulatory function.*
>
> *In overseas practice, such treatments have been associated with broken lines, and in general with yellow pavement markings, whilst locally solid lines and mainly white pavement markings have been used. The use of yellow pavement markings is in accord with that of yellow warning signs, but varied preferences for colour exist and there is currently no provision for yellow in some road regulations or codes of practice. It is therefore a matter for local authorities to determine the colour of markings used for these treatments. Whilst solid or unbroken edge lines are preferred, broken lines may be used.*
>
> ***4.4.6.2 Using Edge Lines***
>
> *Description and Purpose*
>
> *In some jurisdictions, bicycle/car parking lanes (section 4.4.2.1) are rarely used. Alternatively, the road carriageway width may be insufficient to accommodate this treatment*
>
> *However, an edge line can be marked (refer Figure 4-14) between the left motor traffic lane and parking lane. The purpose of the line is to encourage motor traffic to travel away from the left side of the road or from parked cars, and thereby maximise the space available for the riding of bicycles.*

Whilst the treatment is generally used along relatively narrow carriageways, any benefit resulting from this treatment will be maximised if the dimensional requirements are sought for bicycle/car parking lanes recommended in this guide.

The treatment should only be used where constrained conditions exist, where alternative treatments are not available, or where alternative routes are either not available or unlikely to be useful. It is generally not appropriate for new roads and arterial roads, where bicycle lane treatments are preferred.

4.4.6.2 Using Pavement Symbols

Here the available road width is constrained and it is desired to highlight a continuing route, bicycle pavement symbols can be used, as detailed in Figure 4-16 and illustrated in Figure 4-17.

A consistent approach to the use of this treatment should be adopted within a region or State. In some jurisdictions it is being used to designate the locations where the dimensional requirements of a wide kerbside lane are met (see section 4.4.7).”

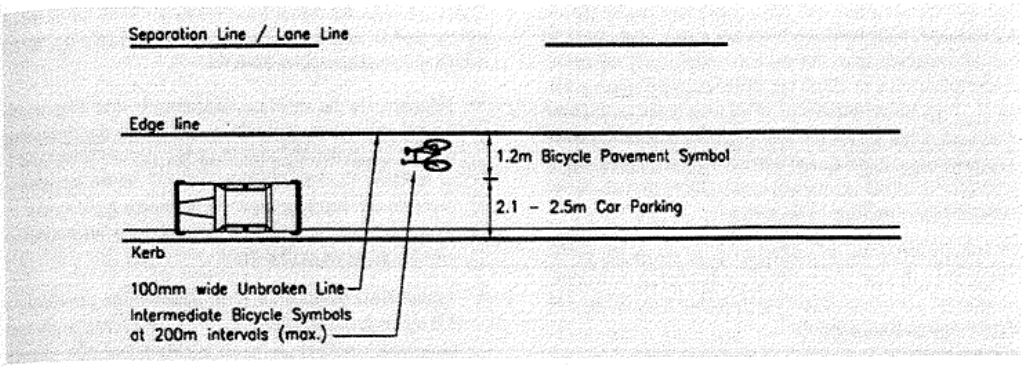


Figure 4-15: Advisory Treatment using Edge Lines – Layout

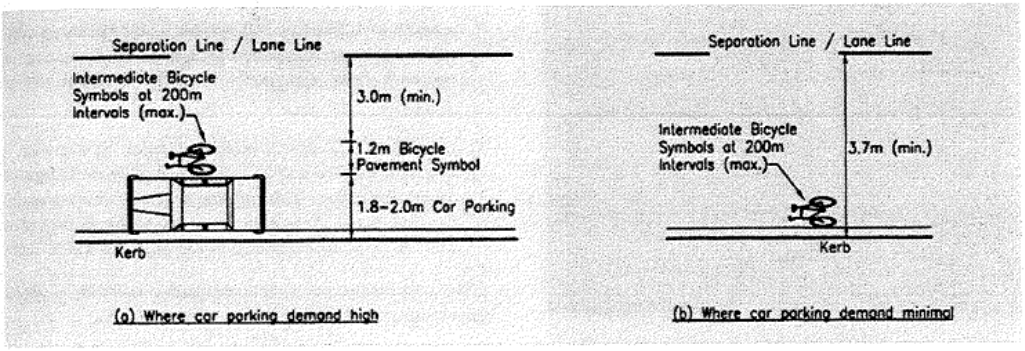


Figure 4-16: Advisory Treatment using Pavement Symbols – Layout

SKM

4. Transit New Zealand Supplement to the Austroads Guide to Traffic Engineering Practice, Part 14: Bicycles

Transit New Zealand (2005) *New Zealand Supplement to the Austroads Guide to Traffic Engineering Practice, Part 14: Bicycles,* Transit New Zealand, Wellington, New Zealand

> *"The Guide to Traffic Engineering Practice, Part 14 2nd Edition (1999) (GTEP Part 14) has been adopted as the reference document for the design of cycling facilities in New Zealand. However the document is based on the regulations and associated traffic signing and road marking regimes of Australia, which are different to New Zealand. Therefore, this New Supplement to GTEP Part 14 has been developed specifically for use in New Zealand"*

The GETP Part 14 is used as the base document and is modified by the provisions in the Supplement where New Zealand conditions are considered to require a different approach.

4.1 Advisory Treatments

The following section discusses the use of advisory treatments such as pavement markings which are not associated with cycle lanes:

4.4.5 Advisory Treatments

The text of this section (page 30 and part of page 31 of Part 14) and Figures 4-14, 4-15, 4-16 and 4-17 are replaced by:

Advisory treatments (or "advisory cycle lanes" (ACLs) as they are more commonly called) are used to a limited extent in Europe, but are not known to exist in New Zealand. They are explained in GTEP Part 14 as "treatments to indicate or advise road users of the presence of cyclists and of locations where cyclists may be expected to ride on a road. They consist of pavement markings and otherwise only warning and guide signs and as such have no regulatory function."

They are not recommended for use in New Zealand at this stage for the following reasons:

- *There needs to be a focus on increasing the understanding of RCAs and drivers about the proper design and use of cycle lanes.*
- *Adding ACLs to the options will make it harder for driver to understand the basic rules of conventional cycle lanes and to distinguish between the two types of facilities.*

Accordingly, advisory treatments proposed in GTEP Pert 14 are not recommended for use in New Zealand at this stage. Various alternatives may be considered where it is desired to improve conditions for cyclists, such as:

- *Removing of parking from one or both sides of a road to provide enough width for cycle lanes;*

- *Provision of wide kerbside lanes (see Section 4.4.7); or*
- *Traffic calming or other methods of reducing motor vehicle speeds.*

This document would appear to give strong guidance against the use of advisory treatments. Should a trial be proposed, each of the issues raised would need to be addressed.

This document also appears to supersede the specifications set out in MOTSAM. The sections below describe this process. Essentially the existing familiar round blue regulatory cycle sign has been replaced with black on white rectangular signage and the yellow advanced warning signs have been updated:

> *"The Traffic regulations or Traffic Control Devices Rule, and the Manual of Traffic Signs and Markings (MOTSAM) Part I (Traffic Signs) and Part II (Markings) specify all traffic signs and pavement marking requirements. MOTSAM should be used instead of the Australian Manual of Uniform Traffic Control Devices (AS 1742). Designers should refer to MOTSAM for all installation and dimension details. The following notes provide general advice only, the advice in MOTSAM should be followed.*
>
> *MOTSAM will be updated to reflect the advice given in this section on signs and markings. In MOTSAM the signs and markings are given a unique number however, at this stage , this has not been undertaken and the signs and markings in this section are referenced by numbers that relate to their figure number.*
>
> *A summary of the changes to existing signs and markings that will be made to MOTSAM are:*
>
> - *Signs withdrawn:*
> - *RG 26, RG-26.1 to RG-26.4*
> - *Signs replaced:*
> - *RG-24 replaced with Sign 9-5*
> - *PW-35 replaced with Sign 9-8*
> - *Markings replaced:*
> - *The existing dashed (1m stripe, 5m gap) cycle lane line marking is replaced by a solid line.*
> - *Diagonal markings should not be marked in a cycle lane*
> - *Cycle lane symbol (MOTSAM Fig: 2.12) replaced with GTEP Part 14: Figure 9-22."*
>
> ***"9.3 Warning Signs***
>
> *This section of GTEP Part 14 is replaced by the following:*
>
> *Sign 9-8 (Figure 9-8: Cyclists Ahead Warning) is used to warn motorists that cyclists are likely to be using the road ahead."*

MOTSAM Part 1: Signs was updated in March 2007 to contain the changes described above.

4.2 Pavement Marking

As previously discussed MOTSAM Part II: Pavement markings has not been updated since July 2004 and does contain some discrepancies with the Transit NZ supplement. These include:

- Marking of cycle lanes – the supplement specifies a solid white line whereas MOTSAM still refers to broken white lines
- The supplement does not advocate the use of diagonal lines in cycle facilities

The supplement also comments on the use of cycle symbols with the replacement of the last paragraph of Section 9.6.1.1 General with

> *"The cycle lane pavement symbol may only be used in cycle lanes and other facilities designated for cyclists such as advance stop boxes. They should not be used for road shoulders, wide kerb lanes or other facilities unless they are cycle lanes and satisfy the geometric design guidelines".*

4.3 Coloured Road Surfacing

The supplement also contains reference to the use of coloured road surfacing and states in section 9.6:

> *Coloured road surfacing should be used in areas where the presence of the cycle lanes needs to be highlighted to other road users*

5. Land Transport Rule: Traffic Control Devices 2004

Ministry of Transport (NZ) (2004) *Land Transport Rule, Traffic Control Devices 2004, Rule 54002*, Wellington, New Zealand
www.landtransport.govt.nz/rules/traffic-control-devices-2004-schedules.html

Amendment 2005 and 2006 also reviewed.

The Land Transport Rule, Traffic Control Devices 2004 have replaced much of the previous NZ Traffic Regulations. As noted in the extract below, the rule is intended to ensure uniformity and safe application of control devices which include pavement markings.

> *"The purpose of this rule is to contribute to the safe and efficient operation of our road network by:*
>
> - requiring uniformity in the form, appearance and placement of traffic control devices;
> - establishing minimum standards for traffic control devices;
> - specifying who may authorise and install traffic control devices;
> - ensuring that road controlling authorities have regard to safe practice in the design and installation of traffic control devices and how they are used for traffic management."

The rules set out the powers and responsibilities of a road controlling authority in relation to use of traffic control devices. The following are of particular relevance:

"2.1(2) A road controlling authority may authorise and, as appropriate, install, operate or remove traffic control devices:

(a) if desirable for the guidance of traffic or to draw attention to a requirement that controls traffic; or

(b) to provide information to road users."

"3.3 Matters to be taken into account when providing, modifying and removing traffic control devices

A road controlling authority, in deciding whether to provide, modify or remove a traffic control device, must:

(a) comply with:

(i) relevant requirements in Schedules 1, 2 and 3; and

(ii) a safety management system developed by the road controlling authority for that area; and

(iii) a direction given by the Director under 13.8; and

(b) ensure that the impact of providing, modifying or removing the traffic control device is consistent with the current regional land transport strategy for that area.

The schedules referred to above list the types of control devices and their specifications. Schedule 1 relates to signage, Schedule 2 relates to pavement markings, while Schedule 3 relates to traffic signals. The "Director" is the Director of the LTSA (LTNZ).

5.1 Special Vehicle Lane Markings

"Special Vehicles" include cycles and there are some specific requirements for marking a cycle lane detailed in the following section:

"11.2 Special vehicle lanes

11.2(1) If defining a part of a road as a special vehicle lane, a road controlling authority must, at the start of the special vehicle lane and at the point at which the lane starts again after each intersection:

(a) mark on the road surface a white symbol, that complies with Schedule 2, defining the class or classes of vehicle for which the lane has been reserved; and

(b) if for other than a 24-hour restriction, install a special vehicle lane sign that complies with Schedule 1:

(i) defining the class or classes of vehicle for which the lane has been reserved; and

(ii) stating the periods for which the reservation applies.

11.2(2) A road controlling authority may provide the following traffic control devices to discourage use of a special vehicle lane by other vehicles, or to draw attention to the likely presence of vehicles entitled to the use of the lane:

(a) additional white special vehicle lane symbols described in 11.2(1)(a) or signs described in 11.2(1)(b) along the length of the lane; or

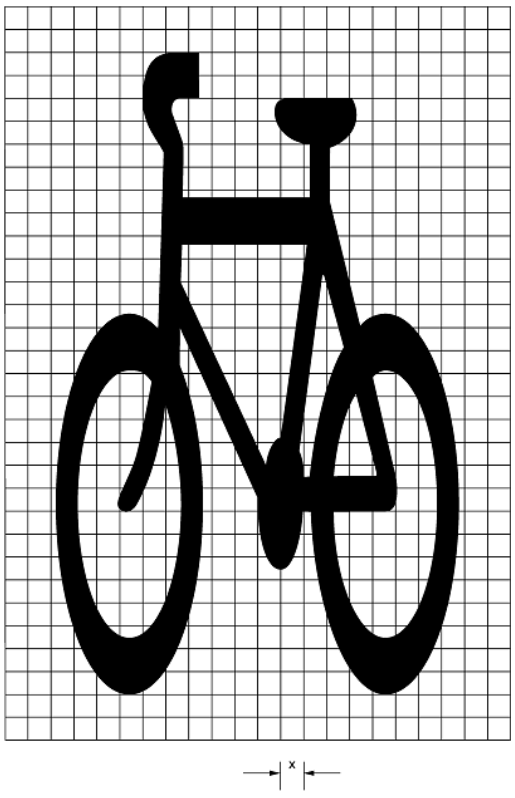
(b) if for a 24-hour restriction, special vehicle lane signs; or

(c) a surface treatment that provides a contrasting colour or texture to that of adjacent lanes used by other vehicles:

(i) at locations along the length of the lane; or

(ii) along the length of the lane."

M2-3 Cycle lane symbol from Schedule 2



Therefore, under these rules, cycle lanes are legally defined when designated by the presence of cycle symbols within them. This makes it possible to enforce motorist transgressions into cycle lanes. (Land Transport New Zealand, 2006). Signage is not required for them to be enforced so the pavement marking has a legal status.

Should this symbol be used in a lane it would indicate that only cycles could use the lane. An advisory symbol which is different to this symbol would have no standing, but would need to be sufficiently different to endure that there was no confusion as to its purpose.

5.2 Trials of Traffic Control Devices

Should ACC wish to implement an advisory cycle pavement marking a trial would be required and such trials are controlled by the rules. This process will require the agreement of the Director of the LTSA (LTNZ) who would place a notice in the Gazette specifying the details of the trial (such as location and duration). The Director will review the trial and will have the power to halt the trial at any time. If the Director is satisfied that the trial is successful and recommends that the rules be amended the trial will be able to continue until the rule is amended.

The following section sets out the process and requirements for a trial:

> ***"3.4 Trials of traffic control devices***
>
> *3.4(1) The Director may, from time to time, by notice in the* Gazette*, authorise a road controlling authority to install and maintain a traffic control device for trial purposes.*
>
> *3.4(2) If the Director declines to authorise a trial under 3.4(1), the Director must advise the road controlling authority of the grounds for doing so.*
>
> *3.4(3) Although it may not otherwise comply with this rule, a traffic control device in 3.4(1) must comply with:*
>
> *(a) subclauses 3.1(a), (b), (c), (d) and (f); and*
>
> *(b) subclause 3.1(e), except to the extent approved by the Director for the purpose of the trial.*
>
> *3.4(4) The Director must state the following in the* Gazette *notice:*
>
> *(a) the purpose of the trial; and*
>
> *(b) the place where the trial is to be held; and*
>
> *(c) the period, not exceeding two years, of the trial; and*
>
> *(d) the terms and conditions of the trial; and*
>
> *(e) any type of traffic control device in use under this rule that is equivalent to the traffic control device to be used in the trial.*
>
> *3.4(5) The Director may impose any other terms and conditions on the trial of a traffic control device that the Director considers necessary.*
>
> *3.4(6) Not less than two weeks before a trial traffic control device is installed, a road controlling authority must advertise separately in at least two editions of a local*

newspaper circulating in the district in which the trial is to be held, the placement of the traffic control device to be trialled and the purpose of the trial.

3.4(7) The Director may terminate the trial of a traffic control device by notice in writing to the road controlling authority, stating the grounds for the decision to terminate the trial, if the Director considers it is unsafe to continue the trial or the circumstances relating to the trial have changed or the conditions of the trial are not being complied with.

3.4(8) If a trial is terminated in accordance with 3.4(7), the Director must notify the termination of the trial by notice in the Gazette.

3.4(9) A road controlling authority must remove a traffic control device installed under 3.4(1) immediately following the receipt of notice under 3.4(7).

3.4(10) If the Director is satisfied that the results of a trial justify a recommendation that this rule be amended to allow all road controlling authorities to use the traffic control device, the traffic control device may continue in use, subject to any conditions that the Director may impose, until either:

(a) the rule is amended, in which case the traffic control device may continue in use provided that it complies with the amended rule; or

(b) a decision is made not to amend the rule and, on written notification of this decision, the road controlling authority must remove the traffic control device immediately.

3.4(11) If 3.4(10)(a) applies, the Director must notify the continued use of the traffic control device by notice in the Gazette*."*

6. Fundamentals of Planning and Design for Cycling, Course Notes

Land Transport New Zealand (2006) *Fundamentals of Planning and Design for Cycling, Course Notes*, Version 2.1 March 2006

This document does not discuss the use of advisory markings.

7. Cycle Network and Route Planning Guide

Land Transport Safety Authority (2004) *Cycle Network and Route Planning Guide*, New Zealand

This document does not discuss the use of advisory markings.

8. Summary

A summary of the current legislation is:

- MOTSAM Part I: Signs has been updated with the signs as described in the Transit NZ Supplement to Part 14.
- The MOTSAM cycle pavement markings have not been updated and some discrepancies between this and the Transit NZ Supplement exist.
- MOTSAM currently provides adequately for the marking of legal cycle lanes. There are regulatory signs for exclusive cycle facilities which are not appropriate to use as an advisory sign. An advisory sign PW-35 is available for cyclists in areas with traffic speeds in excess of 50km/hr.
- There are no advisory pavement markings available for cycle lanes. The only existing cycle marking is MOTSAM Section 2.10 Figure 2.12 which is for use in a cycle lane only.
- Austroads Part 14 contains guidelines for advisory treatments such as edge line treatments of pavement symbols but the Transit NZ supplement does not support the use of these
- The Land Transport Rule contains information on special vehicle lane markings which states that a cycle symbol pavement marking legally denotes a cycle lane.
- The Land Transport Rule Traffic Devices 2001 and Land Transport NZ Traffic Note 10-Rev 1 contains additional information on requirements for trials.

As the Transit NZ document does not currently recommend the use of cycle advisory markings the rational behind the use of these advisory makings will need to be set out clearly. This would include the following:

- Why are traditional cycle treatments or the proposed alternatives to advisory markings outlined in Transit NZ supplement unable to be used?
- What issues are being addressed by the installation of the markings?
- What type of cyclists are they targeted at?
- What road types will be considered – arterial roads, kerbside parking, traffic volumes etc?
- What will be the 'test' for a road to qualify to use these advisory markings so that cycle design in Auckland retains regulatory facilities as a preference and reverts to advisory markings if/when conditions dictate?

Megan Tibby
Transportation Engineer
Phone: (09) 985 3649
Fax: (09) 913 8901
E-mail: mtibby@skm.co.nz

Appendix B International Literature Review

File Note

Date	2 April 2007
Project No	AN00835
Subject	**International Literature Review**

1. Purpose

Auckland City Council (ACC) commissioned SKM to undertake a review of cycle markings. The intention is to undertake a Land Transport New Zealand (LTNZ) trial of non-standard symbols for areas where there is insufficient space for an exclusive on-road or off-road cycle facility and the cyclists are required to share road space. It is envisaged that this symbol may be used as an advisory type road marking to highlight the presence of cyclists and may be used in applications such as wide kerbside or parking lanes. The current road marking cycle symbol M2-3 is not necessarily appropriate for this type of cycle facility. This trial may include the use of lane colouring, signage and road marking.

This note sets out the initial review of international practice to investigate if this problem exists in other countries and what methods are used to overcome it. Four regions have been investigated:

- United Kingdom - London
- Australia - Victoria
- United States
- Netherlands

2. Case Study 1: London

The British Government released a "White Paper on Transport" in July 1998 which set out a new approach to transport with a strong emphasis on sustainability. As a result of this The "Mayors Transport Strategy" committed increased resources for cycling and the "London Cycling Action Plan" was produced by Transport for London (TfL) in 2004. TfL have developed a toolkit for cycling titled "London Cycling Design Standards (LCDS)". This guide contains comprehensive information and design standards for cycling design in London.

London is similar to Auckland in that it has a complex and dynamic cycling environment with roads carrying high traffic volumes and constrained physical road reserve. As a result a number of options have been developed to provide different types of cycle facilities.

The London Cycling Design Standards (LCDS) does advocate the provision of improved conditions for cyclists on a link such as the use of traffic management measures to reduce traffic volume and vehicle speed. It does recognise however that on many main roads this may not be practical and cycle specific measures such as cycle lanes will need to be considered.

2.1 Types of Facilities

The LCDS contains a table as shown in Figure 2-1 which indicates when three main types of facilities can be used:

1) Combined traffic and cycle lane – no markings or symbols
2) Combined traffic and cycle lane with cycle symbols
3) Cycle Lanes (mandatory and advisory)

- **Figure 2-1 LCDS matrix of cycle facility**

Figure 4.1
Matrix of cycle facility solutions based on motor traffic volume and speed

	85%ile Speed			
	<20mph Very Low	20-30mph Low	30-40mph Medium	>40mph High
Very High >10,000VPD	Lanes or Tracks/paths	Lanes or Tracks/paths	Lanes or Tracks/paths	Tracks/paths
High 8,000-10,000VPD 800-1,000VPH	Lanes	Lanes	Lanes or Tracks/paths	Tracks/paths
Medium 3,000-8,000VPD 300-800VPH	Lanes or combined use with cycle symbols	Lanes or combined use with cycle symbols	Lanes or Tracks/paths	Tracks/paths
Low 1,500-3,000VPD 150-300VPH	Combined use with cycle symbols	Combined use with cycle symbols	Lanes or Tracks/paths	Lanes or Tracks/paths
Very Low <1,500VPD <150VPH	Combined use – no symbols necessary	Combined use with cycle symbols	Combined use with cycle symbols	Lanes or Tracks/paths

Notes:
1. This table assumes current conditions and trends.
2. Additional protection to lanes should be used in medium or high speed/flow situations (see drawing CCE/B12 for options)
3. Where Lanes OR Tracks/paths are shown, Lanes should be considered as the first option
4. "symbols" are the cycle symbol road marking to Diagram 1057 of TSRGD. Their use in association with route numbers may be appropriate
5. VPD = number of motor vehicles in typical 24hour weekday
6. VPH = number of motor vehicles in typical morning peak hour
7. In congested areas cycle lanes may be desirable where they are not justified on traffic volume and speed

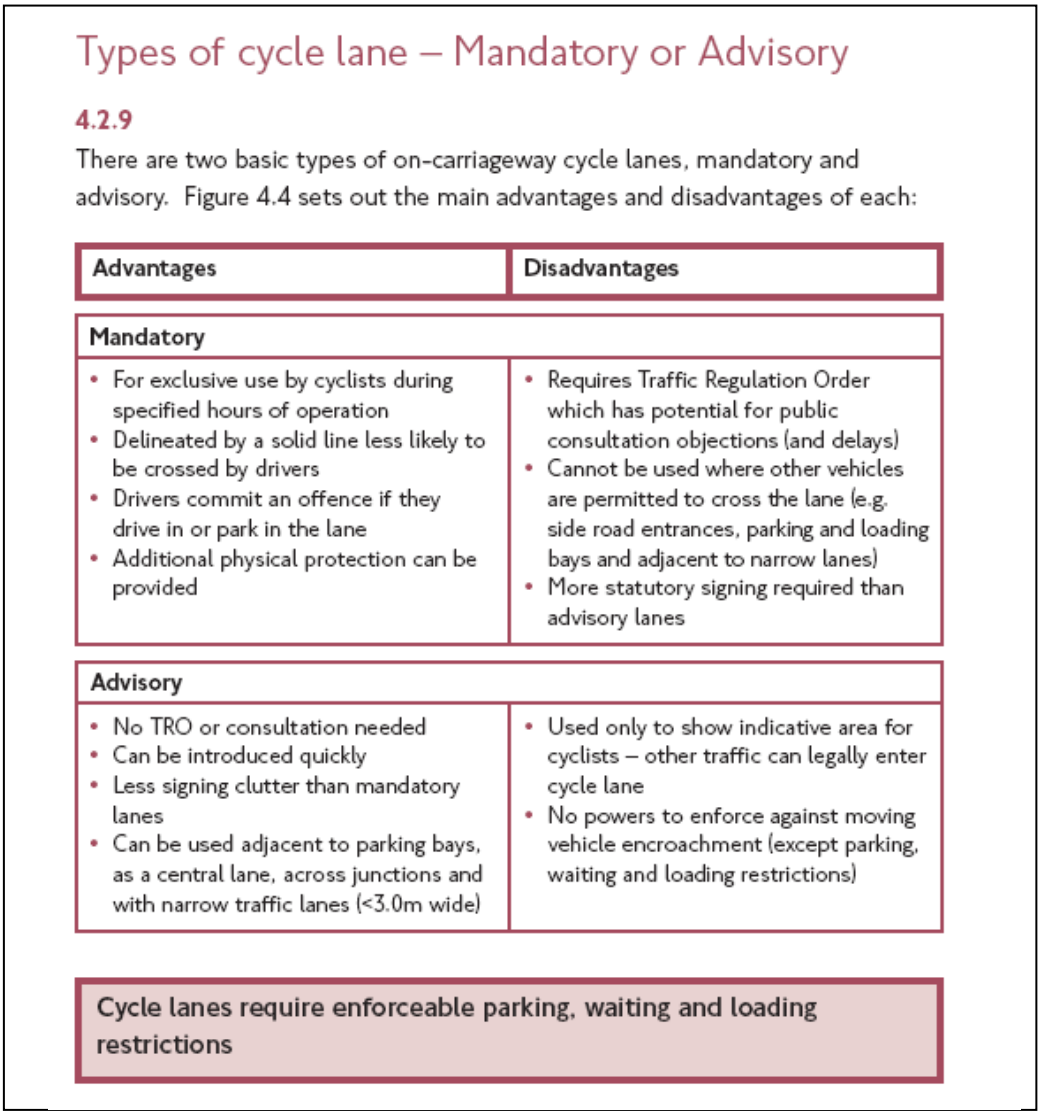
2.2 Mandatory and Advisory Lanes

There are two types of cycle lanes mandatory and advisory. The LCDS describes the purpose of the cycle lanes as

> " the purpose of mandatory cycle lanes is to define an area of the carriageway that is reserved for cyclists, and within which other vehicles may not encroach. Advisory traffic lanes are primarily used to warn motorists of the possible presence of cyclists and to encourage motorists to adopt a line of travel away from the kerb. However it is permissible for motor vehicles to stray into advisory cycle lanes"

Figure 2-2 shows Figure 4.4 of the LCDS which outlines the advantages and disadvantages of mandatory and advisory lanes

- **Figure 2-2 LCDS analysis of mandatory or advisory lanes**



Types of cycle lane – Mandatory or Advisory

4.2.9

There are two basic types of on-carriageway cycle lanes, mandatory and advisory. Figure 4.4 sets out the main advantages and disadvantages of each:

Advantages	Disadvantages
Mandatory	
• For exclusive use by cyclists during specified hours of operation • Delineated by a solid line less likely to be crossed by drivers • Drivers commit an offence if they drive in or park in the lane • Additional physical protection can be provided	• Requires Traffic Regulation Order which has potential for public consultation objections (and delays) • Cannot be used where other vehicles are permitted to cross the lane (e.g. side road entrances, parking and loading bays and adjacent to narrow lanes) • More statutory signing required than advisory lanes
Advisory	
• No TRO or consultation needed • Can be introduced quickly • Less signing clutter than mandatory lanes • Can be used adjacent to parking bays, as a central lane, across junctions and with narrow traffic lanes (<3.0m wide)	• Used only to show indicative area for cyclists – other traffic can legally enter cycle lane • No powers to enforce against moving vehicle encroachment (except parking, waiting and loading restrictions)

Cycle lanes require enforceable parking, waiting and loading restrictions

The main differences between these two types of lanes are the pavement markings:

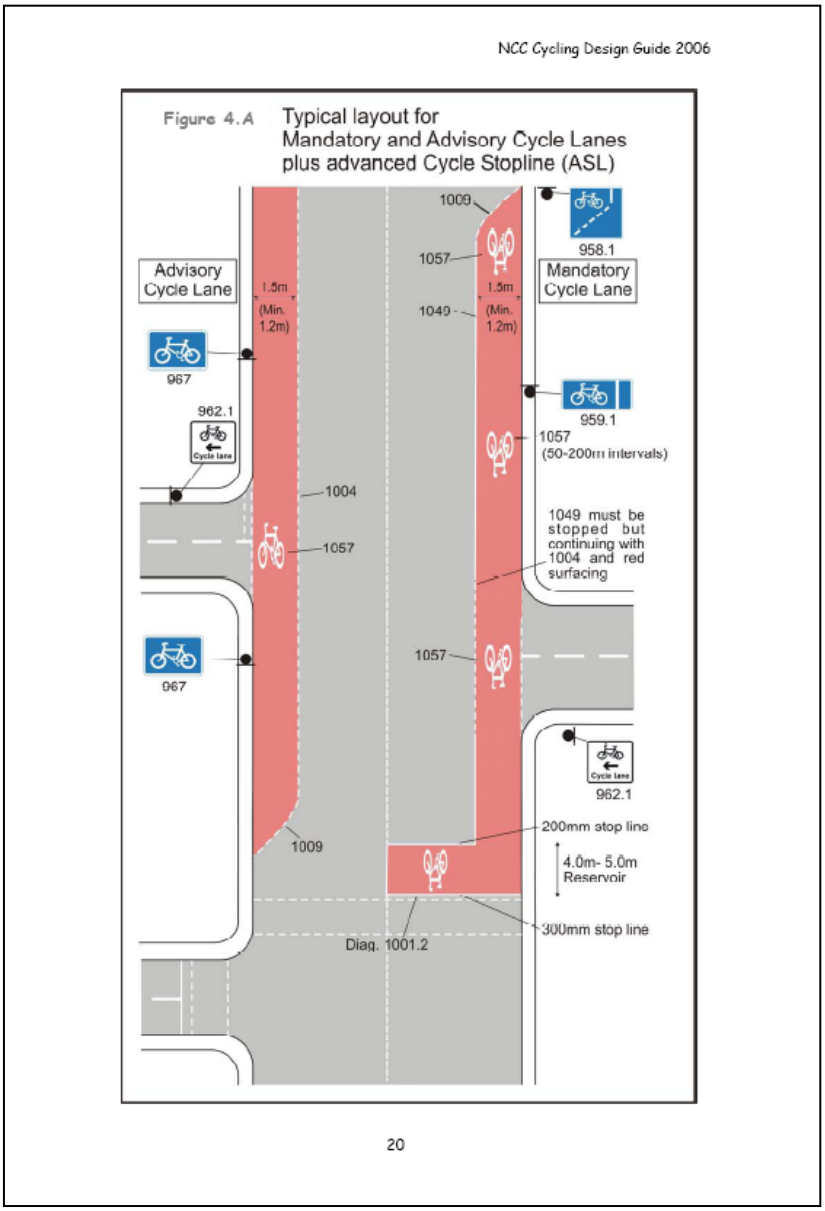
- Mandatory lanes start with a diagonal broken line and then have a solid white line to demarcate between the traffic lane and cycle lane
- Advisory cycle lanes are indicated by broken white lines
- It is apparent that both types of lanes can have coloured surfaces and use the pavement symbol marking. However there are limitations for the mandatory lane with regard to the use of reflective road studs.

The LCDS does describe a drawback of advisory lanes as follows:

> " A major drawback of advisory cycle lanes between junctions is that at times of the day when parking and loading are permitted, cyclists using the lane have to pull out round parked vehicles. This can cause resentment with cyclists who feel that "the vehicle is parked on my cycle lane". Other northern European countries do not use advisory kerbside cycle lanes primarily for this reason"

Examples of markings for mandatory and advisory lanes are shown in

- **Figure 2-3 Typical layout for mandatory and advisory lanes (from Nottinghamshire County Council Cycling Guide)**



2.3 Cycle Lanes alongside Kerbside Parking

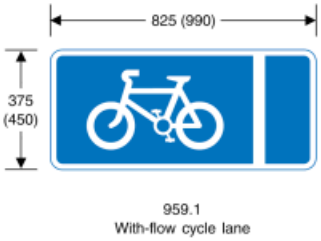
In the situation of parking along a route (as would occur on many of Auckland's arterial roads) the LCDS advocates the first option of removing or relocating the parking to a side road or indented parking bay. If this is not feasible an advisory cycle lane is run on the outside of the marked parking bays. Sufficient clearance of 0.5-1.0m should be created so that cyclists are not unnecessarily endangered by the opening of vehicle doors. This can either be hatched or left unmarked. Entry and exit tapers are also required. The cycle symbol is marked throughout the kerbside lane.

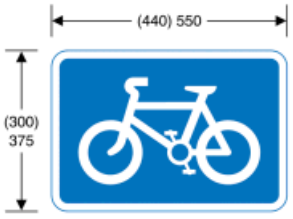
- **Figure 2-4 Kerbside lane examples from Figure 4.2.51 of LCDS**

2.4 Signs and Road Marking

Two different signs are used for mandatory and advisory cycle lanes:

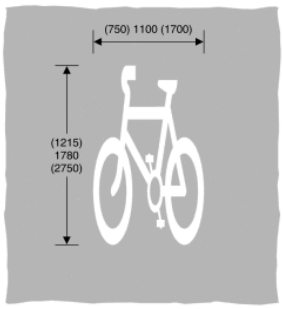
Mandatory Diagram 959.1 **Advisory Diagram 967**





The pavement Cycle Symbol 1057 (refer to Figure 2-5) is advocated to be used to provide visual continuity of cycle routes on roads where cycle lanes are not provided. There is no difference for this symbol between the advisory and mandatory cycle lanes and it can be used on cycle lanes, tracks or routes.

- **Figure 2-5 Diagram 1057 – Cycle Symbol Road Marking**



1057
Cycle lane, track or route

2.5 UK reaction to advisory lanes

There appears to have been some negative reaction to the introduction of advisory lanes with one example commonly quoted as the Blackfriars bridge cycle lane which is shown below in Figure 2-6. A cyclist was killed using this lane which was an advisory lane originally located in between a bus lane and a traffic lane (Photo 3). This has since been changed to the new layout in Photo 4 which shows that the advisory lane has been relocated to the edge and is now a mandatory lane. BBC press reports indicate that other nations such as Denmark and Holland offer segregated cycle lanes such as shown in Photo 1 and do not promote layouts such as Photo 3.

- **Figure 2-6 Blackfriars Bridge Cycle Lane (photos from http://www.londoncyclenetwork.org.uk)**


Photo 1: New Bridge Street protected cycle lane


Photo 2: New footway linking the bridge to Unilever House


Photo 3: Before


Photo 4: After

If advisory cycle lanes are to be utilised the positioning of these lanes should be carefully determined. If the road carries particularly high volumes then segregated facilities or at the least mandatory lanes should be considered.

2.6 Comparison between UK and NZ legislation

- Advisory markings are permitted in the UK and are distinguished by the use of broken lines and a different sign. Advisory markings are not permitted in NZ
- The one cycle symbol pavement markings can be used in mandatory, advisory (including kerbside lanes), cycle tracks and off road facilities
- The guidelines promote the use of a safety strip (typically between parking and cycle lanes) however in NZ these are not recommended

3. Case Study 2: Victoria, Australia

VicRoads is the roading agency for the Victorian Government. The main cycle facility design tools for VicRoads are:

- Austroads Guide to Traffic Engineering Practice, Part 14- Bicycles
- Australian Standard 1742.9 Manual of Uniform Traffic Control Devices, Part 9, Bicycle Facilities
- VicRoads Traffic Engineering Manual Volumes 1 and 2

In conjunction to these references VicRoads have developed a series of 17 cycle Notes covering a variety of cycle design guidelines.

3.1 Austroads GTEP Part 14 Bicycles

This standard is used in New Zealand.

3.2 Manual of Uniform Traffic Control Devices

The Manual of Uniform Traffic Control Devices (MUTCD) has provisions for a number of types of bicycle lanes. The following diagrams have been extracted from MUTCD show the markings and signage for these different types of facilities.

4) Exclusive Full time bicycle lanes

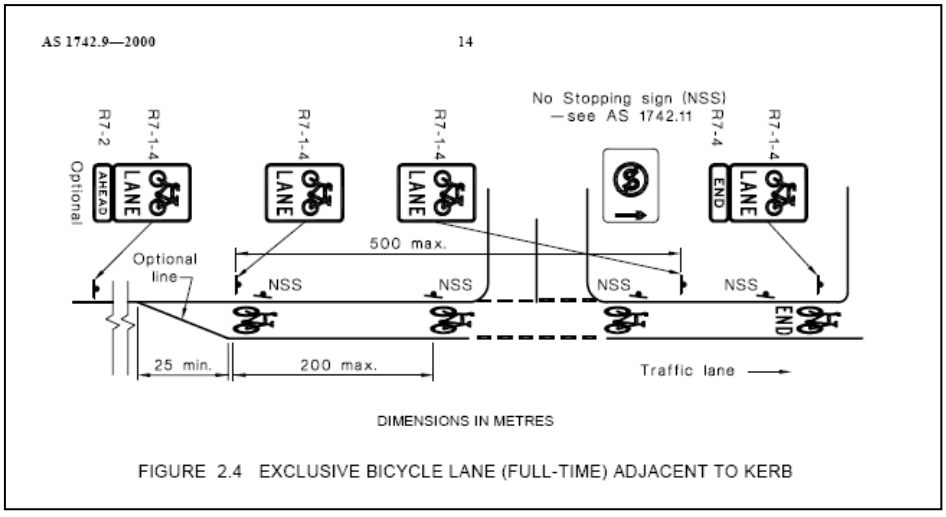
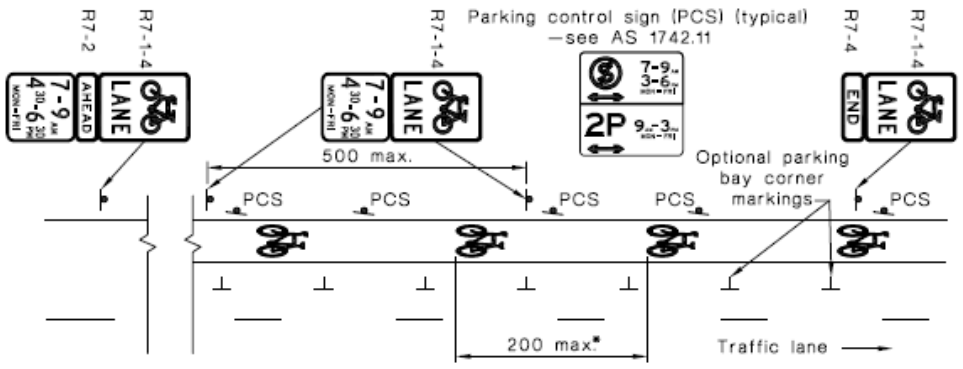


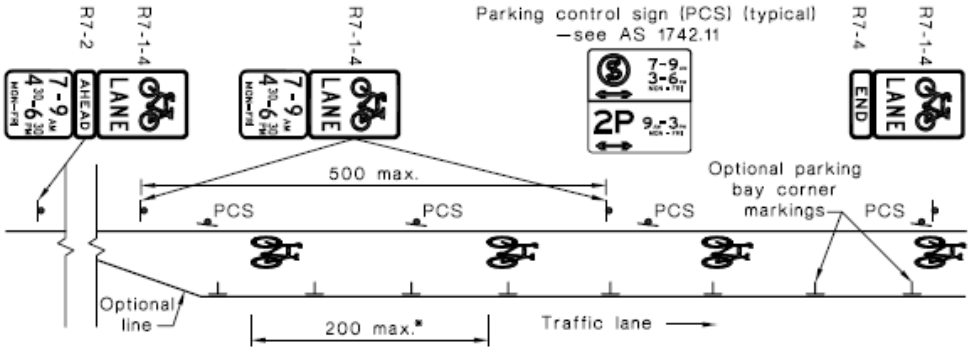
FIGURE 2.4 EXCLUSIVE BICYCLE LANE (FULL-TIME) ADJACENT TO KERB

5) Part Time bicycle lanes – eg in a clearway parking zone



* Bicycle pavement symbols are optional.

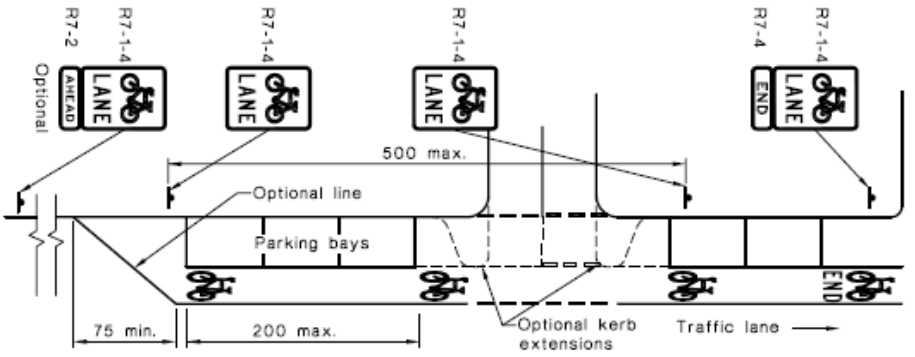
(a) Bicycle lane narrower than parking lane



* Bicycle pavement symbols are optional.

(b) Bicycle lane same width as parking lane

6) Bicycle/Car Parking lanes – these are considered a full time facility



DIMENSIONS IN METRES

FIGURE 2.6 BICYCLE/CAR PARKING LANE WITH OPTIONAL KERB EXTENSIONS

7) Unsigned facilities which are not signed but may be suitable for use by bicycle traffic.

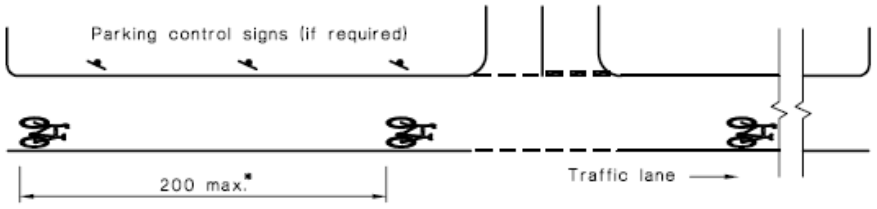
2.4.4 Unsigned facilities

The following facilities are not signed as bicycle facilities but may be suitable for use by bicycle traffic. Where bicycle traffic is expected, bicycle pavement symbols may be placed on the lane or shoulder to encourage its use by cyclists and to warn other traffic of the possible presence of bicycles. The facilities are as follows:

(a) *Wide parking lane with bicycle provision* This is a kerbside lane which is wide enough to allow both kerbside parking and bicycle use. Pavement markings should comprise as a minimum an unbroken line separating the lane from moving motor traffic as illustrated in Figure 2.7. Signs to control parking may be required. The full-outline marking of parking bays should not be applied in this case. If full-outline marking is required, the more formal bicycle car/parking lanes treatment (see Clause 2.4.3) should be considered.

(b) *Wide kerbside lane* This is a normal traffic lane delineated by a broken lane line only, which is wide enough to be shared by bicycle and motor traffic. Bicycle pavement symbols, if used, should be placed close to the kerb at not more than 200 m longitudinal spacing. Signs may be required to control kerbside parking.

(c) *Sealed shoulder* A sealed shoulder separated from motor vehicle traffic lanes by an edge line is appropriate for bicycle use where the shoulder is wide enough to accommodate bicycles but bicycle numbers or other traffic conditions do not require it to be signed as a bicycle lane. A sealed shoulder will not normally require signs or markings related to bicycle use, but if some bicycle traffic is expected, the Bicycle warning sign (W6-7) (see Clause 2.2(e)) or bicycle pavement symbols, or both, should be considered. Pavement symbols at up to 1 km spacing will generally be adequate.



* Bicycle pavement symbols are optional.

DIMENSIONS IN METRES

FIGURE 2.7 WIDE PARKING LANE WITH BICYCLE PROVISION

Of these four options the part time facility in a clearway zone and the unsigned facilities are of interest for application in NZ. The part time facility requires signage to specify the clearway and operation of the cycle lane and uses pavement markings to distinguish the cycle lane and parking limits.

The unsigned facilities are more of an advisory nature and do not employ the use of any signage. The three types of facilities (wide kerbside parking, wide kerbside lane and sealed shoulder) all use the same cycle pavement marking symbol as the full time facility to identify the facility. The positioning of this symbol depends on the type of facility eg) if there is kerbside parking then it will be adjacent the traffic lane, otherwise it would be located adjacent the kerb. Pavement line marking is either broken if it is a wide kerbside lane or unbroken if parking is provided or it is a sealed shoulder.

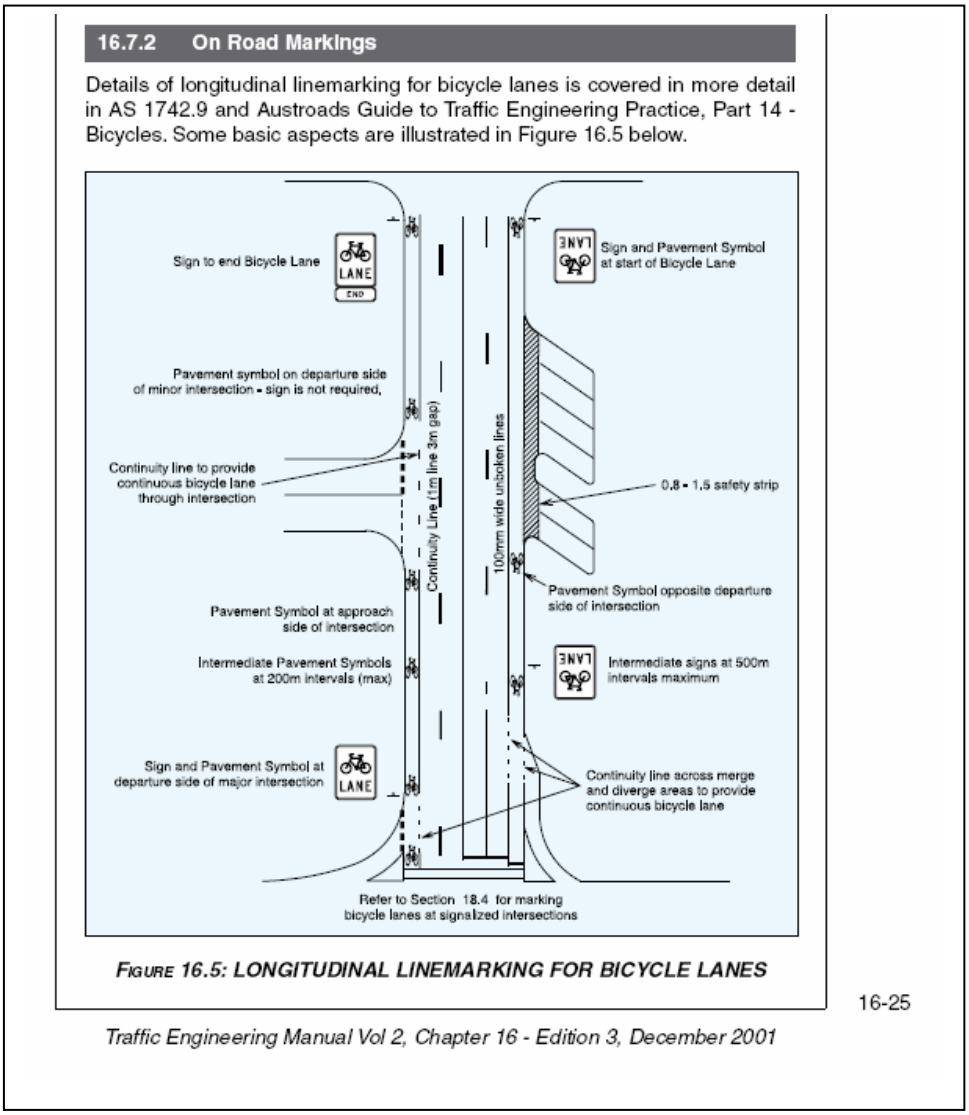
3.3 VicRoads Traffic Engineering Manual Vol 2, Chapter 8

This manual states that the bicycle sign R7-1-4 shall be used “to designate and on road bicycle lane for the exclusive use of bicycles”. Unless otherwise restricted parking is permitted in a bicycle lane.

R7-1-4

The longitudinal lane marking is shown in Figure 3-1

- **Figure 3-1 Longitudinal lane marking from TEM Vol 2**



3.4 VicRoads Cycle Design Notes

Two of these design notes are of particular concern to this study.

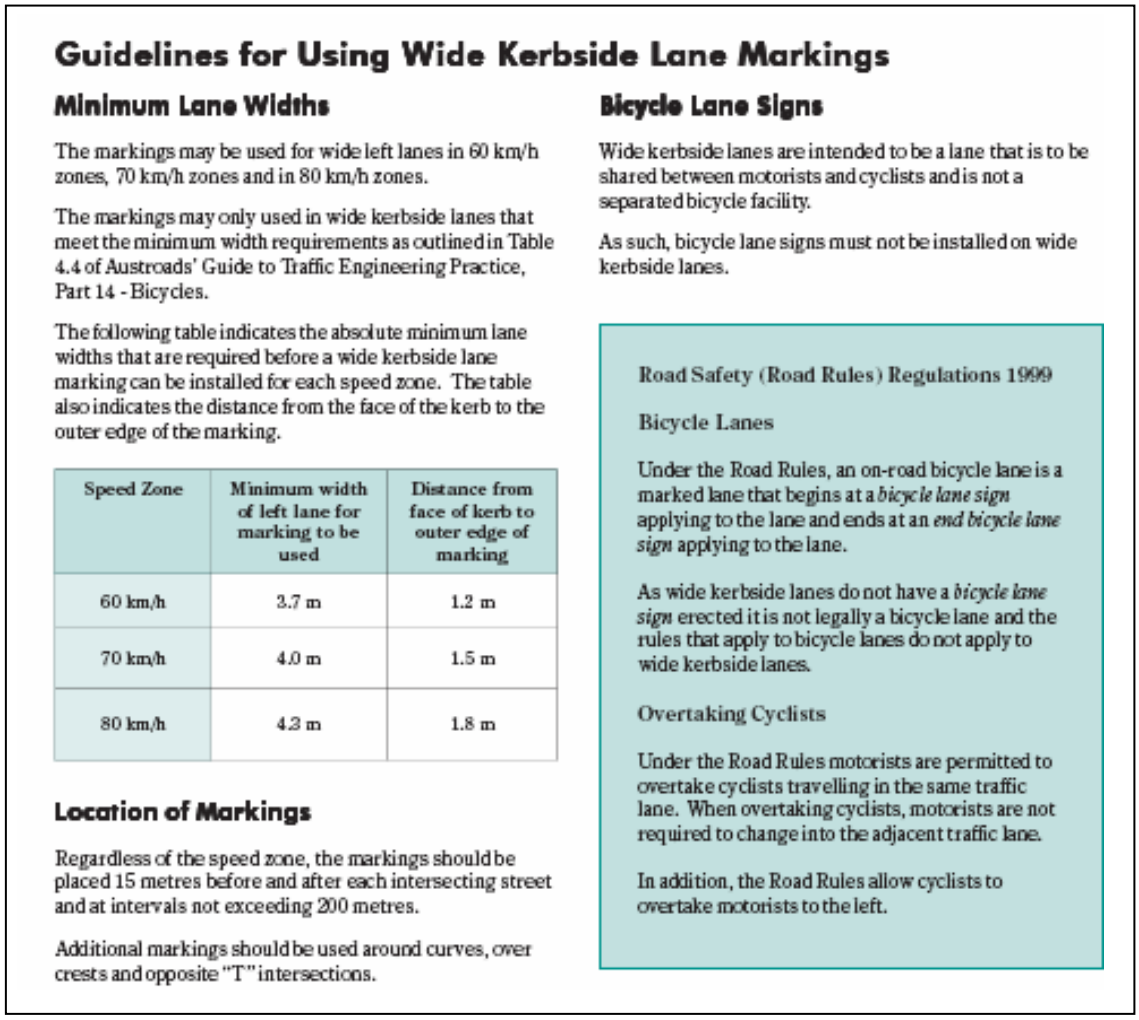
3.4.1 No 13 July 2004: Wide Kerbside Lane Markings

This note outlines the standards and guidelines for the use of wide kerbside lane markings in Victoria. These are installed to indicate to motorists and cyclists that an on-road bicycle facility has been provided. The markings advise motorists that:

- "they are more likely to encounter cyclists along roads with these markings,
- The lanes can be shared between motorists and cyclists,
- Sufficient space is available for sharing the lane with cyclists."

There are minimum widths for using these wide kerbside lane markings as shown in the extract in Figure 3-2

- **Figure 3-2 Extract of VicRoad No 13 Cycle Note**



Guidelines for Using Wide Kerbside Lane Markings

Minimum Lane Widths

The markings may be used for wide left lanes in 60 km/h zones, 70 km/h zones and in 80 km/h zones.

The markings may only used in wide kerbside lanes that meet the minimum width requirements as outlined in Table 4.4 of Austroads' Guide to Traffic Engineering Practice, Part 14 - Bicycles.

The following table indicates the absolute minimum lane widths that are required before a wide kerbside lane marking can be installed for each speed zone. The table also indicates the distance from the face of the kerb to the outer edge of the marking.

Speed Zone	Minimum width of left lane for marking to be used	Distance from face of kerb to outer edge of marking
60 km/h	3.7 m	1.2 m
70 km/h	4.0 m	1.5 m
80 km/h	4.3 m	1.8 m

Location of Markings

Regardless of the speed zone, the markings should be placed 15 metres before and after each intersecting street and at intervals not exceeding 200 metres.

Additional markings should be used around curves, over crests and opposite "T" intersections.

Bicycle Lane Signs

Wide kerbside lanes are intended to be a lane that is to be shared between motorists and cyclists and is not a separated bicycle facility.

As such, bicycle lane signs must not be installed on wide kerbside lanes.

Road Safety (Road Rules) Regulations 1999

Bicycle Lanes

Under the Road Rules, an on-road bicycle lane is a marked lane that begins at a *bicycle lane sign* applying to the lane and ends at an *end bicycle lane sign* applying to the lane.

As wide kerbside lanes do not have a *bicycle lane sign* erected it is not legally a bicycle lane and the rules that apply to bicycle lanes do not apply to wide kerbside lanes.

Overtaking Cyclists

Under the Road Rules motorists are permitted to overtake cyclists travelling in the same traffic lane. When overtaking cyclists, motorists are not required to change into the adjacent traffic lane.

In addition, the Road Rules allow cyclists to overtake motorists to the left.

Important issues to note are:

- The cycle symbols can only be used when the minimum dimensions in the table are met
- NO signs are to be erected with this marking as under Victorian law a bicycle sign indicates an on- road cycle facility with rules about who can use this facility
- These markings are used in 60,70 and 80 km/hr zones

In addition studies have been undertaken by Sinclair Knight Merz in October 2003 for VicRoads. VicRoads was interested in marking these wide kerbside lanes with a special bicycle symbol in order to alert cyclists that an on-road facility has been provided, and also alert motorists that they may encounter cyclists on this section of road. Sinclair Knight Merz carried out a study looking at the tracking position of car drivers in the kerbside lane and also the comfort of cyclists before and after the road marking. The full report is attached to this document in Appendix A however the main conclusions were:

- Overall, marking of a bicycle logo in the kerbside lane did not change the tracking of car drivers. This was true both when a cyclist was present and when no cyclist was present. This confirms the results of the 1998 SKM study.
- Cyclists tended to perceive less riding stress when there was a logo present.
- The width of the kerbside lane had a very significant effect on the clearance that drivers gave to cyclists they overtook. This confirms the two earlier studies mentioned above.
- There were large site to site variations in the car to bike clearance and wide variations between different drivers.
- Drivers squeezed cyclists if another car was in the adjacent lane. Typically they drive 100mm closer, but around 250mm closer where the lane width was small (Canterbury Road site).
- The alarmingly small clearances that many car drivers gave to cyclists when the lane width was 3.5m intrudes well within the cyclists "design envelope".

The recommendations of the report included:

- Because the presence of the bike logo did not appear to have a meaningful effect on car tracking, it is difficult to argue that it should be introduced to alter driver behaviour.
- It is believed that the logo should be introduced more widely on a different rationale. It is best seen as a 'tag' to identify a superior bike facility - a wide kerbside lane. Inexperienced riders have a limited understanding of the role of the width of the kerbside lane in determining their level of stress and the clearance that drivers give when overtaking. By identifying superior lanes in this way, inexperienced riders are more likely to use roads thus marked than (unmarked) parallel routes.
- In 60 km/h speed zones it is considered that lane widths should be above 3.90m or 4.00m with smooth riding conditions near the kerb to qualify.

3.4.2 No 14 April 2005: Coloured Surface Treatments for bicycle lanes

Vic roads uses green colour marking for bicycles. A green coloured surface treatment is an advisory treatment only and does not define a bicycle lane. It is generally used in bicycle lanes in areas where it is considered there is increased conflict between motor vehicles and bicycles.

3.5 Comparison between Victoria and NZ legislation

- Both Countries use the Austroads Guide to Engineering Practice Part 14 as the main cycling design guide
- In Australia, a cycle lane is legally defined by signs where as in New Zealand it is legally defined by a pavement cycle symbol.
- Victoria allows the use of pavement marking symbols in wide kerbside lanes
- Victoria has provision for three types of unsigned bicycle routes which use pavement markings in an advisory nature.
- VicRoads has undertaken research on the use of pavement markings in kerbside lanes. The results indicate there is minimal change in driver behaviour with a pavement marking symbol present however the cycle facility is reinforced.

4. Case Study 3: United States

Two main documents have been referenced for the design of bicycle facilities in the United States:

- The American Association of state highway and transportation officials (AASHTO): *Guide for the development of bicycles facilities 1999* has been referenced to ascertain the general standards for bicycle facilities in America. Each state is likely to have their own guidelines however it is apparent that this manual is used in the formation of most of these state guidelines.
- The US Department of Transportation Federal Highway Administration *Manual on Uniform Traffic Control Devices for Streets and highways (MUTCD), Part 9: Traffic controls for Bicycle facilities.*

4.1 Document Reviews

The MUTCD manual has a standard in Section 3 for Preferential Lane Word and Symbol Markings which states:

> "*When a lane is assigned full or part time to a particular class or classes of vehicles, preferential lane markings shall be used. Signs or signals shall be used with preferential lane word or symbol markings*"

This means that whenever a symbol is used, then the appropriate regulatory signs (R3-17) are to be used in conjunction with the pavement marking. The markings can only be used when a facility is created not as an advisory aid.

AASHTO references the use of three types of bicycle facilities related to this study; shared roads, signed shared roadway and bicycle lanes.

- The shared roadway provides for paved shoulders to be used on rural roads which is not applicable to this study. Wide kerb lanes are also recommended and are usually preferred where shoulders are not provided such as in restrictive urban areas. Widths of 3.6m-4.2m are recommended. No other pavement markings are associated with these designs.
- Signed shared roadways are related to bike routes and can be used on routes with and without bike lanes
- Bicycle lanes are marked using solid white lines with dotted white lines at intersections. Pavement symbols, directional painted arrows and signs are also required for a bike lane. No vehicles are allowed in the designated bike lanes
- Kerbside parking lanes are marked with solid white lines on both sides of the bike lane
- There is no mention of advisory pavement marking however there are a few bicycle warning signs available that can be installed on bicycle facilities.

The City of Chicago has developed a *Bike Lane Design Manual (2002)* and this has been reviewed as a comparison to the AASHTO manual. This manual marks all cycle lanes with solid white lines (of varying thicknesses) including wide parking kerbside lanes.

If the street is less than 44' (approx 27 metres) wide then it is considered that the street is too narrow to mark cycle lanes. On these streets then special signs will be erected informing it is a designated bike route, but no pavement markings are used. The manual also comments that if the street has low level on-street parking then it is considered best practice to mark both sides

of the cycle lane with a solid line to ensure motorists do not use the space as a through travel lane.

4.2 Comparison between United States and NZ legislation

- United States requires the use of pavement markings and signs to identify a legal bike lane whereas in NZ a pavement symbol is the legal marking.
- Like NZ, there are no advisory pavement markings in the United States. However some advisory bike route and warning signs are available. These signs cannot be used in conjunction with road markings.
- Kerbside parking lanes in United States are marked with edgelines and pavement symbols thus defining them as legal bike lanes.

5. Case Study 4: The Netherlands

The Centre for Research and Contract Standardisation in Civil Engineering (CROW) *Sign up for the Bike: Design Manual* is recognised as one of the most comprehensive guides to the design of cycle facilities. It is noted that the latest version available is the 1993 version and we are endeavouring to find out if the policies are still current.

The manual does promote the use of separation between cycle lanes and traffic lanes. Methods discussed include a higher road level or a dividing verge with either a physical separation such as a 1.2m grass verge area or in built up areas providing a concrete kerbing higher than 0.3m.

The design guide does refer to a number of types of cycle facilities:

- A cycle lane has official status and is marked with a solid continuous line if traffic is not allowed in the lane and a broken line if traffic is allowed if it does not impede cyclists. This lane are also preferably coloured red and a pavement cycle symbol must be present to define it as a cycle lane
- A Recommended cycle lane is separated by a broken line with no pavement symbols present. These lanes do not imply a parking ban like the official cycle lane so parking bans may be required. This type of lane normally has the same pavement colour as the main carriageway although coloured pavement can be used if desired. This recommended lane is often a smaller minimum width that cycle lanes and are
- For the instance of kerbside parking a deterrent strip is recommended between the parking and the cycle facility
- This manual did not contain information regarding the acceptable road signage

5.1 Comparison between Netherlands and NZ legislation

- The Netherlands and NZ both legally identify their cycle lanes with a pavement cycle symbol and solid lines
- The Netherlands does allow “recommended lanes” which have broken lane lines and no pavement marking symbol
- The Netherlands do focus a lot more on cyclists and have a far higher mode share than NZ. As such the cycle networks are far more developed than NZ. It appears that much effort has been made to provide official cycle lanes of suitable widths for the numbers with suitable separations between traffic lanes and cycle lanes.

6. Summary and Conclusions

A table has been prepared to summarise what facilities and legislation are available for the case studies discussed in previous sections

- **Figure 6-1 Summary table of international facilities**

Country	Legal Cycle Lane Definition	Advisory markings	Advisory Signage
New Zealand	Pavement Symbol Marking and solid white edgeline	No advisory pavement markings Coloured pavement can be utilised (no legal significance)	One cycle warning sign (PW-35)
United Kingdom	Mandatory cycle lanes have solid white edgeline, with use of regulatory signs and symbol at appropriate locations. A Traffic regulation order (TRO) is required to prohibit other vehicles using this lane. A mandatory lane is required to start with a taper of broken white lines and have broken white "advisory" lines at all intersections	Advisory cycle lanes are marked by broken white lines with the use of the same pavement symbol as mandatory but different advisory signs. Yellow no stopping lines/clearways to be used as appropriate Pavement cycle symbol marking can be used for advisory purposes Coloured pavement can be utilised	There is separate signage for advisory lanes and bike routes
Victoria, Australia	"Bicycle lane" sign and "bicycle lane ends" sign	Pavement cycle Symbol markings Coloured pavement can be utilised (no legal significance)	No advisory signs but some warning signs available for cycle race events etc
United States	Pavement Marking Symbol (2 available), direction arrow and signage	No advisory pavement markings Coloured pavement can be utilised (no legal significance)	Bicycle route signs and some warning signs for bike routes. Not used in conjunction with pavement marking
Netherlands	Pavement Symbol Marking and solid white edgeline	"Recommended cycle lanes" are permitted and these are indicated by a broken white line and no pavement cycle symbol	No signs were discussed in the CROW manual. It is believed that the Netherlands use the European sign standards

It can be seen each country has a different method of legalising and treating cycle lanes. It appears that most countries either create an exclusive cycle facility or provide no treatment (with the exception of route signage). UK does allow "advisory lanes" which allow occasional encroachment of vehicles however this is accompanied by pavement marking and signs so is similar to an exclusive cycle lane.

Under current New Zealand legislation, advisory pavement marking would require a new pavement marking symbol as the existing one only defines a legal cycle lane. New Signage may also need to be developed. The Netherlands appears to have similar legislation tools as New Zealand so is a useful case example.

Megan Tibby MIPENZ (Civil) CPEng
Transportation Engineer
Phone: 09 985 3649
Fax: 09 913 8901
E-mail: mtibby@skm.co.nz

7. Online Resources and Bibliography

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8. Appendix A - Sinclair Knight Merz Report for VicRoads on Wide Kerbside Lanes

Car Tracking Positions in Wide Kerbside Lanes

FINAL REPORT

- 1
- 10/10/2003

Car Tracking Positions in Wide Kerbside Lanes

FINAL REPORT

- 1
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Sinclair Knight Merz
ABN 37 001 024 095
590 Orrong Road, Armadale 3143
PO Box 2500
Malvern VIC 3144 Australia
Tel: +61 3 9248 3100
Fax: +61 3 9248 3460
Web: www.skmconsulting.com

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1. Introduction, Conclusions and Recommendations

A wide kerbside lane is a traffic lane located adjacent to the left hand kerb that is wide enough to accommodate both bicycles and motor vehicles side by side. VicRoads is investigating marking these lanes with a special bicycle symbol in order to alert cyclists that an on-road facility has been provided, and also alert motorists that they may encounter cyclists on this section of road. This study looked at the tracking position of car drivers in the kerbside lane and also the comfort of cyclists before and after the road marking.

Previous studies have been undertaken on this topic in Melbourne. A 1989 Loder and Bayly study determined the comfort of the cyclist whilst varying the left lane width. It found that the width of the kerbside lane had a marked effect on the clearance between cyclists and overtaking cars – the wider the lane, the greater the clearance. In 1998, Sinclair Knight Merz undertook a study in Kew, which found that driver behaviour was the same before and after the bike symbols were marked. All previous studies were in 60km/h speed limit zones. However, a new variable in this study is the speed limit of the roads to be studied – one site was in a 70km/h zone.

The study was undertaken at several sites in the inner and eastern suburbs of Melbourne, using a video camera to record the tracking positions of cars in certain traffic conditions. A total of nine combinations of lane width, speed limit and marking/no marking of a bike logo were examined. The tracking positions of a total of 9906 cars were observed. The data was then used to analyse the effectiveness of the bicycle symbol.

1.1 Conclusions

On the basis of the observations we can draw the following conclusions:

Marking of a bicycle logo

- Overall, marking of a bicycle logo in the kerbside lane did not change the tracking of car drivers. This was true both when a cyclist was present and when no cyclist was present. This confirms the results of the 1998 SKM study.
- Cyclists tended to perceive less riding stress when there was a logo present.

Width of the kerbside Lane

- The width of the kerbside lane had a very significant effect on the clearance that drivers gave to cyclists they overtook. This confirms the two earlier studies mentioned above.

- There were large site to site variations in the car to bike clearance and wide variations between different drivers.
- Drivers squeezed cyclists if another car was in the adjacent lane. Typically they drive 100mm closer, but around 250mm closer where the lane width was small (Canterbury Road site).
- The alarmingly small clearances that many car drivers gave to cyclists when the lane width was 3.5m (Canterbury Road site) confirms the 1989 Loder and Bayley study that highlighted the undesirability of lanes of this width. One driver only allowed 1.0m between their nearside tyre and the vertical face of the kerb when overtaking a cyclist in this study (table 10). This intrudes well within the cyclists "design envelope".

Speed Limit

- We sought to determine the effect of the speed limit by comparing the tracking of drivers at the site with a 70 km/h speed limit (the Burwood Highway site) with the clearance that we would expect for the same lane width if it were in a 60 km/h speed zone. However more experimental data would be needed to test the effect of speed zone on the overtaking clearance. On the basis of quite limited evidence it seems that drivers did not appear to increase their clearance to cyclists when driving in a higher speed zone.

1.2 Recommendations

Use of the bike logo

- Because the presence of the bike logo did not appear to have a meaningful effect on car tracking, it is difficult to argue that it should be introduced to alter driver behaviour.
- We believe the logo should be introduced more widely on a different rationale. It is best seen as a 'tag' to identify a superior bike facility - a wide kerbside lane. Inexperienced riders have a limited understanding of the role of the width of the kerbside lane in determining their level of stress and the clearance that drivers give when overtaking. By identifying superior lanes in this way, inexperienced riders are more likely to use roads thus marked than (unmarked) parallel routes.
- The question then becomes one of "What constitutes a superior riding facility?" In 60 km/h speed zones we consider that lane widths should be above 3.90m or 4.00m with smooth riding conditions near the kerb to qualify.
- The effect of the speed zone is more difficult to incorporate. There is not enough data on which to base a recommendation. An increase of 100mm in the threshold for every 10 km/h is not unreasonable.

Marking of kerbside lanes about 4.5m wide

- The comparison of the average clearance that drivers gave to cyclists at the Burwood Highway site (70 km/h, 4.5m width) and the Bridge Road site (60 km/h, 4.7 combined width of bike lane and next lane) provides some justification to marking a separate bike lane at these widths.

2. Study description

Three locations were nominated by VicRoads for the study:

- Burke Road, Balwyn;
- Belmore Road, Balwyn;
- Burwood Highway, Burwood East.

The former two sites are in a 60km/h zone and already have wide kerbside lanes. The latter is located in a 70km/h zone and does not currently have a wide kerbside lane, so three surveys were undertaken: before the provision of a wide kerbside lane, after the provision of a wide kerbside lane but before road markings, and after road markings.

In order to gain a full appreciation of car tracking positions, surveys were undertaken at another two sites without wide kerbside lanes: Canterbury Rd, Box Hill and Bridge Rd, Richmond. Both of these sites are in a 60km/h zone and the latter has a bicycle lane.

Site	Speed limit (km/h)	Conditions		
		Normal width kerbside lane	Wide kerbside lane	Wide kerbside lane and bike symbol
Burke Rd, Balwyn	60		✓ (4.1m)	✓ (4.1m)
Belmore Rd, Balwyn	60		✓ (3.9m)	✓ (3.9m)
Burwood Hwy, Burwood East	70	✓ (3.7m)	✓ (4.5m)	✓ (4.5m)
Bridge Rd, Richmond	60	✓ (4.7m)[1]		
Canterbury Rd, Box Hill	60	✓ (3.5m)		

- **Table 1 Surveys undertaken at each site in specified conditions. The width of the kerbside lane at the time of the survey is also provided.**

All surveys were undertaken in the morning peak and extended for a duration of 2.5 hours.

[1] Including bicycle lane (3.5m traffic lane, 1.2m bicycle lane)

For each location, four situations were observed:

Category 1: Car in left lane, no car in adjacent lane, no bicycle.

Category 2: Car in left lane, car in adjacent lane, no bicycle.

Category 3: Car in left lane, no car in adjacent lane, bicycle in left lane.

Category 4: Car in left lane, car in adjacent lane, bicycle in left lane.

An example of each category is shown in the following figures.

- **Figure 1 Car in left lane, no car in adjacent lane, no cyclist**

- **Figure 3 Car in left lane, no car in adjacent lane, cyclist**

- **Figure 2 Car in left lane, car in adjacent lane, no cyclist**

- **Figure 4 Car in left lane, car in adjacent lane, cyclist**

3. Methodology

3.1 Initial development of methodology

In order to record the tracking positions of cars, a video camera was set up on the side of the road. Distances were marked on the road so that when the video was played back, the distance between the car and the kerb could be measured. On playback, the distances were recorded in a database along with the traffic situation at that instant.

To ensure that enough cyclists pass by for the situations involving cyclists, casual staff were hired to cycle along the road section for the duration of the survey, emulating the behaviour of a 'real' cyclist as closely as possible. Cyclists were instructed to ride at a set distance from the kerb of 400mm. After each survey, the cyclists were asked to describe their comfort level.

There were two main restrictions in the study:

- Situations where a truck or bus was passing a cyclist were not counted. All site locations formed part of busy bus routes, and several buses did pass the video during the surveys. Trams travel on the Burwood Hwy site, but are segregated from vehicles and did not affect the studies.
- Only situations where the vehicle was moving at a reasonable speed and not changing lanes were included in the database. This restriction was used several times, in particular at Burke Rd where it became congested around 8:00am.

3.2 Site inspection and safety plan

The five sites were inspected for facilities and appropriate locations to set up for the study. After these inspections, a layout of each site was drawn up, the exact location of the survey. Health and safety issues were identified and described in a safety plan, which was given to the cyclists and other personnel.

3.3 Pilot study

A 30-minute pilot study was undertaken at Burke Rd on 6 February 2003 to test the methodology. One casual cyclist was used. After the survey, the data was collected from the video and analysed. No problems were found with the methodology during the pilot study.

3.4 Actual study

The surveys were undertaken on the following days:

Site	Date	Marking conditions	Length of survey
Burke Rd	19/02/2003	No symbols	2.5 hours
Belmore Rd	24/02/2003	No symbols	2.5 hours
Burwood Hwy	2/05/2003	No symbols, no widening	2 hours[2]
Burke Rd	16/5/2003	Symbols	2.5 hours
Bridge Rd	23/5/2003	-	1.5 hours[3]
Canterbury Rd	26/5/2003	-	2 hours[4]
Belmore Rd	30/5/2003	Symbols	2.5 hours
Burwood Hwy	23/6/2003	Widening, no symbols	2.5 hours
Burwood Hwy	30/9/2003	Symbols and widening	2.5 hours

3.5 Data collation

After each survey, the videotapes were transferred from digital tape into a movie file on the computer. The movie was then played back on the computer in fast forward, pausing when a car passed the ruler. An Excel spreadsheet was set up so that the situation, tracking position, and the name of the cyclist if present could be recorded quickly. After all the data had been collected, it was transferred to an Access database for analysis.

3.6 Data analysis

The following analyses were undertaken on the data collected:

- Test for differences between categories across different surveys at the same site (to check whether the road marking and lane widening had an effect). (Effect statistic).
- Test for differences across sites with different lane widths.
- Test for differences across sites with different speed limits.

[2] Finished early due to rain.
[3] Started late due to some cyclists mistakenly going to another site. This survey had to start after 7am and be finished by 9am because of clearway restrictions.
[4] Shortened survey due to site not being particularly "cyclist-friendly" (casual cyclists threatened to "start a union and walk off the job").

4. Results

4.1 Preliminary checks

For each survey two statistical checks were carried out:

- A check for any difference in the clearance given to cyclists (due to visibility or riding style). We used a variety of cyclists with varying experience and models of bikes.
- A check for difference in tracking position between cars overtaking a cyclist and cars that were not. This indicated whether drivers actually change their tracking position when overtaking cyclists.

Both checks were two-tailed hypothesis tests using 5% level of significance.

The first check returned no significant difference between cyclists for all surveys. This means that no cyclist was given more clearance than another cyclist. This test was done for the "fake" cyclists only, as the sample size of "real" cyclists was too small to provide a statistically valid result.

The second check returned a significant difference between the tracking position of cars passing a cyclist and those not, again for all surveys. This means that drivers are changing their natural position to compensate for the cyclist in their lane.

4.2 Burke Rd

Survey dates and times

Before markings: Wednesday 19 February 2003 6:45am-9:15am

After markings: Friday 16 May 2003 6:45am-9:15am

4.2.1 Site Description

The location of the survey was between Birdwood and Eyre Sts, just opposite Second Ave. At this point the road sloped upwards. The speed limit was 60km/h. During the first survey congestion was seen at approximately 8:00-8:15am, and data was not collected during this time as the cars were not moving fast enough. During the second survey, roadworks were taking place on the other side of the road. The congestion was not seen again, possibly due to signs at either end of the roadworks alerting drivers to delays. An interesting aspect of this site was that the road did not have a concrete channel – the asphalt extended all the way to the kerb face.

4.2.2 Tracking Positions

The data for both surveys is shown below:

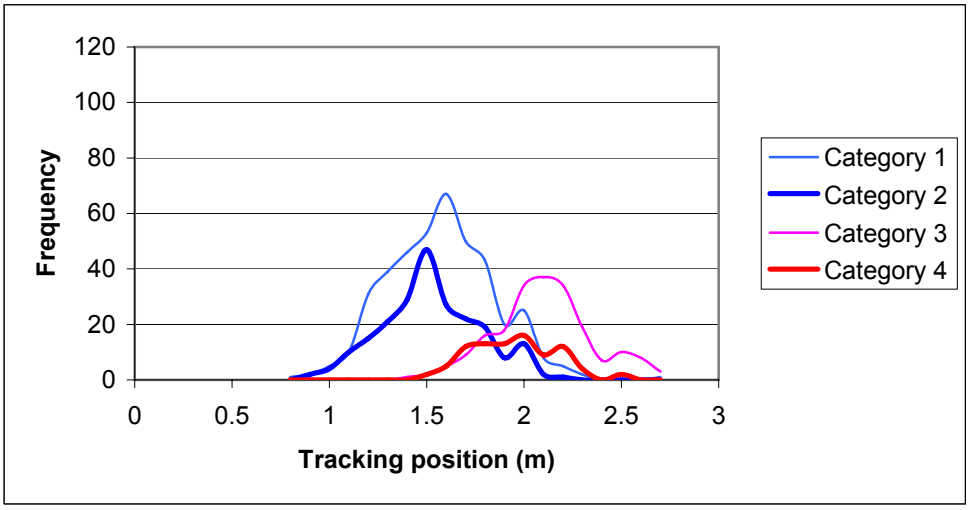
Category	Count	Average	SD	Min	Max
1	408	1.576	0.273	0.8	2.7
2	220	1.525	0.255	0.9	2.2
3	203	2.096	0.251	1.4	2.7
4	88	1.943	0.219	1.5	2.5

- **Table 2 Burke Rd - Summary of car tracking positions before markings (metres from kerb)**

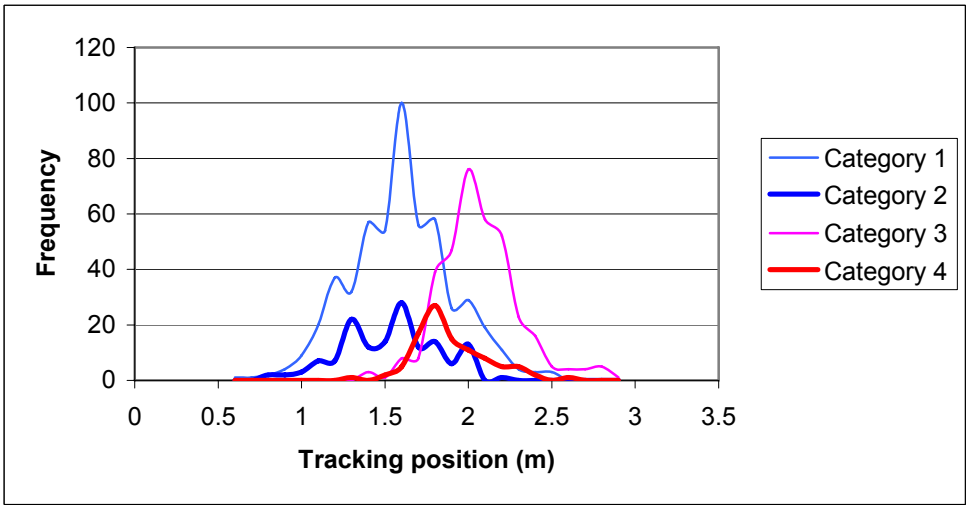
Category	Count	Average	SD	Min	Max
1	526	1.595	0.307	0.6	2.5
2	143	1.530	0.288	0.8	2.2
3	350	2.062	0.239	1.4	2.9
4	99	1.888	0.219	1.3	2.6

- **Table 3 Burke Rd - Summary of car tracking positions after markings (metres from kerb)**

The averages for both surveys are similar, and for both cyclist categories (3 and 4) the average tracking distance was actually worse with the road markings than before. However, the effects statistic showed no significant difference in the tracking position before and after the road marking for all categories.



- **Figure 5 Burke Rd - Distribution of tracking positions by category before lane markings**



- **Figure 6 Burke Rd - Distribution of tracking positions by category after lane markings**

The above figures show changes in the shape of the distribution, however very little change on the range of tracking positions for each category.

4.2.3 Cyclist Comfort and Satisfaction

Before the road was marked, the cyclists were happy with the site, describing it as “fine”, “fairly standard” and “better than some streets”. They had no objections to the position of cars passing them, but did mention that buses and trucks were too close.

After the road was marked, the cyclists described the site as “noticeably better” than previously, even though the quantitative results showed otherwise.

4.3 Belmore Rd

Survey dates and times

Before markings: Monday 24 February 2003 6:45am-9:15am

After markings: Friday 30 May 2003 7:00am-9:30am

4.3.1 Site Description

The location of the survey was between Monash and Elliott Aves. The site formed part of several busy bus routes, which affected the amount of data collected as most cars changed lanes when they noticed a bus ahead of them. The site was also just downstream of a set of traffic lights, which meant the vehicle flow was less constant than the other sites.

4.3.2 Tracking Positions

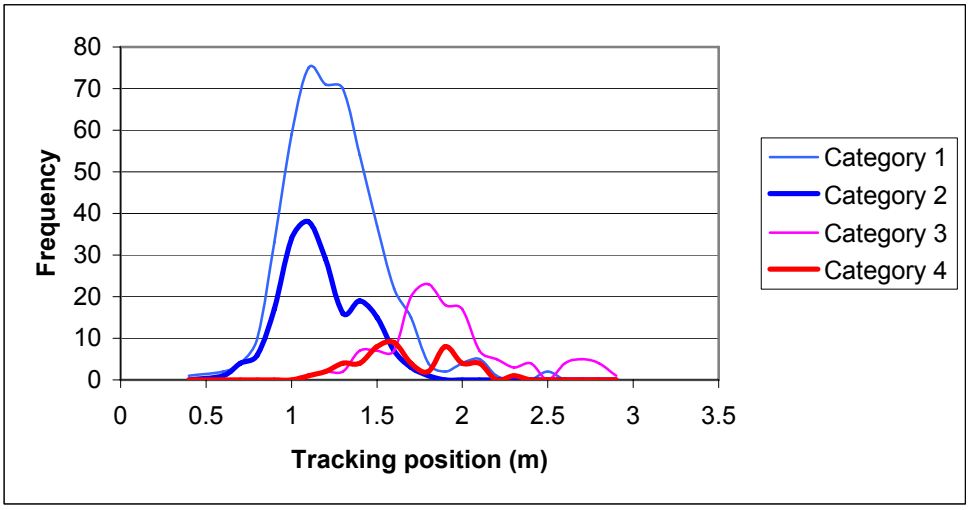
Category	Count	Average	SD	Min	Max
1	471	1.249	0.275	0.4	2.5
2	190	1.168	0.228	0.6	1.8
3	137	1.908	0.370	1.1	2.9
4	51	1.666	0.279	1.1	2.3

- **Table 4 Belmore Rd - Summary of car tracking positions before lane markings (metres from kerb)**

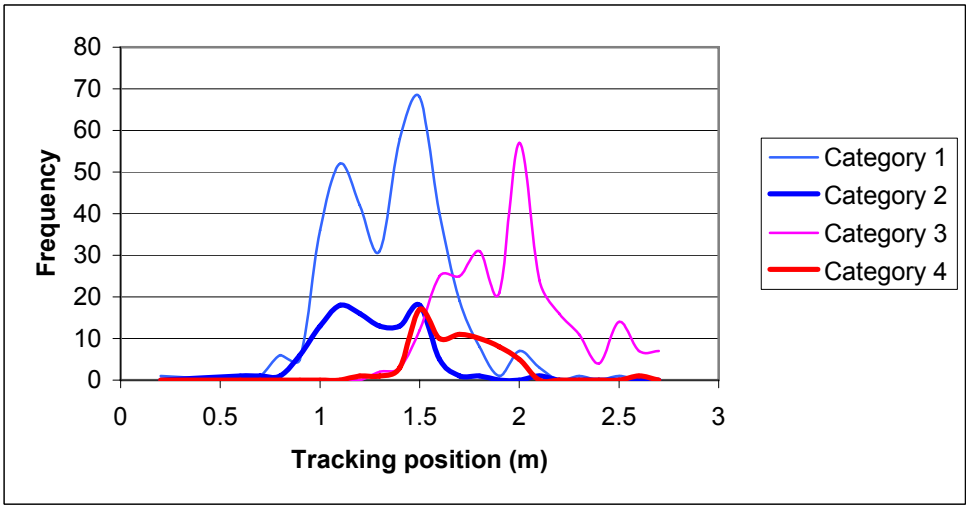
Category	Count	Average	SD	Min	Max
1	380	1.355	0.274	0.2	2.5
2	108	1.251	0.240	0.6	2.1
3	259	1.967	0.307	1.3	2.7
4	67	1.682	0.217	1.2	2.6

- **Table 5 Belmore Rd - Summary of car tracking positions after lane markings (metres from kerb)**

The effects statistic showed no significant difference in the tracking position before and after the road marking for both cyclist categories, however there was a significant difference in the tracking position when a cyclist is not present. In these cases (categories 1 and 2), the average tracking position was 100mm further from the kerb.



- **Figure 7 Belmore Rd - Distribution of tracking positions by category before lane markings**



- **Figure 8 Belmore Rd - Distribution of tracking positions by category after lane markings**

The distributions show a small shift in the tracking positions in category 1 and 2.

4.3.3 Cyclist Comfort and Satisfaction

Before the road was marked the cyclists felt that the traffic was closer and faster than in Burke Rd. This may have been due to the downhill stretch of road and the kerbside lane in Belmore Rd is 200mm narrower than Burke Rd. After the lane marking, the cyclists noted a slight improvement in their comfort.

4.4 Burwood Hwy

Survey dates and times

Before lane widening and markings: Friday 2 May 2003 7:00am-9:00am

After lane widening and before markings: Monday 23 June 2003 7:00am-9:30am

After lane widening and markings: Tuesday 30 September 2003 6:40am-9:10am

4.4.1 Site Description

The survey area at Burwood Hwy consisted of several small hills, and again formed part of a busy bus route, which meant selecting a site clear of bus stops and traffic lights. The location of the survey was between Cornish Rd and Highview Gv. The speed limit at this site was 70km/h, having just changed from 80km/h about 5 metres upstream of the survey position.

4.4.2 Tracking Positions

Category	Count	Average	SD	Min	Max
1	738	1.250	0.263	0.6	2.5
2	246	1.201	0.216	0.6	1.8
3	253	1.841	0.263	1.1	2.6
4	73	1.754	0.229	1.3	2.3

- **Table 6 Burwood Hwy - Summary of tracking positions before lane widening and marking (metres from kerb)**

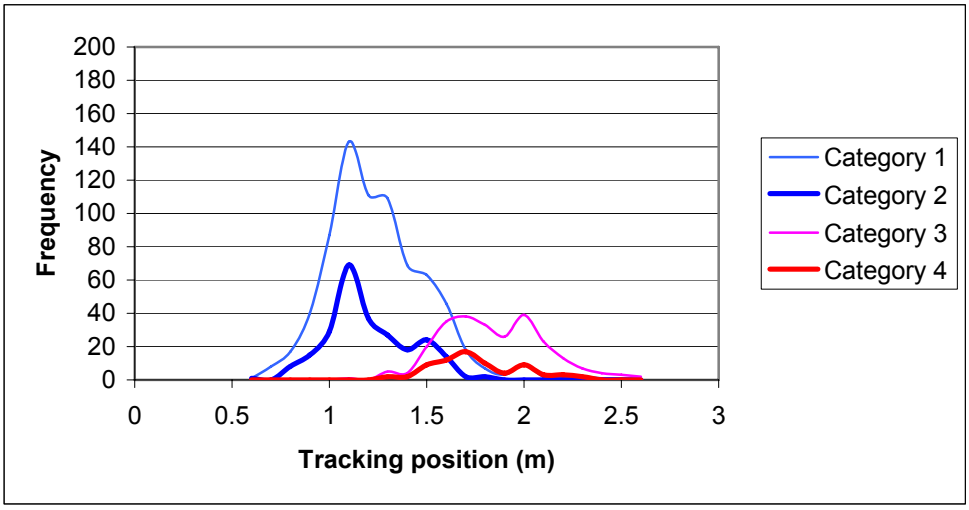
Category	Count	Average	SD	Min	Max
1	821	1.460	0.256	0.6	2.3
2	305	1.411	0.232	0.8	2.5
3	211	1.932	0.230	1.3	2.8
4	113	1.804	0.180	1.4	2.2

- **Table 7 Burwodd Hwy - Summary of tracking positions after lane widening and before lane marking (metres from kerb)**

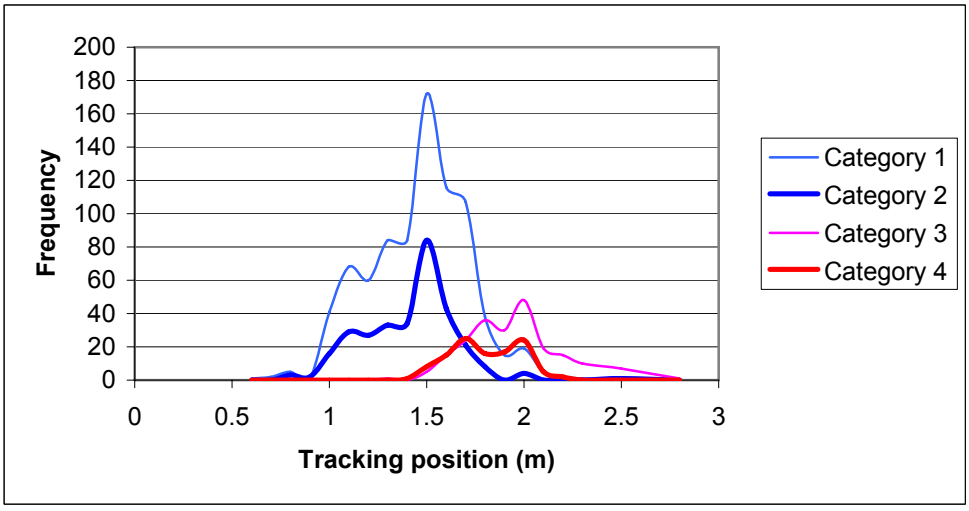
Category	Count	Average	SD	Min	Max
1	830	1.457	0.244	0.6	2.5
2	302	1.413	0.235	0.6	2.2
3	128	1.959	0.220	1.5	2.7
4	55	1.824	0.188	1.5	2.2

- **Table 8 Burwood Hwy - Summary of tracking positions after lane widening and marking (metres from kerb)**

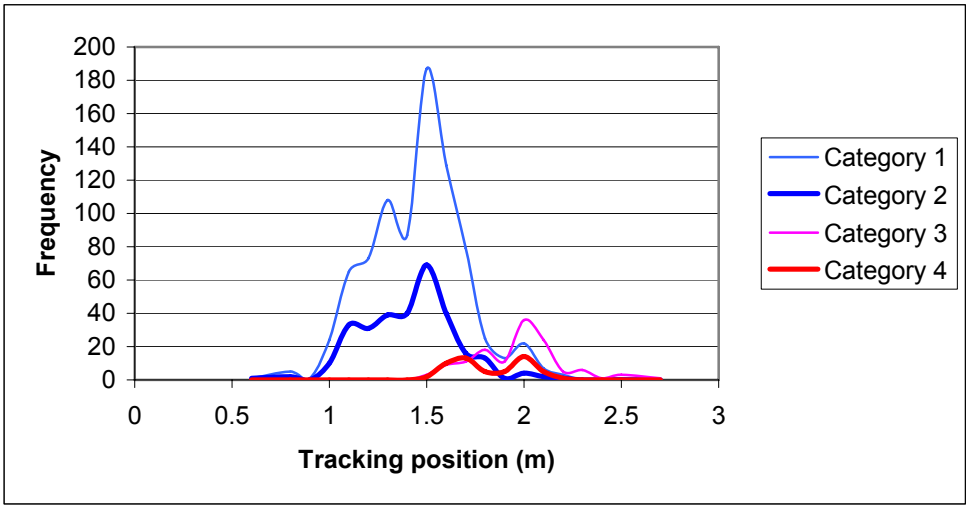
Before and after lane widening, there was a significant difference in the tracking position for all categories except for category 4. Lane marking resulted in no significant difference in all categories.



- **Figure 9 Burwood Hwy - Distribution of tracking positions by category before lane widening and markings**



- **Figure 10 Burwood Hwy - Distribution of tracking positions by category after lane widening and before lane markings**



- **Figure 11 Burwood Hwy - Distribution of tracking positions by category after lane widening and markings**

The above charts show a significant shift in the average tracking position before and after lane widening, however the curves in figures 10 and 11 are very similar.

4.4.3 Cyclist Comfort and Satisfaction

For the first survey, the cyclists felt that the cars were closer and faster than previous sites. A comment was also made about the surface at the edge of the road being "quite bumpy". The cyclists felt that the widening made no difference, however the lane markings were an improvement.

4.5 Bridge Rd

Survey date and time: Friday 23 May 2003 7:30am-9:00am

4.5.1 Site Description

This site had a full bicycle lane that operated during the surveys. However it could be parked in outside clearway times. More "real" cyclists were seen at this site compared to the other sites.

4.5.2 Tracking Positions

Category	Count	Average	SD	Min	Max
1	354	1.834	0.242	1.1	2.8
2	292	1.757	0.209	1.1	2.5
3	122	2.147	0.269	1.3	2.8
4	86	2.022	0.180	1.5	2.4

- **Table 9 Bridge Rd - Summary of tracking positions (metres from kerb)**

4.5.3 Cyclist Comfort and Satisfaction

Two of the cyclists found this site the most comfortable, due to the designated lane. They also mentioned that cars "didn't seem to cross it [the unbroken line] even when there were no cyclists". The presence of other cyclists also made them more comfortable. However one cyclist was not comfortable, stating that the cars were "pretty close and very busy".

4.6 Canterbury Rd

Survey date and time: Monday 26 May 2003 7:00am-9:00am

4.6.1 Site Description

This site had a "normal" width left lane and no bicycle facilities, although some cyclists were seen using it. The location of the survey was east of the overpass near Hay St. This site was a steep section of road and a lot of heavy vehicle traffic was seen. Like Belmore Rd, the site was downstream of a set of traffic lights so the flow was not particularly constant. One characteristic of this site was that when cars approached a cyclist, they either changed lanes (as opposed to veering into the second lane and then returning) or they slowed down, waiting for the second lane to clear. Some congestion occurred at times, meaning cars slowed down to an unacceptable speed for collecting data.

4.6.2 Tracking Positions

Category	Count	Average	SD	Min	Max
1	639	0.985	0.294	0.2	2.5
2	364	0.887	0.254	0.2	2
3	211	1.693	0.352	1	2.8
4	63	1.444	0.174	1.1	2

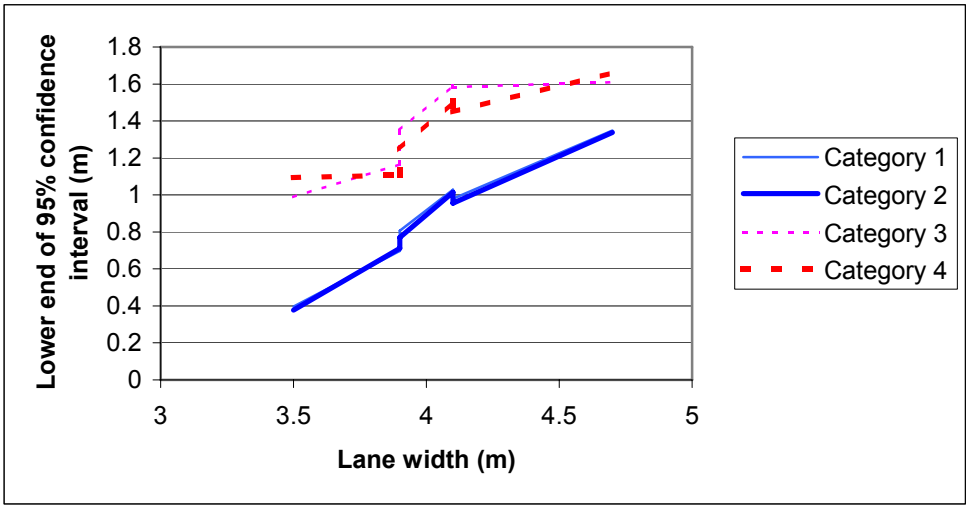
- **Table 10 Canterbury Rd - Summary of tracking positions (metres from kerb)**

4.6.3 Cyclist Comfort and Satisfaction

The cyclist labelled this site the worst of the five. The reasons mentioned included cars too fast and too close. It was the narrowest lane of those observed.

4.7 Width analysis

Only sites with a 60km/h speed limit were used in the width analysis. The lower endpoint of the 95% confidence interval (ie. mean – 2 standard deviations) was used as this was the minimum tracking position for approximately 95% of observations.



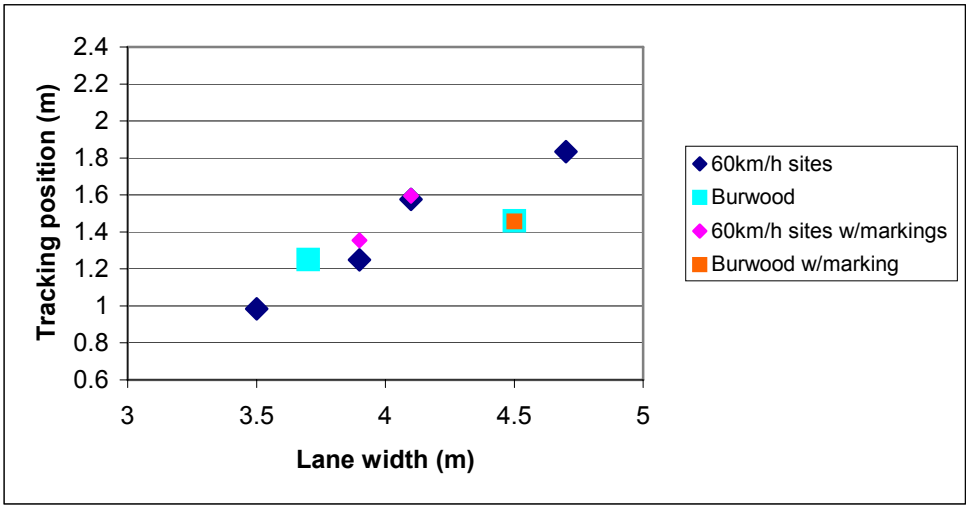
- **Figure 12 Minimum tracking positions for 60km/h sites by category**

This shows that as the width of the lane increases, the greater the clearance provided.

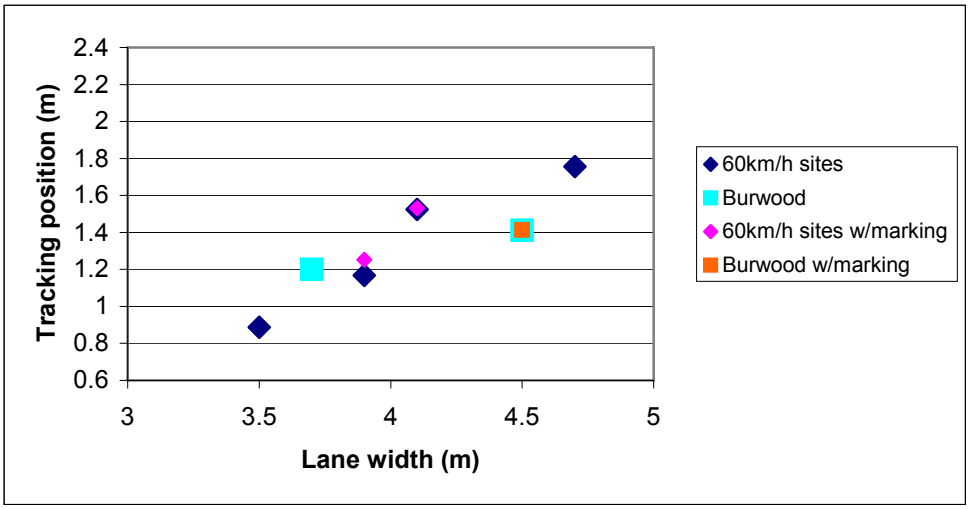
4.8 Speed limit analysis

It is difficult to statistically test the effects of the speed limit as there was not another site surveyed with the same width as Burwood Hwy, therefore any differences cannot be accounted for by speed alone.

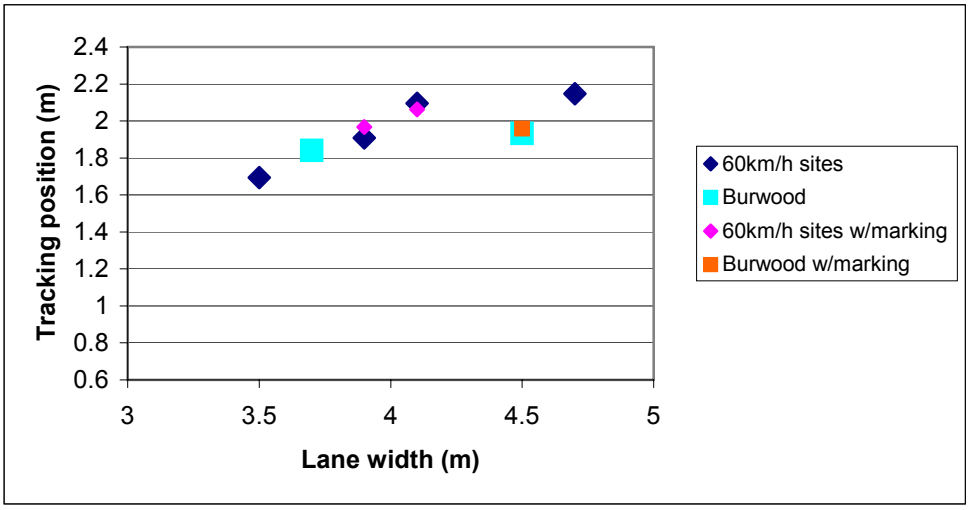
A visual analysis of the survey averages shows that for smaller lane widths, a higher speed limit leads to greater clearances. However, for larger lane widths it appears that the higher speed limit leads to lower clearances.



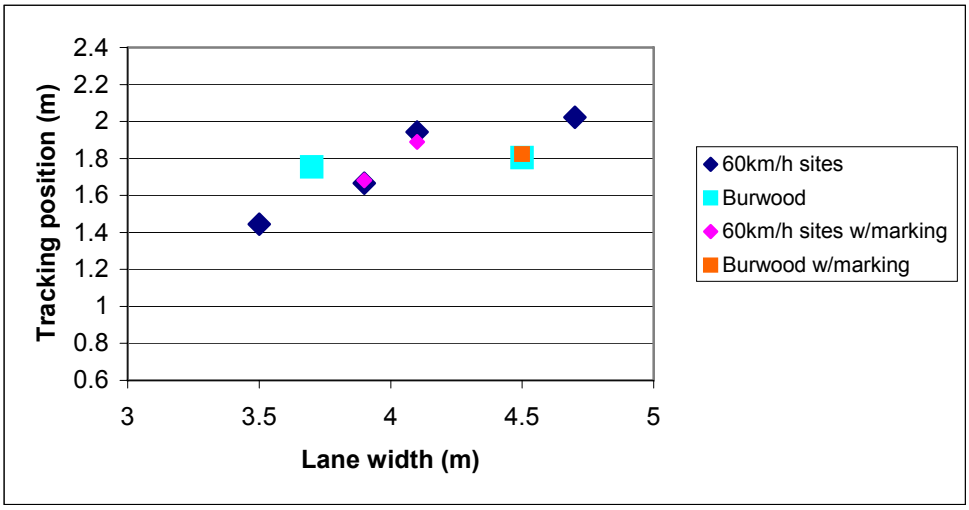
- **Figure 13 Tracking position averages for Category 1 observations**



- **Figure 14 Tracking position averages for Category 2 observations**



- **Figure 15 Tracking position averages for Category 3 observations**



- **Figure 16 Tracking position averages for Category 4 observations**

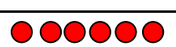
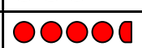
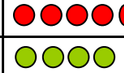
This characteristic could be unique to Burwood Hwy – more investigation is required before we have a clear understanding of the effect of speed limits on clearance.

Appendix A Cyclist Feedback

Date	Location	Daniel	Lachlan	Nick
19/02/2003	Burke 1	Fairly standard, trucks too close	Fine	Better than some streets, buses too close
24/02/2003	Belmore 1	Traffic probably a little closer than Burke Rd, but still OK	Closer than Burke Rd, but not dangerously close	Drivers were a little closer on Belmore, also they were driving faster because of the downhill stretch there. Still didn't feel too unsafe though
2/05/2003	Burwood 1	The cars seemed to be faster and closer than other roads surveyed	About average. Very rarely did a car come close to me. But I Still didn't feel 100% safe as there was no bike line.	Compared to the other two days so far, there were more drivers who drove a bit too close for comfort and the edge of the road was also quite bumpy
16/05/2003	Burke 2	Noticeably better than first ride. More space with the lanes marked.	With the bike symbols was good. I had no problems with cars being too close to me. Apart from one instance where a piece of steel was hanging off the side of a ute and hit me. Luckily it didn't hurt. The bike lane symbols seemed to make a big difference.	With the symbols seemed better than the first time as the cars had an indicator of how much space they should give, however once past the bike they swerved back closer to the kerb.
23/05/2003	Bridge	Cars pretty close and very busy, coming out of the side street and Officeworks.	Good for cycling. The bike lane was effective and I didn't have any problems with motorists. It also seemed like there were lots of other cyclists too, indicating that it was a safe place to ride.	This site was the safest as there was a designated lane and the cars didn't seem to cross it even when there were no bikes riding. There were also no problems entering the road because of the lane.

26/05/2003	**Canterbury**	Bit dodgy. Cars very close and fast at times.	Not too great. Some cars missed me by what seemed like only about 40cm. When trucks drove past me it was not very comfortable. Mostly it wasn't too bad but it is not a good place to ride a bike.	The worst obviously, drivers coming very close when there was no room for them to move over (ie. they didn't slow down behind the bike, they squeezed past).
30/05/2003	**Belmore 2**	(did not respond)	alright, better with symbols	perhaps a little better (ie felt a little safer) with the symbols
23/6/2003	**Burwood 2**	(did not participate)	fine, didn't notice any difference with widened lane	Didn't notice much difference with the widened lane on Monday cars still quite close, parts of the shoulder where we were riding were really rough which didn't help either
30/9/2003	**Burwood 3**	(did not participate)	Better with lane markings, cars kept a good distance, cars also didn't seem to change into the middle lane as much either	(did not participate)

Appendix C Evaluation Frameworks

	Option					
	Different Colour for Existing Regulatory Symbol (eg yellow)	New Advisory Sign	Coloured Pavement	Broken White Edgeline	New Pavement Symbol	Diagonal Lines
Safety						
Clarity and Ease of Understanding of Advisory Status						
Economics						
Practicality						
Sustainability						
Integration						
Overall Assessment (Rank)	4	3	6	2	1	5

Scoring Legend

Beneficial Impacts
Adverse Impacts

* More symbols = larger impact

	Option					
	Different Colour for Existing Regulatory Symbol (eg yellow)	New Advisory Sign	Coloured Pavement	Broken White Edgeline	New Pavement Symbol	Diagonal Lines
Safety	1.5	-3	4.5	6	12	3
Clarity and Ease of Understanding of Advisory Status	-6	-4.5	-6	-6	9	-6
Economics	2.5	4	-3.5	2.5	2	-1
Practicality	0.5	1.5	1	1	1	1
Sustainability	2	2	1	2	2	2
Integration	0.5	3.5	-0.5	3.5	3.5	0
TOTAL SCORE	**1**	**3.5**	**-3.5**	**9**	**29.5**	**-1**

		Options											
		1		2		3		4		5		6	
		Different colour for pavement symbol (eg yellow instead of white)		New Advisory Sign		Coloured Pavement		Broken white edgeline		New pavement symbol		Diagonal Lines	
Evaluation Criteria	**Weighting**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
Safety													
- Cyclist Safety	0.15	Presence of existing pavement symbol in a different colour is likely to be visbile, and will easily be recognised as indicating the presence of cyclists. It is likely to give cyclists a similar amount of safety as currently experienced from the regulatory symbol	1.5	A new advisory sign is unlikely to stand out to private motorists and as such, cyclists may not be afforded with an adequate degree of safety.	-1	A strip of coloured pavement is likely to provide cyclists with a clear designation and other road users will be aware of their presence and as such cyclists would be provided with a relatively safe environment	2.5	A dashed white edgeline will likely have the effect of partially giving cyclists their own space on the road. However, as it is not a solid line, it is more likely that vehicles will cross into this area. There would need to be a sufficient buffer zone between parked cars and the dashed white edgeline.	0.5	A new pavement symbol on the road would be expected to clearly inform all road users of the presence of cyclists. It would be likely to provide a similar level of safety to cyclists as that experienced by the regulatory pavement symbol. However, on its own, it may fail to stand out to other road users.	1.5	There would be a clear area in which cyclists are able to cycle. With other road users made aware of their presence it is likely that cyclist safety will be increased	2
- Safety of other road users such as private motorists and pedestrians	0.15	Private vehicles may feel that cyclists have priority and in a constrained road width may cross over the centre line to keep out of the way of cyclists	-1	Safety of other road users is not expected to change significantly. The new signs may reduce room for pedestians	0	Private vehicles may feel that cyclists have priority and in a constrained road width may cross over the centre line to keep out of the way of cyclists	-1	This option is expected to be relatively safe for other road users. However, with the dashed line partially dividing the road motorists may have the perception that they cannot move into this area when required.	1.5	It is expected that the existing road safety environment for other road users would not change	2.5	Private vehicles may perceive that they are not allowed to cross the lines. In a constrained road width they may cross over the centre line to keep out of the way of cyclists	-1
Clarity and Ease of Understanding of Advisory Status													
- Ease of understanding for cyclists	0.15	Symbol will be widely recognised. However, being the same form as the regulatory pavement symbol there may be confusion as to who has priority	-1	A new advisory sign would need to show clearly that cyclists and cars are to share the lane. However, it is likely that the introduction of yet another sign would simply be confusing.	-0.5	There may be some confusion with the color of the pavement as typically it has been used in combination with the regulatory pavement symbol. Cyclists may tend to think they have priority	-1	Having a broken white edgeline will stand out as being different from the rest of the road markings, but unless it is in conjunction with some other sign/symbol it is unlikely that its purpose will be clear. Furthermore it will likely have the effect of dividing the traffic lane.	-1	As long as the symbol clearly depicted a cycle/cyclist it would be clear that cyclists were to use the route. It would also need to be significanty different to the regulatory sign to avoid any confusion. Both of these requirements are possible and hence such a symbol would be relatively easy to understand	1.5	The diagonal lines on their own would be similar to a median and would not be likely to clearly show that it is a shared cycle/vehicle lane.	-1
- Ease of undertanding for other road users	0.15	Symbol will be widely recognised. However, in being the same form as the regulatory pavement symbol there may be confusion as to who has priority	-1	A new advisory sign would need to show clearly that cyclists and cars are to share the lane. However, it is likely that the introduction of yet another sign would simply be confusing. Furthermore, it would not be as visible to motorists	-1	There may be some confusion with the color of the pavement as typically it has been used in combination with the regulatory pavement symbol. Motorists may tend to think cyclists have priority	-1	Having a broken white edgeline will stand out as being different from the rest of the road markings, but unless it is in conjunction with some other sign/symbol it is unlikely that its purpose will be clear. Furthermore it will likely have the effect of dividing the traffic lane.	-1	As long as the symbol clearly depicted a cycle/cyclist it would be clear that cyclists were to use the route. It would also need to be significanty different to the regulatory sign to avoid any confusion. Both of these requirements are possible and hence such a symbol would be relatively easy to understand	1.5	The diagonal lines on their own would be similar to a median and would not be likely to clearly show that it is a shared cycle/vehicle lane.	-1
Economics													
- Initial cost to implement	0.05	With pavement symbols every 200m, or closer when required, the initial implentation costs will be low	2.5	With advisory signs every 200m the initial implementation costs will be relatively low	2.5	The initial works would be expensive as siginificant lengths of road would have to be marked	-2	This option would be relatively cheap to implement.	1.5	With pavement symbols every 200m, or closer when required, the initial implentation costs will be low	2.5	With a significant amount of road marking required the initial cost would be relatively expensive	-0.5
- Maintenance costs	0.05	As the pavement symbol will be the only indication of an adivsory status, it is important that it is kept clear and repainted on a regular basis.	0	Maintenance costs will be minimal	1.5	Maintainance costs would be quite significant as it likely that after a few years the entire pavement would need to be recoloured.	-1.5	It is likely that maintenance of this option would be relatively cheap	1	As the pavement symbol will be the only indication of an adivsory status, it is important that it is kept clear and repainted on a regular basis.	-0.5	It is likely that maintenance costs would be moderate	-0.5
Practicality													
- Ability to successfully implement	0.05	There are not expected to be any significant issues with implementation	1.5	There are not expected to be any significant issues with implementation. However, depending on the road environment there may be a number of other signs meaning the visibility and effectiveness of the advisory sign is reduced.	-0.5	There are not expected to be any issues with implementation.	1.5	There are not expected to be any issues with implementation	1.5	There are not expected to be any issues with implementation	1.5	There are not expected to be any issues with implementation	1.5
- Ability to implement on all road widths	0.05	In very narrow carriageways the symbol may encroach into the space of private vehicles	-1	Able to be implemented on all road widths	2	There would need to be enough road carriageway width to ensure the colouring did not encroach into the required space of private vehicles.	-0.5	In narrow carriageways where there is parking there would need to be a sufficient buffer zone between the parked vehicles and the dashed white line	-0.5	In very narrow carriageways the symbol may encorach into the space of private vehicles	-1	There would need to be enough road carriageway width to ensure the diagonal lines did not encroach into the required space of private vehicles.	-0.5
Sustainability													
- Encouraging the use of cycles	0.05	It is not expected that there will be a significant increase in the number of cyclists as a result of this option	0	It is not expected that there will be a significant increase in the number of cyclists as a result of this option	0	Potentially more cyclists would use the route	2	It is not thought that more cyclists would use the route with the presence of a dashed white edgeline	0	There will potentiallty be more cyclists using the route as a result of this option	0	It is not expected that there will be a significant increase in the number of cyclists as a result of this option	0
- Long term sustainability of option	0.05	With appropriate maintenance this option would be very sustainable	2	With appropriate maintenance this option would be very sustainable	2	Would not be particularly sustainable	-1	With appropriate maintenance this option would be very sustainable	2	With appropriate maintenance this option would be very sustainable	2	With appropriate maintenance this option would be very sustainable	2
Integration													
- Overall effectiveness of integration into existing road conditions	0.05	Easy and cost effective to implement in most existing road conditions	2	Easy and cost effective to implement in most existing road conditions	2	Relatively easy to implement but has a high cost	1	Relatively easy and cheap to implement in most road conditions	1.5	Easy and cost effective to implement in most existing road conditions	2	Easy and relatively cost effective to implement in most existing road conditions	1.5
- Integration with regulatory markings	0.05	May be confusion as to what pavement symbol has regulatory/advisory status	-1.5	Would integrate well with the existing regulatory pavement symbol markings	1.5	The colouring may confuse people with regard to whether cyclists have regulatory/advisory status	-1.5	Could be readily integrated with regulatory pavement symbol	2	Would integrate well with the existing regulatory pavement symbol	1.5	There may be confusion as to what the lines on their own mean, and as such would not integrate particularly well	-1.5
TOTAL	1.0		5%		18%		-18%		45%		145%		-5%

Scoring Legend:

Very good	+3
Neutral	0
Very poor	-3

		Options															
		1		2		3		4		5		6		7		8	
																No Symbol	
Evaluation Criteria	**Weighting**	**Options**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**	**Description**	**Score**
Visibility	0.5	The painted solid background increases the visibility and highlights the cycle symbol compared to the existing regulatory symbol. The arrow also makes it clear for all road users which way cyclists are moving.	3.0	The thick white lines make this more visible than the current regulatory symbol.	2.5	The colouring of this painted symbol increases its visibility, compared to the white of the existing symbol. However, the non-solid lines decrease visibility.	2.0	The dashed arrow around the cyclist caricature increases the overall size of the symbol and hence makes it more visible. It also provides clarity in regard to cycle direction and positioning on the road. It is proposed that the symbol be white.	3.0	This symbol offers the same level of visibility as the existing regulatory symbol.	2.0	The addition of the two directional arrows above the existing regulatory symbol increases the overall visibility on the pavement and provides clarity in terms of cycle direction	2.5	Level of visibility provided by existing regulatory symbol is satisfactory as a road marking.	2.0	There is no marking and hence no heightened awareness for cyclists.	-3.0
Clarity and Ease of Understanding of Status (i.e. Advisory)	0.5	The 'highlighting' of the existing regulatory symbol is likely to make it seem more dominant and if anything, cyclists will have the perception that they have priority.	-2.0	This is very similar to the regulatory symbol and is only differentiated by the dashed white lines. However, these are likely to suggest to both cyclists and motorists that the lane is to be shared.	1.5	It is likely that the dashed outline will be interpreted as advisory, and that there is no dedicated cycle lane. The yellow marking as shown here may be interpreted as having a legal status, however this option could be modified to be another colour or white.	2.5	This symbol is very different to the regulatory symbol yet still clearly indicates the presence of cyclists. The dashed arrow suggests that it is an advisory marking and also provides some width for cyclists to ride within.	3.0	This is quite different to the existing regulatory marking. However, it is a little unclear what its meaning on the road is.	0.0	The cycle in this symbol is the same as that in the regulatory symbol and this may lead to some confusion amongst road users as to who has priority.	1.5	Recognised as having a legal status which gives the priority to cyclists. This symbol could not be used as the advisory symbol.	-2.0	With no pavement symbol all road users need to be aware of each other. There would be no confusion as to status of pavement cycle symbols as there would just be one.	1.5
TOTAL	1.0		1.0		4.0		4.5		6.0		2.0		4.0		0.0		-1.5

Scoring Legend:

Very good	+3
Neutral	0
Very poor	-3

		Options							
		1	2	3	4	5	6	7	8
									No Symbol
Evaluation Criteria	**Weighting**	**Score**	**Score**	**Score**	**Score**	**Score**		**Score**	**Score**
Visibility	0.5	3.0	2.5	2.0	3.0	2.0	2.5	2.0	-3.0
Clarity and Ease of Understanding of Status (i.e. Advisory)	0.5	-2.0	1.5	2.5	3.0	0.0	1.5	-2.0	1.5
TOTAL	**1.0**	**1.0**	**4.0**	**4.5**	**6.0**	**2.0**	**4.0**	**0.0**	**-1.5**

Scoring Legend:

Very good	+3
Neutral	0
Very poor	-3

		Options							
		1	2	3	4	5	6	7	8
									No Symbol
Evaluation Criteria	**Weighting**	**Score**	**Score**	**Score**	**Score**	**Score**			**Score**
Visibility	0.5	●●●	●●◗	●●	●●●	●●	●●◗	●●	●●●
Clarity and Ease of Understanding of Status (i.e. Advisory)	0.5	●●	●◗	●●◗	●●●		●◗	●●	●◗
Overall Assessment (Rank)	**1.0**	**5**	**3=**	**2**	**1**	**4**	**3=**	**3=**	**7**

Scoring Legend

● **Beneficial Impacts**
● **Adverse Impacts**

* More symbols = larger impact