CYCLE NETWORK AND ROUTE PLANNING GUIDE

Land Transport Safety Authority

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ISBN 0-478-24172-0

ACKNOWLEDGEMENTS

The following consultants contributed to the project:

Paul Ryan of Opus International Consultants, Hamilton, team leader, literature review and drafting.

Roger Boulter, Transport Consultant, Hamilton, literature review and drafting.

Kym Dorrestyn, Consultant, Adelaide, literature review and drafting.

Soeren Underlien Jensen, Atkins Global Consultants, Denmark, peer review.

STEERING GROUP
Tim Hughes (Project Manager) **and Lyndon Hammond,** LAND TRANSPORT SAFETY AUTHORITY
Gerard Burgess, TRANSFUND NEW ZEALAND
Ian Clark and David McGonigal, TRANSIT NEW ZEALAND
Michael Blyleven and Nick Bryan, ENVIRONMENT CANTERBURY
Michael Ferigo, CHRISTCHURCH CITY COUNCIL
Esther Sassenburg, NORTH SHORE CITY COUNCIL
Rachel Algar, MANUKAU CITY COUNCIL
Glen Koorey, CYCLING ADVOCATES NETWORK
Michele Gyde, CYCLE SAFE CHRISTCHURCH (SCHOOL CYCLE EDUCATION)

CONTENTS

GLOSSARY OF TERMS

BUS LANE
A bus lane that cyclists can also use.

CONTRA-FLOW LANE
A lane that permits cyclists to ride against traffic in a one-way street.

CYCLE
A vehicle with two or more wheels and pedals that is propelled mainly by the muscular effort of the rider. It includes bicycles, tricycles and power-assisted cycles with no more than 200 watts total auxiliary power.

CYCLE ADVISORY GROUP
A group of stakeholder representatives that advises on improving cycling conditions.

CYCLE FACILITY
Infrastructure that is cycling-specific, such as cycle lanes, paths and parking.

CYCLE LANE
A lane marked on a road with a cycle symbol, which can only be used by cyclists.

CYCLE NETWORK PLAN
A map of the primary cycle route network (see definition below) and a schedule of the cycle infrastructure projects required to develop it.

CYCLE PATH
An off-road path for cycles. It can be an exclusive cycle path, a shared-use path or a separated path (see definitions below).

CYCLE PROVISION
The provision of satisfactory conditions for cycling, whether or not there are specific cycle facilities.

CYCLING PLANNER / CHAMPION
A road controlling authority employee who is responsible for the day-to-day planning and implementation of cycle provision in the authority's area.

CYCLING POLICY
A general course of action relating to cycling to be adopted by the government or an organisation.

CYCLING SAFETY AUDIT
A formal process to identify factors that could either increase the risk of crashes involving cyclists, or increase the severity of cyclists' injuries in a crash.

CYCLING STRATEGIC PLAN
A document setting out cycling objectives and the actions required to achieve them including a cycle network plan.

DESIRE LINE
A straight line between the origin and destination of a potential cycle trip.

EXCLUSIVE CYCLE PATH
A path that can be used legally only by cyclists.

GRADE SEPARATION
The vertical separation of cyclists by a bridge or underpass across a roadway, railway line etc. It contrasts with an at-grade intersection or level crossing.

HOOK TURN
A right turn a cyclist makes at traffic signals, where they keep left while proceeding straight through the intersection, wait at the far left side for the lights to change, then cross with the side road traffic.

LEISURE CYCLING
Cycling done just for the journey itself, not to get to an activity at the journey's end. Sports and recreation cyclists and cycle tourists do leisure cycling.

LEVEL OF SERVICE
The quality measure of how well conditions provide for road users. For motor traffic it mainly assesses interruptions to free traffic flow. For cycling, other factors seem to be more important such as perceived safety, comfort, and directness of route. Refer to section 9.5

PRIMARY CYCLE NETWORK
The most used cycle facilities, designed mainly for trips across town and between suburbs.

SEPARATED PATH
A path where the section for cyclists' use is separated from the section for pedestrians' use.

SHARED-USE PATH
A path provided for use by both cyclists and pedestrians.

TRAFFIC CALMING
A combination of measures (mostly changes to the road environment) aimed at altering driver behaviour (such as by reducing speed) and improving conditions for pedestrians, cyclists and residents.

TRANSIT LANE
A lane which can only be used by public passenger vehicles, motor cycles, cycles and motor vehicles carrying a specified minimum number of passengers.

UTILITY CYCLING
Cycling done mainly to get to an activity at the journey's end, such as commuting trips to work, education or shops.

ABBREVIATIONS

BCI
Bicycle compatibility index

CDS
(Cycle design supplement). *New Zealand supplement to Austroads Guide to traffic engineering practice: Part 14: Bicycles.* (Transit New Zealand, 2004)

EECA
Energy Efficiency and Conservation Authority

LOS
Level of service (see glossary)

LTCCP
Long term council community plans

LTSA
Land Transport Safety Authority

RCA
Road controlling authority

RLTC
Regional land transport committee

RLTS
Regional land transport strategy

SPARC
Sport and Recreation New Zealand

CHAPTER 1 INTRODUCTION

- Purpose
- Scope
- Guide outline

INTRODUCTION

What provisions should be made for cyclists, and where?

This guide aims to promote a consistent approach to planning the provision for cycling in New Zealand.

1 INTRODUCTION

1.1 Cycle network planning

Cycle network planning is a process of improving community mobility by providing interconnected routes and facilities based on bicycle users' needs (Bach and Diepens, 2000). It aims to provide cyclists with safe, comfortable, direct routes from all origins to all destinations that:

- link to form a network
- retain existing cyclists
- encourage more people to cycle.

1.2 Cycle route planning

Cycle route planning is the organisation of the most appropriate facilities and treatments into a continuous path for cyclists that will take them safely and comfortably for the greater part of their journey (Bach and Diepens, 2000). Facilities will differ depending on the environment through which the route passes, and different types of cyclists will need different types of cycle route (Dorrestyn, 1996).

Cycle route planning aims to provide cycle routes that:

- provide the highest level of service (LOS) for cyclists, including safety, convenience and comfort
- provide operating space to cycle and other users
- minimise conflicts with other users.

(Cumming, Barber, Smithers, 1999; Jensen et al, 2000; Scottish Executive, 1999).

1.3 Purpose

This guide aims to promote a consistent, world's best practice approach to cycle network and route planning throughout New Zealand. It sets out a process for deciding what cycle provision, if any, is desirable and where it is needed.

The guide is intended to help people involved in cycle planning to develop cycle networks that contribute to the outcomes required by the *New Zealand Transport Strategy* and the national walking and cycling strategy. It will also help people preparing regional and local cycling strategies.

1.4 Scope of guide

The guide covers all aspects of cycle network and route planning, with a focus on the role and importance of cycle infrastructure in cycling strategic plans, and on planning for cycling for transport.

It expands on chapter 2 of the *Guide to traffic engineering practice: Part 14: Bicycles* (Austroads, 1999) and complements the New Zealand supplement to that guide *(CDS)* (Transit New Zealand 2004).

The cycle planning approaches and interventions adopted will depend on the circumstances at each location. With this in mind, the guide does not prescribe a single approach or intervention, but presents a variety, along with their advantages, disadvantages and limitations and the circumstances when each would be most appropriate. It recognises that financial, technical and political factors may affect what can be achieved at any particular location or time.

This is not an instruction manual, or a guide for cycling facility design, planning a mountain bike network or preparing cycling strategies. It is a best practice guide to the process of cycle network planning, with tools that may help cycle planners and communities. It does not have the force of law.

1.5 Methodology

The project to develop this guide was managed by the Land Transport Safety Authority (LTSA), as one of the *Road Safety to 2010* strategy projects. Consultants were employed to develop the drafts. A stakeholder steering group (see page 2) guided its development and gave feedback on the various drafts.

The guide's content was informed by a review of international literature on cycle network and route planning. A separate report on this is available on the LTSA website at **www.ltsa.govt.nz** (Opus, 2003).

It is a best practice guide to the process of cycle network planning, with tools that may help cycle planners and communities.

A draft of the guide was released for public submissions before the New Zealand Cycling Conference 2003.

After the final draft was received from the consultants an international expert peer review was performed. The LTSA carried out some final edits.

1.6 Future revision

The guide will be updated as cycle network and route planning knowledge and practice develops. Priorities for research have been developed. The LTSA has already started a project on New Zealand-appropriate methods for assessing the LOS provided for cyclists, while assessing the latent demand for cycling is another area that needs more work.

1.7 Guide and process outline

Figure 1.1 (see opposite) provides an outline of the guide's three main sections:

- The planning and policy context.
- The principles of cycle network planning.
- The cycle network planning process.

1.8 Safer Routes

The development of the Safer Routes programme is another LTSA *Road Safety to 2010* strategy project. Safer Routes applies many of the tools in this guide at a location identified by the community to be a high risk for cyclists (and/or pedestrians). It then develops and implements an integrated package of engineering, enforcement and educational interventions to address locally identified risk factors.

The LTSA is currently trialling Safer Routes in a number of territorial local authorities, and developing guidelines for safe routes facilitators. As part of the ongoing Safer Routes programme LTSA can assist with the funding of facilitators and provision of exert advice. For more information on Safer Routes contact your regional LTSA office.

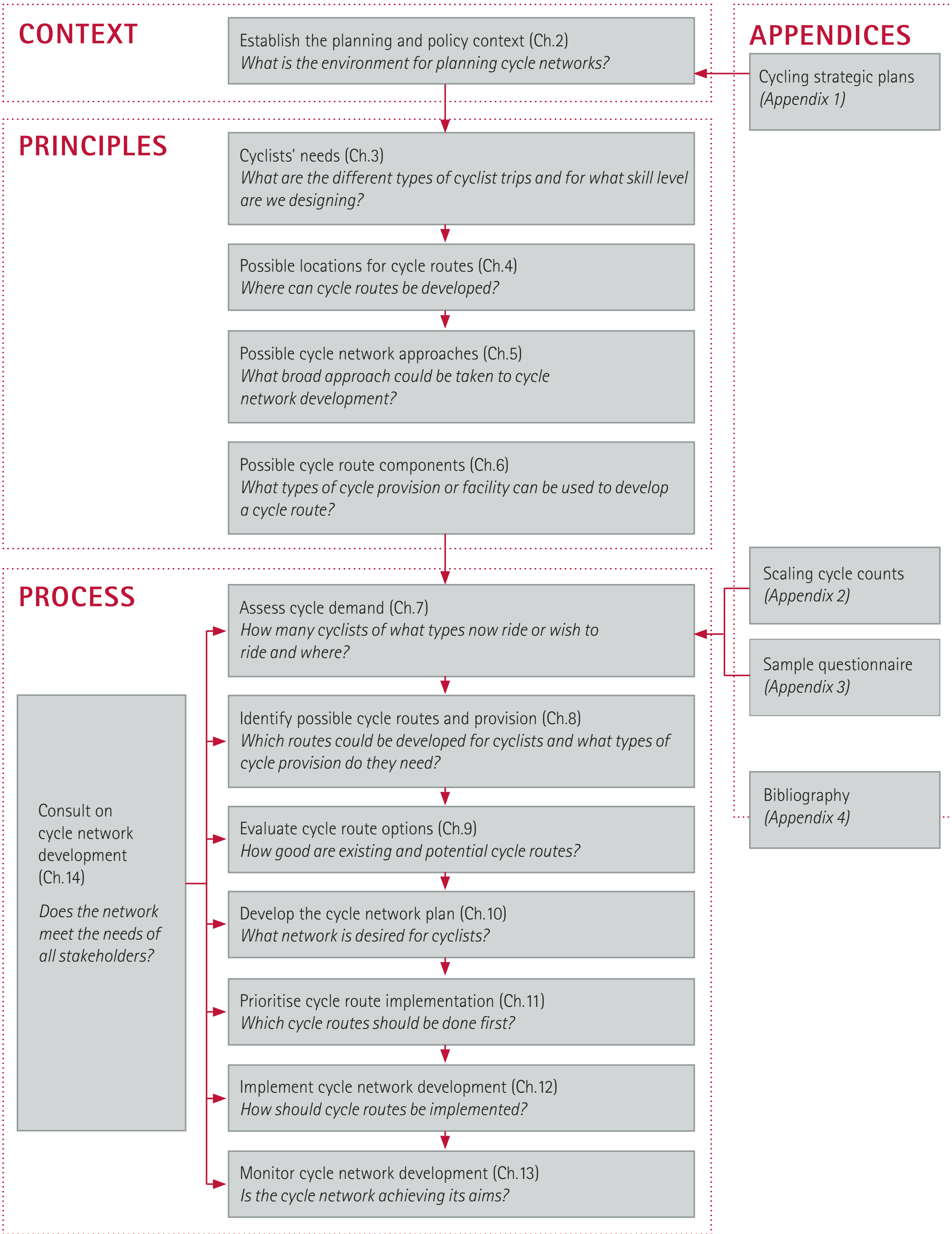
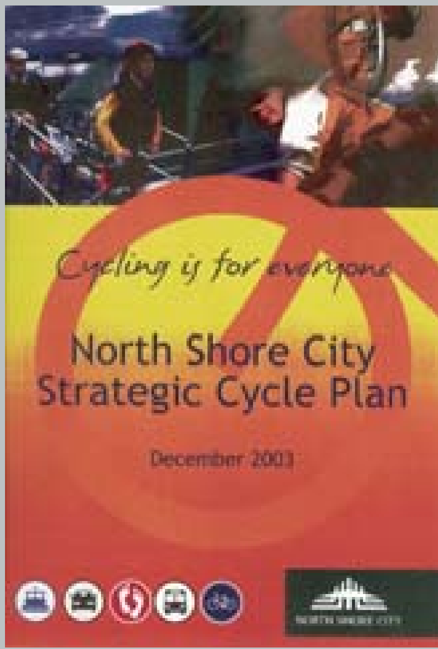


Figure 1.1: Outline of the guide and the cycle network and route planning process



CHAPTER 2 THE PLANNING AND POLICY CONTEXT

- Law, guidelines, strategies
- National and regional transport strategies
- Local authority responsibilities
- Cycling strategic plans – why, what, how?

THE PLANNING AND POLICY CONTEXT

Cycle network and route planning takes part within a legal, transport, social and administrative context – and can't take place in isolation from it.

Those planning for cycling need to understand transport and the law affecting it, plus the variety of government roles, policies and strategies at national, regional and local levels.

This section outlines this larger context, and then discusses cycling strategic plans – why we have them, what they should contain, and how they fit with the bigger picture. Cycle network and route planning is only one part, alongside others, of preparing a cycling strategic plan.

2 THE PLANNING AND POLICY CONTEXT

2.1 Cycling as transport

At its most essential, cycling is a means of transport, and in this respect is no different from the car. In both cases, about three-quarters of trips are for utility (practical, day-to-day) purposes, and one-quarter for leisure (New Zealand Travel Survey, LTSA 2000), with significant variations by location and ages of road users.

Most journeys are short. About two-thirds of all vehicle trips are less than six km (LTSA, 2000), which is an easy cycle ride for most people. Cycling's travel range can be extended by cycle carriage on buses and trains, or secure parking at stations.

Cycling can potentially take place from all origins to all destinations, and is not restricted to a small number of routes.

2.2 Transport and the law

Law includes not only Acts of Parliament, but also common law, which is understood and accepted by everyone and defined by law court judgements.

Common law includes everyone's duty to care for their own safety and to avoid causing harm to others. For example, in a crash we need to establish not only who should have given way, but also whether those involved were trying to avoid danger to themselves and others.

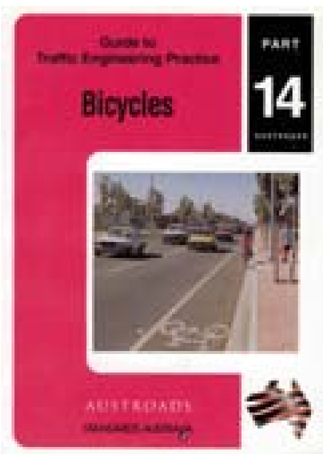
Under common law everyone has the right to travel unimpeded along all public roads, except where legal restrictions have been imposed (for example, prohibiting walkers and cyclists from using motorways). Road controlling authorities (RCAs) are obliged to safeguard this right for all lawful road users, including cyclists.

Legislation includes Acts of Parliament, as well as Rules and Regulations made by people or organisations to whom Parliament has delegated this power (for example, the Minister of Transport for Land Transport Rules). The main laws relating to cycling are found in the Traffic Regulations, which are currently being converted to the *Road user rule* and the *Traffic control devices rule*. In these rules, cyclists are regarded as drivers of vehicles and their obligations are in most respects the same as those of motor vehicle drivers. There are also relevant rules on the use of land under the Resource Management Act 1991 in regional and district plans.

2.2.1 Bylaw powers

Local authorities and road controlling authorities have power to enact bylaws for areas within their responsibility. Bylaws can cover activities on the road (for example one-way traffic and contra-flow cycle movement, speed limits, parking, and restrictions on cyclists' use of some roadways) and off the road (for example restrictions on cycling within parks and reserves).

By 2010 New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system.



2.3 Guidelines

Guideline documents do not have force of law, but are recognised as best practice when adopted by legally responsible bodies, such as RCAs or other government agencies.
This publication is a guideline. The official New Zealand guide to road and path design is Austroads *Guide to traffic engineering practice: Part 14: Bicycles* (1999). Transit New Zealand has prepared a cycle design supplement (CDS), which is the official guide to its application in New Zealand. Also relevant is the New Zealand *Manual of traffic signs and markings, Parts 1 and 2* (Transit New Zealand/LTSA 1998 and 2004).

2.4 National transport strategies

The *New Zealand Transport Strategy* (2002) contains the government's position on transport. Its overall vision is: By 2010 New Zealand will have an affordable, integrated, safe, responsive and sustainable transport system.

Broader objectives include:

- creating an integrated mix of transport modes
- protecting and promoting public health
- assisting safety and personal security
- enhancing economic, social and environmental wellbeing
- ensuring environmental sustainability
- improving access and mobility, including walking and cycling.

Promoting walking and cycling is recognised as one of five priority areas because of its contribution to the strategy's vision and objectives. This priority is now enshrined in the Land Transport Management Act 2003, so Transfund New Zealand now funds the promotion of walking and cycling in a separate output class.

2.5 Regional land transport strategies

Each regional council is required to develop a regional land transport strategy (RLTS) with help from a regional land transport committee (RLTC). RLTCs are required by law to represent a range of road users, and some now include cycling representatives.

Although regional councils do not directly manage the roads, all projects in their regions must take RLTSs into account. RLTSs also carry weight in Transfund New Zealand's decisions on funding RCA projects and packages.

Some regional councils have supplemented their RLTS with a regional cycling strategy.

A New Zealand where people from all sectors of the community choose to walk and cycle for transport and enjoyment – helping ensure a healthier population, more lively and connected communities, and a more affordable, integrated, safe, responsive and sustainable transport system.

2.4.1 National walking and cycling strategy

The draft walking and cycling strategy *Getting there – on foot, by cycle* (October 2003, expected to be finalised during 2004) provides more details. It articulates a vision of: A New Zealand where people from all sectors of the community choose to walk and cycle for transport and enjoyment – helping ensure a healthier population, more lively and connected communities, and a more affordable, integrated, safe, responsive and sustainable transport system.

It sets out a wide range of actions that would make cycling a more attractive mode of travel. Priorities relevant to cycle planning include:

- expand our knowledge and skill base to address walking and cycling
- encourage planning, development and design that support walking and cycling
- provide supportive environments for walking and cycling in existing communities
- improve networks for long-distance cycling
- address crime and personal security concerns around walking and cycling
- improve road safety for pedestrians and cyclists.

The LTSA is preparing a *Pedestrian and cyclist safety framework*, which addresses safety issues.

2.6 Road controlling authorities

RCAs have direct responsibility for the road system. They usually own the roads and public paths, and (often through contractors) construct, improve and maintain them. RCAs have powers to regulate road users' behaviour, for example by banning parking, creating one-way streets and installing traffic signals.

As well as being a local authority, every city and district council is an RCA and Transit New Zealand is the RCA for state highways. In some areas local authorities manage state highways on Transit New Zealand's behalf (for example, Rotorua and Marlborough).

2.7 Other local council responsibilities

Local councils have other roles, besides that of RCA, that affect transport and cycling.

2.7.1 Resource Management Act 1991

Under the Resource Management Act 1991, councils prepare district plans and regional councils regional plans. Both types of plan include rules regulating what may or may not happen.

2.7.2 Reserves Act 1977

Under the Reserves Act 1977, local councils are responsible for managing various types of reserve land.

Off-road cycle paths are often located on recreation reserves. Councils may allow for these in their relevant reserve management plans.

2.7.3 Local Government Act 2002

The main Act governing local councils' activities is the Local Government Act 2002, which includes the power to declare a path a cycle track. Under the Act, councils prepare and consult on annual plans setting out proposed spending during the coming year, and long term council community plans (LTCCPs) outlining spending over the forthcoming 10 years. The public submission processes of these plans may be used to argue for spending on provision for cyclists.

2.8 Integrated transport planning

Integrated transport planning aims to embrace a range of perspectives traditionally covered separately, including:

- a variety of forms of transport (for example car, bus/rail, cycling and walking)
- the relationships between transport and land use
- the contribution transport makes to other economic, social, health and environmental objectives.

This type of planning may become more significant in light of Transfund New Zealand's Allocation Process Review (2003/2004) which encourages integrated proposals. Cycling should be integrated into all transport planning.

2.9 Other government strategies

Actions to promote cycling are implied under other strategies as well, such as those covering energy efficiency, urban design and form, preventive health and environmental protection. Non-transport agencies such as the Energy Efficiency and Conservation Authority (EECA) and Sport and Recreation New Zealand (SPARC) have sometimes taken the lead in significant cycling promotion initiatives. These include EECA's support for school travel plans, projects and organisations, and SPARC's cycle-friendly employer schemes.

Mass cycle rides can be a significant encouragement element for a cycling strategy. (Photo: Roger Boulter)

2.10 Cycling strategic plans

Cycling strategic plans need to address engineering, education, enforcement and encouragement – the four Es (Geelong Bike Plan Study Steering Committee, 1977). This guide focuses on planning for the engineering element of cycling strategic plans.

Appendix 1 provides guidelines on matters recommended for inclusion in cycling strategic plans. Funding is available from Transfund New Zealand for their preparation.

Typically, cycling strategic plans aim to increase the number of cycle trips while reducing cyclist injuries. This appears to be realistic as many cities in the world have achieved it, for example York in the United Kingdom and Portland in the United States. Because traffic dangers deter cycling, improving cycle safety is an essential part of cycle promotion. There is evidence that higher cycling numbers result in a lower crash risk (Jacobsen, 2003).

Reducing traffic volumes and speeds may do more to improve cyclist safety than providing cycling facilities, depending on the circumstances (Institution of Highways and Transportation et al, 1996). Consequently, a cycling strategic plan needs the support of more general traffic and transport strategies (Koorey, 2003).

The quality of provision for cyclists will reflect the commitment to increasing cycling's share of total journeys. Lower quality facilities require more skill to negotiate and may not attract new, less confident cyclists.

2.11 Document hierarchy

Figure 2.1 shows how cycling strategies at regional and local levels relate to some of the other policy and strategy documents referred to in this section.

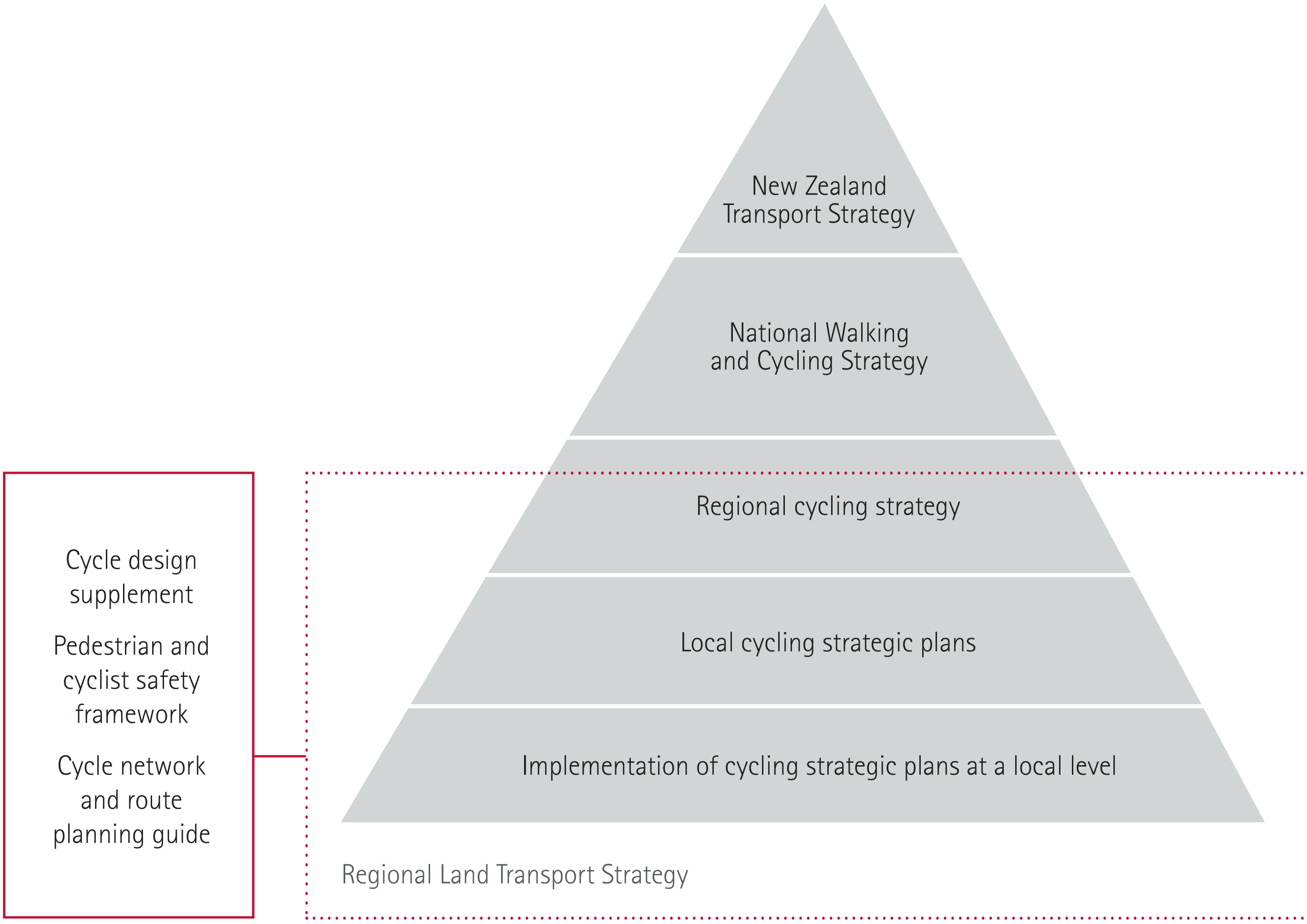


Figure 2.1: Document hierarchy

THE PRINCIPLES OF CYCLE NETWORK PLANNING

A network contains many types of facilities, and the cyclists using it vary in age and cycling skills. Different cyclists have different needs and prefer different types of facilities. Before deciding what provision should be made for cyclists, it is necessary to understand clearly what cyclists need.

Should cycle facilities be provided on-road or off-road? Should they be provided on urban arterial roads, or should these roads be avoided? What provisions should be made for cycling in rural areas?

This part of the guide describes and discusses alternative approaches to network planning and the array of cycle facilities available.

3 CYCLISTS' NEEDS

3.1 Introduction

Satisfying cyclists' needs and providing a high level of service (LOS) for cyclists are vital to maximising cycling. These needs vary according to cyclists' skill levels and their trip purposes. One type of cycle provision may not suit all cyclists using a particular part of the cycle network. This chapter discusses:

- the purpose of cycling
- cyclists' skill levels
- general route requirements
- cyclists' trip types and their preferred route characteristics
- complementary facilities.

3.2 The purpose of cycling

Cycling generally has two main purposes:

- utility
- leisure.

Utility cycling involves making a journey for the main purpose of doing an activity at the journey's end, such as work, education or shopping. Time is often an important consideration.

Leisure cycling is done for the journey itself. Leisure cyclists include sports training cyclists, recreation riders and cycle tourists. They also include children playing on their bikes near their homes.

Cycling for recreation on rural road shoulder, Prestons Road, Christchurch, New Zealand. (Photo: Tim Hughes)

3.3 Cyclists' skill levels

For the purpose of planning, cyclists may be grouped into three skill levels:

- child/novice
- basic competence
- experienced.

3.3.1 Child/novice

These are children and beginner adults. Depending on their age, children have serious knowledge, perceptual and cognitive limitations in relation to roads (Crossing, 1987). They can be unpredictable, do not have a good appreciation of road hazards and are generally unfamiliar with road rules. However, children as young as eight do not pose as high a risk as adolescents as they have a reduced tendency for deliberate risk-taking behaviours.

Novice cyclist, Oriental Parade, Wellington, New Zealand. (Photo: Juliet Rama)

Children receiving cycle training, Wellington, New Zealand. (Photo: Maria Cunningham)

These cyclists most commonly ride to school and shops and for recreation near their homes. This local environment should be safe for them. They cannot safely interact with traffic apart from on traffic-calmed neighbourhood roads. They prefer full separation from other traffic if travelling along busier roads and grade separation or traffic signals for crossing them.

Cycling strategic plans can aim to provide on-road training for novices who have reached about 10 years of age. A good example is the CycleSafe Team at Christchurch City Council.

Similar training for novice adults is also beneficial.

Intermediate school-aged cyclist, Christchurch, New Zealand. (Photo: Tim Hughes)

3.3.2 Basic competence

Cyclists can achieve basic competence at about 10 years of age with appropriate training. Their utility trips generally extend further to intermediate and high schools.

These cyclists can ride on quiet two-lane roads, manoeuvre past parked cars, and merge across and turn right from beside the centreline. They can cope with simple traffic signals and single-lane roundabouts that are well designed to slow through traffic. On busier roads they prefer cycle lanes and facilities at junctions. They are not equipped to interact with faster traffic, multi-lane roads and multi-lane roundabouts. They usually lack the confidence to defend a lane in narrow situations.

Cycling strategic plans should consider whether it is practical to design all local facilities so they are suitable for cyclists of basic competence. If not, more advanced training from about age 13 could be beneficial.

Experienced cyclist, Oriental Parade, Wellington, New Zealand. (Photo: Juliet Rama)

3.3.3 Experienced

These cyclists have usually learnt by long experience how best to interact assertively with traffic .

They typically make longer commuting trips, sports training rides and cycle touring journeys. They do not require specific cycle facilities, just enough room for faster/busier situations. They will defend a lane where there is not enough room, judge the merge across faster multi-lane traffic, use multi-lane roundabouts in most cases (though apprehensively), and will not usually divert to a cycle path.

3.4 General route requirements

Cyclists' routes should provide:

- safety
- comfort
- directness
- coherence
- attractiveness.

3.4.1 Safety

Cycle routes should be safe, provide personal security, and limit conflict between cyclists and others.

Traffic speed and volume affect cyclists' safety. As these increase, it may be more desirable to separate cyclists from motorists. Safe provision at intersections is crucial.

Public lighting and other features that improve personal safety are also crucial.

Cyclists should always have available a convenient route that provides a high level of personal safety. Routes used at night should have lighting.

Cyclists' perceptions of safety are important. Appropriate infrastructure standards and design will help cyclists feel more secure.

Safety — traffic slowed where cycle path crosses minor road — Nelson, New Zealand. (Photo: Tim Hughes)

3.4.2 Comfort

Cycling routes should be smooth, non-slip, well maintained and free of debris, have gentle slopes, and be designed to avoid complicated manoeuvres.

Rain and wind discourage cycling. Measures to reduce their effects and make cycling more enjoyable include:

- considering walls, embankments or suitable hedges next to paths, but being aware of maintaining public surveillance
- paying attention to exposed paths near foreshores or ridges
- providing shelter at critical destinations. (Bach, 1992).

Comfort — path with good surface, some shielding from weather and no motor traffic, Christchurch, New Zealand. (Photo: Kym Dorrestyn)

3.4.3 Directness

Cycle routes should be direct, based on desire lines, and result in minimal delays door to door. Parking facilities should be in convenient locations.

Indirect cycle routes or excessive delays may lead cyclists to choose more direct routes with greater risk. Some cyclists are unlikely to divert to safer routes greater than 10 percent extra in length (Hudson, 1982).

Directness – Cycle bridge over major arterial road, Auckland, New Zealand. (Photo: David Croft)

3.4.4 Coherence

Cycle routes should be continuous and recognisable, link all potential origins and destinations, and offer a consistent standard of protection throughout.

To be recognisable, cycling routes should use consistent standards and design.

Coherence – Separate cycle path becomes cycle lane to continue through signals, Delft, The Netherlands. (Photo: Tim Hughes)

3.4.5 Attractiveness

Cycle routes should integrate with and complement their surroundings, enhance public security, look attractive and contribute in a positive way to a pleasant cycling experience.

Attractiveness – Shared roadway along canal, Delft, The Netherlands. (Photo: Tim Hughes)

3.5 Cyclists' trip types and requirements

For the purposes of cycle planning, cyclist trip types can be grouped into:

- neighbourhood cycling
- commuter cycling
- sports adults
- recreation cycling
- touring cycling.

3.5.1 Neighbourhood cycling

Most neighbourhood cycling involves trips to local schools and shops, and children playing on their bikes. Cyclist provision should therefore be based mostly around the needs of novices.

Speeds are typically lower than 15 km/h. However, busy roads and short lengths of the primary cycle network may still need to be crossed to get to local destinations, and many potential destinations are along well trafficked arterial roads.

The highest priority is ensuring a safe environment for children and novices in their local streets and around shops and schools.

These cyclists prefer:

- the highest degree of safety
- comfort and personal security
- low traffic speeds and traffic volumes
- a good separation from traffic when local destinations require them to travel busy roads
- minimal gradients
- facilities for crossing busy roads, such as traffic signals
- secure parking at destinations
- good lighting for evening trips
- screening from weather and wind integrated with the surrounding landscape design.

3.5.2 Commuter cycling

Most commuter trips are done by high school students or adults commuting to work and tertiary education. However, for the purpose of this guide they include any longer-distance utility trip.

For most of their length these trips are on arterial roads or other primary cycle routes. Regular commuters generally ride at speeds of 20 to 30 km/h. The *New Zealand Travel Survey 1997/98* (LTSA, 2000) indicates the median trip length for commuting cyclists is about five km. Most will choose a faster route at the expense of higher perceived safety, comfort and attractiveness. They are the main users of the primary cycle network.

It is important to note that designs based on ensuring the repeat business of current, more experienced commuters may not attract new users with less confidence. As far as practical, across-town cycle facilities should cater for cyclists of basic competence, while maintaining the qualities valued by more experienced commuters.

These cyclists prefer:

- high-quality road surfaces
- direct and coherent routes
- minimal delays
- facilities that give them their own space
- intersections that minimise conflicts with other traffic
- good lighting for evening trips
- secure parking at or very close to destinations
- facilities for changing clothes, lockers and showers.

3.5.3 Sports adults

Sports adults often travel at speeds higher than 30 km/h. They are confident cyclists and prepared to claim their road space. They generally cycle over long distances, mainly along urban arterial or rural roads, and may seek challenging terrain. They often travel in groups of two or more and like to ride two abreast.

These cyclists prefer:

- high-quality road surfaces
- minimal delays
- physically challenging routes and demanding gradients
- generous road widths.

3.5.4 Recreation cycling

Recreation cyclists ride mainly for leisure and place a high value on enjoying the experience. They are usually less constrained by time and vary widely in skill and experience.

Popular recreation cycling destinations include routes along rivers, coasts and reserves, as well as attractive routes with low traffic volume and speed.

These cyclists prefer:

- comfort
- good surfaces
- minimal gradients
- a high degree of safety and personal security
- routes that are pleasant, attractive and interesting
- screening from weather and wind
- parking facilities where they dismount to use facilities or visit attractions on the journey.

3.5.5 Touring cycling

Touring cyclists travel long distances carrying camping gear and provisions. They are often experienced and travel in pairs or groups.

These cyclists prefer:

- routes that are, or lead to, pleasant, attractive and interesting locations
- generous roadside shoulders
- high-quality road surfaces, although some may seek journeys on lightly trafficked back roads.
- rest areas – water, toilets, shelter.

3.6 Complementary facilities

3.6.1 General

Cycling planning needs to consider the whole journey. All cyclists need to store or park their bicycles securely. For other than short local trips, they may need to change clothes, have a shower and store items. For longer recreational journeys toilets, clean water and attractive resting places are important.

Such facilities will often benefit people other than cyclists. For example, rest areas could benefit motorists and pedestrians, and changing areas, lockers and showers at a workplace could benefit lunchtime joggers.

3.6.2 Secure bicycle parking

All journeys require secure parking at each end. Most people will not cycle if they cannot secure their bicycle at their destination or public transport terminal (or take the bike with them on public transport).

The type of parking will depend on the need for security and convenience. The most common is the ability to lock cycles to a cycle stand. Older cycle-parking stands that support the bicycle by one wheel offer inadequate security and weather protection, and can easily cause wheel damage.

Choice of parking facility

Three types of cycle parking are recommended:

- stands
- enclosures
- lockers.

Stands

Stands are short-term parking devices that can be located in almost any position. They are suitable outside shops where there is a high degree of passive security. The frame and wheels of the cycle are locked to the rail.

Cycle stands – Christchurch, New Zealand. (Photo: Neil Macbeth)

Hi-tech secure enclosure, Odense, Denmark. (Photo: Tim Hughes)

Enclosures

Enclosures are a communal compound, generally at workplaces, where there may be a large number of cyclists.

As a longer-term parking option often located away from the public eye, enclosures should be protected from the weather and have a high degree of security and an appropriate form of access control. Swipe cards are often used for access. Within the compound, stands are generally installed to control internal parking and provide additional security. It is sometimes appropriate to require users to sign a contract to ensure they understand their obligations.

Bike lockers, Bielefeld City Council, Germany. (Photo: Tim Hughes)

Bike lockers

Bike lockers are for individual cycles and are used where the highest security level is needed. They are mostly used for long-term parking.

Lockers are sometimes provided at public transport interchanges. As with enclosures, there are numerous access control choices, including coin-operated locks. Lockers can also be used to store cycling equipment such as helmets and other personal items.

Changing room with showers and lockers, Henry Deane building, Sydney, Australia. (Photo: Tim Hughes)

3.6.3 Other end-of-trip facilities

Some situations require a conveniently located clothing change area.

For example, cyclists travelling distances more than 5 to 10 km often wear cycling clothes to cope with the build-up of body heat and perspiration and the need to move freely while cycling (although whether they need to change depends on the trip's purpose and the destination activity, for example if it involves wearing formal clothing). In wet weather, cyclists travelling any distance may need protective clothing.

Baggage lockers are also needed at workplaces and transport interchanges, as modern cycles have numerous detachable items such as seats, lights and pannier bags but no lockable space in which to store them. Cyclists also appreciate clothes-drying facilities or places to hang wet clothes and towels to dry.

Showers can also be important. It has been determined that more than 80 percent of cyclists who commute to a central business district, and travel more than 10 km, require shower facilities (Adelaide, Australia. Dorrestyn, 1995).

3.6.4 Trip facilities

Recreation and touring cyclists often undertake long trips and consequently have special requirements.

Urban recreation cyclists using reserves and similar resting places need drink fountains and toilets, typically at five km intervals.

Touring cyclists need rest areas at about two-hour (30 to 40 km) intervals. These should include water supply points, shelter from the weather, tables and toilets. They also need access to shops for provisions, and to phones in emergencies. Such facilities will often be available in towns along routes.

Good examples of remote rural rest areas include Kawatiri Junction between Nelson and Westport, and Lyell in the Buller Gorge. Rural townships are ideal locations for rest areas.

Rest area with toilets, water and shelter, Waiau township, North Canterbury, New Zealand. (Photo: Tim Hughes)

3.7 Summary

Table 3.1 summarises the relevance of cyclists' needs to cycle planning. It is necessarily broad and subjective, and individual cyclists will vary. Interpret the table with caution, and use your own judgement.

	CYCLIST TYPE	NEIGHBOURHOOD	COMMUTING	SPORTS	RECREATION	TOURING
	Cyclists' possible cycling objectives	To shops, school, or riding near home	To get to their destination efficiently	To be physically challenged	To enjoy themselves and get some exercise	To see and enjoy new places and experiences
NETWORK/ROUTE REQUIREMENTS	CRITERIA					
Safety	Personal security (good lighting etc)	🚲🚲🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲
	High degree of safety	🚲🚲🚲🚲🚲	🚲🚲🚲	🚲	🚲🚲🚲🚲🚲	🚲🚲🚲
	Separated from busier/faster urban traffic	🚲🚲🚲🚲🚲	🚲🚲🚲	🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲
	Rural road shoulders or paths	🚲🚲🚲🚲🚲	🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲
Comfort	Screening from weather and wind	🚲🚲🚲	🚲🚲🚲🚲		🚲🚲🚲	🚲
	High-quality riding surfaces	🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲	🚲🚲🚲
Directness	Direct routes	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲		🚲🚲🚲
	Minimal delays	🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲	🚲🚲
Coherence	Continuity	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲	🚲🚲🚲🚲🚲
	Sign-posted; recognisable	🚲	🚲🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲
Attractiveness	Pleasant and interesting routes or destinations	🚲🚲🚲	🚲🚲	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲
	Physically challenging routes or grades			🚲🚲🚲🚲🚲	🚲🚲	
Complementary facilities	Parking facilities located near destinations	🚲🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲	🚲🚲🚲🚲	🚲🚲
	Security of bicycle parking	🚲🚲🚲🚲	🚲🚲🚲🚲🚲	🚲🚲	🚲🚲	🚲🚲🚲🚲🚲
	Showers, baggage lockers		🚲🚲🚲🚲			🚲🚲
	Water, toilets, shelter, shops, phones	🚲	🚲	🚲	🚲🚲🚲🚲🚲	🚲🚲🚲🚲

Legend: 🚲 minimal benefit, 🚲🚲🚲 moderate benefit, 🚲🚲🚲🚲🚲 most benefit

Table 3.1: The relative importance of network or route criteria to different cyclist groups

4 POSSIBLE CYCLE ROUTE LOCATIONS

4.1 Introduction

Cycle networks are made up of interconnected routes and facilities. This chapter describes potential locations for cycle routes and discusses their advantages and disadvantages.

ROADS

- State highways
- Urban arterial roads
- Urban backstreets
- Urban off-road paths
- Rural arterial roads (includes state highways)
- Rural secondary roads

PATHS

- Operating railways
- Disused railways
- Watercourses
- Foreshores
- Reserves and parks
- Other locations
- Public transport

4.2 State highways

State highways are a special class of arterial road of national importance. They are managed by Transit New Zealand and include motorways, expressways, urban arterial roads and rural highways.

State highways form the main spine of the national road network. They are used by all road users, particularly heavy transport vehicles, and often carry high volumes of traffic.

Urban and rural state highways are an important part of the cycle network. This makes it important that state highways have appropriate cycle provision that is integrated with the cycle provision on other roads. This requires co-ordination between Transit New Zealand and other RCAs. Transit New Zealand should be involved at an early stage in planning any networks that include state highways.

Transit New Zealand prohibits cycling on motorways under the Transit New Zealand Act. However, it sometimes permits cycling in the motorway corridor, but off-road.

Cycle path by north-western motorway, Auckland, New Zealand. (Photo: David Croft)

4.3 Urban arterial roads

Description

Arterial roads are the main roads in an area. Their main function is to provide for through-traffic rather than access to adjoining properties, but many important destinations are found along them.

Minor arterial roads, with lower traffic volumes and speeds, are typically single lane each way and can usually be adapted to provide for cyclists of basic competence both between intersections (called mid-block) and at intersections.

Major arterial roads are busier and faster, and typically have multiple lanes. They are not appropriate for cyclists of basic competence unless they have more effective separation and facilities to turn right, such as hook turns.

Rifle Range Road, Hamilton, New Zealand. (Photo: Tim Hughes)

Advantages

Arterial roads are generally well used by cyclists and have several benefits for those experienced and comfortable enough in using them. They need to be made as safe as possible.

Most arterial roads are flatter than surrounding local roads and have better surface conditions and maintenance standards. They are coherent and direct, and intersections favour the major flow of traffic.

Arterial roads often have safety advantages for competent cyclists because of fewer side roads and driveways and because major intersections are controlled.

Disadvantages

High traffic volumes and speeds make arterial roads unattractive for less confident cyclists and those riding for pleasure.

Cyclists are more exposed to traffic fumes on these roads, although tests have shown they inhale less air pollution than car occupants (Koorey 2004).

Even where cycle lanes are provided, urban arterial roads are unsuitable for children and novices until they achieve basic competence.

The main constraints to developing cycle routes on arterial roads are insufficient space at intersections, parking demands, and conflict with adjacent commercial activities. The trade-offs may involve politically unpalatable decisions.

Recommendations

Arterial roads will be used by many cyclists and will need cycle provision aimed as far as possible at cyclists with basic competence.

Alternative routes merely supplement the arterial routes and rarely eliminate the need for cycle provision on the latter.

Wherever possible, arterial roads should be planned with cycle facilities from the outset – or retrofitted to bring them up to best practice standard.

4.4 Urban backstreets

Description

Many cyclists undertaking inter-suburban trips prefer quiet routes, especially if they are not confident mixing with busy traffic. Local or collector road routes can provide this as long as they form a coherent pattern. Commuter cyclists will use them only if they are as convenient as the most direct route.

Advantages

Grid-based road systems, characteristic of older cities, lend themselves to backstreet cycle routes.

Backstreets are more readily available than off-road paths and do not require extra land, unless there are missing links that obstruct direct routes.

As destinations are served directly from these routes, they can enable cyclists to avoid particularly daunting arterial roads. They can also offer a lower-stress and enjoyable cycling experience owing to the streetscape and other attractions, and can be quite suitable as part of a leisure or tourist route.

Disadvantages

To attract significant numbers of cyclists, backstreet cycle routes need to be safer and more convenient than the arterial road network, but this is rarely possible. Compared with arterial roads, these routes usually have more hazards from side roads, driveways, parked cars and give-way requirements at intersections with busier roads.

Crash records on backstreet routes appear to be no better than those on arterial roads (United Kingdom Government, 1995).

Backstreet route terminates into cycle only path crossing arterial road at signals, Cambridge, United Kingdom. (Photo: Tim Hughes)

Recommendations

Use backstreet routes where they are safer and more convenient than the arterials they parallel.

Use backstreet routes in dual networks to give a choice for those who prefer them.

Pay careful attention to intersections between backstreets and arterial roads. Traffic signals may be necessary.

Consider traffic calming these routes.

Signpost them well.

4.5 Urban off-road paths

Description

These are paths totally separated from roads, usually through parks and reserves

Advantages

The perceived safety of urban off-road paths is high owing to the absence of conflicts with motor vehicles, so they are attractive to less confident users and relatively safe for novice cyclists.

Most cyclists prefer a traffic-free environment and will divert to enjoy one. These paths also encourage new trips, particularly by recreational riders and neighbourhood cyclists. They also benefit walkers, joggers, scooters, parents with prams, skateboarders, etc.

Off-road cycle link, Guildford, NSW, Australia. (Photo: Tim Hughes)

Disadvantages

Cyclists have poor perceptions of personal security on urban off-road paths, particularly at night and when there is little use. These paths must be well lit and need to be clearly signposted, or only knowledgeable local cyclists will be able to find their way.

Like backstreet routes, the key safety issue with urban off-road paths is how they connect to or cross roads. Traffic controls and traffic calming are likely to be required.

Without a high design standard they can be less safe than the roads they parallel.

Recommendations

Urban off-road paths are especially recommended where they provide a direct, safe and personally secure alternative to an intimidating arterial road.

Use them where they can provide quality alternatives in dual networks (see section 5.4).

Pay careful attention to intersections between paths and roads. Traffic signals may be necessary.

Pay attention to design quality and the LOS to both cyclists and walkers.

4.6 Rural arterial roads

In New Zealand's rural areas, cyclists rarely have any alternative but to use the same road system as motorised traffic. State highways are often the only suitable routes between settlements.

Because this traffic is fast, a high proportion of rural cyclist crashes involves deaths or serious injuries. Cyclists particularly benefit from a sealed road shoulder. Separate paths have even greater safety benefits on rural roads, so their feasibility should always be considered. Narrow rural bridges are a particular hazard.

Path beside major rural highway, State Highway 1, north of Plimmerton, New Zealand. (Photo: Tim Hughes)

4.7 Rural secondary roads

Rural secondary roads can provide a coherent route and be an excellent cycling alternative to more heavily trafficked rural arterials or state highways.

They can also offer a better cycling experience than major roads, particularly for touring cyclists.

Even unsealed secondary rural roads may be adequate, as in some cases cyclists prefer them to adjacent sealed roads with heavy traffic.

Secondary rural road, Baden, Switzerland. (Photo: Kym Dorrestyn)

4.8 Operating railways

Description

Some very useful cycle routes can be developed beside operating railways.

Cycle path beside main trunk railway, Fendalton, New Zealand. (Photo: Tim Hughes)

Advantages

Operating railways are invariably direct and relatively flat. They are also often aligned with central business districts and may provide the shortest route from outlying suburbs to a business centre.

Disadvantages

It can be difficult to accommodate cyclists at tunnels, underpasses, bridges and obstructions caused by electrical and other rail infrastructure.

Public safety near railways is also a concern, and appropriate barriers are required.

Rail-side environments are typically neglected and unattractive, with landscaping needing upgrading

4.9 Disused railways

Description

Disused railways are mainly found in rural areas and provide important opportunities for touring cyclists. The Otago Central Rail Trail is an example. Those in urban areas, such as the Nelson-Richmond Railway Reserve, can cater for everyday utility and recreation trips by cyclists and pedestrians.

In a worldwide trend over the past decade, old railway reservations have been secured for recreation or tourism by cyclists and others. Developments like these require specialist expertise, and specific organisations (such as Sustrans in the United Kingdom and Rails to Trails in the United States of America and Australia) have often been established for this purpose.

Ideally, rural routes provide a cycling experience lasting at least several days. Their potential is enhanced by accommodation at regular intervals, practical facilities such as toilets, rest areas and water, servicing opportunities or arrangements, and transport assistance at principal connection points.

Some overseas examples have been highly successful, using public art and interpreting the local history of the route. Some of these have attracted very high numbers of cyclists and walkers.

Otago Central Rail Trail, Otago New Zealand. (Photo: DOC Otago/Gilbert van Reenen)

Advantages

Cycle routes on disused railway corridors are usually relatively flat and direct.

They have significant value as icons of cycling, raising its profile among the general non-cycling public.

Rail trails in rural areas can have an economic benefit. They bring cycle tourists into areas not frequented by motorised tourists. Cycle tourists also take less luggage and so spend more locally to meet their needs. (Hillman and Grimshaw, 2000).

Disadvantage

Their isolated nature means disused railways can only be one element in an urban or rural cycle route network.

4.10 Watercourses

Routes adjacent to watercourses are often picturesque, relatively flat and therefore well used as recreational cycling routes, particularly in urban areas.

If they provide access to central business districts, they are also popular commuter routes. In this case, care should be taken to avoid meandering, indirect paths. They tend to also attract pedestrians, so conflicts between pedestrians and cyclists need to be considered.

Floating cycle path, Yarra, Melbourne, Australia. (Photo: Tim Hughes)

4.11 Foreshores

Paths along the coastal foreshores of cities and next to lakes and harbours are often popular for leisure cycling and can offer unsurpassed riding experiences. Perth and Melbourne in Australia offer extensive foreshore routes. However, establishing foreshore routes often generates significant controversy.

Generally, foreshore paths are located to provide attractive views for cyclists. However, strong coastal winds may dictate situating them behind dunes.

Foreshore cycle path, Oriental Parade, Wellington, New Zealand. (Photo: Juliet Rama)

4.12 Reserves and parks

Reserves and parks are popular cycling environments.

Ideally, these cycling routes need to be several kilometres long to provide a meaningful cycling experience. Alternatively, important links can be established through reserves and parks, which enhance the directness or coherence of a backstreet cycle route.

Shared path through Jellie Park, Christchurch, New Zealand. (Photo: Tim Hughes)

4.13 Other locations

- Undeveloped transport corridors
- Dedicated bus lanes or corridors
- Water and sewerage easements
- Power line corridors
- Conservation land tracks
- Redundant road formations

Bicycles parked at railway station, Cambridge, United Kingdom. (Photo: Tim Hughes)

Bicycle rack on light rail, Portland, United States of America. (Photo: Tim Hughes)

4.14 Public transport

Public transport extends cyclists' travel range. Buses, trains, ferries and planes could be considered part of the cycle route network, and links to public transport should be recognised in the cycle network plan.

Links to public transport can be critical to cyclists:

- to ensure the viability of longer trips, especially for cycle tourists
- in hilly terrain
- where there are poor, hazardous or non-existent road options
- where cycling is prohibited, for example at some road tunnels or bridges
- as part of a leisure experience.

The potential for multi-mode travel involving cycling is demonstrated in The Netherlands, where 35 percent of train travellers cycle to the station (MTPW and WM, 1992).

The viability of such links depends on appropriate:

- cycle access at each end of the journey
- cycle storage in transit
- cycle parking at each end of a journey if storage in transit is not possible, or where a key destination is adjacent to a transport interchange
- transit or storage costs.

5 POSSIBLE CYCLE NETWORK APPROACHES

5.1 Introduction

This section describes five approaches to developing a cycle route network:

- every street
- roads or paths
- dual networks
- hierarchy approach
- needs approach.

5.2 Every street

Every street is a bicycle street (Geelong Bikeplan Study Steering Committee, 1977). Cyclists' trip origins and destinations are as complex as those of car drivers, and they use all streets to access activities beside them. Whether or not such streets have specific cycling facilities, cyclists' needs must be considered. This principle applies to all approaches to network planning.

If all streets and intersections provide quality cycling conditions, it is not necessary to provide for primary cycle routes. In practice, roads are arranged in a hierarchy so that longer-distance traffic is concentrated on higher-standard routes. This is done for efficiency and to manage traffic effects on the enjoyment of adjoining land and vice versa. This usually requires a similar arrangement of provision for cycling.

Cycle lanes separated by interrupted kerb, Utrecht, The Netherlands. (Photo: Tim Hughes)

5.3 Roads or paths

A fundamental issue in cycle planning is the degree to which cycle facilities will be segregated from motor traffic. There are several kinds of separation, such as:

- isolated paths
- paths next to roads separated by kerbs, islands or nature strips
- marked space on the roadway, such as cycle lanes and road shoulders
- fully shared mixed road space.

Section 6 discusses the detailed merits of each in more detail.

While primary cycle networks may be based on one type of facility, most cycle networks contain a mixture of different facility types.

5.3.1 Segregated networks of cycle paths

It is only practical to consider a fully segregated primary cycle network when planning new suburbs and townships.

The aim of such networks is to provide pleasant, off-road cycle paths free of conflict from motorised traffic that serve all areas. An outstanding example is Houten, a satellite town of Utrecht in The Netherlands, where 16 neighbourhoods are accessed by car from a fast circumferential ring road. Motor vehicles can only travel between zones via the ring road. Within neighbourhoods, cyclists and motorists share the use of slow-speed (30 km/h) streets. Neighbourhoods are joined by a spine of cycle and walking paths that provide much shorter routes than for motor traffic. As a result, 44 percent of trips less than 7.5 km long are made by bicycle and 23 percent by walking. Traffic crash risk is half that of comparable towns.

Cycle path with right of way at intersection, Houten, The Netherlands. (Photo: Tim Hughes)

Other examples of full segregation have not been so successful. Milton Keynes (United Kingdom) suffered from sub-standard path design that has a poor safety record, and has failed to achieve higher modal share by cycling (Franklin, 1999). Canberra's system also failed to live up to the expected benefits with only three percent of trips to work made by bicycle. This is largely due to a high quality of provision for cars and a lack of directness and coherence in the cycle path network for utility cycling. Canberra is now retrofitting a primary cycle network to the arterial roads.

Cycle shelter near bus stop and underpass under ring road, Houten, The Netherlands. (Photo: Tim Hughes)

5.3.2 Road-based networks

Land use in already-existing towns makes it impractical to develop an off-road path network, so cycle networks are based around the established network of (mostly arterial) roads. There remains the issue of whether to provide a physically separated path beside the roadway.

Places such as Sweden, and Copenhagen in Denmark, have made an expensive commitment to redesigning arterial roads to provide cycle paths on berms behind relocated kerbs. More recently, and where there has not been enough funding to build cycle paths, some European towns have tried cycle lanes as an interim measure and found them successful.

5.3.3 General considerations

Many factors influence whether roads or paths will best suit cyclists' needs. For example:

- increased segregation from motor traffic is usually accompanied by increased interference from pedestrians, pets, skateboarders, slower cyclists etc
- one choice is not inherently safer than another; both can be hazardous and both require high-quality design to achieve safety – 'the devil is in the detail'. Paths tend to be safer between intersections as long as there is room for adequate design and minimal crossing-driveway traffic
- cycling through a junction on the roadway is generally safer than from a path. Junctions between paths and busier roads generally require traffic calming or signals
- at junctions between paths and roads, New Zealand law requires cyclists on the path to give way, which reduces cyclist LOS
- geometric design standards for roads are often higher than for paths
- it is incorrect to suggest that roads can only satisfy commuters' needs, or that paths cannot satisfy commuter cyclists' needs. Most leisure cycling takes place on roads, and many commuters enjoy well located paths
- a road is not necessarily less expensive to maintain but will often benefit through existing pavement management systems
- it is usually easier and less expensive to accommodate the needs of commuter cyclists on roads than on separate paths
- the freedom from traffic danger and fumes brings obvious benefits for recreation cycling and novices (Dorrestyn, 1996a).
- it is difficult to provide a coherent and direct path system that is as convenient for commuters as the arterial road network
- where origins and destinations are on the same side of an arterial road, a two-way cycle path means cyclists don't have to cross the road twice to get there. However, such two-way paths are generally not recommended.

5.3.4 Relative advantages

Subject to appropriate design standards being achieved, roads generally have the following advantages over paths.

They are:

- direct
- coherent
- convenient
- efficient
- available everywhere

and also:

- have established intersection controls
- serve well the needs of experienced cyclists
- have high levels of surveillance and therefore personal security.

Between intersections, isolated paths generally have the following advantages over roads. They have:

- no motor traffic
- slower speeds
- low stress
- an attractive environment

and also:

- provide extra links that advantage all cyclists
- serve well the needs of novice/child cyclists.

Depending on the circumstances and design detail, there is usually no clear advantage between roads and paths in relation to:

- safety
- conflict with other users
- expense
- maintenance.

5.4 Dual networks

Description

Dual networks provide two different types of cycle route network – for instance, one based on urban arterial roads, the other comprising cycle paths or backstreets.

Dual networks are sometimes provided within one road reserve. For example, a cycle path may be appropriate where it provides a short link for primary school aged children near shops or a school, even though it is beside an arterial road with cycle lanes.

A rural road may have a sealed shoulder suitable for experienced and sporting cyclists, but a path may also be provided for less experienced cyclists.

Dual path and lane facility, North Parade, Christchurch, New Zealand. (Photo: Tim Hughes)

Advantages

Some cyclists value off-road and backstreet options more than others. By providing choice, each can choose what suits them.

Even experienced cyclists will value more pleasant alternatives as long as they are still direct. As a rule of thumb, a 10 percent extra journey time has been suggested as sometimes acceptable (Hudson, 1982).

Disadvantages

Where a dual network is provided within one road reserve, motorists may not expect cyclists to be riding on the road as well as on a path. This can compromise safety, especially when crossing driveways and side roads.

Dual network provision also costs more and may be seen politically as over-supply, especially if an element involves a significant difficulty or cost (financial, or to other road users).

Recommendation

Dual networks should be considered where the extra cost is outweighed by the benefits to cyclists.

If only one network can be funded, the LOS provided by each option to the different cyclist groups should be assessed. Consultation with cyclists over the choice will be important.

Having a path next to a roadway should not automatically exclude cyclists from using the road instead. On-road bans should only be instigated after assessing whether the paths and roadway meet the needs of all users in terms of technical standards. Other factors to consider include:

- the potential for delay and confusion at intersections and driveways
- the adequacy of sight distances and shoulder or lane widths
- the adequacy of the path condition and width
- the potential for conflict with other path users
- the relative LOS for cyclists of different skills.

5.5 Hierarchy approach

Description

Cycle routes are sometimes assigned to hierarchies based on trip length and user type. For example, cycle routes in regional or district networks may be classified as regional, inter-urban or tourist, while cycle routes in a large urban area may be classified as principal, collector or local.

Principal routes are for longer-distance movement, are direct with minimal delays and may even be separated from motor traffic to provide a 'motorway' LOS for cyclists. Collector routes distribute cycle traffic between the principal routes and local origins and destinations (Cumming, 1996).

Some urban cycle route hierarchies aim to provide a designated cycle route within 100 m of each home (such as in Delft, The Netherlands).

Advantages

Hierarchies can be used to assign implementation priorities (so that routes higher in the hierarchy are implemented first) and can be linked to design standards (so that more important routes provide a better LOS).

Disadvantage

A cycle route hierarchy will not work if using it involves significant detours.

Recommendation

Consider using cycle route hierarchies for setting target design standards, LOS and implementation priorities.

5.6 Needs approach

This approach involves choosing the option that best provides for cyclists' needs in each situation.

It aims to achieve the best results for cyclists and other stakeholders within the context of all the prevailing opportunities and constraints. It may include any of the options or locations in this guide, as well as dual provision over some sections if it is needed and feasible.

When deciding on facilities that best meet cyclist needs, it is important to remember that each situation is different. Space limitations, cost and other constraints usually dictate one solution over another.

This guide recommends comparing the route options for each situation on their merits, and over the following pages provides processes and tools for developing, evaluating and comparing these options. Note that facilities within an area should be consistent so that users know what behaviour is expected of them, and so they can reliably predict the behaviour of others.

Recommendation

Adopt the needs approach, but aim for consistent facility standards.

5.7 General recommendations for new and existing areas

Below are some suggestions for applying these approaches in various situations.

5.7.1 New areas

Design neighbourhood streets for slow, mixed traffic.

Ensure cycling and walking networks are more closely spaced and permeable than motor traffic networks; add traffic-free links to achieve this. Ideally provisions for cyclists should be spaced less than 600 m apart.

Position paths in parks and reserves so that they link homes to significant local destinations such as schools and community facilities, and so that children and novices do not have to mix with faster or busier traffic.

Use paths to link communities along and across the barriers of busy roads.

Successful examples show a commitment to high-quality design, grade separation at main obstacles such as major roads, and careful attention to connections to the road network and across it.

5.7.2 Existing areas

Existing road hierarchies usually provide the basis for a primary cycle network.

Use the cycle planning process to identify places where people already cycle, and look for new opportunities of all the types of facilities described in this guide.

Develop options to improve the on-road provision and seek alternatives that will bypass obstacles or hazards or provide new, convenient links or alternatives for less competent cyclists.

Pay particular attention to intersections.

Consider the network needs of neighbourhood cyclists in their local environments.

Integrate with school travel planning initiatives and local area traffic management planning.

6 POSSIBLE CYCLE ROUTE COMPONENTS

6.1 Introduction

Planning cycle routes involves considering the most appropriate facility for any particular situation. This chapter identifies the available facility types and their advantages and disadvantages.

6.2 Provision requirements

The *New Zealand supplement to Austroads Guide to traffic engineering practice: Part 14: Bicycles* (Transit New Zealand, 2004) (CDS) is the main design guidance tool for cyclist facilities on roads and paths.

Figure 6.1 is a guide to the desirable facilities in the road corridor for cyclists in relation to traffic volume and speed and is most useful when planning for new situations. In practice, constraints on space, presence of side roads and driveways, type of users and costs will also dictate the choice of facilities to retrofit to existing situations. These and other considerations are discussed below.

The flow chart in Figure 6-15 of the *Cycle design supplement* is a guide to choosing the desirable path facilities for cyclists in different circumstances.

6.3 Mid-block facilities

Cycle facilities that can be provided between intersections include:

- kerbside cycle lanes
- cycle lanes next to parking
- contra-flow cycle lanes
- wide kerbside lanes
- sealed shoulders
- bus-bike lanes
- transit lanes
- mixed traffic
- paths.

Cyclists do not always need special or dedicated facilities. They do need provisions appropriate to their needs. For instance, wide kerbside lanes on arterial roads have similar benefits for cyclists as bicycle lanes (Hunter, 1998). However, cyclists prefer marked cycle lanes wherever possible.

Depending on the circumstances, cyclists may find the following provision quite adequate, without dedicated facilities:

- wide kerbside lanes
- sealed shoulders
- bus-cycle lanes
- shared paths
- slow, mixed traffic
- lightly trafficked streets of adequate width
- unsealed roads and paths
- one-way streets where signs and markings permit two-way use by cyclists.

However, it may be necessary to use special guide or route signs to ensure a cycle route that includes such provision forms part of a coherent network.

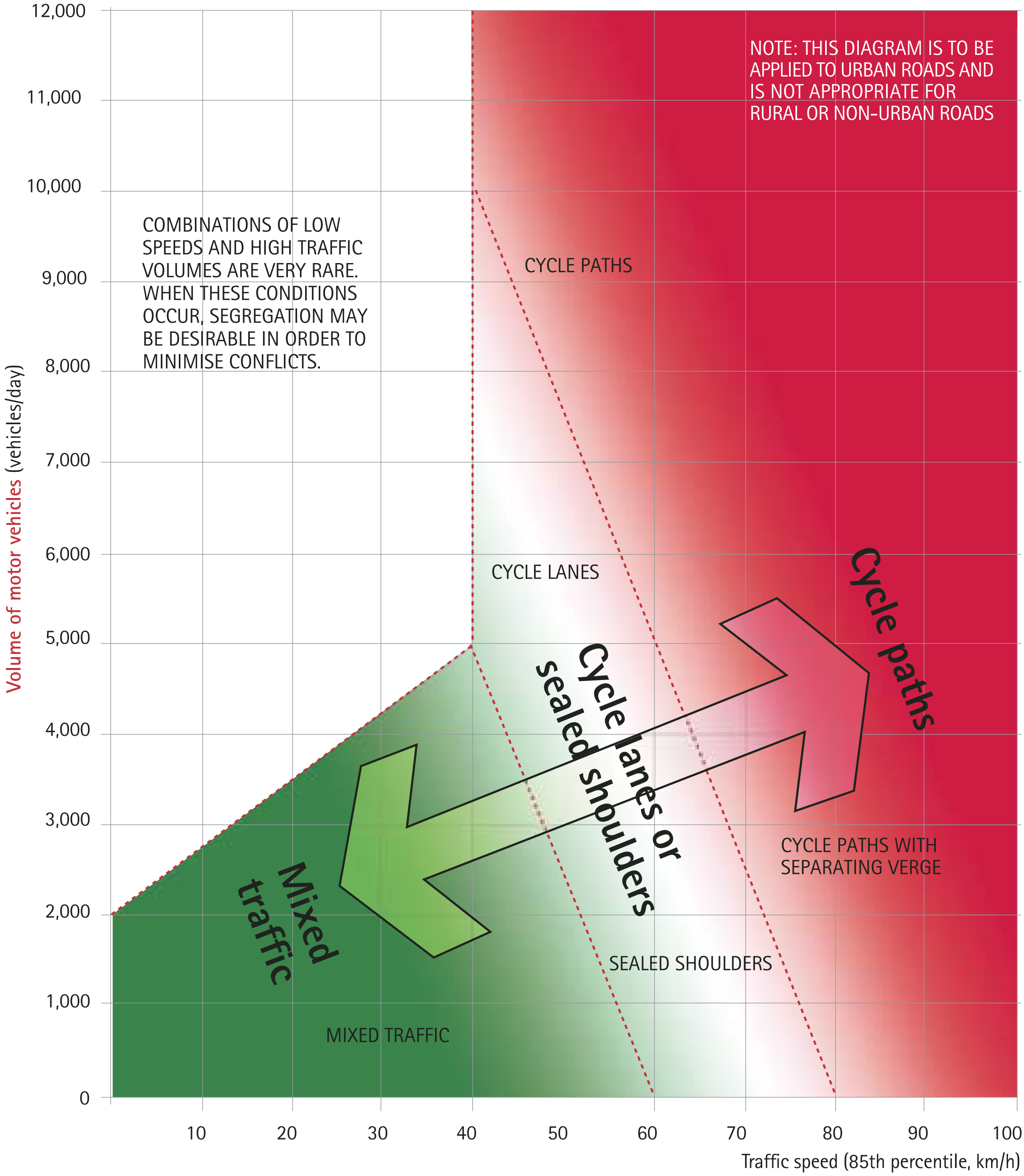


Figure 6.1: Preferred separation of bicycles and motor vehicles according to traffic speed and volume.
This diagram is based on RTA NSW (2003) and Jensen et al (2000), also DELG (1999), Ove Arup and Partners (1997) and CROW 10 (1993).

Figure 6.1: Notes

1. In general, roads with higher traffic speed and traffic volumes are more difficult for cyclists to negotiate than roads with lower speeds and volumes. The threshold for comfort and safety for cyclists is a function of both traffic speed and volume, and varies by cyclist experience and trip purpose. Facilities based on this chart will have the broadest appeal.

2. When school cyclists are numerous or the route is primarily used for recreation then path treatments may be preferable to road treatments.

3. Provision of a cycle path does not necessarily imply that an on-road solution would not also be useful, and vice-versa. Different kinds of cyclists have different needs. Family groups may prefer off-road cycle paths while racing or training cyclists, or commuters, tend to prefer cycle lanes or wide sealed shoulders.

6.4 Kerbside cycle lane

Description

This is a cycle lane marked beside a kerb, exclusively for cyclist use. The markings comprise an edge line and cycle symbols at regular intervals.

Advantages

All road users are likely to recognise the cycle lane and expect to find cyclists there.

It provides a degree of separation between motor traffic and cyclists.

It highlights cyclists' rights to the road.

Disadvantages

This facility restricts car parking.

Unless swept regularly, debris from the adjacent traffic lanes will accumulate in the cycle lane.

It may not provide enough protection for inexperienced cyclists.

Kerbside cycle lane, East Coast Road, North Shore City, New Zealand. (Photo: Tim Hughes)

Recommendations

As long as car parking issues can be resolved, kerbside cycle lanes are the favoured facility for roads.

Cycle lanes are preferred at the kerbside rather than adjacent to parked cars, so that cyclists can avoid opening car doors and pedestrians darting out from between parked cars.

Kerbside cycle lanes should apply permanently. Temporary applications, such as during daily traffic peaks, do not offer enough provision for cyclists outside those periods.

6.5 Cycle lane next to parking

Description

Cycle lanes comprising an edge line and regularly spaced cycle symbols can be provided next to marked parallel parking.

Advantages

This facility eliminates the need for parking restrictions and benefits other road users as it:

- increases drivers' ease of parking and entering and leaving parked vehicles
- effectively reduces the road-crossing distance for pedestrians
- improves the channelling of traffic, encouraging a more orderly and predictable traffic flow.

Disadvantages

A significant carriageway width is required.

When parking demand is low, motor vehicles will occasionally travel in the lane.

Some cyclists could still ride into an opening car door.

Car parking manoeuvres could inconvenience cyclists, and potentially cause conflicts.

Angle parking is not suitable next to a cycle lane unless there is extra clearance for parking manoeuvres.

Debris swept from the adjacent traffic lanes accumulates in the cycle lane and requires sweeping. Traditional gutter sweeping misses this, so it needs special attention.

Recommendations

If the road is wide and parking restrictions are unlikely to be acceptable, a cycle lane next to parking is likely to be an appropriate choice.

Kerbs protruding the width of the parking bay should be constructed at intervals to discourage vehicles travelling over unoccupied parking spaces.

Cycle lane next to parking, Marshland Road, Christchurch, New Zealand. (Photo: Tim Hughes)

Cycle lane outside angle parking, Greers Road, Christchurch, New Zealand. Note: clearance is barely sufficient. (Photo: Tim Hughes)

6.6 Contra-flow cycle lane

Description

Contra-flow lanes allow cycling against the legal direction of travel in a one-way street. They have the same features as traditional cycle lanes and are located so that cyclists ride in the normal position on the left. (Cyclists pass motorists right shoulder to right shoulder.)

Advantages

Contra-flow lanes contribute to the network's directness and coherence by allowing cyclists to avoid diversions along indirect or less safe routes.

See section 6.4 Kerbside cycle lane.

Contra-flow cycle lane, Cambridge, United Kingdom. (Photo: Tim Hughes)

Disadvantages

Other road users, including pedestrians, may not expect cyclists to travel in the opposite direction to other traffic.

Contra-flow lanes generally preclude parking on the cyclist's side of the road, though exceptions may be possible in traffic-calmed situations.

Recommendations

Contra-flow cycle lanes should be used in one-way streets where cyclists might otherwise be forced to divert along indirect or less safe routes.

Any new proposal for a contra-flow cycle lane should be well publicised.

Intersection layouts must support this facility, particularly at start and end points and at side road intersections.

Contra-flow lanes should have a:

- contrasting surface
- road markings or islands separating the opposing directions of flow.

6.7 Wide kerbside lane

Description

A wide kerbside lane is wide enough to allow cyclists and motor traffic to travel beside each other with a reasonable degree of comfort. It can be used where there is not enough road width for cycle lanes or as prescribed by CDS Figure 4-1. It is the preferred on-road facility where part-time parking is required, such as in clearways.

Wide kerbside lane, Burwood Highway, Melbourne, Australia. (Photo: Tim Hughes)

Advantages

This facility requires less space than the combined width of a travel lane and a cycle lane.

It is easily implemented by re-marking the position of a kerb lane line, subject to width requirements.

Disadvantages

Wide kerbside lanes do not highlight cyclists' legitimate presence on the road.

Car parking restrictions are required.

Motor traffic in the wider left lane may travel faster.

Recommendations

Wide kerbside lanes should be considered where no other facility is possible.

The road surface next to the kerb side of the road must be of a high quality.

6.8 Sealed shoulder

Description

A sealed shoulder comprises space and an appropriate surface for cycling outside the main carriageway, along the edge of an un-kerbed road. It is generally used in rural areas.

Sealed shoulder, Marshland Road, Christchurch, New Zealand. (Photo: Tim Hughes)

Advantage

Widened shoulders benefit all road users.

See section 6.4 Kerbside cycle lane.

Disadvantages

Sealed shoulders usually narrow at bridges, at passing lanes, and at intersections with turn lanes. Generally, motorists travel at high speeds along roads with sealed shoulders, so cyclists are at significant risk in these situations.

Sealed shoulders are sometimes made of lower-quality pavements, contrary to cyclists' requirements.

See section 6.4 Kerbside cycle lane.

Recommendations

Sealed shoulders contribute to all road users' safety. They are beneficial to cyclists, particularly along high-speed rural roads. They should be smooth, continuous and debris-free to encourage cyclists to use them.

6.9 Bus lanes

Description

A bus lane is a lane reserved for buses in which cyclists are allowed to travel. By law, bus lanes may be used by cyclists unless specifically excluded by a sign.

Bus-cycle lane (but note lost continuity through junction), Auckland, New Zealand. (Photo: David Croft)

Advantages

Bus lanes may be more easily justified than either bus-only lanes or cycle lanes alone, as they benefit both buses and cyclists.

Buses often use these lanes infrequently during off-peak times, offering cyclists unobstructed access for the most part.

Cyclists also benefit from any bus priority measures along a bus lane route.

Disadvantages

The LOS is limited, as buses obstruct cyclists by stopping regularly – and in narrow lanes cyclists can prevent buses passing.

Lane widths where drivers are unsure whether there is sufficient room to pass, create the greatest cyclist stress.

Recommendations

Wide lanes should be used wherever possible so that buses can pass cyclists within the lane.

Narrow lanes may be acceptable where there are no bus stops, bus speeds are low or buses can pass cyclists by temporarily moving out of the lane.

Avoid ambiguous lane widths that are neither wide nor narrow.

6.10 Transit lane

Description

A transit lane can only be used by public passenger vehicles, motor cycles, cycles and motor vehicles carrying a specified minimum number of passengers. From a cycling perspective, it is similar to a bus lane.

Recommendation

Transit lanes must be wide so that cyclists and motor traffic can travel in parallel within them.

6.11 Mixed traffic

Description

Most roads are mixed traffic roads, where no formal cycle facilities are provided and cyclists share the roads with other road users.

There are two types of urban mixed traffic situations. These occur where:

- traffic volumes are low, traffic conditions are straightforward, and there is enough space for motor vehicles to overtake cyclists
- traffic is slowed to near cycle speeds, the road is narrow and cyclists and motor vehicles share the same space travelling in single file.

Situations where drivers are unsure whether there is enough space to overtake appear to create the greatest stress.

Advantage

There are few costs apart from traffic calming, which is also done for other reasons.

Disadvantage

Continuity of route standards may be compromised where there are mixed traffic conditions on a route that is part of the primary cycle network.

Mixed traffic on backstreet, Delft, The Netherlands. (Photo: Tim Hughes)

Recommendations

Cycle facilities may not be required if the roads are in an appropriate condition.

Ensure the continuity and integrity of cycle routes by using signage and continuing cycle lanes where mixed conditions are otherwise appropriate.

Ensure the environment makes it clear where cyclists have room to travel beside motor traffic or need to travel single file. Avoid ambiguous widths and layouts.

6.12 Paths – general

There are three main path types for cyclists:

- exclusive cycle path
- shared path
- separated path.

Each may be isolated from roads or right next to them. A 'cycle path next to road' is also discussed on page 42.

Cycling through Hagley Park, Christchurch, New Zealand. (Photo: Neil Macbeth)

6.13 Exclusive cycle path

Description

An exclusive cycle path can only be used legally by cyclists.

Exclusive cycle path, Southern Veloway, O'Halloran Hill, South Australia. (Photo: Kym Dorrestyn)

Advantages

On exclusive cycle paths cyclists can generally proceed without delays caused by, or in conflict with, other path users.

This facility can offer cyclists a higher LOS.

Disadvantage

Walkers sometimes use exclusive cycle paths when their own facilities are comparatively poor.

Recommendations

Exclusive cycle paths are preferred where they are likely to be used by a significant volume of commuter cyclists.

Care is required to ensure pedestrians can be well accommodated elsewhere.

6.14 Shared path

Description

A shared path is shared with pedestrians and possibly others (for example horse riders).

Advantages

This facility is useful to cyclists as well as pedestrians, and therefore maximises the benefit of the path to the general community.

It is beneficial to vulnerable cyclists where an existing footpath can be adapted or widened.

Shared path, Wairere Drive, Hamilton, New Zealand. (Photo: Paul Ryan)

Disadvantages

Conflict between cyclists and pedestrians is common where, for instance, there is a significant volume of cyclists and pedestrians or a mix of recreational walkers and commuting cyclists.

The LOS for cyclists can be poor where interference by other path users results in slower speeds.

See also 6.16 Cycle path next to road.

Recommendations

Shared paths are beneficial to a range of path users but need to be managed effectively. They are appropriate where both cyclists and pedestrians need a path, but their numbers are modest.

It is important that:

- the path's design is suitable for its use and demand
- authorities adequately monitor users' behaviour on the path.
- the connections between path, road and driveways are carefully considered.

6.15 Separated path

Description

This is a path with separate sections for cyclists and pedestrians.

Separated path with barrier rail, Bielefeld, Germany. (Photo: Tim Hughes)

Advantages

Separated paths may help to avoid the conflict between pedestrians and cyclists that is common on shared paths.

Cyclists can ride without the delays possible on paths shared with walkers.

Disadvantages

Higher cyclist speeds are possible, but having a cycle path close to pedestrians means they can stray into the cycling space.

Separated paths are wider than other paths, so they cost more.

Recommendations

Separated paths are appropriate if large numbers of cyclists and pedestrians will use them.

There should be adequate separation (such as different path levels) between cyclists and pedestrians.

6.16 Cycle path next to road

Description

This is a common facility in Europe, usually for one-way cycle traffic. The paths are generally paved in a different colour and texture from adjoining sections of the berm, and may also be separated by a low kerb.

Advantages

Cycle paths next to roads can offer a low-stress environment that can be attractive to many cyclists.

They can be particularly helpful for short lengths, such as at squeeze points in the road carriageway.

One way cycle path next to road, Utrecht, The Netherlands. (Photo: Tim Hughes)

Disadvantages

Under New Zealand traffic law, cyclists on paths are required to give way to other traffic when crossing side roads. This results in delay for cyclists.

Intersections are where cyclists are at the highest risk. In Europe, paths on berms have been shown to be less safe at junctions than if the cyclist was on the roadway. For this reason best European practice requires cycle tracks to return to the roadway before intersections. At signals, special cycle phases can be introduced for cycle paths, at the expense of complexity and delay to all road users.

The benefits of cycle paths alongside a road between junctions can be negated by:

- inadequate clearance for visibility at driveways
- frequent or busy driveways
- inadequate clearance from opening doors of parked vehicles
- bus passengers boarding and alighting from the cycle path
- pedestrians encroaching on the cycle path when the footpath is congested, or while waiting to cross
- garbage awaiting collection obstructing the path.

Where cyclists ride in both directions along paths, drivers using driveways and side roads may not expect cycle traffic from both directions. Best European practice outlaws two-way cycle paths alongside roads with access from driveways and side roads.

It is less convenient to turn right from a cycle path next to a road. Cyclists have to cross the whole traffic stream in one manoeuvre, whereas from a cycle lane they can first merge across to the centre. However, a right turn from a separate path may be safer.

It is generally expensive to establish this facility, due to relocating kerblines.

Conflict at bus stops, Copenhagen, Denmark. (Photo: Tim Hughes)

Pedestrians obstruct cycle path while waiting to cross, Bielefeld, Germany. (Photo: Tim Hughes)

Cycle path by Albany Highway, North Shore City, New Zealand. (Photo: Tim Hughes)

Recommendations

Between intersections, cycle paths next to roads can provide attractive and safe facilities for a wide range of cyclists, provided there is adequate space and interference from other users is minimal.

Carefully consider safety and delay at intersections, where it is usually preferable for the path to rejoin the roadway.

6.17 Unpaved roads and paths

Description

Unpaved roads or paths can be acceptable to cyclists in some circumstances.

Unpaved path, Ionia, Michigan, United States of America. (Photo: Dan Burden www.pedbikeimages.org)

Advantages

The initial cost of establishing an unsealed facility is relatively low.

Unsealed facilities help in integrated cycling with environmentally sensitive locations.

Disadvantages

Unsealed facilities can be hazardous, depending on gradient, crossfall and surface media.

They also require regular maintenance.

Recommendations

In general, the surface must be well compacted and drained.

The surface medium should be capable of self-repair.

In steep terrain, erosion can be minimised and user safety maximised by using devices such as hairpin switchbacks for turns (International Mountain Bicycling Association, 2000).

6.18 Suitability for cyclist types

Most facilities are likely to benefit cyclists, but how much will depend on the cycling environment. Table 6.1 shows the relative benefits of the different facilities for cyclists with different skills. It is necessarily broad and subjective, and individual cyclists will vary. Interpret the table with caution, and use your own judgement.

CYCLE FACILITY OPTION	CHILD/NOVICE	BASIC COMPETENCE	EXPERIENCED
Kerbside cycle lane	🚲 🚲	🚲 🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲 🚲
Cycle lane next to parking	🚲	🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲
Contra-flow cycle lane	🚲	🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲 🚲
Wide kerb side lane	🚲 🚲	🚲 🚲 🚲	🚲 🚲 🚲 🚲
Sealed shoulder	🚲 🚲	🚲 🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲 🚲 🚲
Bus lane	🚲	🚲 🚲	🚲 🚲 🚲 🚲
Transit lane	🚲	🚲 🚲	🚲 🚲 🚲 🚲
Slow mixed traffic	🚲 🚲 🚲	🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲 🚲
Paths	🚲 🚲 🚲 🚲 🚲	🚲 🚲 🚲 🚲	🚲 🚲 🚲

Legend: Benefit: 🚲 minimal benefit, 🚲 🚲 🚲 moderate benefit, 🚲 🚲 🚲 🚲 🚲 most benefit

Table 6.1: Suitability of cycle facility option for different cyclist categories

6.19 Intersections

6.19.1 General

When planning intersections for cyclist use, the goal is to accommodate cyclists safely with a reasonable LOS, and at a reasonable cost, within the available constraints.

6.19.2 Key principles

The key planning principles relate to the type of intersection control and the provision of adequate space.

The design should ensure that:

- the intersection performs efficiently for cyclists under the traffic conditions expected throughout the planning period
- it is as far as possible suitable for cyclists of basic competence
- all normal manoeuvres are possible, particularly right turns (including the option of hook turns)
- the conflict area between through-cyclists and left-turning traffic (especially heavy vehicles) is managed. Left-turn slip lanes can simplify this by moving left-turning traffic conflict points away from the intersection and providing space for hook turns
- conflict points are easily identified
- cyclists and drivers know where cyclists are expected to be on the road
- the intersection is consistent in alignment and standards with mid-block facilities on approach and departure.

Helpful design information can be found in the CDS, Vicroads (2001), Austroads (1999) and Transfund New Zealand (2003).

6.19.3 Roundabouts

A higher proportion of cyclist injuries happens at roundabouts than at any other intersection type. Multi-lane roundabouts are the main culprits and should be avoided on cycle routes where possible.

Small, single-lane roundabouts, that are designed to tame traffic speeds, have been proven to reduce cycling injuries. These roundabouts slow traffic by using the shape of the islands to deflect traffic onto a curved path, and by ensuring visibility to other traffic is not excessive. They require no special provision for cyclists (Austroads, 1999; Bach and Diepens, 2000).

External perimeter paths should be considered for large multi-lane roundabouts (Austroads, 1999; Bach and Diepens, 2000), but will generally result in a poor LOS for cyclists owing to crossing delays. Grade separation or conversion to traffic signals is strongly preferred over multi-lane roundabouts.

Cycle lane leading to advanced stop box, Colombo Street, Christchurch, New Zealand. (Photo: Neil Macbeth)

Hook turn, trial markings, Merivale, Christchurch, New Zealand. (Photo: Andrew Macbeth)

Slip lane treatment, Hamilton, New Zealand. (Photo: Tim Hughes)

Cycle lane diverts to cycle path to negotiate multi-lane roundabout, Otaha Valley Road, Albany, New Zealand. (Photo: Tim Hughes)

Grade separation at multi-lane roundabout, Wairere Drive, Hamilton, New Zealand. (Photo: Paul Ryan)

6.20 Structures

A number of structures are used in association with cycle provision, such as bridges, underpasses and overpasses.

This section outlines a number of grade separation options that aim to help cyclists cross railways and high-volume, high-speed roads that have significant risks and potential for delays.

Railway cycle underpass and footpath, Utrecht, The Netherlands. (Photo: Tim Hughes)

Bridges need to be much higher to clear trucks using a road, than underpasses carrying cyclists need to be down below a road. Cyclists also prefer to speed up going down a ramp to an underpass, and use their momentum to travel up the ramp on the other side. Bridge ramps are generally higher requiring more effort to negotiate.

However, bridges are generally less expensive, have no drainage requirements, have fewer lighting requirements and offer advantages in personal security and vandalism.

Site topography may favour either a bridge or an underpass.

Covered bridge over railway prevents objects being dropped and provides shelter, Cambridge, United Kingdom. (Photo Tim Hughes)

Personal security is important. CROW (1993) provides numerous suggestions to enhance personal security at tunnels.

Because structures are expensive, the needs of cyclists and others must be properly identified, particularly in relation to:

- constructing a motorway
- planning new residential areas
- designing a structure.

6.21 Traffic calming

Traffic calming devices can improve cycling conditions in local streets with mixed traffic conditions. A wide variety of devices are used, so accommodating cyclists will depend on the individual characteristics of the devices.

For example, cyclist bypasses are generally appropriate where there are:

- single-lane devices
- road narrowings
- devices with abrupt changes in vertical alignment.

Bypass facilities can often be constructed using the original carriageway surface.

Other measures that may be appropriate are:

- path links at road closures
- contra-flow lanes or path links at one-way devices.

Speed cushions with cycle lane bypass, Melbourne, Australia. (Photo: Tim Hughes)

6.22 Restricted traffic areas

Pedestrian needs and comfort are paramount in pedestrian zones and public places where traffic is restricted. In these areas, the desirability of cycling (and any associated provisions) needs to be determined – bearing in mind that it is important to accommodate cyclists whose desire lines pass through a pedestrian area.

The common options are:

- allowing cyclists and pedestrians to mix freely
- providing designated paths for cyclists through the area
- allowing a combined use with selected motor vehicles (for example, buses, taxis and service vehicles)
- restricting cycling during certain periods
- prohibiting cycling in certain places.

The most appropriate approach will depend on the situation and the nature and behaviour of both pedestrians and cyclists.

Permitted cyclists are guests, and are expected to travel at a speed and in a way that is consistent with a walking space and to yield to pedestrians unless they have their own defined space.

Priority should go to information signs and public relations campaigns for the peaceful coexistence of pedestrians and cyclists, with minimal use of signs and line markings.

Cyclists walk through pedestrian precinct on riverside cycle way, Portland, Oregon, United States of America. (Photo: Tim Hughes)

6.23 Complementary facilities

End-of-trip facilities (such as secure parking, lockers and showers) and trip facilities such as shelter, water and toilets are important infrastructure for cyclists. These are covered in section 3.6.

THE CYCLE NETWORK PLANNING PROCESS

7 ASSESSING CYCLE DEMAND

ASSESS CYCLE DEMAND
Map cycling trip origins and destinations. Map land use using district planning data. Assess their importance as cycling trip generators. Map desire lines.
Map existing cycle routes and the numbers of cyclists using them. Map cycle crashes. Map existing cycle facilities. Count and map cycle traffic and parked cycles. Consult and/or survey cycle users. Assess trip purposes and types of cyclists.
Identify infrastructure barriers, using discrepancies between desired and actual use.
Assess, map and quantify latent demand: what additional cycling could be expected with better conditions and promotion?

7.1 Introduction

To know what to provide for cyclists, and where, it is important to have good information – such as how many people cycle or wish to cycle, where they wish to ride, for what purpose they ride, and how competent they are to handle a variety of conditions.

To help build this picture, this chapter describes cyclists' trip origins and destinations, methods for identifying the routes cyclists take, and the types and numbers of cyclists who use them or who may use them in the future.

7.2 Cyclists' origins and destinations

Cyclists may wish to cycle everywhere. Particular origins and destinations include:

- residential areas
- tourist accommodation
- education establishments
- areas with large employment
- shopping areas
- leisure and entertainment facilities
- public facilities
- public transport interchanges
- historic and tourist sites.

By mapping these locations, trip desire lines can then be plotted, permitting a qualitative assessment of where cycle demand is likely to be significant. Methods for identifying origins and destinations are outlined below. They may be supplemented by questionnaires.

7.2.1 City/district planning information

Description

District planning documents map the existing land use and the hierarchy of roads. They also contain information about land use zones and growth areas, major residential subdivisions or commercial or community developments. They are a most useful source of primary data about likely origins and destinations of cyclist trips. A higher concentration of cyclists can be expected near popular cycling destinations.

Advantages	Disadvantage	Recommendation
This information is readily available and helps identify cyclists' origins and destinations.	This method provides no information about numbers of cyclists or the routes they use.	Identify where cycle traffic could be expected by plotting cyclists' significant trip origins and destinations on a map, alongside any existing cycle facilities and the road hierarchy.

7.2.2 Census data

Description

The five-yearly Census includes questions about the mode of travel to work on Census Day and the locations of the respondent's residence and workplace.

This data can identify the number and distribution of residents and employees in various age brackets and those who cycled to work on Census Day.

Advantages

This data provides reliable numbers. It can be used to plot graphically the significance of areas as origins and destinations for cyclists' trips to work and by connecting them, the desire lines for commuting to work.

Plotting family size or population density in school-age or the 30 to 45 age bracket may allow a comparison of the likely uptake of cycling in different parts of cities. Larger families and these age groups are likely to yield more cyclists.

Disadvantages

There are disadvantages in time and cost. It duplicates some of the qualitative information available from land use which may sometimes be sufficient for the purpose.

Census data does not reveal cyclists' route choices.

The Census trip-to-work data is a snapshot of one day. It is affected by weather and any other factors peculiar to that day and provides no data about cycling trips that are not trips to work.

Recommendation

If using this method, be aware of its limitations.

7.2.3 School cycle traffic

Description

School cycle traffic is localised and likely to be a significant proportion of the total cycling in many areas. If not, a poor cycling environment is likely to be suppressing use.

Questionnaires and counting parked cycles are commonly used to assess cycle demand at schools.

By obtaining the number of students attending school on a survey day, the percentage of students cycling to school can be calculated.

Advantage

A school represents a concentration of cycle users who are relatively easy to survey.

Disadvantages

Surveying school cycle traffic:

- requires school approval
- has a time and cost factor, especially when questionnaires are used
- is limited as some areas have few children cycling to school.

Recommendations

During network planning, count parked cycles to quantify existing school cycle demand.

During route planning, use questionnaires to identify detailed information on route choice and problem areas. Where possible, incorporate this survey into a Safer Routes to School programme.

Plot of locations where school children have had a cycle crash (black spots) or feel unsafe (green spots). Source: Christchurch City Council, New Zealand.

7.2.4 Visitor numbers

Description

This method uses the total number of visitors to particular locations, attractions or facilities to indicate their likely significance as cyclist destinations.

Advantage	Disadvantage	Recommendation
As long as the information is readily available, this is a quick method for prioritising sites for more detailed investigation, such as counting cycle traffic or parked cycles.	There are disadvantages in time and cost if the information is not readily available.	Use this method where the information is readily available.

7.2.5 Counting parked bicycles

Counting the number of bicycles parked at particular locations on a typical day can help determine the significance of those places as cyclist destinations.

Advantage	Recommendation
Counts of parked cycles are particularly useful for places with defined cycle parking places such as schools. They are quick and simple to perform.	Develop a program for counting parked bicycles at key destinations.

7.2.6 Travel surveys

Description

Information on cycle demand can be gleaned from surveys conducted for transport planning and modelling, or from LTSA travel surveys.

Advantage	Disadvantage	Recommendations
The *New Zealand Travel Survey 1997/98* (LTSA, 2000), available on the LTSA website (www.ltsa.govt.nz), identifies the general characteristics of cycle trips and the people who cycle.	The LTSA travel survey is a national survey, so the results do not necessarily reflect the characteristics of an individual study area. It does not identify routes.	Use any available information from local transport planning or modelling surveys; otherwise use the LTSA travel survey data.

7.3 Desire lines and barriers

The cycle demand information gathered should be reviewed and the major trip origins and destinations plotted on a map, followed by the major desire lines linking origins and destinations.

Such maps permit barriers to cyclists travelling along these desire lines to be identified. Barriers could include waterways, motorways, railways, large industrial estates and sections of road that cyclists perceive as hazardous. The latter might include heavily trafficked roads that have to be crossed or travelled along, multi-lane roundabouts, or sections of busy roads with no dedicated space for cyclists.

7.4 Use of routes by cyclists

7.4.1 Road hierarchy method

Description

District plans usually include maps of the road hierarchy in their areas (typically arterial, collector and local roads).

A first assumption could be that the number of cyclists wishing to use a particular link in the road network will be in direct proportion to those using motor traffic on that link. So highly trafficked roads could be expected to carry relatively high volumes of cycle traffic, given appropriate cycling conditions.

Advantage

This method gives the simplest and quickest indication of potential cycle demand across the whole area.

Disadvantages

Cyclists may avoid sections of arterial roads that they perceive as hazardous or unpleasant for cycling, or may take a short cut not available to motor traffic.

Cycling conditions may be perceived as so dangerous or unpleasant that people either cease cycling or don't take it up in the first place. This suppressed or latent demand for cycling might be realised if cycling conditions were improved.

Recommendations

This method is a good way to begin assessing cycle demand. Other cycle demand assessment methods should be used to refine further the understanding of cycle travel patterns in an area.

7.4.2 Cycle crash data

Description

Cycle crash data for a long period of time can indicate those routes that cyclists have difficulty negotiating safely.

Useful crash data can be obtained from the LTSA, ambulance services and RCAs' databases of locally reported crashes.

Advantage

This data is readily available and is also needed for evaluating cycle route options.

Crash plot showing LTSA data (black dots) and ambulance data (blue dots)
(Source: Christchurch City Council)

Disadvantages

LTSA data generally excludes crashes that do not involve a motor vehicle, and off-road crashes.

Ambulance data has good location information but is biased towards the more serious injuries.

This method will be poor at identifying:

- sections of the road network that carry significant numbers of cyclists and are relatively safe for cyclists
- off-road routes (ambulance data is useful here).

Also, cyclists may avoid hazardous sections of an otherwise desirable cycle route.

Recommendations

Use this method, but be aware of its limitations.

Start with LTSA data. For a more complete picture, supplement this with ambulance and RCA data, but remove any duplicate data from the combined database to avoid double counting.

7.4.3 Existing cycle facilities

Description

This method involves plotting on a map the location of any existing cycle facilities. This may indicate where cycle demand is, or has been considered, significant.

Advantage	Disadvantage	Recommendation
This information has more than one use, as it is part of the base inventory required before cycle route options are evaluated.	The existence of cycle facilities does not always indicate significant cycle traffic, as they may be poorly sited or isolated.	Use this method as it provides information needed for other purposes, including cycling promotion.

7.4.4 Cycle counts

Manual cycle counts

In this method, people at cycling sites record the numbers of cyclists, their travel direction, and possibly whether each cyclist is a primary school pupil, secondary school student or adult.

At busy sites cyclists should be counted separately rather than as part of a general traffic count, as they are easily overlooked. Counting is usually done during the morning or afternoon peak, but counts undertaken at other times can also be scaled up (see Appendix 2).

The methods already mentioned will indicate where to start counting.

Automated cycle counts

Automatic mechanical counters can be used to count bicycles, even in conjunction with counting other traffic (Transfund, 2002).

Installing continuous automated counters on key routes provides control data for monitoring cycle use on the network. This can also be used for scaling short-term, seasonally affected or weather-affected counts and for calculating modal split.

Bicycle detectors at traffic signals can also be used to regularly monitor the number and time pattern of cycle use. Beware of false counting of cars driving in adjacent lanes or straying into the cycle lane.

Detector loops on railway cycle path, Christchurch, New Zealand. (Photo: Axel Wilke)

Advantage

Cycle traffic counts provide hard, conclusive evidence of existing cycle demand.

Disadvantage

The method only has time and cost disadvantages.

Recommendation

Each local authority should carry out an annual programme of cycle counts to monitor cycle use trends and provide data to support funding applications.

In addition to counting cycles using sections of routes soon to be investigated or designed in detail, it is recommended that some strategic counts be repeated annually. This could include counting cycles crossing a cordon around the central business district and or other key cyclist destinations, as well as on some outlying arterial routes.

7.4.5 Consultation with cycle users

Description

This method involves consulting local bicycle users on popular cycle routes with which they are familiar in the areas where they cycle.

Advantages

Bicycle users usually have excellent local knowledge of the routes they use and their associated problems. This can also be an excellent way of identifying leisure cycle routes.

Disadvantages

Individual cyclists, unless they cycle many different routes, can talk accurately only about the number of routes with which they are familiar. It is necessary to speak to a representative group of cyclists covering all areas.

Experienced cyclists may not be able to represent less confident, new cyclists' needs and desires.

Recommendation

Use this method. If there is no bicycle users' group, convene one for the purpose of ongoing liaison during cycle planning and implementation.

7.5 Questionnaires

Description

Questionnaires help to identify:

- the types of cyclist
- origins and destinations
- routes travelled
- hazard locations
- crash or incident locations
- alternative routes cyclists would use if hazards or barriers were removed
- reasons why people do not cycle, the infrastructure or other measures that would induce them to cycle, and the routes they would take.

Questionnaire distribution methods include:

- newspapers
- cycle shops, libraries or places that cyclists visit often
- the internet: survey forms can be copied from the internet and posted to the surveyor, or the survey could be completed and submitted online
- placing questionnaires on parked bicycles
- roadside interviews
- handing out questionnaires to cyclists on popular cycle routes
- in classrooms for school surveys, and at tertiary institutions and workplaces.

Survey results may also be available from workplace and school travel plan projects.

Surveys of non-cyclists are better incorporated in a survey on a wider range of issues, such as an annual citizens' satisfaction survey, because non-cyclists may have little or no interest in responding to a survey solely about cycling.

Appendix 3 has an example of a typical questionnaire.

Advantages

The route and hazard information is usually plotted on a map of the study area and can be used to identify route, or site-specific, improvements.

Information about the type of cyclist is needed to identify the most appropriate type of facility for any route in the network.

Disadvantages

Issues associated with questionnaires are:

- margins of error with various sample sizes
- questionnaire distribution
- encouraging responses, for example by providing prizes
- obtaining responses from a cross-section of cyclists or the general population
- processing the gathered information efficiently
- response bias
- cost and time.

The questionnaire has to be developed, distributed, collected, collated and interpreted. A Christchurch City Council questionnaire asking for current routes, routes avoided and other information about cyclists resulted in about 800 responses; each took about an hour to map and collate (Transfund, 2003, p.20).

Recommendations

This method is recommended where the above methods do not provide sufficient information. If questionnaires have not been used for network planning, they should still be considered for route planning.

Developing and using a questionnaire are not simple exercises; it may be wise to seek specialist advice to ensure cost-effective and useful results.

7.6 Which methods to use ?

7.6.1 Existing cycle use

Start identifying existing cycle demand with a focus on the arterial road network. The following methods (described in detail above) can then be used in combination to form a clearer picture of the popularity of routes cyclists are likely to take:

- LTSA cycle crash data
- city/district planning and Census information
- existing cycle facilities
- consultation with cycle users
- visitor numbers at important cyclist destinations
- counting cycles parked at schools.

Then undertake a programme of cycle counts at strategic locations to confirm the actual cycle travel patterns.

It may be difficult to identify accurately an adult's cycling skill level simply by observing them. It may be necessary to either conduct a brief, kerb-side interview or use a questionnaire.

7.6.2 Identify users and trip purpose

Methods for identifying user type and trip purpose include:

- consultation
- travel surveys
- manual counts
- counting parked cycles at key destinations
- census data
- questionnaires.

7.7 Estimating latent demand

Latent demand describes potential new cycle trips that are currently suppressed, but that would be made if cycling conditions were improved.

Latent demand can be assessed in relation to specific route improvements or to the whole network, assuming it is fully developed and that complementary cycle promotion activities are undertaken.

A wide range of methods have been proposed for forecasting cyclist travel demand. These methods have not been assessed for use in New Zealand. Some are quite complex. They are described in:

- Traffic flow models allowing for pedestrians and cyclists (Taylor and Damen, 2001)
- Guidebook on methods to estimate non-motorized travel (FHWA, 1999)
- Forecasting demand for bicycle facilities (Katz, 2001).

Advantage

Taylor and Damen concluded that there are a number of useful tools for assessing the demand for proposed bicycle facilities.

Disadvantages

There are time and cost disadvantages.

Recommendation

While these methods require further research for application in New Zealand, the simpler methods may be useful until this research can be done.

7.8 Data presentation

Geographical information systems (GIS) are well suited to data presentation. By presenting collected data as layers on common maps, many aspects can be considered together and a complete picture of cycle demand and obstacles developed. Sufficient work should be done to obtain a clear picture of where people wish to cycle, where they currently cycle and where the key network barriers to more cycling exist. The aim is to have usage information that is useful for project evaluation and prioritising improvements in cycle provision.

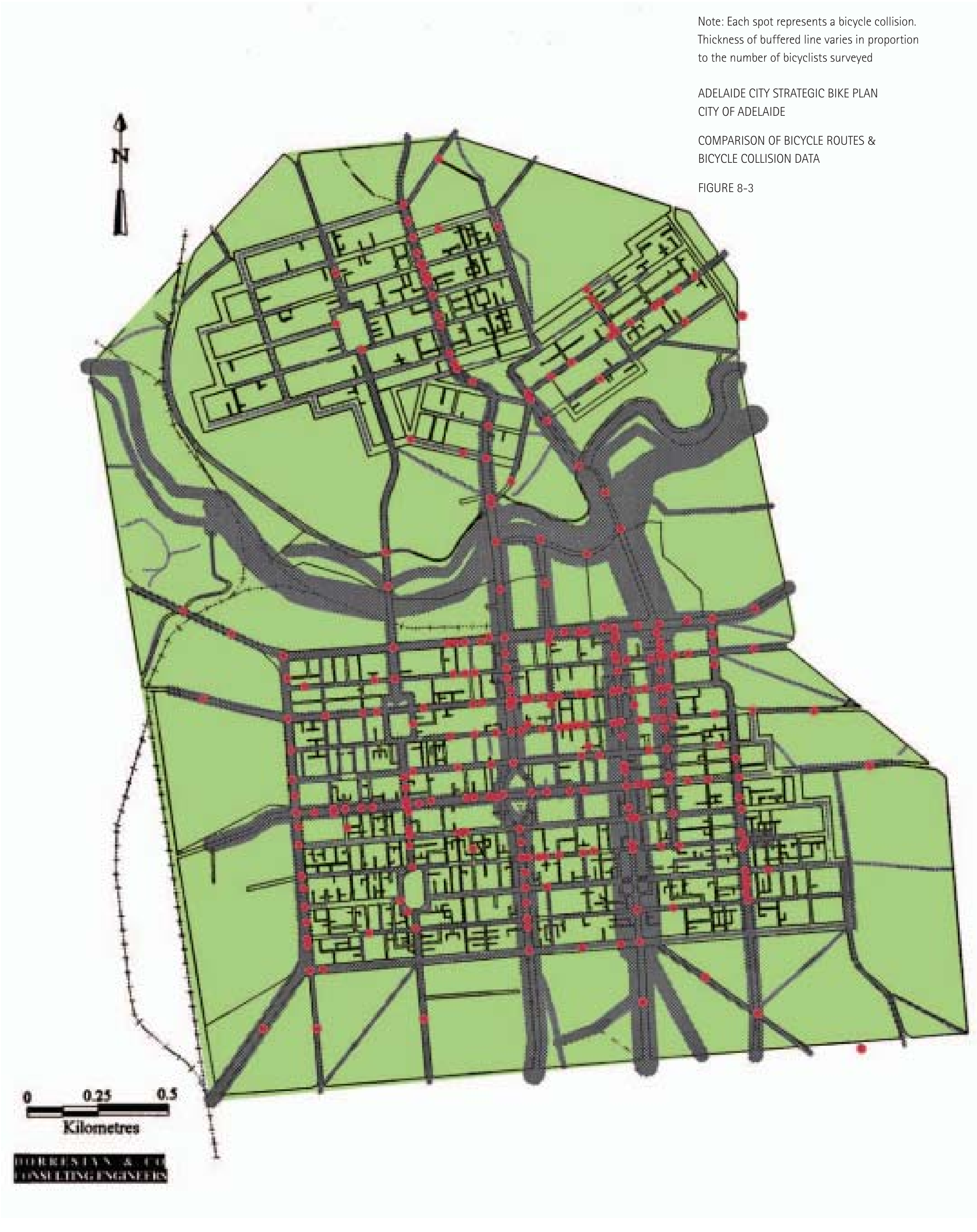


Figure 7.1: Cycle crash data assessment

8 IDENTIFYING CYCLE ROUTE OPTIONS

IDENTIFY EXISTING AND POTENTIAL CYCLE ROUTE OPTIONS
Identify opportunities for upgrading existing routes, or for new or alternative routes, and add them to the map of existing routes.
Identify the alternative facilities that could be provided on each route to satisfy the needs of the cyclists who would use them.

8.1 Introduction

This chapter describes a process for identifying alternative ways to satisfy the needs of the different types of cyclists who will use the route.

8.2 Identifying opportunities

This involves considering the:

- maps produced in the cycle demand assessment (chapter 7)
- needs of cyclists who will be using each route (chapter 3)
- possible locations for cycle routes (chapter 4)
- possible approaches to developing a network (chapter 5)
- cycle route components (chapter 6)
- five-point hierarchy (chapter 8)
- factors listed in Table 8.1.

From this assessment, opportunities for upgrading existing routes or developing new routes can be identified. All should provide cyclists with an appropriate LOS and be feasible.

TRAFFIC	ENVIRONMENT	INFRASTRUCTURE	CONTROLS/OTHER
• Traffic speeds and volumes • Traffic composition, especially % of heavy vehicles • Other road/path users' demands and requirements • Collision history	• Route/road cross-section measurements • Topographic and land use information • Parking controls • Access and parking demand characteristics • Intersection layout details • Key infrastructure details • Local traffic calming measures	• Drainage and utility services • Public lighting • Property driveway positions • Traffic management controls and operational details, for example traffic signals	• Planning regulations • Local initiatives and developments • Local technical requirements • Applicable route design guidelines • Land ownership • Land owner requirements

Table 8.1: Factors to consider during route option assessments

8.3 Five-point hierarchy

The five-point hierarchy of measures to help cyclists (IHT et al, 1996) is considered in this order:

- Reduce traffic volumes.
- Reduce traffic speeds.
- Adapt intersections.
- Re-allocate road space.
- Provide on-road cycle lanes and off-road cycle paths.

These measures can be applied to the road and path system as a whole and to individual routes.

Cycle lanes and cycle paths, often the most commonly suggested measures, should only be considered after the issues higher in the list.

8.4 Finding space on existing roads

See section 6.2

Facility choices often need to be accommodated within available space along any route. Bicycle Victoria (1996) details techniques to obtain space on existing roads.

Rearranging space

- Adjust carriageway lane positions or widths.
- Upgrade service roads for cyclist use.
- Seal road shoulders.

Trading space

- Indent car parking.
- Widen road at the verge (as long as this will not result in higher speeds).
- Restrict car parking to one side of a road, resulting in an asymmetric road layout.
- Widen the road at the median.
- Remove a traffic lane if there is excess road capacity.
- Close the road.

If a desired facility cannot be accommodated on the road, an off-road route may be a viable alternative if it:

- is more direct
- has a high standard of geometric design, construction and maintenance
- has a similar travel distance to the road route.

8.5 Opportunities lost

In addition to identifying new cycle routes, it is important to protect existing cycle corridors. Some existing reserves that are surplus to recreation space requirements have been sold off for general urban development purposes, despite the existence of long-standing cycle routes.

It is important that formal planning documents such as district plans and/or reserve management plans recognise all routes that are well used or have significant potential for cycling. This will ensure future development proposals accommodate cycle routes rather than obstruct them.

It is also interesting to note that property developers have funded some cycle route improvements, where existing routes were recognised in district plans or reserve management plans.

8.6 Key infrastructure opportunities

Table 8.2 lists some key infrastructure or features that can be central to developing cycle routes. These features are often so strategically important that entire routes are planned around or heavily influenced by their existence.

GRADE SEPARATED FACILITIES	ROUTE OPPORTUNITIES	TRANSPORT INTERCHANGES
• Road tunnel • Pedestrian overpass • Pedestrian underpass • Road bridge, to which a cycle platform could be attached • Viaduct	• Traffic signals • Service road • Lane	• Railway station • Ferry service • Airport • Park-and-ride station/public transport interchange

Table 8.2: Key infrastructure that influences cycle route development opportunities.

8.7 Opportunities identified

This assessment should have identified opportunities for upgrading existing routes or developing new routes. All options identified should provide cyclists with an appropriate LOS and must be feasible and provide value for money.

9 EVALUATING CYCLE ROUTE OPTIONS

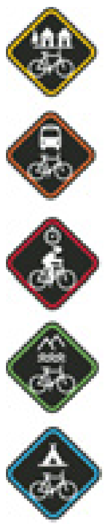
EVALUATE CYCLE ROUTE OPTIONS
Evaluate, compare and contrast the options for satisfying the needs of the various cyclist types and trip purposes likely on each cycle route.
Select the preferred option(s) for each route.

9.1 Introduction

A perennial problem in cycle route network planning is the reliance on bright ideas and pet projects that may not have been critically evaluated for usefulness and value for money.

This chapter describes how to evaluate routes or facilities identified in accordance with chapter 8 using the following assessment methods:

- needs assessment
- audits
- cycle review
- level of service assessments.



9.2 Needs assessment

Description

This is an assessment against the criteria in chapter 3 in relation to each cyclist type and the route characteristics they need.

To permit a comparison, a summary for each option could be prepared in a standard format – and from this a conclusion or recommendation determined. This summary can be reported on a single page in a similar format to Table 3.1 as a table indicating how the proposal will suit each cyclist type.

Advantages	Disadvantage
This assessment provides an opportunity to consider all overarching issues, including intangible matters such as attractiveness and comfort.	This is a qualitative assessment.

Recommendations

Always perform a needs assessment. No other assessment satisfactorily considers the full range of cyclists' needs.

Include the outcome of other assessments, for example the LOS, in a needs assessment report.

9.3 Audits

Description

Audits are a formal process for identifying deficiencies in provision for cyclists. They can be applied to existing facilities or new proposals and can be applied during all project phases, from concept to post-construction audit. They can also be applied to a specific facility, a route or a network.

Four different types of audit affect cycling.

A cycle audit aims to identify all matters that affect how well a situation meets the needs of cyclists, such as in *Guidelines for cycle audit and cycle review* (IHT et al, 1998).

A road safety audit is a well established and respected process aimed at identifying deficiencies that will affect the safety of all road users. The best practice guide is the *Austroads Guide to road safety audit.*

A cycling safety audit concentrates on cycle safety issues. It typically interprets safety broadly, as most other matters affect safety in some way. It was developed because traditional road safety audits frequently overlooked cycling issues. Refer to *Cycling by design* (Scottish Executive, 1999) and *Guide to traffic engineering practice: Part 14: Bicycles* (Austroads, 1999).

A vulnerable road user audit combines a cycle audit with the needs of pedestrians, including disability access issues. It was developed in Oxfordshire County Council because cycle audits on their own were difficult to justify; cycle use is a small proportion of United Kingdom traffic (two percent). By contrast walking, cycling and mobility-impaired users together account for about 30 percent of urban traffic deaths, so clearly deserve more careful attention. The United Kingdom Transport Research Laboratory is developing this concept further.

Advantages

Audits take a systematic approach to identifying safety and other problems and help to prevent inappropriate designs being constructed.

Disadvantages

The quality of audit results under this method depends on the cycling experience and knowledge of the auditor(s).

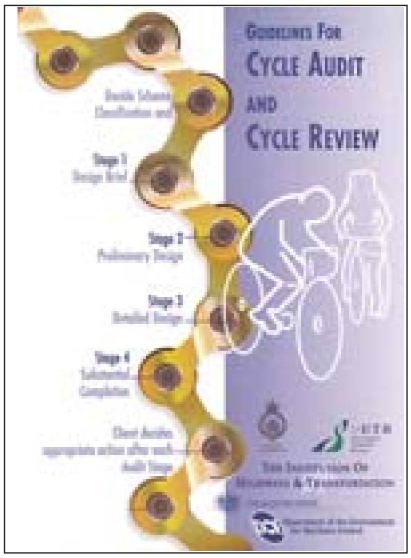
While audits identify the deficiencies of an option, they do not distinguish between options or rate them.

Recommendations

Use cycle audits routinely in project development. Ensure that the audit process includes all the features of a cycle audit, whether as a stand-alone process or as part of a wider audit process.

Use a cycle audit to identify deficiencies on existing roads and paths.

Don't use a cycle audit as a tool to evaluate and compare options.



Guidelines for Cycle Audit and Cycle Review

9.4 Cycle review

Description

Guidelines for cycle audit and cycle review (IHT et al, 1998) is an audit process for an existing road situation, combining professional engineering and user perceptions of quality. It reviews how well existing facilities meet cyclist needs and provides a thorough process for identifying improvements. It includes data collection, LOS assessment and deficiency analysis.

Among other purposes, a cycle review seeks to:

- systematically assess cycling conditions
- highlight the greatest problems for cyclists
- enable LOS to be assessed quantitatively
- identify feasible measures for improvement
- provide a framework to help with choosing the preferred option.

Cycle review is applied at different levels and in its complete form represents a comprehensive process that can be applied to routes intended to form part of a cycle route network.

Advantages

The value of this model lies in its partially holistic assessment methods. As well as considering the nature of a facility it assesses route directness and coherency, and the need to influence surrounding conditions such as the traffic speed environment. Importantly, accessibility and safety issues are key considerations in this model.

Disadvantages

The credibility of the package depends on the judgement of the experts that prepared it. Further research is desirable to confirm how well it reflects cyclists' needs and perceptions.

The overall package is a little cumbersome, even though the individual reviews are straightforward.

Recommendation

Individual road authorities should consider implementing a cycle review model.

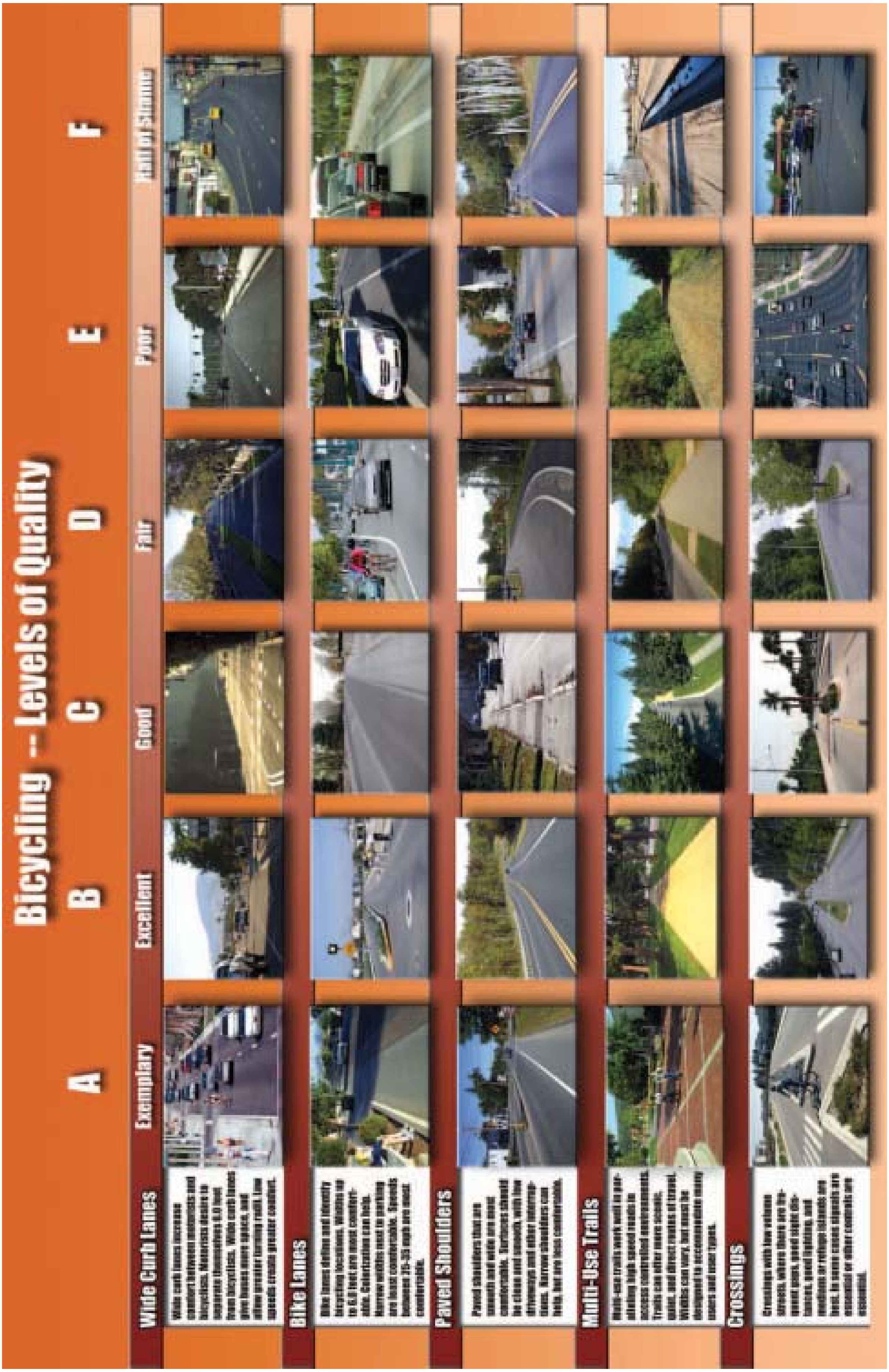


Figure 9.1 Bicycling — levels of quality

9.5 Level of service (LOS) assessments

LOS is a traffic engineering term that describes traffic quality. It is traditionally applied to motor traffic, where it is primarily concerned with delays and interruptions to traffic. However, when applied to cycling other aspects seem to be more important. To distinguish it from traditional LOS measurements it is sometimes also referred to as 'level of stress', 'level of quality', 'bicycle compatibility' and 'cyclability'.

Cycling LOS assessment is based on a significant volume of empirical research on cyclists' views and reactions to specific road environments, conducted mostly over the past 10 years. United States research is reported in Sorton and Walsh (1994), Epperson (1994), and Landis et al (1997) and (2003). United Kingdom research is described in Guthrie et al (2001). Further US research is being conducted into multi-modal LOS assessment.

This approach has limitations but is helpful in comparing routes and options. Its most desirable aspect is that it is an independent and objective measure.

Several cycling LOS methods have been published. *The bicycle compatibility index* (BCI) (FHWA, 1998), *Cycle review level of service* (IHT et al, 1998) and *Multi-modal level of service assessment, handbook* (Florida DOT, 2002) describe methods worth further investigation.

The levels of quality developed by Walkable Communities Inc (see Figure 9.1 opposite) provide a visual guide to service levels for different facility types.

Note that different assessment methods will not produce identical results.

Table 9.1 lists an alternative service level description used in a cycle review LOS assessment.

LOS	SCORE	TYPICAL TRAFFIC CHARACTERISTICS	LIKELY ROAD/PATH TYPE
A	81 – 100	Little or no motor traffic; low speeds; good passing width; no significant conflicts; good riding surface; lit; good social safety	High-quality cycle path; well surfaced minor rural road; 30 km/h limit urban road
B	61 – 80	Light/moderate traffic flows; good/adequate passing width; few conflicts; good riding surface	Minor road; well surfaced but unlit cycle path
C	41 – 60	Moderate traffic flows; 85th percentile speeds around 50 km/h; adequate passing width; some conflicts (not major)	Minor road/local distributor
D	21 – 40	Busy traffic, HCV/buses; speeds around 70 km/h	Urban single carriageway; poor-quality cycle path
E	1 – 20	Heavy traffic flows; speeds >70 km/h; HCV	Dual carriageway speed limit 70 km/h or higher; large roundabouts
F	<0	Heavy traffic flows, HCVs; speeds 100 km/h, narrow lanes; unlit	Narrow rural single carriageway or dual carriageway; grade separated junctions

Table 9.1 Cycle review LOS scales

HCV = Heavy commercial vehicles

9.5.1 Bicycle compatibility index (BCI)

Advantages

The BCI measure is flexible and simple to use and can be used to distinguish between conditions on roads during different periods.

As Table 9.2 (see opposite) demonstrates, a minimum of data is required to determine a BCI/LOS result for an entire route. The data is readily sourced in most instances.

Disadvantages

BCI does not account for:

- low traffic volume environments where cyclists readily integrate with other traffic
- significant intersections
- strategic considerations such as route directness, coherence and purpose
- paths. A similar US-developed process is available for paths, but it is not known whether the two methods may not be compatible for comparing path and road options.

Recommendations

The BCI method is most useful when comparing mid-block route options at an early stage, and when a quick and simple method is desirable.

9.5.2 Cycle review LOS

Advantages

This is more comprehensive than the BCI method. Among other factors, it gives basic consideration to intersections and route directness, and includes paths.

Disadvantages

A significant volume of data is required.

It can be time consuming to compare several quite different route options.

Recommendations

This comprehensive method (IHT et al, 1998) can be used to examine existing infrastructure and to compare different route options provided concept proposals for routes are reasonably well defined.

It should be used at a level appropriate for each route.

Straightforward situations with obvious choices will not gain much benefit from the full depth of the process, but will nevertheless benefit from analysis based on its concepts.

It can be used to assign an overall LOS score for a route proposal.

9.5.3 Florida bicycle LOS

This method is the most widely used approach in the USA. It assesses bicycle LOS on links and straight through intersections as part of a multi-modal assessment of LOS. It is based on the research by Landis. The method includes a computer program to simplify the calculations. Refer to Florida DOT (2002).

9.6 Which method?

Further research

Further investigation into the appropriateness of the above methods for application in New Zealand is required and will be undertaken. Local authorities are invited to contact the LTSA with a view to participating and/or leading trial projects.

Practitioners are encouraged to assess other methods where appropriate and available.

Recommendations

Use a mix of the methods outlined above.

A needs assessment is always important. In general, many of the issues associated with developing a cycle route are qualitative, and only this type of assessment will consider all the overarching issues.

For a quantitative assessment, the cycle review LOS method appears to be the most useful.

Individual RCAs are encouraged to consider implementing a cycle audit and cycle review style of process, and to work with the LTSA to develop a New Zealand recommended process.

A review of crash records (see section 7.3.2) is also worthwhile when assessing existing conditions.

Two aspects stand out as being important in any cycling assessment:

- Does the facility meet the users' needs?
- 'The choice of routes in urban areas is largely determined by the extent to which junction features can be resolved where the cycle route meets or crosses more heavily trafficked roads' (Ove Arup and Partners, 1997).

LOCATION		South Terrace – Greenhill Road	Greenhill Road – Fisher Road	Fisher Street – Cross Road	Cross Road – Grange Road	Overall route
GEOMETRIC & ROADSIDE DATA	Length (km)	0.62	1.87	0.86	1.19	4.54
	No. of lanes (one direction)	2	2	2	2	
	Kerb lane width (m)	3	3.4	3.4	3	
	Bicycle lane width (m)	1.5	1.5	1.5	1.5	
	Paved shoulder width (m)	0	0	0	0	
	Residential development (y/n)	y	n	n	n	
TRAFFIC OPERATIONS DATA	Speed limit (km/h)	60	60	60	60	
	85th percentile speed (km/h)	60	50	60	60	
	Traffic flow (AADT)	28,000	28,000	28,000	31,000	
	Large truck % (HCV)	0.50	0.50	0.50	0.50	
	Left turn %	0.00	0.09	0.05	0.05	
PARKING DATA	Parking lane (y/n)	y	n	n	n	
	Occupancy (%)	50				
	Time limit (minutes)	120				
RESULTS	BCI	4.74	3.78	4.00	4.43	4.12
	Level of service	E	D	D	E	D
	Bicycle compatibility level	Very low	Moderately low	Moderately low	Very low	Moderately low

Table 9.2: Example of BCI calculation

9.7 Evaluate the whole route

Routes should be assessed in their entirety wherever possible. However, it is not uncommon for the project scope to be limited for financial or other reasons.

For example, a route may extend through more than one local authority's area or depend on access to land under the control of another authority. In cases like this, any insurmountable issues with another authority may limit the route's feasibility.

If the project scope means a route cannot be considered in its entirety, it is important to conduct a less rigorous review beyond the area of detailed assessment. This will help determine any likely physical, financial and political influences that could render a project unfeasible in the future.

9.8 Financial considerations

Any evaluation of cycle facilities must include considering the financial commitment required to implement them. Any measures must be both viable and represent value for money. Economic evaluations should use the procedures for cycling projects in Transfund New Zealand's *Project evaluation manual.*

9.9 Other assessments

Proposals should also be assessed for their effects on the environment, including effects on other road users, authorities or property owners.

9.10 Consultation

Consultation with cyclists is an important part of assessing the impact of a proposal on existing or potential users.

The ways cyclists' views are obtained are less important than that they are obtained.

Unsolicited complaints (or praise), such as letters to the RCA, are an importance source of feedback on existing routes.

A local cycling advocacy group (see section 14.5) can be included in the process. In a more structured way, cyclists could be asked to rate elements of a route for safety and LOS.

9.11 Route option selection

Cycle route option evaluation concludes with the selection of the preferred option(s) for each route.

A plan can be produced of the proposal ready for further planning and consultation — see Figure 9.2 for an example.

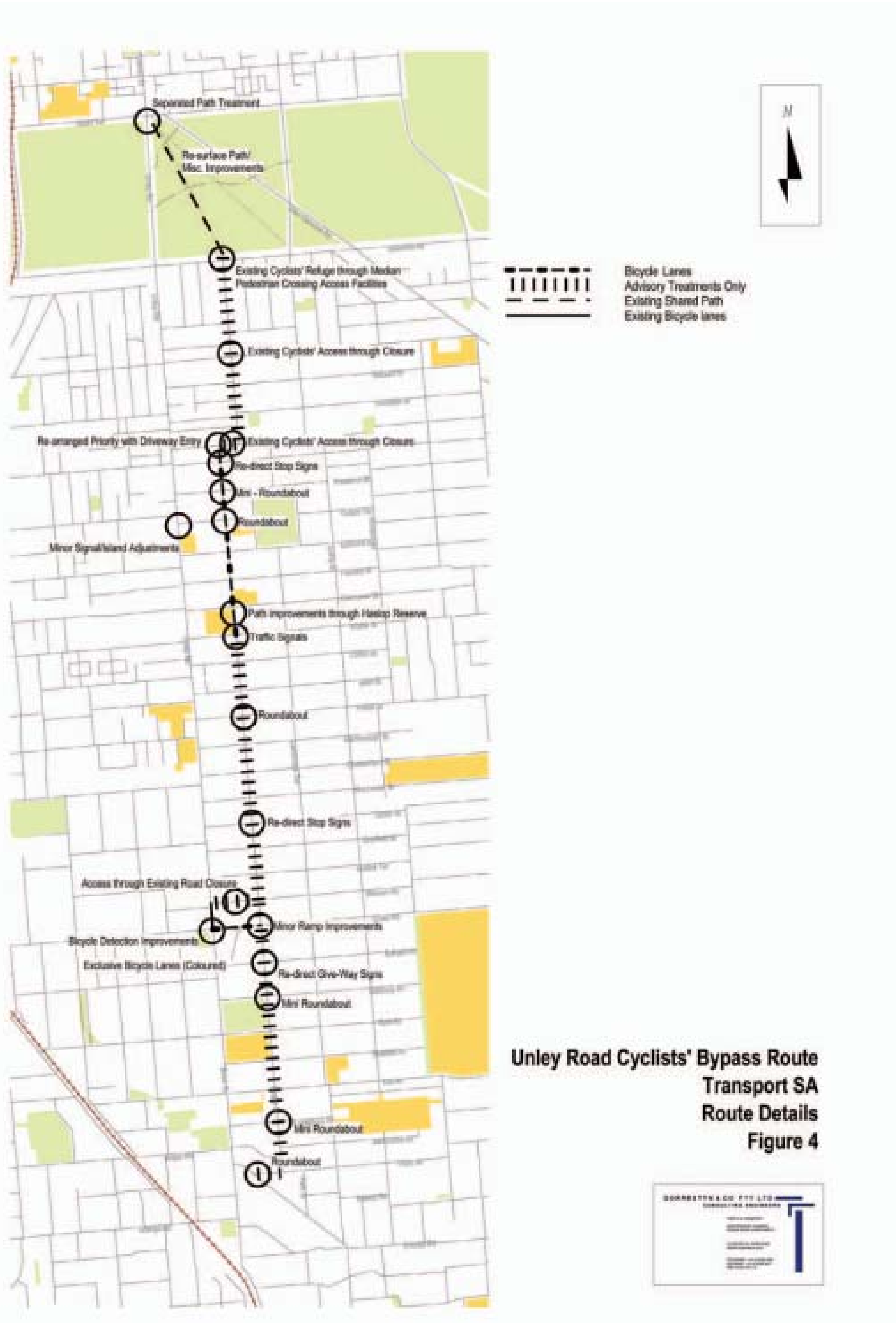


Figure 9.2: Cycle route plan
Source: Dorrestyn & Co Pty Ltd

10 THE CYCLE NETWORK PLAN

PREPARE CYCLE NETWORK MAP AND PROJECT SCHEDULE
Map the primary cycle route network and any area-wide treatments.
Schedule the infrastructure projects.

10.1 The cycle network plan

Once cycle route options have been evaluated, the cycle network plan is prepared. This should include:

- a map of the primary cycle route network
- a schedule of the cycle infrastructure projects required to develop it.

10.2 Cycle network map

While only some routes are identified and signed as forming the primary cycle route network, all roads and paths usable by cyclists are part of the total cycle network.

In addition to showing the primary cycle route network, cycle network maps should indicate any areas, such as town centres or schools, where area-wide treatments such as traffic management or 30 or 40 km/h zones are to be implemented. In some circumstances, such as in traffic-calmed areas or fully controlled grid networks, it could be preferable to make every road as cycle-friendly as possible and not to try to direct cyclists to particular routes.

10.3 Project schedule

The schedule should describe the works to be implemented and their estimated cost. Costs can be estimated initially using unit rates per kilometre for different types of facilities.

10.4 Network development cost

It is useful to have a rough-order cost for implementing the entire primary cycle route network.

This figure can be used to calculate the realistic annual expenditure required to complete the network in a reasonable timeframe, or the realistic timeframe to complete network development given the allocated funding. Without this information, a cycling strategic plan can stagnate with no clear council support for funding, and no likely timeframe for completion.

However, the cost of cycle network development may appear so high that it fails to get the necessary support. An alternative approach is to identify a limited network to be implemented over 10 years based on achievable funding.

The network development planning process, timelines and budget setting will need to dovetail with other planning processes such as asset management plans, annual plans and LTCCPs.

10.5 Sample maps

Figure 10.1 (see opposite) is from a detailed cycle network map for a city and shows:

- relevant land use – schools, reserves and retail centres
- graded cycle routes – highly trafficked, intermediate and recreational
- existing and proposed paths
- locations for intersection treatment and existing and proposed grade separated crossings.

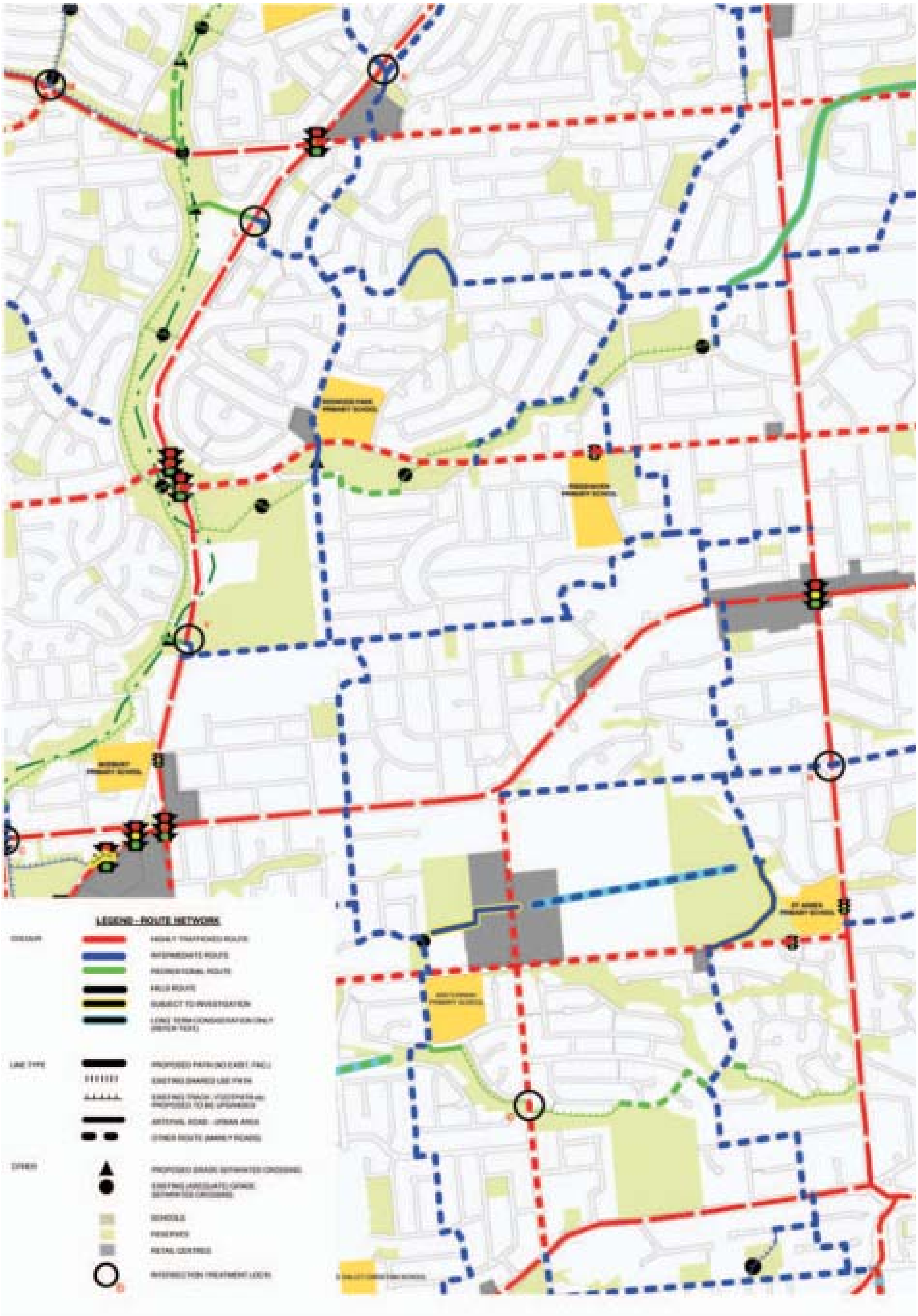


Figure 10.1: Cycle route network plan

Source: City of Tea Tree Gully Bicycle Route Network (Dorrestyn & Co Pty Ltd, 1998)

11 PRIORITISATION

PRIORITISE CYCLE ROUTE DEVELOPMENT

Prepare a programme of projects for detailed investigation, design and implementation.

11.1 Introduction

Prioritising cycle route network implementation is more an art than a science.

This chapter discusses possible criteria for the order in which the network will be developed:

- LOS/cycle review.
- Existing usage numbers.
- Crash records.
- Blockage removal.
- Demonstrable achievement.
- Area consolidation.
- Quality demonstration projects.

11.2 Level of service/cycle review

Description

Priority could be assigned to treating sections of routes that have the worst LOS, or to projects which provide the most LOS improvement.

See section 9.5.

Advantages	Disadvantages
See section 9.5.	See section 9.5. The approach does not take demand or cost into account, although this could be overcome, for example, by assessing the cost per LOS improvement per number of cyclists who will benefit.

11.3 Usage numbers

Description

This approach assigns priorities to existing routes with the most cyclists, which can be based on counts at peak times.

Advantages

It is sound business practice to retain existing customers before seeking to attract new ones. Observing cyclists' preferred routes tends to be a sounder measure of their attractiveness than theoretical models.

Disadvantages

This approach does not consider:

- demand suppressed by the traffic dangers, physical difficulties or personal safety concerns that most affect more timid cyclists
- route elements that do not yet exist, such as a path or bridge yet to be constructed.

11.4 Crash records

Description

This method assigns priorities according to the crash cost savings that can be achieved.

Advantages

Crash data and costs are readily available (see section 7.3.2) and will give some indication of potential dangers.

Disadvantages

Cyclist crash data suffers from some inadequacies. See section 7.3.2.

Cycle usage levels, suppressed demand and the nature of hazards must also be considered, as a low-crash cost could reflect low usage, serious hazards deterring cycle use or a high level of cyclist safety.

11.5 Blockage removal

Description

Priority is assigned to projects where removing a blockage would achieve the greatest increase in cyclist numbers or other cyclist benefits.

Blockages could be due to road or traffic danger (such as a pinch point or large roundabout), physical factors (such as access to a destination across an unbridged gully), or personal safety concerns (such as a secluded path or underpass).

Bridging a river, Millennium Bridge, York, United Kingdom. (Photo: Tim Hughes)

Advantage

This approach is particularly useful in relatively cycle-friendly situations where there is established demand on both sides of a blockage.

Disadvantage

It can be difficult to predict cycle usage increases that would result from removing individual blockages.

11.6 Easiest or cheapest first

Description

The easiest or cheapest elements in a programme are given priority.

Advantages

A simple achievement measure, such as the total length of a cycle route meeting a certain LOS, gives an impression of achievement. This is useful when the value of a cycle route programme is questioned.

Disadvantages

The easiest or cheapest elements are not always the most needed. The importance of the different elements also needs to be considered.

There is a risk that such a short-term approach will lead to lower-quality outcomes in the longer term.

11.7 Quality demonstration projects

Description

Priority is given to flagship projects that showcase attractive, high-quality facilities that others will want to emulate in their own communities.

Advantage

This can build community support for providing quality facilities of which they can be proud.

Disadvantage

It may be expensive and use up all the budget.

11.8 Area consolidation

Description

This gives priority to spreading cycle provision across a substantial area. Once a consistently high cyclist LOS has been consolidated in one discrete area, provision is spread to another.

Advantages

Consolidation may increase cycling and be a more clearly demonstrable achievement.

If the whole area has achieved a satisfactory standard, cycling promotion can take place without undue concerns about an unsafe environment for cycling.

Disadvantage

A focus on a single area over several years may lead to charges of inequitable treatment in relation to areas that do not enjoy this investment.

11.9 Recommendations

Several criteria should be used together.

The cycle review or LOS criteria could usefully be combined with cycling usage data and cross-compared with crash data and project costs. Together, these may indicate a programme focus on a particular geographical area, bringing forward other lower-ranked projects and removing identified blockages. This treatment could then be repeated for the next highest-ranked area, and so on.

This approach should not, however, neglect the value of some demonstrable achievement through implementing easy or cheap network elements or some quality flagship projects. Similarly, a focus on a particular area should not neglect particularly strong needs identified elsewhere.

During implementation, it may be useful to advance a lower-ranked cycling project and combine it with the timing of a mainstream project. See section 12.2.1.


adidas

12 IMPLEMENTATION

IMPLEMENT CYCLE NETWORK DEVELOPMENT
Allocate funding for detailed investigation, design and construction/implementation.
Detailed investigation and design of individual cycle projects.
Audit of individual cycle projects.
Physical works.
Maintenance.

12.1 Introduction

This section discusses implementing an agreed plan to improve cycle infrastructure in an area.

12.2 Integration

Cycle network planning needs to be integrated with mainstream transportation planning and policy. If not, conflicting policies and infrastructure provision can undermine its potential to achieve its objectives – for example, measures that increase the volume and speed of traffic with which cyclists have to mix.

Providing for cyclists' needs should be the responsibility of all departments or divisions of a local authority or road controlling authority, whether or not they have a cycling officer or unit.

This is because their decisions and activities have the potential to either help or hinder the satisfaction of cyclists' needs. The task is too big to be the sole responsibility of one person or small specialist unit.

OPPORTUNITIES FOR IMPROVING PROVISIONS FOR CYCLISTS
Road marking after resealing.
Carriageway adjustments with kerb and channel replacement.
Shoulder widening as part of edge-break repairs or drainage improvements.
Railway, motorway and pipeline corridors.
Conservation land.
Using strategic properties that come up for sale for off-road facilities.
Co-ordinating with projects carried out by adjacent local authorities and Transit New Zealand.
Arterial road traffic management – parking restrictions and crossing facilities.
Safety improvement works and intersection changes.
Traffic signal upgrades – cycle-friendly detectors, signals and phasing, and lane arrangements.
Bus priority schemes – bus-bike lanes, head start signals.
Bridge replacement or widening.
Local area traffic management schemes, including contra-flow lanes.
Safer Routes to Schools projects and school travel plans.
Improvements for pedestrians, such as barrier removal, crossings and footpath widening – include wider, shared paths.
Urban renewal projects.
Parks and reserves redevelopments.
Other developments by the local authority and others.
Riverfront and waterfront developments.
New subdivisions, including paths and links.
New commercial developments or redevelopments.

Table 12.1: Opportunities for improving provisions for cyclists

Source: Fundamentals of planning and design for cycling: Course notes: Version 01 (Transfund, New Zealand, 2003, p.55)

12.2.1 Infrastructure projects

Each local authority has forward work programmes identifying the infrastructure works to be implemented in the planning period, including road, path and bridge construction and maintenance (see Table 12.1).

A plan showing these infrastructure works should be superimposed on the cycle network plan to identify where the two sets of works overlap. Any desirable cyclist facilities should be incorporated in the mainstream infrastructure works rather than being retrofitted at greater expense and possibly to a lesser standard later.

Also, cycle facilities can be provided as part of other infrastructure works (or maintenance) rather than being funded by a local council's dedicated cycle facilities fund. This means the fund can be made to go further and the primary cycle route network can be achieved sooner.

Individual opportunities to incorporate cycling works with other programmed works are likely to be scattered around the network, which means fragmented facilities until the inter-linking portions are completed. This is unavoidable and acceptable as long as suitable transitions are designed. However, it is desirable to implement whole routes wherever possible as incomplete cycle facilities are likely to result in significant cyclist dissatisfaction. Refer to section 13.4 for more information on monitoring programme implementation.

12.2.2 District plans

Include maps of the primary cycle route network in district plans, together with appropriate objectives, policies and rules relating to avoiding, remedying or mitigating the adverse effects of other activities on cycling, in a similar way to provisions for arterial roads. Mitigation measures could include, for example, off-street car parking provision to allow for cycle lanes, and private contributions towards implementing an adjacent section of the network.

12.3 Implementation programmes

12.3.1 Long-term programme

The long-term implementation programme, which needs to be flexible, should record each project's name, location, estimates of construction cost and professional fees, and proposed year of implementation.

The professional fees for investigation and design can be significant compared with other roading projects.

For the purpose of integration, the cycle network implementation programme should have the same planning period as the local authority's LTCCP.

Separate plans showing each stage of the work should be prepared. Such plans help identify and avoid any gaps in the network.

12.3.2 Short-term programme

A more precise one- to five-year cycle network implementation programme should be prepared, based on the longer-term programme. This programme can feed into the local authority's annual planning process.

12.4 Cycle network and programme review

At least every five years, the entire cycle network and implementation programme should be reassessed to confirm its currency. Factors to consider include:

- has the cycle network development progressed as planned?
- have cyclist desire lines or cycle route usage changed?
- has cyclist safety improved?
- have there been significant changes to the district transport infrastructure or major land-use developments that require changes to the network plan?
- have cycle network and route design and planning practice changed?
- has the way that cycle projects are evaluated and funded changed?
- are there opportunities to complete gaps in the network that should be given a higher priority?

12.5 Detailed investigation and design

This step involves assessing individual cycling infrastructure projects in more detail than at the network planning stage, which may have been undertaken some years previously.

It may be appropriate to confirm that the planned option is still the most appropriate. Refer to the earlier sections of this guide for details of these assessments.

12.6 Audit

The audit tools discussed in section 9.3 can be applied at scheme concept stage, to detailed design plans, and after construction.

12.6.1 Design audit

Before the detailed investigation and design are complete, plans should be audited to identify any design deficiencies and to ensure that opportunities to improve cycling conditions are properly considered.

12.6.2 Post-construction inspection

When a cycle facility is complete, and preferably before it is opened for use, it should be inspected using a bicycle. The inspection aims to identify any deficiencies that could compromise cyclists' safety. Any remedial works considered necessary should be carried out as soon as possible and preferably before the facility is opened for use.

12.7 Personnel resources

It is essential that all personnel, including politicians, responsible for planning, implementing and promoting cycling facilities are available, appropriately trained and skilled and aware of the latest technical guidance and relevant research findings. There also needs to be a wider understanding of cycling policy, its objectives and benefits. Specialist training should be undertaken where necessary (McClintock, 2002, pp32-33).

12.7.1 Cycling planners

Many projects in different administrations and organisations can affect cycling, and planning and implementing a cycle network involves a significant amount of work.

For this reason, each RCA should have someone with overall responsibility for preparing and implementing its cycling strategic plan. Where large urban areas are involved this position should be full-time, and may need the support of other full-time staff dedicated to this function.

Those responsible for co-ordinating cycle provision need to have a high profile within their organisations and be supported by senior management.

12.7.2 Cycling advocates

Cycling advocates, who often form groups to further their collective interests, can make a significant contribution at most stages of the cycle network planning and implementation process. If there is no group in an area, the local authority could help establish one. However, it must be independent to remain effective.

Details of the consultation required at each step in the planning process are discussed in the relevant sections of this guide.

12.7.3 Cycling advisory groups

It is recommended that each local authority convene a cycling advisory group.

12.7.4 Consultants

There are consultants who specialise in cycle planning and cycle infrastructure design. Before engaging a consultant, check they have the specialist skills and experience relevant to the tasks required. Experience in general roading or transport planning and design is not sufficient on its own.

12.8 Maintenance

'To achieve adequate maintenance there need to be clear performance standards, and adequate staffing and revenue funding covering the maintenance of both on- and off-road cycle routes with reference to surface quality, signing, markings and cutting back intrusive vegetation. Regular inspection is vital as well as clear and well-publicised mechanisms for reporting defects' (McClintock, 2002 p.30).

In York, United Kingdom, cycle-mounted maintenance rangers, each towing a trailer of tools, have been appointed to help improve cycle facility maintenance (Harrison, 2002, p.151).

In Odense, Denmark, four cyclists are equipped with cellphone cameras, with which they photograph defects, to send to the roads and parks maintenance officer with a text message description and location. They get paid for each accepted message.

Inspections and any necessary maintenance should be carried out after storms and during and after road works or property development that could result in detritus on the cycle route.

12.9 Funding for infrastructure

Long-term investment in cycle infrastructure and promotion is needed to induce a significant modal shift (Harrison, 2002, p.153).

RCAs fund cycling projects. Such funding must be provided for in LTCCPs and annual plans. Cycling projects that meet a transport need and satisfy the relevant criteria are eligible for a subsidy from Transfund New Zealand. Refer to Transfund's *Programme and funding manual* and *Project evaluation manual* for details of the criteria.

Community groups, community trust funds and tourism interests are potential alternative sources of labour or funding for recreational cycling routes.

Construction of cycle parking facilities also qualifies for a Transfund New Zealand subsidy.

12.10 Funding for other initiatives

The central government responsibility for funding of non-infrastructure initiatives is not well defined. Activities that meet the requirements of Transfund NZ's travel demand management category may be subsidised by Transfund NZ. School road safety education funding is being reviewed.

Discuss your cycle safety education proposals with the nearest LTSA regional manager.

12.11 Timeframes and levels of funding

It takes time to develop a well connected cycle network, and the annual expenditure will determine the rate at which this happens. It is unrealistic to expect a significant increase in cycle use before significant portions of the network are complete, not least because the cycle network is just one aspect of the overall provision cyclists require.

However, in the longer term, cities overseas have been able to improve cycle safety and increase cycling's modal share. Consistent and continuing effort eventually achieves results.

12.12 Quality of cycle provision

Design standards are often compromised because of space and finance constraints, resulting in substandard facilities that can sometimes put cyclists more at risk than if no provision were made at all.

Cycle paths are often not safe, convenient, attractive or direct. More attention needs to be given to the quality of initial design, construction and maintenance. Attention to detail is very important. Cyclists may avoid an otherwise adequate cycle route because of one particularly hazardous or inconvenient obstacle.

12.13 Publicising facilities

Cycling facilities need to be publicised and cycling promoted to maximise cycle use. These activities can include:

- media releases to announce complete routes or facilities
- providing a cycle network map showing cycle routes, cycle-friendly routes and cycle parking facilities
- providing network signage to indicate recommended cyclist routes.

Network signage

Having route and destination signage for cyclists is important in promoting facilities. Initially it will be necessary to plan signage for parts of the network that are complete.

Once erected, the signs should be recorded and managed using a signs inventory and asset management system.

Signage of cycle routes is eligible for a Transfund New Zealand subsidy.


North
Hagley
Park
Fendalton Rd
City
Riccarton Ave
City
Guildford
West
Guildford
Fairfield
Merrylands West
Blacktown
Guildford
Fairfield
Guildford
Fairfield
Christchurch City Council
d pathway.
be considerate.
Kilmarnock St
Riccarton Bush
University
North
Hagley
Park

13 MONITORING

13.1 Introduction

This section describes the monitoring required, particularly once the implementation of the cycle network plan has started.

13.2 Features to monitor

The following features should be monitored and included in an annual or biennial report on cycle network development:

Physical works programmes.

Cycle use and modal share.

Cycle crashes.

Satisfaction levels regarding cycle facilities.

Cycle facilities' condition.

Cycle network implementation.

LOS improvements.

13.3 Pragmatic approach

For efficiency purposes, monitoring and surveys of cycling should be integrated with similar local authority or RCA activities where possible.

13.4 Physical works programmes

As discussed in section 12.2.1, physical works programmes should be monitored to identify opportunities to include provisions for implementing sections of the cycle network, or for otherwise satisfying cyclists' needs.

Planned general or reactive maintenance works (including storm damage repair) should be monitored on a monthly, or as appropriate, basis. Meanwhile, the infrastructure and maintenance works programme of Transit New Zealand and adjacent local authorities should be monitored at least annually.

13.5 Cycle use

The number of cyclists using key sections of the network should be counted annually to:

- detect any changes in cycle use that may affect cycle network implementation priorities
- collect data to support funding applications.

Installing continuous automated counters on key routes provides some control data for monitoring cycle use on the network. This can also be used for scaling short-term or seasonally affected counts and for calculating modal split.

Individual locations do not need to be counted every year. A rolling five-year programme of cycle counts will be adequate for monitoring and design purposes.

Cyclists' trip patterns are important clues to the effectiveness of cycle network planning. If these differ significantly from those envisaged by network planners, it may indicate the need for a change of approach.

13.6 Cycle crashes

Cycle crash data should be monitored annually in order to detect:

- any new or growing hazards that may require urgent attention, or an adjustment to the cycle network implementation priorities
- any problems associated with recently completed cycle facilities
- whether cyclists' safety is increasing or decreasing.

13.7 Satisfaction levels

A sample of all road users (including pedestrians) should be surveyed annually or biennially in order to identify the degree of satisfaction or dissatisfaction with provisions for cyclists in the study area. This survey is probably best included in a local authority's residents' survey, if it has one. A more specific survey of cyclists is also desirable.

13.8 Cycle facilities' condition

The condition of existing cycle facilities should be monitored and any necessary maintenance programmed and carried out.

A system for cyclists to report hazards could be implemented, for example by freepost reply cards, email, the internet or phone hotlines.

Some European towns pay cyclist advocacy groups to conduct regular condition surveys.

13.9 Cycle network implementation

It is important for cycle network planning and maintenance purposes to maintain an up-to-date plan and schedule of the sections of the cycle network that have been implemented. From these, the percentage of the ultimate network completed can be calculated and compared with the planned progress, and reported where appropriate.

13.10 Level of service

The LOS of critical sections of the network (see section 9.5) can be monitored periodically to determine whether cycling conditions have deteriorated to an extent that upgrading should be given a higher priority.

13.11 Benchmarking

Several towns in Europe participate in benchmarking surveys to assess the adequacy of RCA policies and the performance of their networks in relation to the network attributes listed in Table 3.1.

These can be used to monitor progress in improving cycling conditions, and to compare network performance with other comparable centres that have taken part.

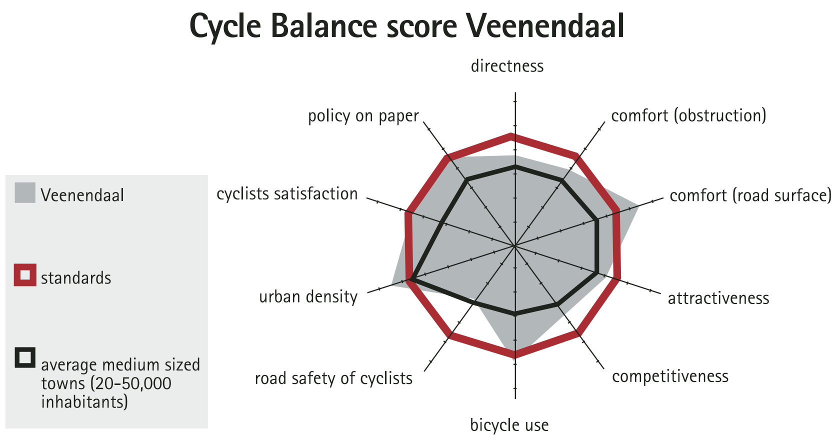
Bicycle Policy Audit (BYPAD), is offered by specialist consultants throughout Europe.

This process involves questionnaires completed by politicians, municipal officials and cyclists' representatives. The auditor then facilitates the development of quality aims and measures for the future on the basis of the assessment results. More information is available at www.bypad.org

The Dutch Cyclists Union (Fietsersbond) also conducts benchmarking surveys called the *Cycle Balance* for the Dutch Government. This involves surveying cyclist representatives and the local authority's officers. An instrumented bicycle is used to ride a sample of routes between randomly selected homes and common cyclist destinations. These are compared with car travel for the same trip. Cities are rated on their directness, delays to cyclists, road surface quality, noise levels, competitiveness with the car, bicycle modal share (for trips under 7.5 kms), bicycle injury rates, cyclist satisfaction and documented cycling policies. The project is described in Borgman (1993). The score table of 125 Dutch towns can be viewed on www.fietsbalans.nl (Dutch language).

13.12 Plan review

The monitoring results should be assessed at least every three years and the cycle network plan and programme adjusted as appropriate. Whether the plan is yielding value for money should also be assessed.



Cycle balance diagram for Veelendaal, The Netherlands.

14 CONSULTATION

14.1 Introduction

This section describes the consultation that is appropriate at all stages of the planning process.

14.2 Why consult?

Consultation underlies governance in a democratic society, and the Local Government Act 2002 emphasises a partnership with the community in everything local government does.

Also, most politicians and officials do not rely on cycling as everyday transport. This means they have no recent personal cycling experience on which to assess proposed cycling measures. In addition, consultation is a way of accessing cyclists' extensive local cycling knowledge and experiences and identifying their, and potential cyclists', attitudes.

14.3 What is consultation?

Consultation may mean informing the community, or being informed by it, or both. It may range from informing the public and asking for their consent to the public owning the strategy formulation process and contributing their own perspectives.

Consultation is distinct from survey work or information gathering, which are controlled by cycle planners and essentially focus on factual data. Consultation, by contrast, seeks to give others a voice and to focus on views and perspectives contributed to the cycle planning process.

14.4 Who to consult

Cycle planning expertise frequently rests with a small group of specialists and cycling advocates. Strong dialogue is required with cycling advocacy groups and specialists to ensure this expertise is incorporated and to test the technical aspects of cycle planning. Cycling advocates will need to be informed by technical perspectives.

Because cyclists' needs vary, a range of cyclist types will need to be consulted. Confident and less confident cyclists, those cycling longer distances (often at higher speeds), local commuters, school cyclists and those cycling for sport or leisure, should all be included.

Other transport stakeholder groups and the wider community will also need to be consulted on cycling-related proposals. These will include representatives of car drivers, truck operators, public transport operators and users, and pedestrians. A balance will be frequently needed to ensure each group's needs are appropriately met without unreasonably disregarding those of others.

14.5 When to consult

Consultation is required throughout the cycle planning process (see Table 14.1).

It is important to consult when proposals are still at a formative stage. Although consultation is often seen as an extra expense, it is usually repaid many times over in avoiding inappropriate design and sometimes the need to retrofit later.

14.6 How to consult

The requirement to consult is more important than the precise way in which consultation takes place. The following are some avenues that have been found useful. They are not exclusive, often needing to be used in combination:

- Cycling working parties or advisory groups, usually comprising technical and professional staff from a range of official stakeholders (for example, local authority and Transit New Zealand, LTSA, New Zealand Police, and the regional council) along with cyclist representatives.
- Public workshops, open forums or focus groups.
- Formalised submission processes (for example on annual plans or LTCCPs).
- Public notices, letter-drops of proposals, and internet-based information and response opportunities.
- Cycle audit and cycle review processes (see section 9.4).
- One-on-one meetings with individual stakeholders as required, on specific subject matter.
- Cycling planners or champions employed by the RCA, whether full-time, part-time or incidental to another role, who can act as brokers between their employers and local advocates. Strong support to this role is important because otherwise impossible pressures may be generated by unrealistic expectations (especially if, as often is the case, the person is at a relatively junior position within the organisation). Professional ethical issues need to be recognised and this role needs to supplement, not replace, support for cycling across the wider organisation.

14.7 What to consult on

The full range of road and transport proposals affects cyclists, not just cycling facilities. Care must be taken to avoid cycling facilities being rendered of limited use, or even dangerous (for example, a cycle path emerging where motorists will not be expecting it on a busy road). Formalised cycle audit processes are helpful in relation to specific projects, and avenues such as those outlined above can be used for a sample of projects. General lessons learned can be incorporated in wider cycle planning.

14.8 Resources for consultation

Cycling advocates generally contribute to the consultation process in their own time. This is appropriate in their role as customers, but there is a case for supporting them with public resources if they provide specialist expertise that contributes to the public benefit.

Direct payment for consultation creates a precedent that may be best avoided, except in cases where clearly a form of expert consultancy service is being provided through formal contractual arrangements. However, RCAs often support cycling advocacy groups through small grants, in kind, or for specific services (such as a ride-over of routes to test maintenance from a cyclist's perspective).

In Europe, some RCAs pay cycling advocate groups for auditing projects, condition surveys and benchmarking performance.

WHEN?	WHO?	WHAT ABOUT?
Annually	Local and neighbouring RCAs	Forward programmes for infrastructure works to identify opportunities to incorporate provisions for cyclists in those works
Detailed investigation of individual cycle projects	Existing and potential cycle route users	Origins, destinations and routes Trip purpose and user types Hazard location Route and facility preferences
	Other road users including pedestrians Owners and occupiers of adjoining properties Other affected stakeholders	Hazard location Effects of proposals Route and facility preferences
	Existing and potential cycle route users Other road users, including pedestrians Owners and occupiers of adjoining properties Other affected stakeholders	Effects of proposals

Table 14.1: Consultation that cycle planners should undertake during the implementation phase

APPENDIX 1
CYCLING STRATEGIC PLANS

This appendix describes the elements that should be included in a cycling strategic plan (note other terms may be used such as bike plan and cycling strategy).

A1.1 Policy context

An outline of the relevant broader policies and strategies, which often contain the justification for preparing the cycling strategic plan (see chapter 2).

A1.2 Authorship and participation

A local authority or regional council usually authors a cycling strategy. However, other appropriate agencies should be closely involved and agree to any content that they are responsible for implementing. Other agencies include Transit New Zealand, local councils (regional/city/district), the LTSA, Transfund New Zealand and the New Zealand Police. Local cycling advocacy group(s), other road user groups, employers and cycle retailers will also need to be consulted.

A1.3 Cycling policy objectives

Brief statements setting out, in general terms, what is intended to be achieved.

A1.4 Targets

Targets against which achievement is measured could include:

- cycle use and modal share
- cyclist injuries and hospitalisations
- satisfaction levels regarding cycle facilities
- cycle facilities' condition
- cycle network implementation
- LOS improvements
- the proportion of school pupils trained to basic competence each year.

A1.5 Actions

These will include both engineering and non-engineering actions. They will tend to be in generalised terms within the cycling strategic plans, and where necessary supplemented by other documents specifying the requirements. Typical elements include:

- cycle route network planning and implementation (the subject of this guide)
- educating cyclists in road rules, bicycle maintenance, safety precautions and practical skills in relation to other traffic
- educating motorists and pedestrians on the cyclists' needs and likely behaviour
- educating cyclists and pedestrians on safe path sharing
- enforcing correct and appropriate behaviour by motorists and cyclists
- measures to overcome perceived negative aspects of cycling
- measures that integrate cycling with travel behaviour change programmes
- crash reduction studies focusing on cycle crash patterns
- measures to integrate cycling with public transport, such as secure parking at stations and cycle carriage on buses
- a cycle parking strategy and implementation programme (covering different types of parking demand)
- recommended actions by non-RCA agencies (for example, Police, regional council, schools, employers), sometimes with funding assistance
- an outline of the sources and roles of funding for implementation of the cycling strategic plan
- incorporating the network and any associated rules into the district plan
- a programme of signs for cycling facilities.

A1.6 Cycling data

The data needed to plan and implement the cycling strategic plan, including cycling usage and crash data.

A1.7 Liaison channels

An outline of the formal channels and processes (for example, cycling advisory group) by which politicians, officials (both within the RCA and between it and other governmental bodies) and cycling advocacy groups are consulted and involved in progressing the cycling strategic plan.

A1.8 Cycling engineering standards

An endorsement of *Austroads' Guide to traffic engineering practice: Part 14: Bicycles* as amended by the New Zealand *Cycling design supplement*, with allowance for local variations.

A1.9 Cycle route network prioritisation criteria

A statement of how priorities are set for implementing cycling infrastructure projects.

A1.10 Cycle network plan

A map of the proposed network.

The timeframe and proposed investment by which the entire cycle route network will be implemented. This should include a general staged programme and description of the geographical areas and particular needs or problems that will be tackled.

A1.11 Short-term cycling route network implementation programme

A description of projects and detailed costings for the next three years of the cycle route network implementation programme. Costings should preferably be based on the outcome of formal project feasibility studies. On first adoption of a cycling strategic plan, the outcomes of such studies may not be available; in this case these elements should be incorporated in the cycling strategic plan at its first review.

A1.12 Review period

The term after which the cycling strategic plan will be reviewed. This will often be three years, but should align with the review periods and timings of other relevant RCA documents (such as LTCCPs).

A1.13 Monitoring indicators

Progress towards targets as measured by appropriate indicators should be included in an annual report. For a discussion on these see sections 13.5–13.10. In addition to these measures, the reach and effectiveness of cycling promotions and the number of school students that pass the basic competence road test following school cycle education could be monitored.

A1.14 For more information

A generic cycle strategic plan is available from the Environment Canterbury website **www.ecan.govt.nz** .

A discussion of the range of policies needed to support cycling is provided in Koorey, 2003.

APPENDIX 2
SCALING CYCLE COUNTS

Introduction

The number of cyclists using a facility varies by time of day, day of the week and week of the year. Based on some Christchurch cycle counts described below, the variation over an average weekday is shown in Figure A2.1. The variation in weekly flows across one year is shown in Figure A2.2. The purpose of this appendix is to recommend a procedure for estimating the average annual daily flow of cyclists (cycling AADT) from cycle counts conducted at one time. It is not normally practical to count cyclists over a whole year. A formula for scaling up short-period cycle counts is described below.

Scaling factors

The scale factors in Tables A2.1 to A2.3 are based on year-round continuous cycle counts from 13 cycle loops around Christchurch. If an adequate set of continuous count data is available for the local area concerned it should be used instead. (A programme for collecting and updating such data for each area is recommended elsewhere in this guide.) The scale factors account for the time of day (H), day of the week (D), and week of the year (W). The week factor varies with school holidays and season. The pattern was found to vary depending on the presence of cyclists riding to and from school. The presence of school cyclists is shown by a peak after 3 pm (see Figure A2.1) that is absent from work commuting. The amount of school cycling at the site also affects the extent of the drop in cycling during school holidays. For this reason there are two sets of factors in the tables to provide for situations with and without school cycle traffic.

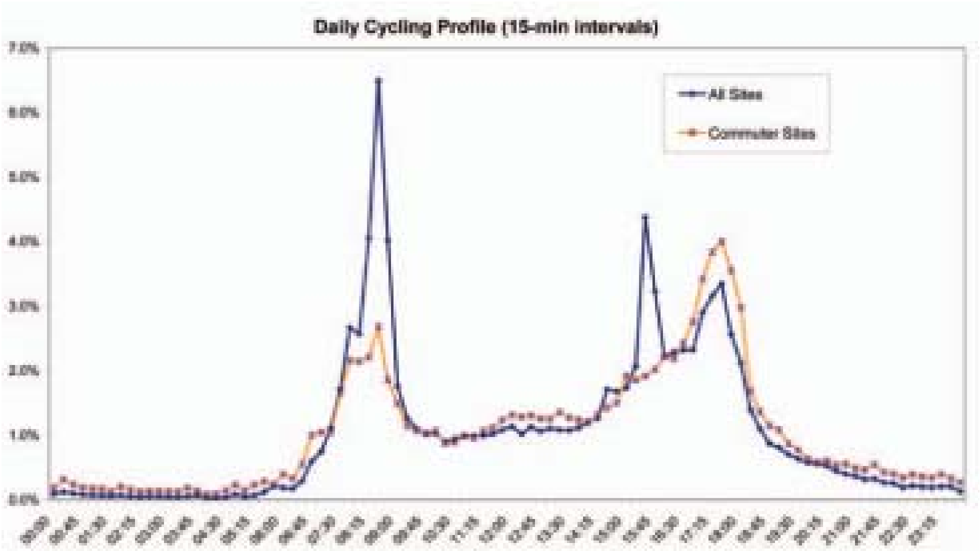


Figure A2.1 Weekday daily cycling count profile corresponding to H-weekday for all sites in Table A2.1.

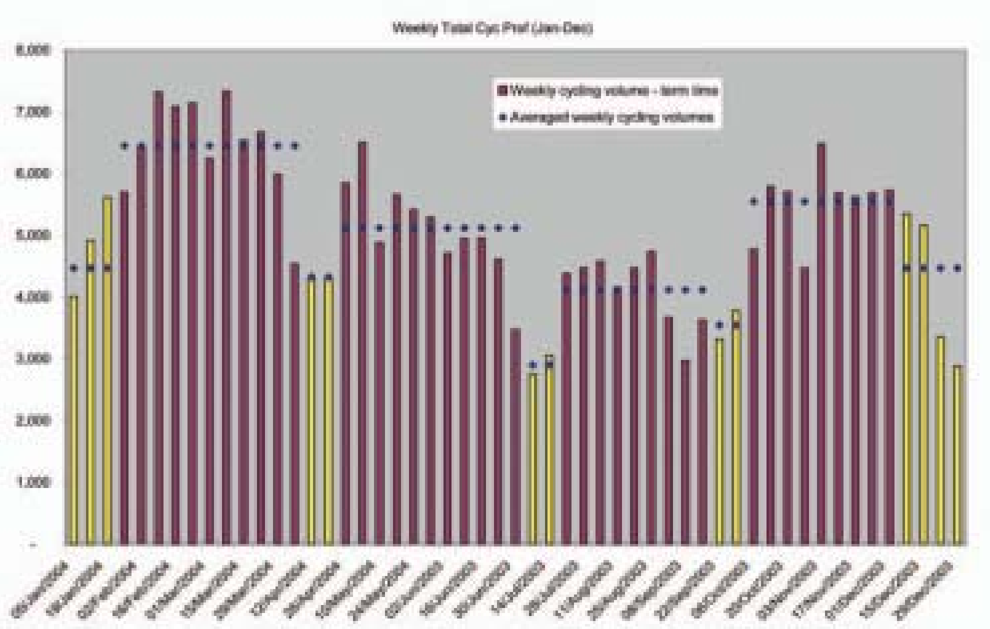


Figure A2.2 Profile of weekly cycling counts corresponding to W-all in Table A2.3.

Calculation equation

The following equation yields the best estimate of a cycling AADT:

$$AADT_{Cyc} = Count \ast \frac{1}{\times H} \ast \frac{1}{D} \ast \frac{W}{7}$$

where *Count* = result of count period

H = scale factor for time of day

D = scale factor for day of week

W = scale factor for week of year

If cycle count data for more than one day is available, then the calculation should be carried out for each day, and the results averaged.

Worked example

Suppose two counts (of 90 and 165 minutes respectively) have been undertaken on weekdays in May. The site is used by both school children and commuters. The count data and the coefficients to be used are shown in the table below, as well as the AADT estimates resulting from the two counts.

	AM COUNT	PM COUNT
TIME	7.30 to 9.00	3.00 to 5.45
CYCLISTS	125	127
DATE	29-May-03	30-May-03
DAY	Thursday	Friday
H	25.5%	30.6%
D	16.8%	15.2%
W	0.98	0.98
AADT ESTIMATE	410	382

Averaging the estimates yields a cycling AADT of 396.

Recommendations

We recommend using the above equation for approximating the cycling AADT. As cycling volumes fluctuate from day to day depending on the weather, this method should be used with caution, and ideally the estimate should be achieved based on the average of the results of several counts. Individual counts should be for periods of no less than 60 minutes. Counts should be of cyclists in both directions and cover at least the morning peak period, the after school hour and the evening commuter peak. Counts during warmer months and school terms will provide the most reliable estimates. Also take note of tertiary calendars when planning counts. It is not appropriate to scale up counts from Christmas/New Year holidays.

Use the Christchurch data in the absence of better local information, but take into account any demonstrable local factors. While the data has limitations, being from a limited number of sites in Christchurch only, it is now possible for the first time to scale up cycle count data with some confidence.

Acknowledgement

The method was developed by Axel Wilke of Christchurch City Council, building on work by Aaron Roozenburg (Beca Christchurch) in preparing data and undertaking some of the analysis. A fuller description of how the method was derived is available for Axel Wilke at Christchurch City Council. As more data is collected and the figures are refined, updated tables will be published.

PERIOD STARTING	PERIOD ENDING	ALL SITES		COMMUTER SITES	
		H WEEKDAY MON TO FRI	H WEEKEND SAT & SUN	H WEEKDAY MON TO FRI	H WEEKEND SAT & SUN
0:00	7:30	4.8%	5.3%	7.8%	12.7%
7:30	7:45	2.0%	0.5%	1.9%	0.5%
7:45	8:00	3.1%	0.6%	2.5%	0.5%
8:00	8:15	3.0%	0.5%	2.5%	0.5%
8:15	8:30	4.9%	0.7%	2.6%	0.5%
8:30	8:45	7.8%	1.1%	3.1%	1.0%
8:45	9:00	4.7%	1.2%	2.0%	1.0%
9:00	10:00	5.1%	5.2%	4.9%	4.2%
10:00	11:00	3.1%	7.5%	3.4%	6.0%
11:00	12:00	3.1%	8.3%	3.8%	6.8%
12:00	13:00	3.5%	8.5%	4.6%	8.2%
13:00	14:00	3.5%	8.5%	4.5%	8.0%
14:00	14:15	0.9%	2.7%	1.1%	1.6%
14:15	14:30	1.0%	2.2%	1.2%	1.7%
14:30	14:45	1.6%	2.4%	1.4%	1.8%
14:45	15:00	1.5%	2.4%	1.4%	1.7%
15:00	15:15	1.5%	2.8%	2.0%	1.7%
15:15	15:30	1.9%	2.7%	1.8%	2.0%
15:30	15:45	4.7%	2.8%	1.9%	2.0%
15:45	16:00	3.3%	2.9%	1.9%	2.3%
16:00	16:15	2.2%	2.5%	2.2%	2.2%
16:15	16:30	2.2%	2.7%	2.2%	2.1%
16:30	16:45	2.2%	2.8%	2.5%	2.0%
16:45	17:00	2.3%	2.7%	2.9%	2.0%
17:00	17:15	3.1%	2.2%	3.8%	1.9%
17:15	17:30	3.5%	1.8%	4.3%	1.6%
17:30	17:45	3.7%	1.8%	4.6%	1.7%
17:45	18:00	2.8%	1.4%	4.0%	1.4%
18:00	19:00	5.7%	4.5%	7.4%	5.9%
19:00	20:00	2.7%	2.8%	3.2%	3.9%
20:00	0:00	4.6%	6.0%	6.4%	10.4%

Table A2.1 Typical daily cycling profile.

DAY	D ALL %	D COMMUTE %
MONDAY	17.1%	16.1%
TUESDAY	16.4%	16.6%
WEDNESDAY	16.5%	16.7%
THURSDAY	16.8%	17.0%
FRIDAY	15.2%	16.3%
SATURDAY	9.0%	9.9%
SUNDAY	9.0%	7.4%

Table A2.2 Weekday usage percentages.

SECONDARY SCHOOL PERIOD	W ALL (FACTOR)	W COMMUTE (FACTOR)
SUMMER HOLIDAYS	1.13	1.02
TERM 1	0.78	0.84
APRIL HOLIDAYS	1.17	0.97
TERM 2	0.98	1.04
JULY HOLIDAYS	1.74	1.40
TERM 3	1.22	1.19
SEPT/OCT HOLIDAYS	1.42	1.24
TERM 4	0.91	0.93

Table A2.3 Period adjustment factors.

APPENDIX 3
SAMPLE QUESTIONNAIRE

** Fold form with reply paid label out & seal with sticky tape along the top edge and sides. No staples please. **

Delivery Address:
PO Box 62
ST AGNES SA 5097

No stamp required if posted in Australia

Roxby Downs Council - Roxby Downs Bicycle Strategy
Reply Paid 62
ST AGNES SA 5097

Fold Here

DORRESTYN & CO PTY LTD
TRAFFIC & TRANSPORT

ROXBY DOWNS
COUNCIL

Bicycle Strategy - Resident Survey

The Roxby Downs Council in association with Transport SA, is preparing a 'Bicycle Strategy'.

The Strategy will result in a safer and more accessible environment for cycling in Roxby Downs.

By completing and returning this survey form, you will be making a contribution towards improved cycling conditions.

Completed questionnaires should be returned to the above address by 20 April 2001.

Fold Here

1. ***Do you own a bicycle ?*** YES ❑ No ❑
2. ***Do you own a bicycle helmet ?*** YES ❑ No ❑
   IF SO, DO YOU WEAR IT? YES ❑ No ❑
3. ***How often do you cycle?*** *(Please select one only)*
   EVERY DAY ❑ EVERY WEEK ❑
   AT LEAST ONCE A MONTH ❑ AT LEAST ONCE A YEAR ❑
   NEVER ❑
4. ***A map of the roads around the town has been provided (see reverse side). Please draw in your most common route of travel by bicycle.***
5. ***What is the purpose of your trips along this route?*** *(Please select one only)*
   TRAVEL TO/FROM SCHOOL ❑ RECREATION ❑
   SHOPPING ❑ TRAVEL TO/FROM WORK ❑
   OTHER ________________ ❑
6. ***What are the factors that concern you the most in regard to cycling in or around Roxby Downs?*** *(Choose 3 factors ranked 1-3, with 1 being the greatest concern)*
   TRAFFIC CONDITIONS ____ LACK OF SECURE PARKING ____
   LACK OF OFF-ROAD PATHS ____ LACK OF ON-ROAD SPACE ____
   MOTORIST BEHAVIOUR ____ CROSSING BUSY ROADS ____
   ROAD SURFACE ____
   OTHER ________________ ____
7. ***If you commute to work, school, etc. by bicycle, how far is your trip (in one direction)?*** ______ km
8. ***If you don't ride to work, school, etc. by bicycle, what is the main reason you don't ride?***
   ____
9. ***Are secure bicycle parking facilities needed in or around Roxby Downs?*** YES ❑ No ❑
   IF SO, WHERE ? ________________

10. Have you had a bicycle stolen in the last 5 years? Yes ❑ No ❑

If so, was it securely locked? Yes ❑ No ❑

From where was it stolen? ____________________

11. Do you often cycle at night? Yes ❑ No ❑

If so, do you have lights? Yes ❑ No ❑

12. Do you support the encouragement of cycling by the Council? Yes ❑ No ❑

13. If you are aware of any specific problems related to cycling in or around Roxby Downs, please describe them (eg. 'squeeze' points, poor surface, safety issues).

____

____

____

____

14. If you have any suggestions for improvements or of routes / destinations for recreational cycling, in or around Roxby Downs, please describe them.

____

____

____

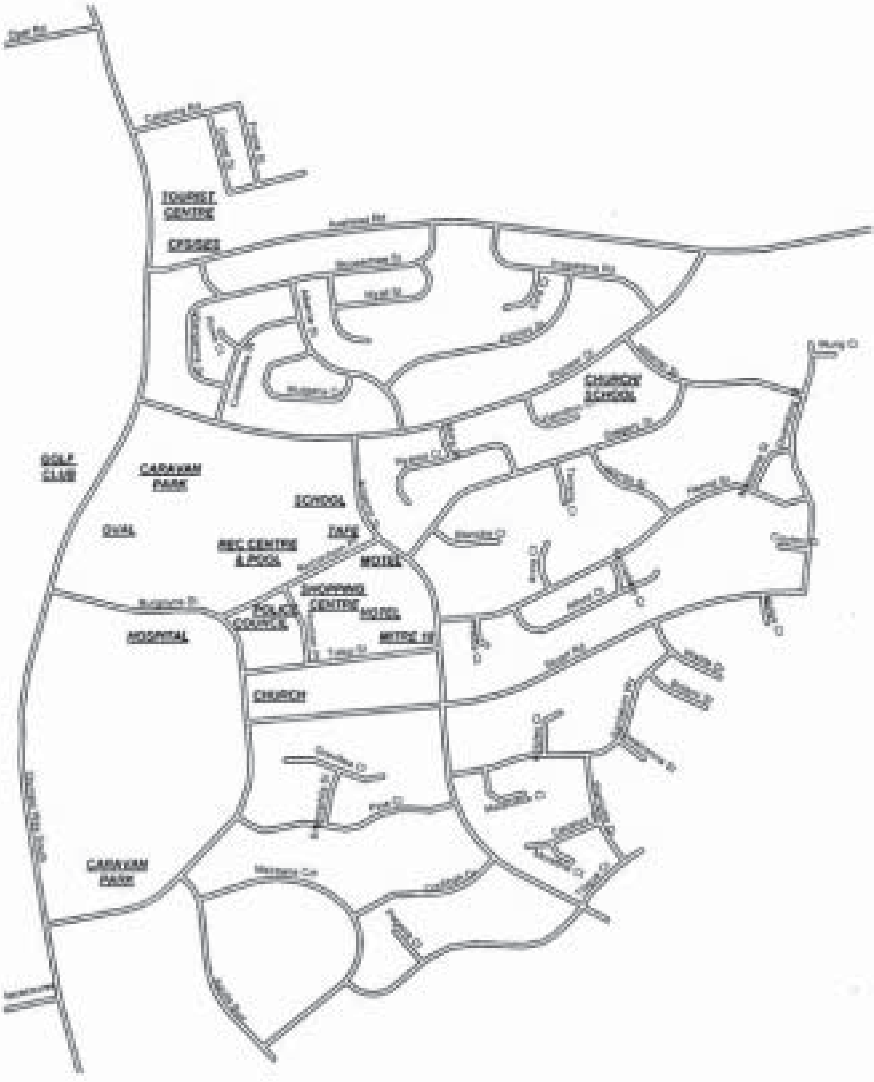
____

____

15. Are you? Female ❑ Male ❑

16. Please specify your age (years). 0-9 ❑ 10-14 ❑ 15-19 ❑ 20-29 ❑ 30-39 ❑ 40-49 ❑ 50-54 ❑ over 55 ❑

Thank You



Source: Kindly made available by Kym Dorrestyn, Dorrestyn & Co Pty Ltd.

APPENDIX 4
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