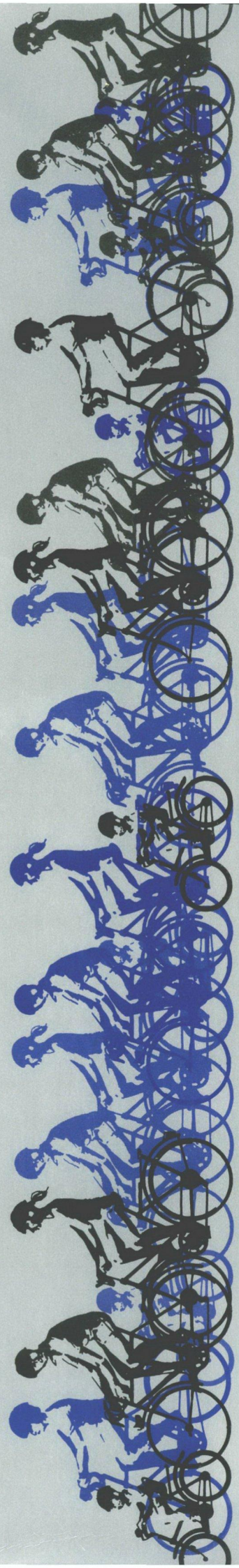

planning for the bicycle

TRAFFIC AUTHORITY OF NEW SOUTH WALES

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planning for the bicycle

Acknowledgements

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Chapter 7 of this Bulletin i.e. "Guidelines for Improving Local Traffic Areas for Cyclists" was prepared by Loder and Bayly, a firm of Planning and Engineering Consultants.

The Traffic Authority of N.S.W. also wishes to acknowledge the substantial contribution made by the Geelong Bike Plan Committee in the preparation and financing of the Bulletin.

July 1982

I.S.B.N. No. 0 7240 7776 6

Foreword

In November, 1976 the Geelong Bike Plan, the first major study undertaken in Australia into how cyclists could be provided for in existing built-up urban areas, was published. This Bike Plan proposed that the provision of physical facilities was not enough to bring about significant improvements in the safety of cyclists but should be complemented by a range of non-engineering programs designed to improve the road sense and behaviour of all bicycle riders. Out of this proposition grew the concept of the 4E's of comprehensive bicycle planning, i.e. Engineering, Education, Enforcement and Encouragement.

Since the publication of the Geelong Bike Plan comprehensive bicycle studies based on the 4E's concept have been undertaken in Melbourne, Adelaide and Newcastle and from these studies, there has evolved a distinct planning method for the preparation of the engineering component of the work.

The purpose of this Bulletin is to describe the method with the view of providing assistance and guidance to Local Government Authorities in the planning of bicycle transport systems. The Bulletin may also be useful to Universities, Colleges of Advanced Education and other tertiary institutions who wish to include a unit on bicycle planning in an appropriate course stream.

Following practical application of this manual by the user, comments on any aspect in implementing the procedures detailed would be appreciated. Such comments and requests for further information should be directed to:

The Secretary
Traffic Authority of New South Wales
P.O. Box 110
Rosebery N.S.W. 2018
Telephone (02) 663 8222

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Glossary of Terms

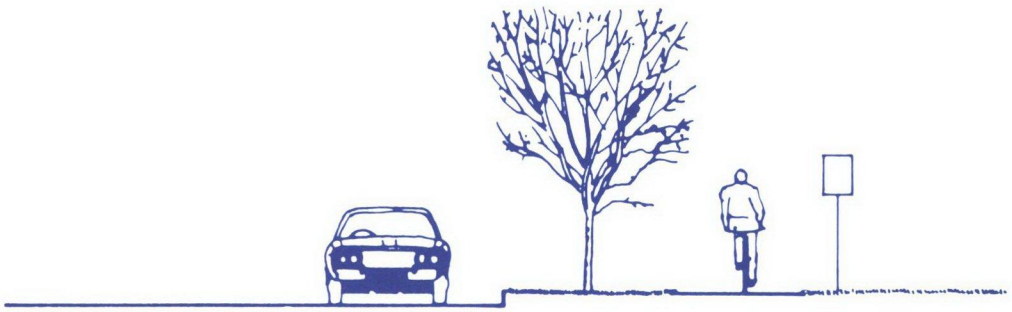
The terminology used in this Bulletin is defined below. An attempt has been made to be consistent with the National Road Traffic Code in these definitions but because of certain peculiarities in State laws deviations are necessary.

BIKE/BICYCLE — any two or three-wheeled vehicle designed to be propelled solely by human power.

BIKEWAY — an all inclusive term for a bicycle transportation system.

OFF-ROAD BICYCLE FACILITY — a collective term for bikeways completely separate from a street carriageway.

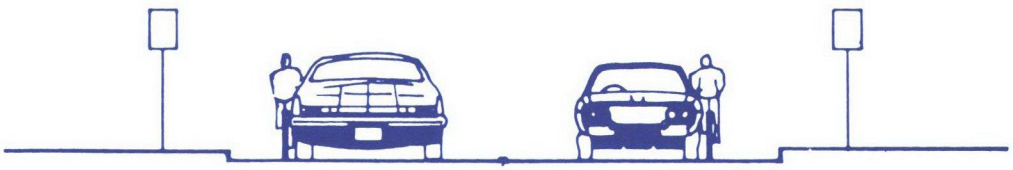
BIKE PATH — a bikeway completely separated from a street carriageway though not necessarily out of the road reservation.



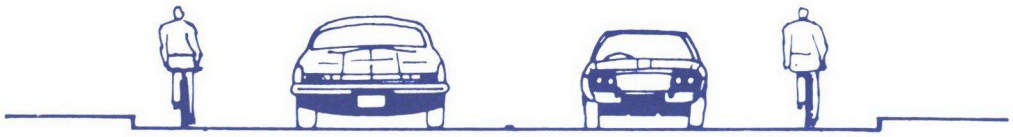
PEDESTRIAN/ BIKE PATH — a footpath or other bikeway for joint use by both cyclists and pedestrians.

ON-ROAD BICYCLE FACILITY — a collective term for bikeways sited on a street carriageway.

BIKE ROUTE — a road signed for cycling but with cyclists sharing the carriageway with other vehicles.



SHARED KERBSIDE LANE — a lane on a street carriageway for shared bicycle/motor vehicle use but of sufficient width to permit the cyclists to travel outside the main traffic stream.



BIKE/CAR PARKING LANE — a lane on a street carriageway designated for shared bicycle use and motor vehicle parking.

BIKE LANE — a lane on a street carriageway separated from motor vehicle traffic by line marking or by a physical barrier.

ARTERIAL ROADS (>15,000 AADT)[1] — predominately carry through traffic from one region to another forming principal avenues of communication for metropolitan traffic movements. They are usually part of the proclaimed Main Road system, including highways and freeways. Freeways are those roads having full access control and grade separated intersections, whose primary function is to serve large traffic volumes.

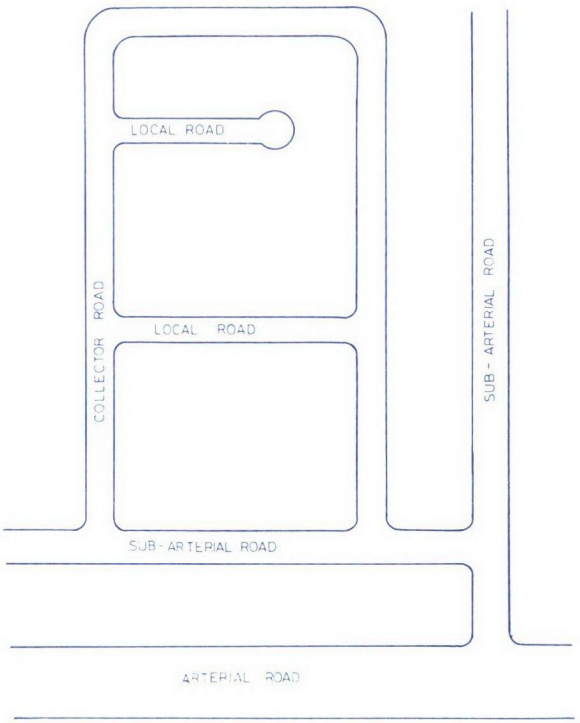
SUB-ARTERIAL ROADS (5,000-20,000 AADT) — connect the arterial roads to areas of development or carry traffic directly from one part of a region to another. They may also relieve traffic on arterial roads in exeptional circumstances

COLLECTOR ROADS (2,000-10,000 AADT) — connect the sub-arterial roads to the local road system in developed areas.

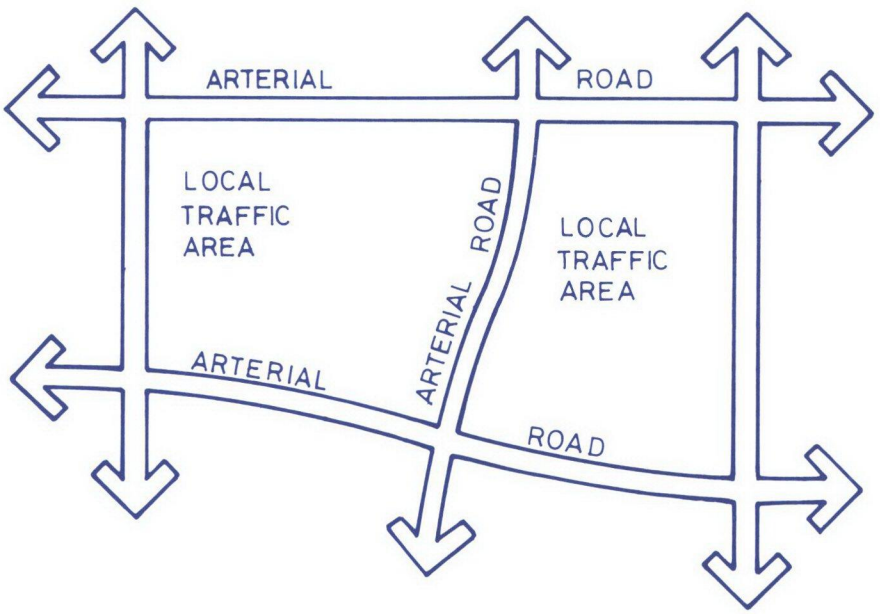
LOCAL ROADS (<2,000 AADT) — are the sub-divisional roads within a particular developed area. These are used solely as local access roads, but traffic volumes and types of vehicles will depend on the intensity and nature of the development -e.g. residential, commercial, industrial, recreational, etc.

1. AADT = ANNUAL AVERAGE DAILY TOTAL (TOTAL ROADWAY VOLUMES)

HIERARCHY OF ROADS



LOCAL TRAFFIC AREA — localities bounded by arterial and/or sub-arterial roads.



CARRIAGEWAY — that portion of the road reserve constructed for the conveyance or parking of vehicles.

RIDER STRESS — a term used to describe the level of anxiety or harrassment, a cyclist perceives when riding along a carriageway.

SQUEEZE POINT — a location where due to a constriction in the normal carriageway width a cyclist is forced out into the main traffic stream and hence into a potential conflict situation. e.g. a railway crossing; a narrow bridge; a reduction in pavement width.

1. introduction

1. Introduction

1.1 background

Until recently the emphasis of bicycle transport planning has been to separate bicycles from motor vehicles. This has meant that planners have sought to create a system of bikeways largely independent of the road system, and where this has not been possible allocate space on the road pavement for the exclusive use of cyclists. While this type of planning approach can be applied to some urban situations such as Canberra where extensive areas of open space have permitted the establishment of a network of off-road bikeways, it is not appropriate in most built-up urban areas. The difficulty in finding suitable locations for off-road bikeways in existing cities has often led to the construction of bicycle facilities which take advantage of off-road alignment opportunities without first determining whether demand for a particular facility exists.

A further factor that has constrained the establishment of separate bikeways is that of cost. The cost of developing a comprehensive separate system can be prohibitive and well beyond the financial resources of most local Councils, who are for the most part the authorities responsible for bikeway construction.

Perhaps one of the most important criticisms of this bicycle planning philosophy is that the creation of separate infrastructure for cyclists may not in fact increase their safety. Accident statistics show that most serious accidents involving cyclists occur at intersections. Unless grade separated or signalized crossings can be provided the bikeway intersections can be less safe than normal road intersections, and cyclists may prefer to use the roadway.

The change in emphasis in bicycle planning practices in Australia came with the publication of the Geelong Bike Plan in November 1977. Following extensive research and evaluation of bicycle rider characteristics and trip patterns, road conditions, road rules and traffic regulations and the needs of all road users, it was clearly evident that it is impossible to create a comprehensive separate bikeway system to serve all cyclists' trip ndeds in an existing built-up urban area. The solution lay in catering for cyclists on the existing road infrastructure.

"Road space is a high cost utility, maintained at ever increasing costs. It is there, in place, ready to serve a transportation purpose for commuters, recreation riders and school children alike. Combined with sensitive and appropriately placed off-road paths along rivers, creeks, waterfronts and open spaces, together with short-cut paths to schools and other short connecting links, a practical system (of bikeways) is attained at low cost, on a flexible demand-based approach to bicycle planning."[1]

This philosophy has been widely accepted as the appropriate engineering strategy to apply when planning for the bicycle in existing urban areas.

The redirection in emphasis has brought about the need to develop a planning method which recognises the cyclist as a legitimate road user and hence integrates the bicycle with all other road transport. Based on the Geelong study a simple and cost-effective planning method has been developed and used to prepare the bicycle Engineering strategies and programs for Newcastle, Adelaide and Melbourne.

1.2 aims and objectives of bikeplans

The main objectives of a comprehensive bikeplan strategy can be stated as follows:

- *To make cycling safer.* This objective can be partly achieved by the provision of bikeways. However, there is also a need to instruct the cyclist in correct and responsible riding practices and to educate the motorist to recognise the cyclist as part of the traffic mix, particularly as a legitimate road user.

- *To make cycling more convenient.* The creation of a comprehensive bikeway system together with the provision of secure parking facilities at all major destination nodes will achieve this objective.

[1] Freewheeling Australia Offprint. **Geelong Bike Plan.** ***"At Last Recognition for Cyclists".***

- *To increase public awareness of the needs of cyclists.* The achievement of this objective is required for three principal reasons. First, the only way to achieve a desirable level of expenditure on the provision of cycle facilities is to gain public acceptance of the bicycle as a serious form of transport. Second, changes in attitudes and behavior towards cyclists will only occur when motorists are made aware of the difficulties confronting the cyclist using the road system. Third, planners and engineers should understand cyclists' requirements so that the bicycle can be considered in the design of new works.

- *To encourage cycling for health, sport, physical fitness and recreation.* This objective is in line with the Australian Federal Government policy of improving the health and well-being of the community.

- *To promote the bicycle as a viable and versatile mode able to satisfy a range of day to day transport needs.* If a greater proportion of the population could be encouraged to use the bicycle it eventually would reduce traffic and parking problems and help to conserve fuel resources.

These objectives cannot be achieved by engineering measures alone. The Geelong Bike Plan proposed that a four pronged Bicycle Strategy was required to satisfy these objectives. The four, but integrated streams of the bicycle strategy comprised:

Engineering — physical improvements to create a safer cycling environment.

Education — education programs designed to improve the road sense and behaviour of cyclists' and car drivers' behaviour towards cyclists.

Enforcement — programs directed at both cyclists and motorists to create a safer integration of motor vehicles and bicycles.

Encouragement — programs to create greater community and governmental awareness of cyclists' needs and to stimulate greater ridership.

Following the lead given by the Geelong Bike Plan most Bicycle Planning studies undertaken in recent years have adopted this four pronged approach to improve cycling conditions and hence make cycling safer.

1.3 objectives and scope of this manual

This Bulletin is designed to provide assistance and guidance to Councils and other Authorities in the preparation of bicycle transport schemes. The planning method presented in this document is by and large for the development of a bicycle Engineering strategy for an existing metropolis or a large provincial city. However, the method can be modified and tailored to suit most urban situations. In this regard, Chapter 8 describes the principle factors that should be considered for the preparation of a bikeway system for a small municipality or town.

The specific aims of the Bulletin are:

- to identify factors that influence the level of bicycle usage,

- to provide details of the background philosophy and approach to bicycle planning,

- to detail the current planning methodology to prepare a comprehensive bicycle Engineering strategy,

- to describe measures to improve the cycling environment within existing residential precincts, and

- to describe how the bicycle can be provided for in the design of new residential areas.

2. planning philosophy

2. Planning Philosophy

2.1 general

Bike planning proposals must be developed on a thorough and rational basis. Realistic and effective plans require a solid foundation of facts about existing and future demand and the real need of cyclists. Most municipalities cannot afford to provide bicycle facilities and introduce programs that will not give the public an adequate return on their investment. The bicycle planning objectives of safety and use, together with efficiency, mobility and pleasure must be satisfied whilst producing a plan that is cost-effective, flexible and economical. The 4E's strategy of the Bikeplan offers a way to achieve these objectives.

2.2 engineering strategy

Bicycles are a difficult transport mode to plan for. Cyclists range in age from five years upwards, and each age group uses the bicycle for a variety of purposes. Thus the planner is confronted with the problems of evolving a strategy which caters for the full spectrum of age and user groups. For the strategy to achieve the goal of improving safety conditions for cyclists, it must take account of the wide differences in the riding skills and behaviour of each age group.

These strategic problems are compounded in built-up urban areas. Cyclists' needs have tended to be ignored in town and transport planning for many years, a time in which motor traffic volumes and road congestion have steadily increased. As a consequence the introduction of bikeways into this type of environment is difficult. The solution lies as previously indicated, in providing a safe integration of bicycles with the existing transport infrastructure and in considering bicycle transport needs in future planning proposals.

The primary aims of an Engineering strategy for bicycles are:

- *to establish a system of safe and convenient bikeways,*
- *to enhance the overall cycling environment within residential areas, and*
- *to provide secure bicycle parking facilities at all major attractors of bicycle trips.*

The first and second of these aims are paramount to the success of a Bikeplan. While the Educational and Enforcement measures will do much to improve riding skills and behaviour, physical bicycle facilities and improved riding conditions must be created if the bicycle accident rate is to be contained, if not reduced. The provision of bicycle infrastructure will also do much to encourage greater use of the bicycle.

With regard to the third aim, it has been found from previous studies that one of the major deterrents to greater ridership is the lack of secure bicycle parking facilities at the major destination nodes. There is a high bicycle theft rate, and with the increasing value of bicycles, it is not unreasonable to predict that the theft rate will continue to grow unless action is taken. The provision of bicycle parking facilities at major transport nodes may also assist in promoting dual-mode use e.g. bike-train, bike-bus and bike-ferry.

In addition to an Engineering program for the establishment of physical infrastructure for cyclists, the preparation of a bike map is seen as being an important and essential output of the Engineering strategy of a bikeplan. A bike map can be likened to a street directory for cyclists in that it shows the existing riding conditions on all designated on-road bikeways, hazardous locations and other information useful to cyclists in the selection of their route of travel. It is of immediate benefit to cyclists and will assist to increase safety by showing cyclists preferred bicycle routes.

The Traffic Authority in New South Wales is preparing a technical bulletin on the design and construction of bicycle facilities including intersection control and sign posting.

2.3 education

A Bikeplan should have three broad educational aims:

- *to instruct cyclists of all ages in legal, safe and responsible riding practices,*
- *to educate motorists to recognise and respect the cyclist as a legitimate road user, and*

- *to educate planners, engineers and politicians to consider the bicycle in the design of new works and redevelopment/reconstruction work.*

Cyclist accident statistics clearly demonstrate the need to introduce programs to educate cyclists. A high percentage of accidents occur through the unpredictable behaviour of cyclists. This is particularly the case amongst the large proportion of the cycling population under 14 years of age.

While the majority of bicycle accidents involving motor vehicles are caused by the irregular behaviour of the rider there is also a need to ensure that the motorists respects the rights of the cyclist as a legitimate road user.

As discussed above the bicycle has been the forgotten element in transport planning for many years with the result that little to no provision has been made for cyclists in the existing transport infrastructure. The cost of providing these bicycle facilities can be greatly reduced if they are incorporated in the construction of new residential developments, roads and other civil works. Thus engineers, and planners should be made aware of the needs of cyclists so that the opportunities for the integration of the bicycle facilities in new works are maximized.

2.4 enforcement

Enforcement comprises the third major element of a bikeplan.

Enforcement emphasises the reinforcement of the educational "message" rather than punitive measures. Thus it is closely related to and integrated with the two other non-engineering streams of the bicycle strategy, Education and Encouragement.

The scope of the Enforcement program is not restricted to just enforcement procedure, but embraces all matters and issues relating to the bicycle and cycling of a legal and semi-legal nature. The specific aims of the Enforcement program are:

- *to reinforce road safety education through the effective enforcement of traffic laws, and*
- *to clarify existing legislation and regulations relating to cyclists and bicycle facilities.*

As mentioned, the enforcement of cyclists' behaviour is seen as being critical to the effectiveness of the Education programs. These programs aim to influence the behaviour of both the cyclist and motorist to create a safer on-road environment and a more positive attitude by all sections of the community to cyclists. In contrast, Enforcement programs should reinforce education by focussing attention on the serious nature of cycling in today's traffic environment.

Cyclists present a number of peculiar enforcement problems which differ from those of the motorist. For example, there is no minimum age for cyclists. Thus there is a need to ensure that the laws relating to the use of the bicycle are clear ald readily understood by all age groups. There may also be a need to review and modify Councils' by-laws to permit cyclists to legally use pedestrian infrastructure and resolve the liability issues surrounding off-road bicycle facilities generally.

2.5 encouragement

Encouragement is the last program stream of the 4E's strategy. An Encouragement program is required to achieve the safety and promotional objectives of the Plan and to complement and reinforce the Engineering, Education and Enforcement strategies.

The Encouragement program can be divided into two parts. The first relates to the introduction of a variety of promotional measures to stimulate and encourage the use of the bicycle for everyday transport needs and for recreation, sport and physical fitness. The second is to publicise the Engineering, Education and Enforcement program, with the main thrust being to foster safe cycling. It is obvious that the first part of the program should be deferred until the Engineering program is well advanced. The objectives of an Encouragement program can be stated as follows:

- *to promote safe cycling,*
- *to publicise the attributes and benefits of cycling,*
- *to create public and governmental awareness of cyclists' needs, and*
- *to publicise the objectives and programs of the other three "E's".*

Although this Technical Bulletin does not deal with planning for the three non-engineering "E's" of the strategy their importance in the Bikeplan should not be overlooked.

2.6 public participation

It is considered essential to foster a high level of involvement and participation in the preparation of a bikeplan by all relevant State and Local Government agencies, community organizations, in particular cyclist groups, and individuals. This involvement will ensure that the recommendations and programs are cost-effective, practical and reflect community ideals and aspirations and thus have support for implementation. Based on previous experience, the following techniques to engender community input are recommended. However, the emphasis on any one technique would be subject to the locality, scale and budget of the study.

- establish and maintain contact with key officers from State and Local Government agencies and submit proposals and draft programs for review and comment throughout the course of the study.
- establish contact with all major interested community groups and invite them to prepare study submissions.
- establish and maintain contact with all cyclist organizations in the study area. Hold a series of meetings with representatives of these organizations to fully brief them on the study and exchange ideas. Invite each cyclist group to prepare a map showing existing and suggested bikeways, other bicycle facilities, hazardous locations and other pertinent information.
- at the commencement of the study place an advertisement in the metropolitan and selected local newspapers inviting submissions on all aspects of cycling.
- prepare a poster advertising the study and display in libraries, Council Chambers, tertiary institutions and other public places.
- make provision for members of the public to visit the offices of the study team during the initial study period to review the work and provide information.
- hold a public exhibition to allow all sections of the community to review and comment on draft proposals and strategies prior to final documentation. This exhibition should be held in a highly accessible location(s) and be extensively advertised.
- produce an information sheet or kit explaining the scope, goals and objectives of the study and distribute to politicians, aldermen and all sections of the media.
- if sufficient funds are available, organize cyclist rallies, public meetings and bicycle events such as bike-athons, fun rides and road races to raise the public awareness of cyclists' needs and problems.

3. strategic issues

3. Strategic Issues

3.1 general

As described, there are four major aspects of bike plan studies. The need to carry out such studies and the emphasis required on each of the four aspects is dependent on the following basic strategic elements:

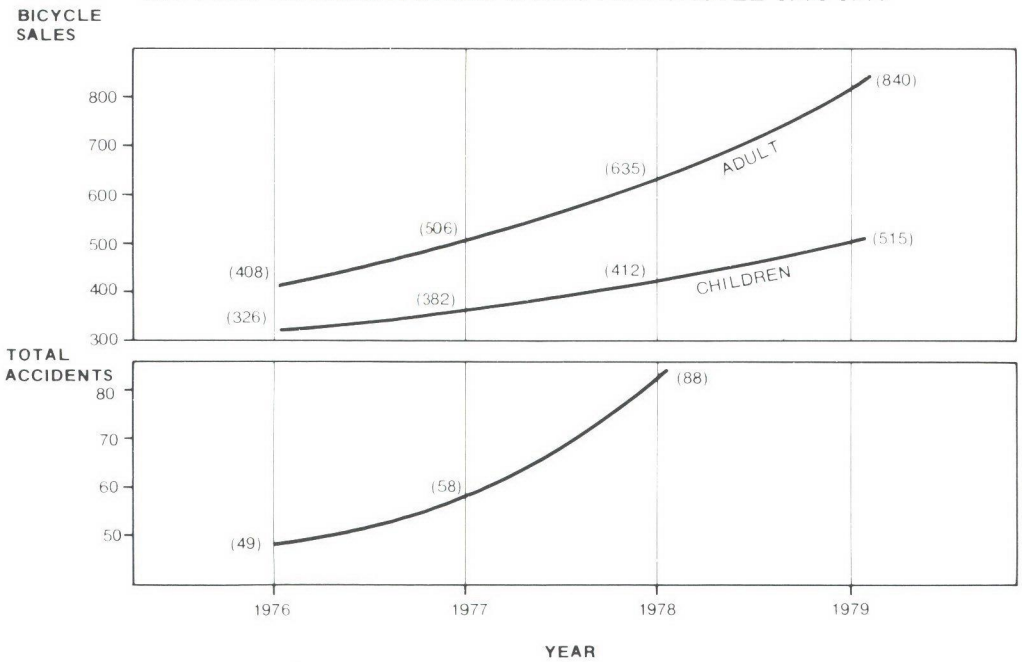
- Bicycle usage
- Bicycle movements
- Accidents
- Cyclists' needs

Before a bikeplan study is undertaken, these elements must be considered by the authority to determine the need for a plan and whether they have the resources to implement improvements and proposals. The identification of the strategic issues in a preliminary study is therefore required and from this study the need for a bikeplan can be assessed and the objectives of the bikeplan formulated. These preliminary considerations are described below under the main strategic elements headings.

3.2 bicycle usage

The increase in bicycle usage by both adults and children has been apparent in recent years, and it is generally considered that this increase has been constrained in most urban areas by concern over safety issues. An assessment of the usage for the particular area can be made by observations and discussions with representatives from cycling bodies, commerce and schools. The views of these people can provide the background to the current situation and the forecast for the future. In addition, data on current ridership levels can be obtained by bicycle volume counts at strategic locations within the study area and undertaking school surveys. Time series bicycle sales figures can also provide an indication of ridership trends.

BICYCLE ACCIDENTS AND SALES NEWCASTLE 1976-1979



Source: Bicycle Sales data from a sample of Newcastle Bicycle Retailers, 1979.

3.3 bicycle movements

The greater use of bicycles has increased the public awareness of the safety aspects of cycling. Requests for measures to improve safety for cyclists would identify routes with particular problems and general observations of cyclists would indicate route patterns. Planning maps of the area indicate the major land use attractors together with the opportunities for route establishment both on and off roads. A map of

the area should be prepared showing the likely movements and notes from discussions held with interested people.

Surveys should also be carried out at schools, tertiary institutions and other locations attracting high bicycle use to obtain current bicycle movement data.

3.4 accidents

This factor is of major importance in any bikeplan study since the improvement in safety is a primary goal of any Bikeplan. Accident statistics should be obtained to provide a guide to the level of the safety problems and to identify locations which may be hazardous to cyclists.

3.5 cyclists' needs

It is crucial that any bicycle strategy recognises and incorporates the real needs of cyclists. Extensive survey work and consultation with cyclists have shown that the main concerns of bicycle riders include:

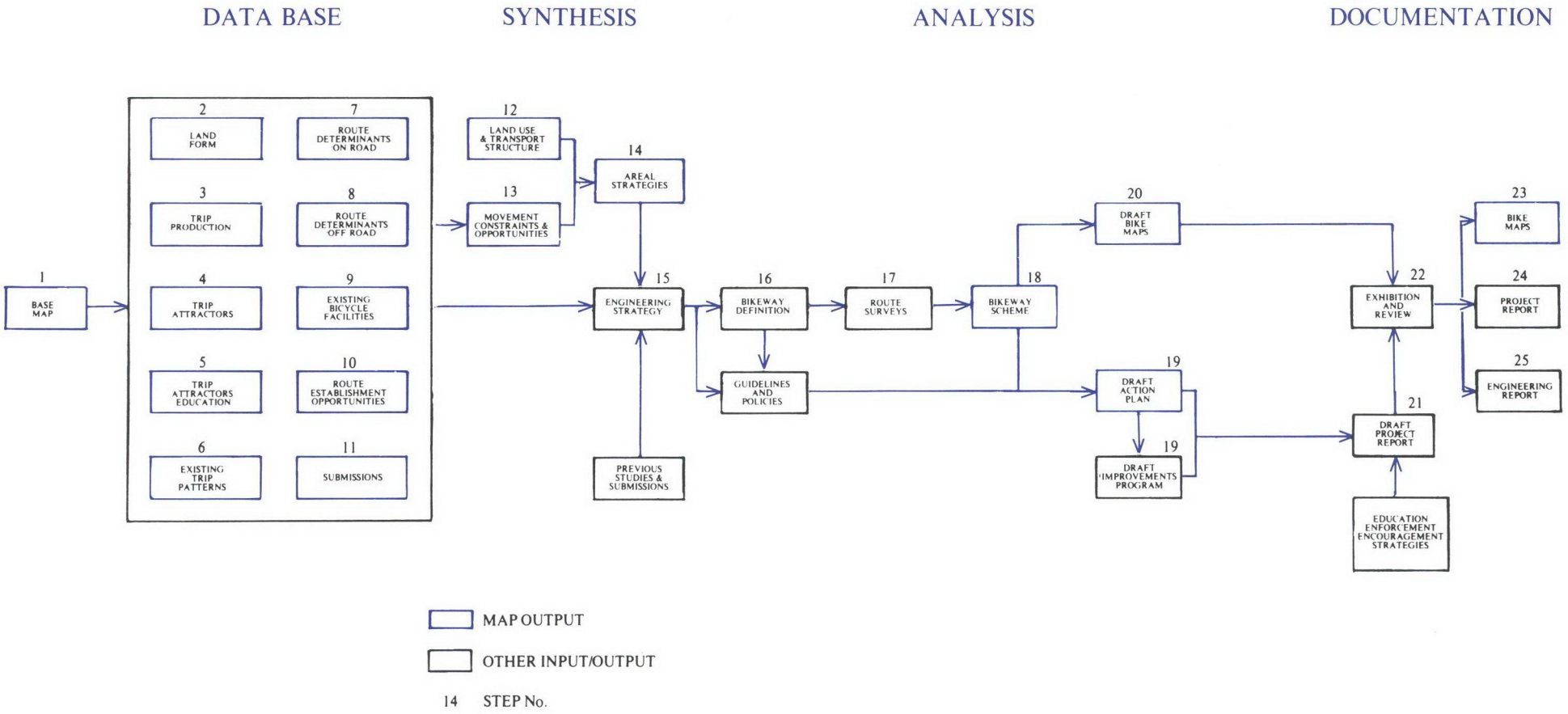
- a smooth clean riding surface,
- adequate width in the kerbside lane to permit cyclists to travel outside the main traffic stream,
- proper traffic channelisation and control of intersection,
- ability of cyclists to actuate traffic signals,
- the removal or moderation of "squeeze points",
- regular maintenance and sweeping of the kerbside lane to ensure the pavement is smooth and free from loose material, oil and water,
- replacement of longitudinal wooden rail bridge decks,
- regular pavement maintenance at railway crossings,
- the erection of warning or advisory signs for both motorists and cyclists at all potentially dangerous conflict points,
- recreation bike paths,
- short cut paths through parks and reserves,
- bikeways away from but paralleling main road arteries for night and wet weather riding,
- an improved cycling environment within each neighbourhood precinct,
- adequate signposting of bikeways,
- secure bike parking facilities at all major bicycle trip destinations, and
- locker and shower facilities at all major employment centres.

All these needs must be considered in the formulation of the Engineering strategy.

4. data base

FIGURE 1.

ENGINEERING STUDY FRAMEWORK



4. Data Base

The planning methodology used to prepare the bicycle scheme and engineering action program involves a four tiered approach comprising:

- a pre-strategy or data collection phase,
- a synthesis phase in which a broad scheme framework is developed and areal bicycle strategies defined,
- a detailed route planning phase in which engineering action is specified for the establishment of the recommended bikeway system and other bicycle facilities, and
- the documentation of the proposals and recommendations.

The various components of the planning method are shown in Figure 1. (Opposite)

Broadly, the approach is an adaptation and combination of the traditional transportation planning model in that consideration is given to trip generation, distribution and assignment and the conventional "constraints and opportunities" land use model. Information is collected, analysed and summarised on a series of drawings or overlays to a base map of the study area. This is considered to be a realistic and practical method of presenting and analysing the complex data collected.

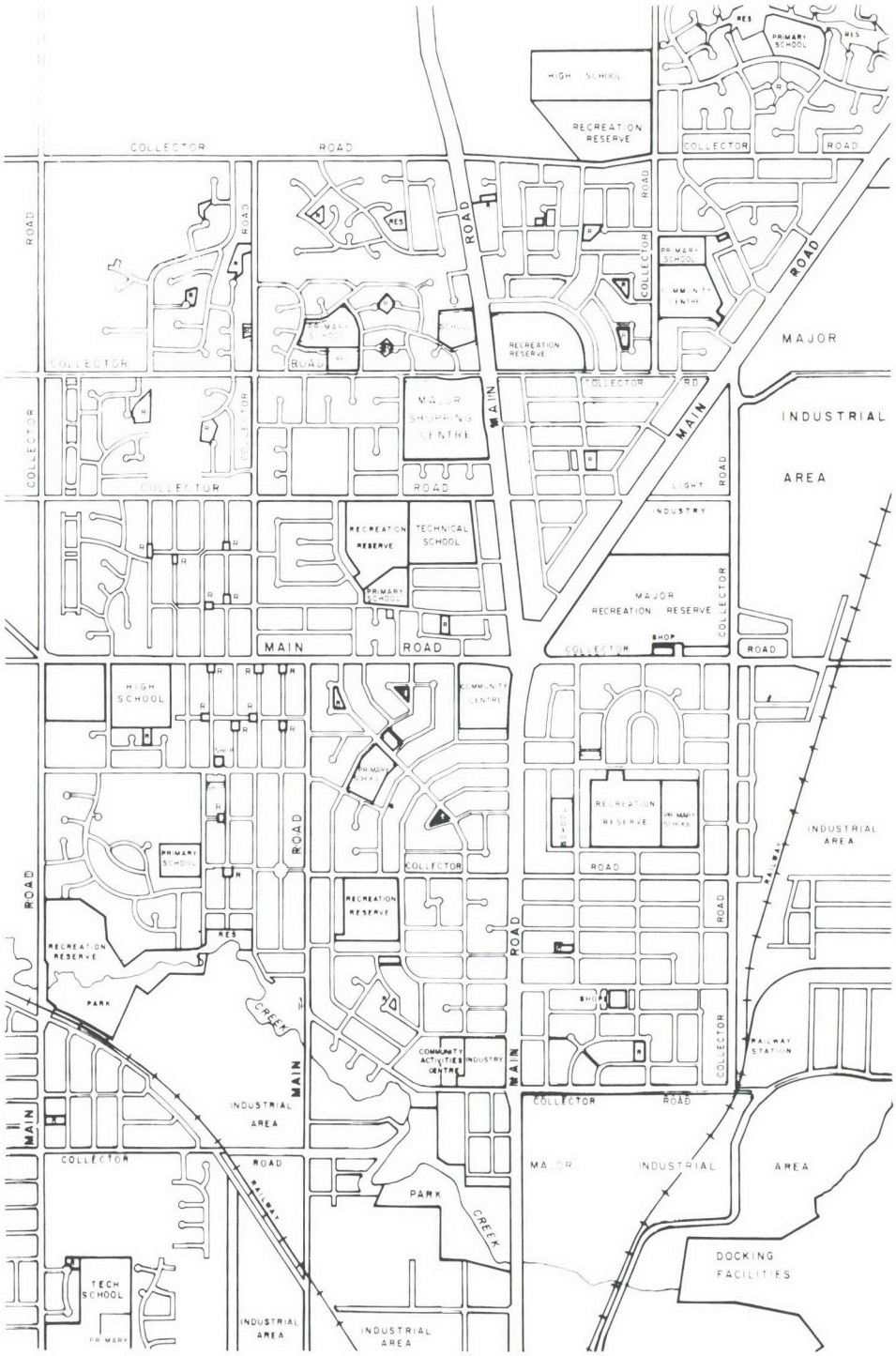
As mentioned, the purpose of the pre-strategy phase of hhe work is to systematically collect and analyse data from those subject areas relevant to cycling or factors affecting the design of the bikeway scheme. The following ten separate data base overlays are prepared.

- Landform
- Trip Production
- Trip Attractors
- Trip Attractors: Education
- Existing Trip Patterns
- Route Determinants: On-Road
- Route Determinants: Off-Road
- Existing Bicycle Facilities
- Route Establishment Opportunities
- Submissions

The pre-strategy or data base maps provide input at various stages in the engineering study framework. These comprise:

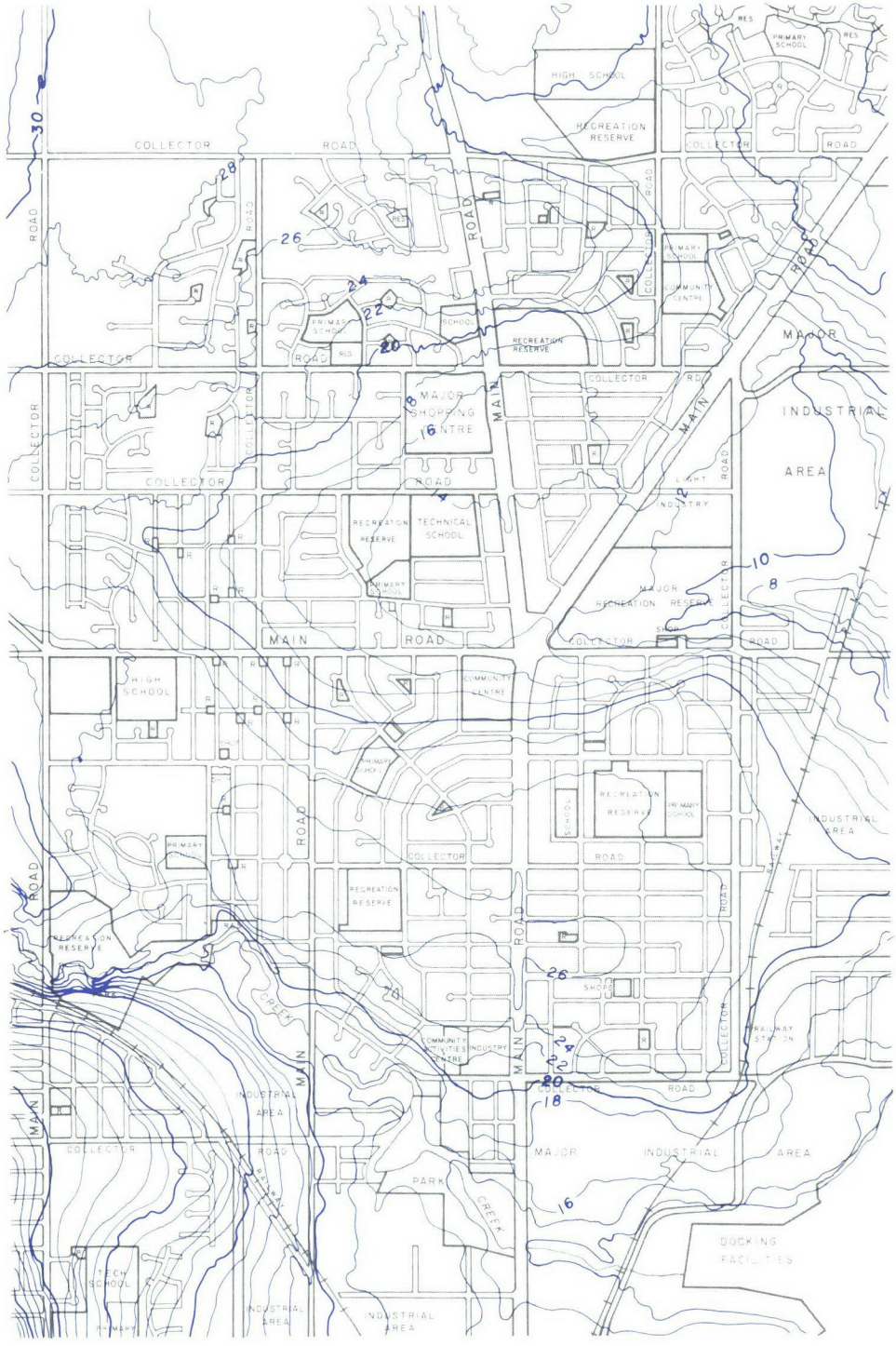
- Engineering Strategy: the maps are used to systematically analyse and review population characteristics, trip data and structural variables in the determination of appropriate areal and composite bicycle strategies for the study area.
- Bikeway Definition and Action Planning: the maps provide a data "sift" mechanism to verify and determine the bikeway systems and identify route priorities and construction opportunities.
- Draft Bike Map: the pre-strategy maps provided source data for inclusion on the bike route map, e.g. land use features, road hierarchy and traffic control infrastructure.
- Consultation and Review: the maps provide display material for public exhibitions.

The content of each pre-strategy map is described below.



The selection of a base map is determined by the availability of mapping and the scope of the study. Base maps should be produced at a scale to either totally cover the study area or sections only, depending upon the size of the area under study. For example, in Newcastle four maps were produced at 1:15,000 scale to cover the study area, while in Geelong, one base map at 1:20,000 scale was sufficient. In the Melbourne Study, a scale of 1:15,000 was chosen and eight base maps were required to cover the study area. Sufficient detail is shown at this scale for the analysis and provides a manageable base to work with overlay drawings. More detailed plans can be referred to for route evaluation. Orthophotos, maps and town planning scheme maps are particularly useful for this purpose.

STEP 2: PREPARE LAND FORM MAP



Grade is one of the factors considered by cyclists when selecting their route of travel. In the majority of cases, a rider will deviate from the most direct route to avoid a steep hill. A study carried out in Newcastle[2] showed that a grade of 4° for a length of 100 metres could be considered as a steep "pinch" or the ruling gradient for an average cyclist on a 10-speed bicycle.

The purpose of the land form (or contour) maps is to identify areas of moderate to steep terrain over which cycling would be difficult in the study area.

[2] Mathieson, J. "Cycling Effort". Unpublished 1980. (Newcastle Cycleways Movement).

STEP 3: ESTIMATION OF BICYCLE RIDERSHIP POTENTIAL

As in most transport studies the determination of existing and future areal trip production potentials is an important consideration in the planning of bikeway systems. These measures provide a guide to:

- appropriate bicycle strategies for an area. For example in a zone with a high school aged population, a bikeway system which focusses on schools and local activities may be the desirable strategy for that area. In contrast, the appropriate strategy for an area with an older population structure, may be the provision of bike-rail dual mode facilities and strong links to employment and commercial centres.

- likely changes in macro bicycle trip desire lines. While existing travel patterns provide an indication of potential bicycle trips within the between zones, consideration should be given to how these patterns of movement may alter over time due to population and urban structural changes.

- the assignment of priorities for the establishment of bicycle facilities. Where the age structure of the population is ageing in a particular area, there is possibly a lesser need to establish bicycle facilities in that area compared to one which has a growing school age population.

There are many factors influencing the propensity to ride a bicycle. These include population age structure, socio-economic characteristics, car ownership, availability of public transport, structural patterns of land use activities, traffic conditions, terrain and micro-climate. The factors considered in the estimation of ridership potential will very much depend on the data available. Ideally a single measure of potential should be calculated to formulate meaningful areal comparisons.

In the Melbourne and Geelong bicycle studies the following procedure was used to estimate zonal trip production potentials[1]:

- Trip Production Zones: Since age structure and bicycle ownership data were only available at the L.G.A. level, these were used as the analysis unit. If data are available a finer areal grain should be employed.

- Population and Age Structure: To define the different bicycle ridership behaviour of various sections of the community the population of each zone was divided into the following six age specific groupings: 0-4, 5-9, 10-14, 15-19, 20-44 and 45+ years. These groups generally reflected pre-school, primary school, secondary school, young adults and other adults respectively.

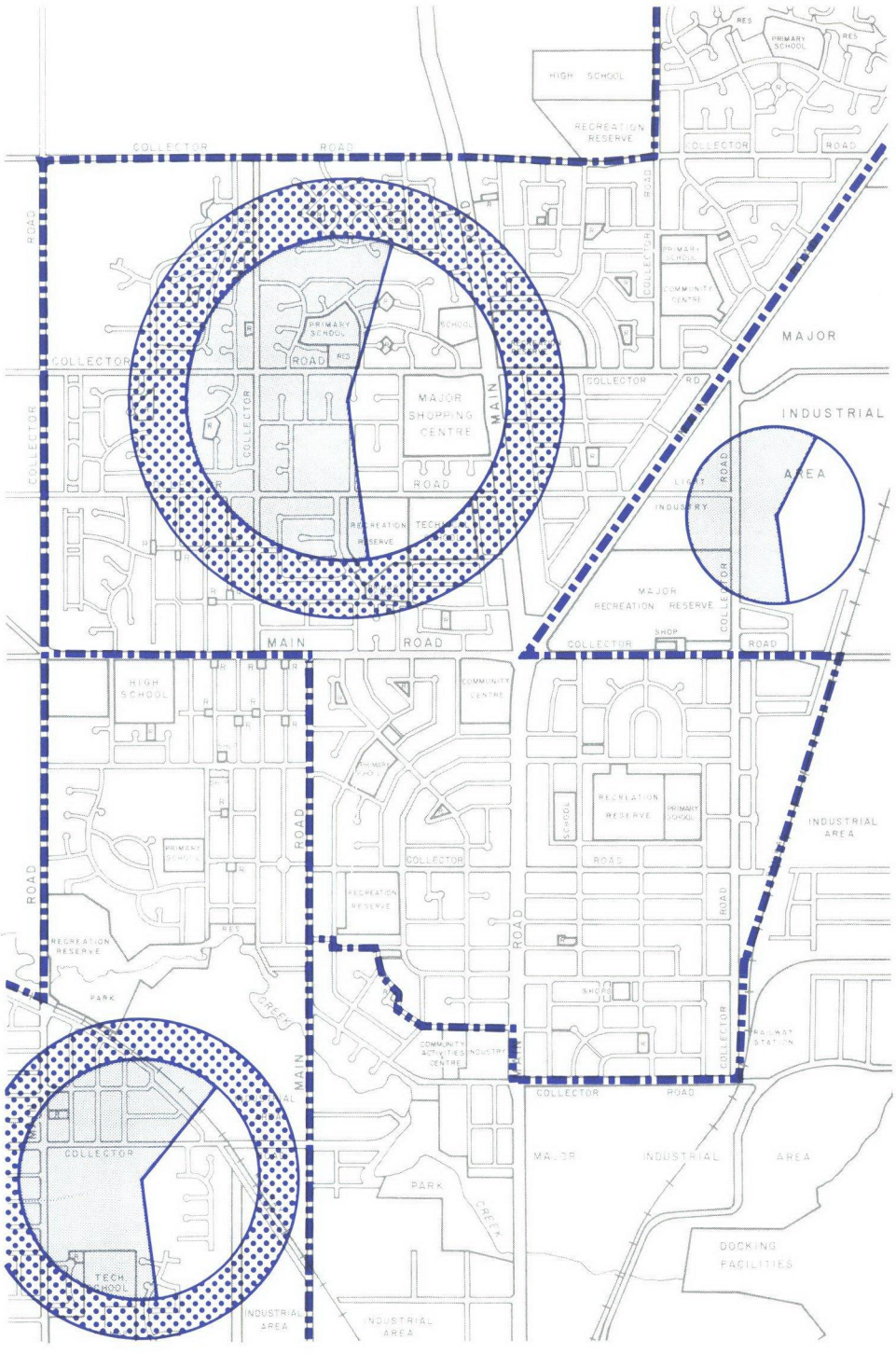
- Bicycle Ownership and Usage: The number of bicycle owners in each age group was derived from ownership and/or ridership rates from previous surveys. It was hypothesised that these provided a good surrogate measure for such factors as socio-economic characteristics, terrain, traffic conditions and the availability of public transport. Based on the figures, bicycle ridership potential was estimated. i.e. the number of persons who could ride or have access to a bicycle in the zone.

  These rates, expressed as percentages were then multiplied by the population within each age group to yield the maximum ridership potential within that age group. These were summed and divided by the total population to give an index of trip production potential for the zone.

- Category of Trip: Following the estimation of total ridership potentials, this measure was divided into local and district trips. Local trips comprised journey to school, other local activities and recreation. District trips included: high school journeys, trips to major retail/commercial and recreational facilitites and work journeys. Where data were available, the potential for each trip type was calculated.

  The local and district trip potential indexes together with the existing and future ridership measures were summarized graphically as shown.

[1] Refer to Document No. 9 "Estimation of Bicycle Trip Production Potential" Melbourne Bicycle Strategy Stage II for a full description of the procedure used.



LEGEND

LOCAL GOVERNMENT AREA

LOCAL BICYCLE TRIP POTENTIAL

DISTRICT BICYCLE TRIP POTENTIAL INDEX

EXISTING BICYCLE TRIP POTENTIAL

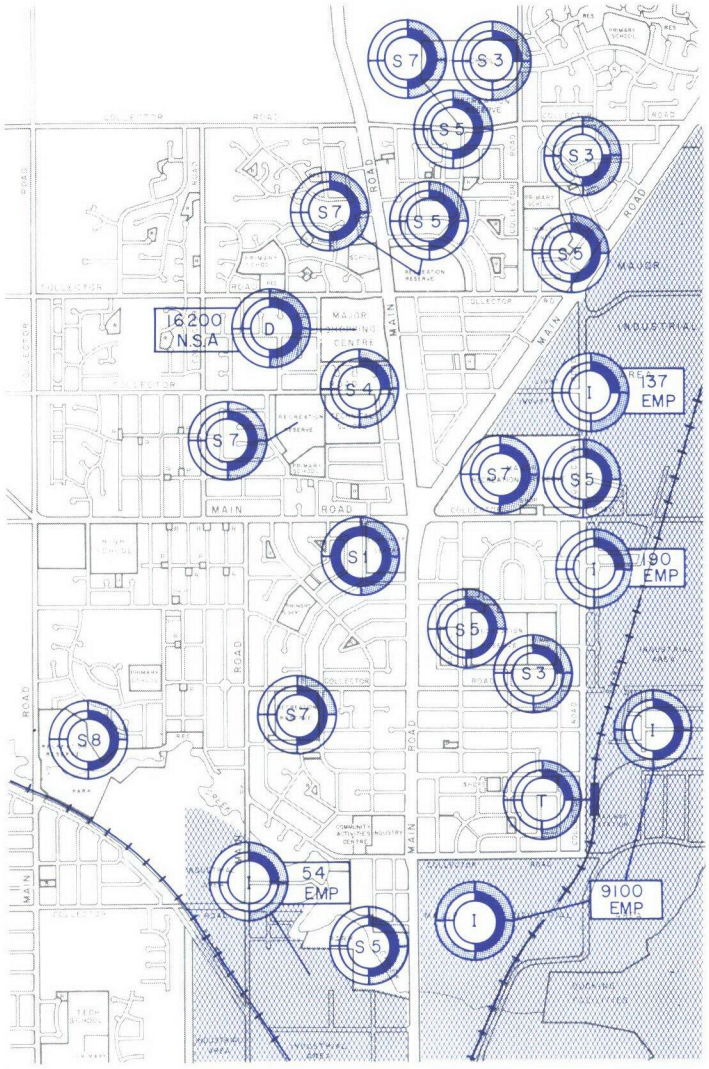
FUTURE BICYCLE TRIP POTENTIAL

STEP 4: MAP TRIP ATTRACTORS

All land uses and activities apart from schools and other education institutions that have the potential to attract bicycle trips are mapped. These include employment centres, retail centres, swimming pools, sporting facilities, parks and recreation reserves, bike shops and railway stations.

Based on data from bicycle trip origin-destination surveys and bicycle destination counts, the attraction potential of each attractor node is estimated. In addition using relevant "mass" measures such as employment figures, floor space and visitation rates, the catchment area of each attractor is approximated. These two measures are combined graphically as shown to indicate the relative attraction strength of each node with regard to bicycle trips.

By combining the Trip Production and Trip Attractors overlays, macro bicycle trip desire lines are determined.



LEGEND

- DISTRICT RETAIL CENTRE: NET FLOOR AREA
- SWIMMING POOL
- TENNIS COURT
- BOWLING ALLEY
- PARK/RESERVE
- OVAL/SPORTS GROUND
- YOUTH CLUB
- EMPLOYMENT NODE: EMPLOYEES
- INDUSTRIAL AREA
- TRANSPORT NODE
- RAILWAY LINE

BICYCLE TRIP ATTRACTION POTENTIAL

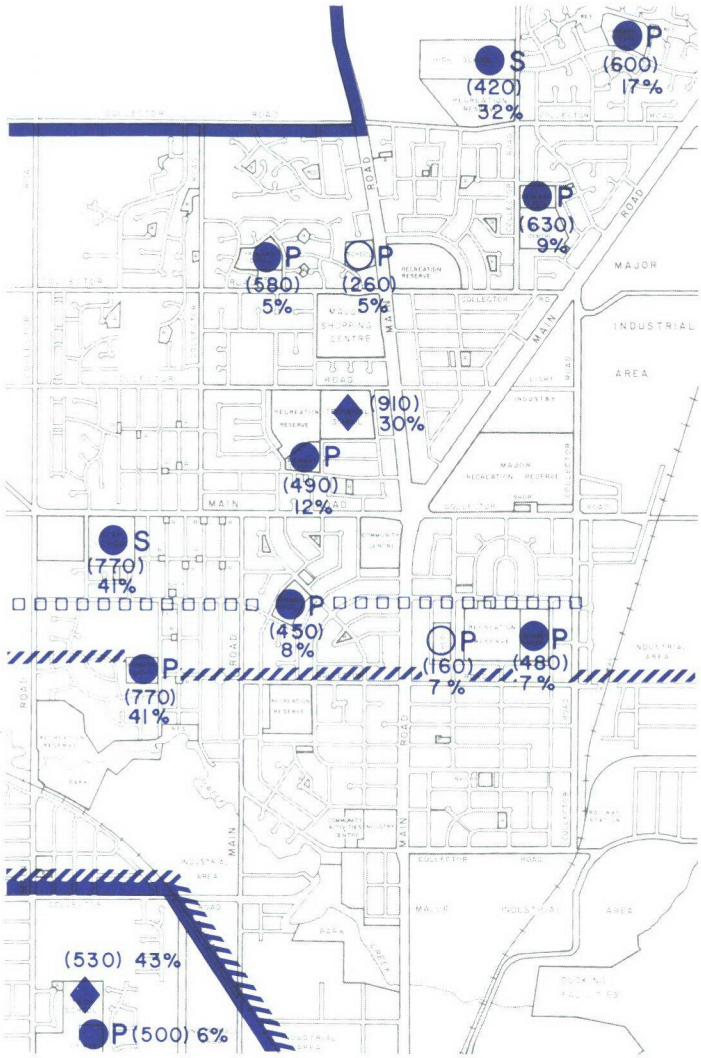
low — high

CATCHMENT AREA

local — regional

STEP 5: MAP EDUCATIONAL TRIP ATTRACTORS

Because of the importance of schools and other educational facilities with respect to bicycle trip attraction, a separate map is prepared to show these activities. Journeys to school and other education institutions have been found to comprise a significant proportion of daily bicycle trips.



LEGEND

●P	PUBLIC PRIMARY SCHOOL
○P	PRIVATE PRIMARY SCHOOL
●S	HIGH SCHOOL
◆	TECHNICAL COLLEGE
(160)	STUDENT ENROLMENT
7%	BICYCLE RIDERSHIP%
	SCHOOL CATCHMENT AREAS

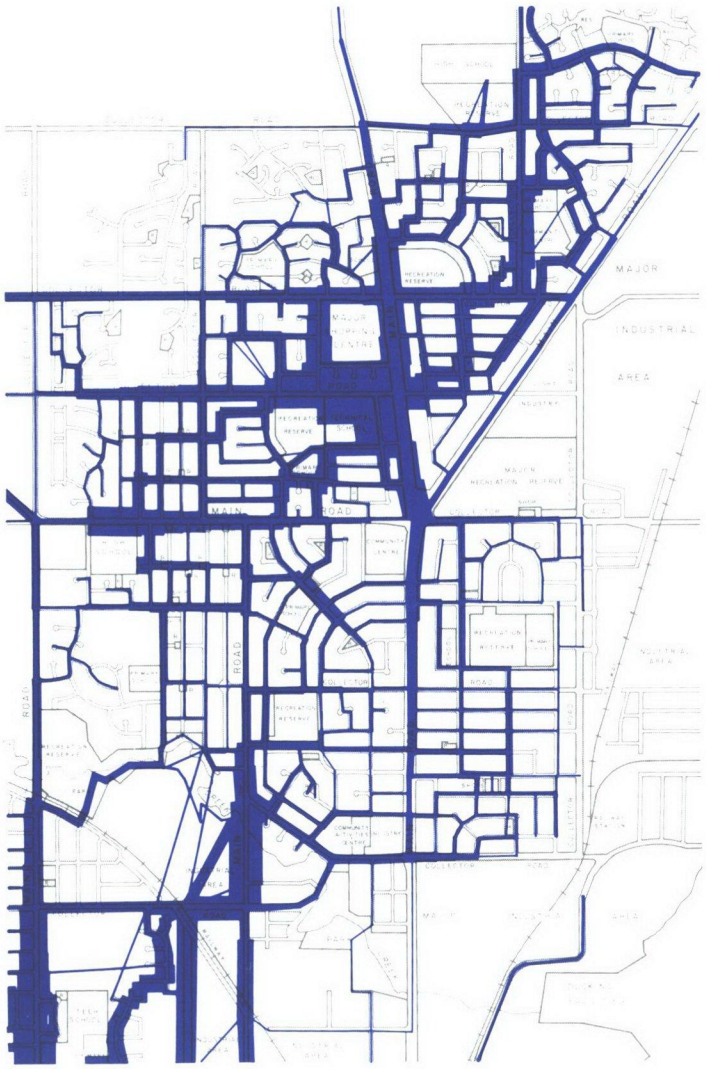
The overlay shows the location of government and non-government schools and tertiary institutions, together with enrolment numbers and existing levels of bicycle usage, obtained by surveying schools in the study area. The catchment or feeder areas are used in the identification of "identity" areas undertaken in the synthesis phase and provide an indication of journey to school patterns and other localised trips such as journey to local recreational and other facilities.

STEP 6: SURVEY EXISTING TRIP PATTERNS

To gather information on ridership levels, bicycle user characteristics and routes travelled by cyclists, the following types of surveys can be undertaken:

- primary and secondary school student questionnaire and route surveys,
- newspaper surveys,
- spot interview surveys of adult cyclists, and
- bicycle counts at all major trip attractors.

In the Newcastle and the Melbourne bicycle studies, a sample of students from each high school were invited to complete a questionnaire relating to bicycle usage. As part of this survey participants were requested to show on a map the route they most frequently used for school and other journeys by bicycle. This route information was compiled and used to identify candidate bikeways.



LEGEND

100 TRIPS/WEEK
200 TRIPS/WEEK
1000 TRIPS/WEEK
2000 TRIPS/WEEK

Copies of the questionnaire used to collect this type of information in Melbourne and Geelong are shown opposite.

MELBOURNE BICYCLE STRATEGY STAGE II
CYCLIST QUESTIONNAIRE

GHD – PARSONS BRINCKERHOFF PTY LTD
OCTOBER, 1980

1. SURVEY NO
2. LOCATION NO
3. TIME — AM [1] PM [2]
4. DAY — M [1] T [2] W [3] T [4] F [5] S [6] S [7]
5. SEX — F [1] M [2]
6. AGE (Years) — <13 [1] 13 – 19 [2] 20 – 24 [3] 25 – 34 [4] 35 – 44 [5] 45+ [6]
7. MEMBER OF CYCLE CLUB — Yes [1] No [2]
8. YEARS OF RIDERSHIP — < 1 [1] 1 – 3 [2] 4 – 10 [3] >10 [4]
9. MAJOR REASON (S) FOR TAKING UP RIDING (Specify)
10. FREQUENCY OF BICYCLE USE

5 or more days per week	3 – 4 times per week	At least once per week	Infrequently
[1]	[2]	[3]	[4]

11. TRIP PURPOSE:

Primary School	[1]
High School	[2]
Technical College	[3]
C.A.E.	[4]
University	[5]
Other Education	[6]
Work	[7]
Shop	[8]
Library	[9]
Club	[10]
Personal Service	[11]
Other Community Facilities	[12]
Swimming Pool	[13]
Beach	[14]
Squash Court	[15]
Tennis Court	[16]
Local Park	[17]
Sports Oval	[18]
Other Recreation Facilities	[19]
Recreation Ride / Touring	[20]
Railway Station	[21]
Bus Interchange	[22]
Visiting Friend	[23]
Home	[24]

If "home" also circle trip purpose for the first leg of the trip

12. FREQUENCY OF THIS TRIP (BY BICYCLE)

5 or more days per week	3 – 4 times per week	At least once per week	Infrequently
[1]	[2]	[3]	[4]

13. MARK ON THE MAP THE ROUTE YOU MOST FREQUENTLY USE TO MAKE THIS TRIP.

14. IF FREQUENCY OF THIS TRIP IS NOT "EVERYDAY" THEN STATE OTHER MODE USUALLY USED FOR THIS TRIP. (Circle only one)

Car	[1]	Train	[5]
Motor Bike	[2]	Taxi	[6]
Bus	[3]	Walk	[7]
Tram	[4]	None	[8]

15. IF FREQUENCY OF THIS TRIP IS "EVERYDAY" THEN STATE OTHER MODE PREVIOUSLY USED FOR THIS TRIP. (Circle only one)

Car	[1]	Train	[5]
Motor Bike	[2]	Taxi	[6]
Bus	[3]	Walk	[7]
Tram	[4]	None	[8]

16. ARE ANY OTHER MODES USED IN CONJUNCTION WITH A BICYCLE TO MAKE THIS TRIP

Car	[1]	Train	[4]
Bus	[2]	Taxi	[5]
Tram	[3]	Bicycle only	[6]

17. TRIP ORIGIN (Specify)
18. TRIP DESTINATION (Specify)
19. TRAVEL TIME (Minutes)
20. REASON (S) FOR ROUTE CHOICE

Safest	[1]	Most Scenic	[5]
Most Direct	[2]	Less Pollution	[6]
Fastest	[3]	Other Reasons	[7]
Flattest	[4]		

21. HOW MANY TIMES HAVE YOU BEEN INJURED IN A BICYCLE ACCIDENT IN THE LAST 12 MONTHS & REQUIRED MEDICAL TREATMENT (O.U.O.)
22. HAS YOUR BICYCLE EVER BEEN STOLEN:

Yes & not recovered	[1]	Yes but not recovered in working order	[3]
Yes but recovered in working order	[2]	Never stolen	[4]

23. TYPE OF BICYCLE — BMX [1] 1 Gear [2] 3 Gears [3] 5/10 Gears [4]
24. CONDITION OF BICYCLE — Poor [1] Average [2] Good [3]
25. HAND BRAKES FRONT AND REAR — Yes [1] No [2]
26. BICYCLE LIGHTS — None [1] Rear only [2] Front only [3] Front & rear [4]
27. BICYCLE REFLECTORS — None [1] Rear only [2] Standard [3]
28. BICYCLE "SAFETY" FLAG — Yes [1] No [2]
29. USER WEARING HELMET — Yes [1] No [2]
30. USER WEARING "SAFETY" VEST — Yes [1] No [2]
31. ADDITIONAL SAFETY CLOTHING CARRIED FOR WET WEATHER USE. — Yes [1] No [2]
32. OBSERVANCE OF (SPECIFIED) TRAFFIC CONTROL LAW — Yes [1] No [2]

GEELONG BIKE PLAN
SECONDARY SCHOOL QUESTIONNAIRE

GEELONG BIKE PLAN COMMITTEE

OFFICE USE ONLY

1. SURVEY NO
2. SCHOOL NO
3. YEAR NO

GHD - PARSONS BRINCKERHOFF PTY LTD
380 Lonsdale Street, Melbourne 3000
Telephone (03) 67 9341

MARCH 1981

Many of the GEELONG BIKE PLAN programs designed to make cycling safer and more convenient in Geelong have been introduced progressively over the last two to three years. To help us assess the effectiveness of these programs would you please answer the following questions by ticking the appropriate box or boxes.

4. SEX — Male / Female
5. HAVE YOU HEARD OF THE GEELONG BIKEPLAN?
   Yes / No
   IF "YES", FROM WHAT SOURCE?

Newspaper		Friends	
Radio		Bikeplan Activities	
Television		School	

6. WHAT MAIN METHOD (S) OF TRANSPORT DID YOU USE FOR FOR GETTING TO SCHOOL LAST WEEK AND HOW OFTEN?

TRANSPORT	TIMES PER WEEK: Once	Twice	3 Times	4 Times	Every day
1. Bicycle					
2. Bus					
3. Train					
4. Walk					
5. Drive yourself					
6. Driven					
7. Motorbike					

7. DID YOU RIDE A BICYCLE AT LEAST ONCE LAST WEEK (INCLUDING THE WEEKEND) FOR ANY PURPOSE, INCLUDING GETTING TO SCHOOL?
   Yes / No

IF YOU ANSWERED "YES" TO QUESTION 7, GO TO QUESTION 10

IF YOU ANSWERED "NO" TO QUESTION 7, ANSWER QUESTIONS 8 AND 9 AND THEN GO TO QUESTION 20

8. HAVE YOU EVER RIDDEN A BICYCLE REGULARLY? (ie. AT LEAST ONCE A WEEK)
   Yes / No
9. FOR HOW MANY YEARS DID YOU CYCLE BEFORE YOU STOPPED RIDING REGULARLY?
   Less than 1 / 1 – 2 / 3 – 4 / 5 – 10 / More than 10
10. HOW OFTEN LAST WEEK DID YOU CYCLE TO THE FOLLOWING PLACES?

	More than 3 times	3 times	2 times	Once	Not at all
1. To a swimming pool					
2. To a sporting oval					
3. To near your house					
4. To shops in the city					
5. To a friend's home					
6. On long, fun trips					
7. For no real purpose					
8. Other					

11. HOW MANY YEARS OLD IS THE BIKE YOU RIDE?
    Less than 1 / 1 – 2 / 3 – 4 / 5 – 10 / More than 10
12. WHAT KIND OF GEARS DOES YOUR BIKE HAVE?
    No gears / Three speed / Five speed / Ten speed / Other
13. DO YOU OWN A B.M.X. BIKE? (NOT HIGH RISER OR DRAGSTER)
    Yes / No
14. WHICH OF THE FOLLOWING ITEMS DO YOU CARRY ON YOUR BIKE?

	Yes	No		Yes	No
1. Tool kit			4. Side reflectors		
2. Lights			5. Safety flag		
3. Rear mudguard reflector					

15. ON YOUR BICYCLE DO YOU KNOW HOW TO

	Yes	No		Yes	No
1. Mend a puncture?			3. Adjust the wheel cone?		
2. Adjust the brakes?					

16. DO YOU WEAR A BICYCLE HELMET?
    Almost always / Sometimes / No
17. HOW WELL DO YOU KNOW THE TRAFFIC RULES OF THE ROAD?
    Very well / Not really well / Not at all
18. HOW MANY ACCIDENTS DID YOU HAVE IN THE PAST YEAR ON YOUR BICYCLE THAT CAUSED YOU AN INJURY THAT REQUIRED ATTENTION FROM THE DOCTOR OR A HOSPITAL?
    None / 1 / 2 / 3 / More than 3
19. HAS YOUR BICYCLE EVER BEEN STOLEN? (TICK ONLY ONE)
    Yes and not found / Yes and found but not in working order / Yes but found in working order / No
20. HAVE YOU COMPLETED THE BIKE-ED COURSE?
    Yes / No
    IF "YES", HOW WOULD YOU RATE THE COURSE?
    Excellent / Fair / Good / Poor
21. HAVE YOU EVER RECEIVED LESSONS ON SAFE RIDING FROM

	Yes	No		Yes	No
1. Your Parents?			4. Police?		
2. Teachers?			5. Others?		
3. Scouts?					

22. HAVE YOU READ THE GEELONG SPOKESMAN?
    Yes / No
    IF "YES", HOW WOULD YOU RATE THE GEELONG SPOKESMAN?
    Excellent / Fair / Good / Poor
23. DID YOU ATTEND THE GEELONG BIKE PLAN DISCOVERY RIDE AT BELMONT?
    Yes / No
    HOW WOULD YOU RATE THE DISCOVERY RIDE?
    Excellent / Fair / Good / Poor

THANK YOU FOR YOUR ASSISTANCE

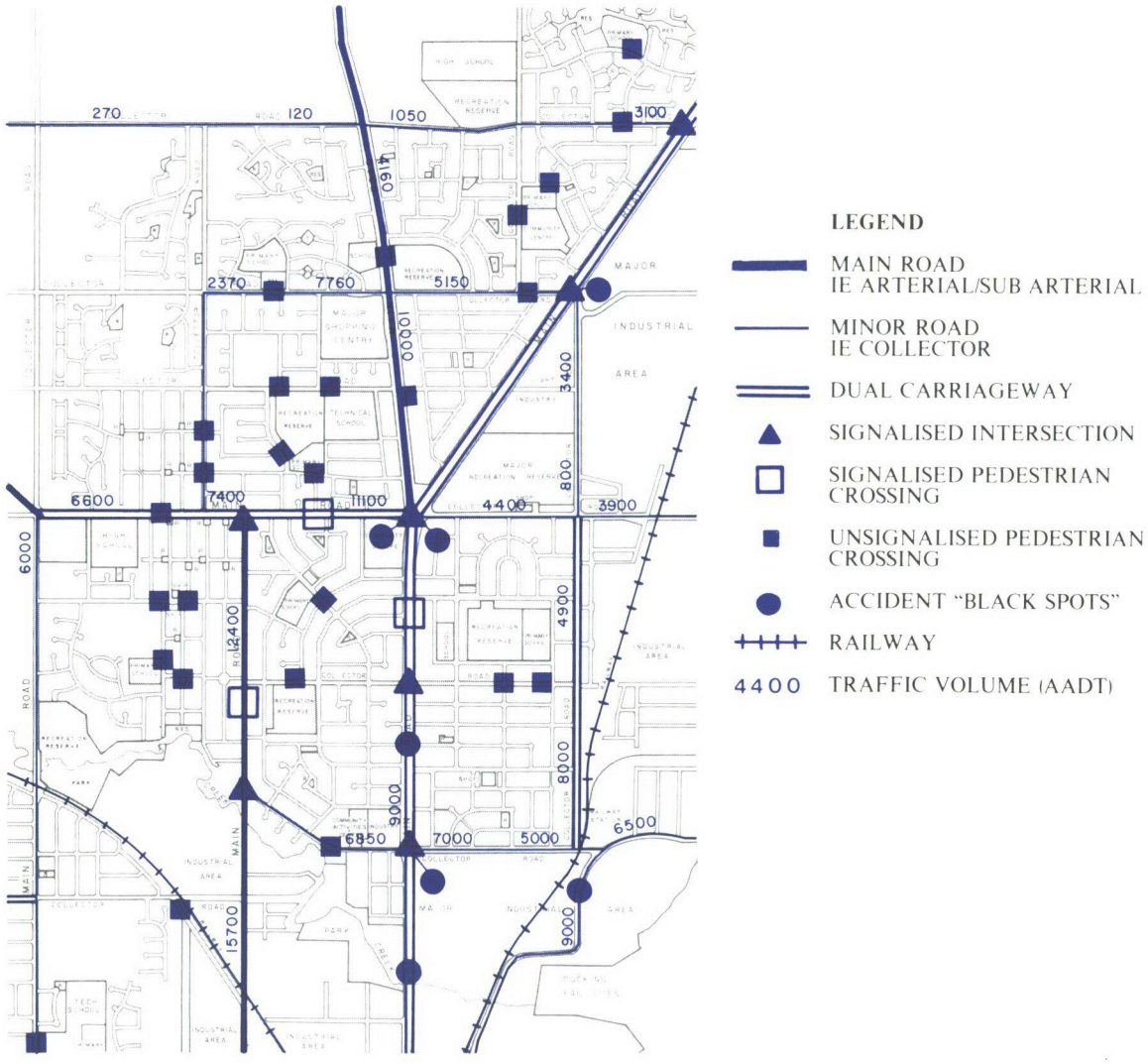
STEP 7: MAP ROAD INFRASTRUCTURAL CONSTRAINTS AND OPPORTUNITIES

Since it is not feasible either in physical or economic terms to provide a system of off-road bicycle facilities to adequately serve all cyclists' trip needs in most urban areas, the existing road and traffic control infrastructure are important considerations in the design of a comprehensive bikeway network. The bicycle should be provided for within the context of the overall traffic management of an area and in particular, account must be taken of existing road hierarchy, traffic control and traffic management policies if cyclists are to be safely integrated with other road users.

An overlay is prepared to show the principal road network and other information including traffic volumes, the percentage of commercial vehicular traffic, signalised intersections, roundabouts and pedestrian and railway crossings. Locations where there is a high incidence of accidents are also shown.

Using these data the road hierarchy is defined or verified and local traffic areas (areas bounded by arterial roads) identified.

In addition, supplemented by information collected as part of the "saddle" surveys (step 17), a preliminary estimate is made of the "rider stress" level on all roads[1]. These estimates are used to identify those roads which should, if possible, be excluded from the bikeway scheme by the establishment of safer alternatives and to provide an indication of the type of engineering action required to improve on-road cycling conditions.

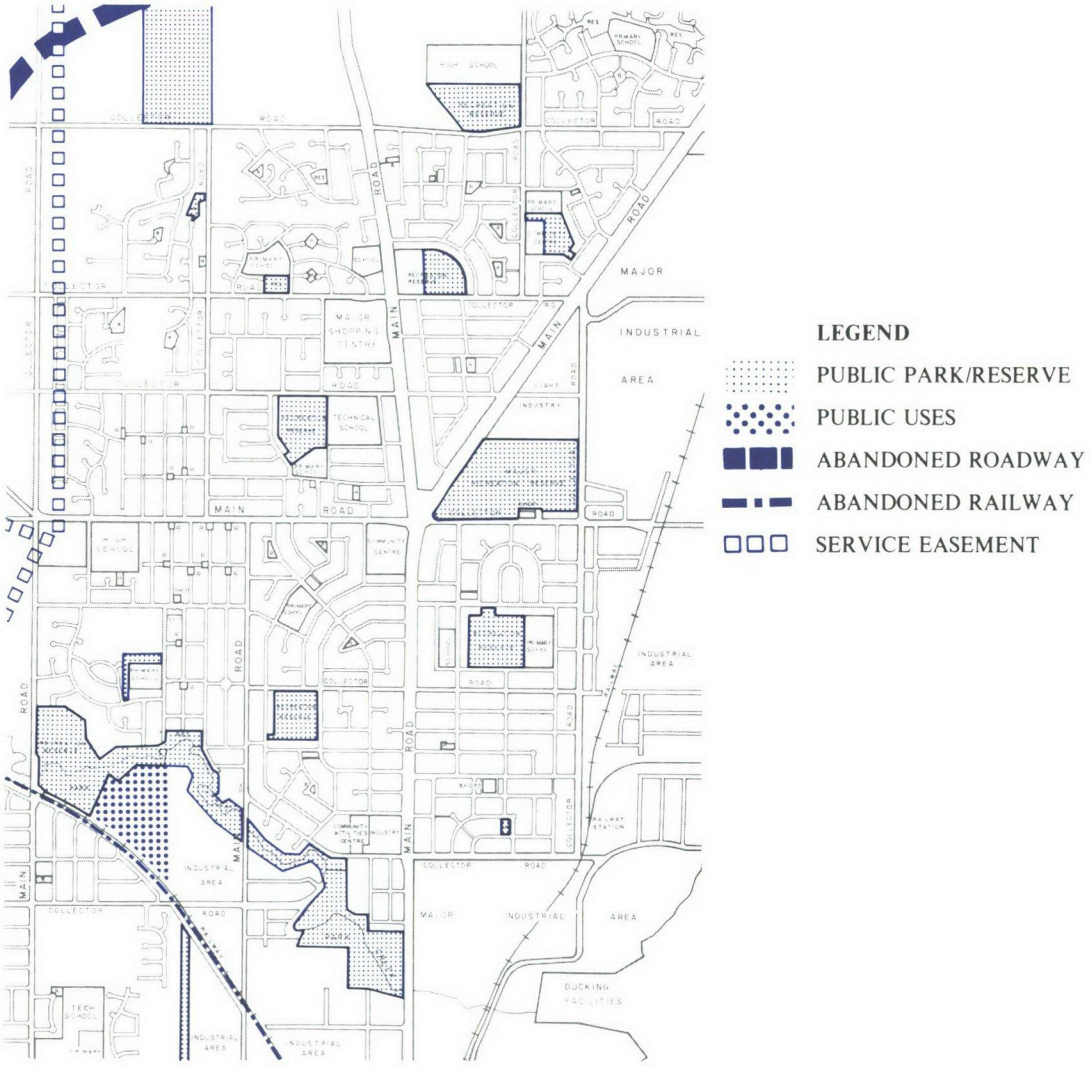


Refer to Document No. 8 "Rider Stress Level Assesment", Melbourne Bicycle Strategy Stage II, for details of the estimation procedure.

STEP 8: MAP OFF-ROAD BIKEWAY ALIGNMENT OPPORTUNITIES

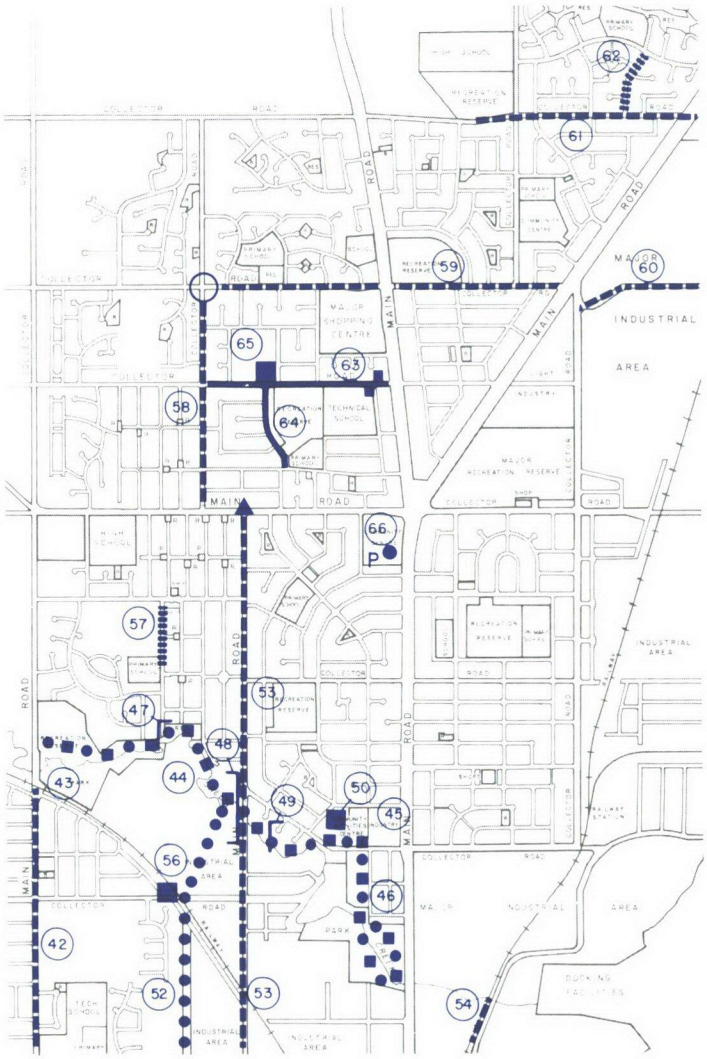
While much of the bikeway system for the majority of built-up urban areas must be on-road there are often a number of excellent opportunities to establish major commuter and recreational pathways off-road. Possible off-road alignment opportunities include abandoned roadways, disused transport corridors, service easements and parks and reserves in which link paths can be built to provide short cut routes. These link paths also greatly improve the connectivity of the road system and thus enhance bicycle accessibility.

To take full advantage of off-road route opportunities, a map is prepared to show all potential alignment corridors and areas of open space. Public and semi-public land such as schools and churches where the possibility exists to negotiate access are also depicted.



STEP 9: MAP EXISTING BICYCLE FACILITIES

All existing bicycle facilities should be considered in the planning of the bikeway system. Field surveys should be undertaken to note the type of facility provided and the level of use it currently receives.



LEGEND

OFF-ROAD FACILITIES

- BICYCLE PATH
- SHARED BIKE/PEDESTRIAN PATH
- LINK PATHS

ON-ROAD FACILITIES

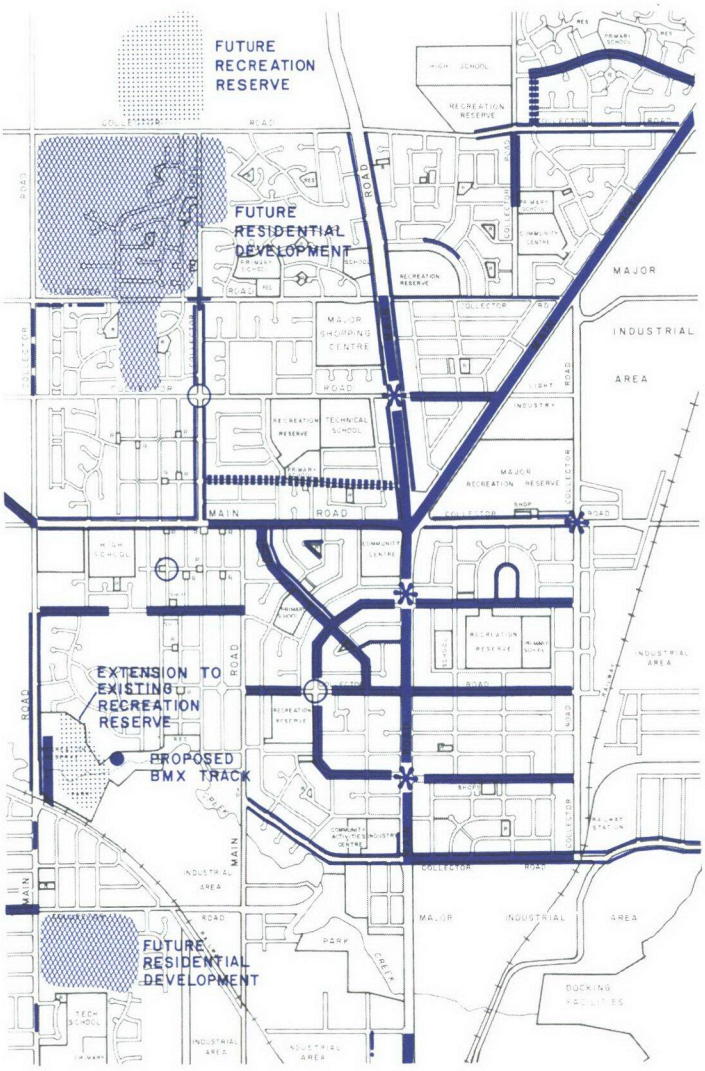
- SIGNED BIKEWAY
- BIKE/CAR PARKING LANE
- ROAD WIDENING

SPOT ACTION

- P BICYCLE PARKING FACILITIES
- INTERSECTION TREATMENT
- BICYCLE BRIDGE
- ROAD CROSSING
- ROUNDABOUT
- TRAFFIC MANAGEMENT DEVICE
- (53) REFERENCE No.

STEP 10: MAP BIKEWAY ESTABLISHMENT OPPORTUNITIES

Consideration should be given to opportunities for the incorporation of both on-road and off-road bicycle facilities in the design and construction of road and land development proposals. Local Government and the Department of Main Road's general road upgrading and maintenance programs provide a basis for improving on-road cycling conditions. As shown on the example map, details of the nature and staging of the proposed works are documented.



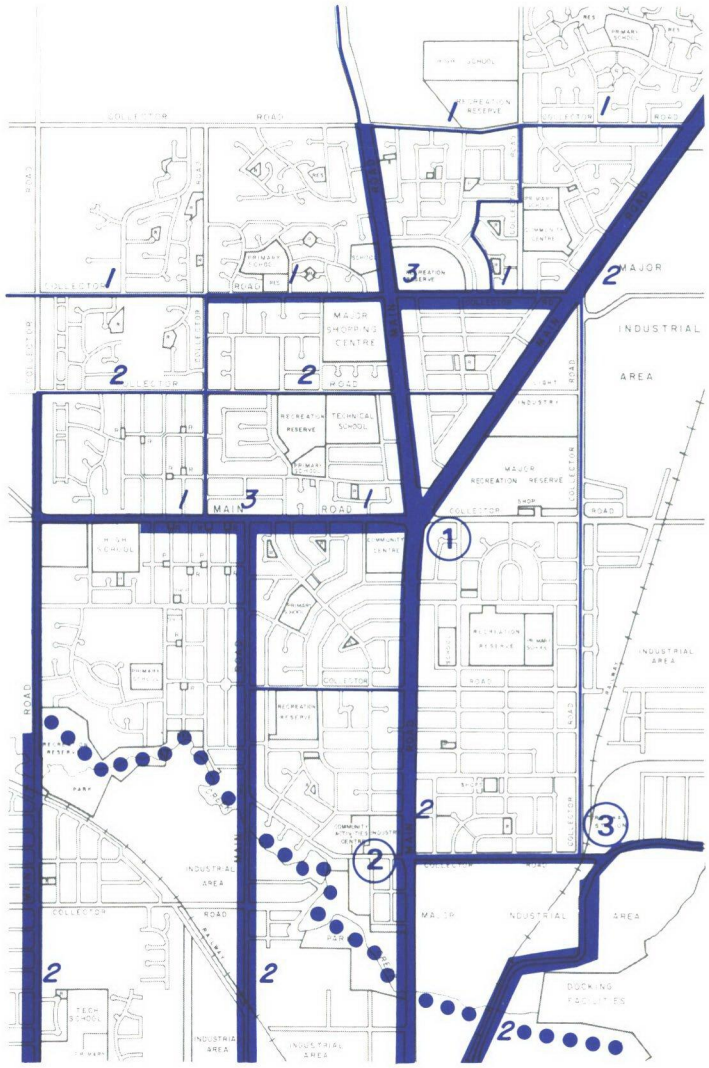
LEGEND

- FUTURE RESIDENTIAL DEVELOPMENT
- FUTURE RECREATION RESERVE
- ROAD WIDENING
- ROAD UPGRADING AND LINEMARKING
- ROAD RESEALING
- ROAD SEALING
- PROPOSED ROUNDABOUT
- PROPOSED TRAFFIC SIGNALS
- INTERSECTION IMPROVEMENT
- "SPOT" ACTION

STEP 11: DOCUMENT PUBLIC SUBMISSIONS

A map or a series of maps are prepared to show all public submissions relating to bikeway proposals. In addition, information supplied by cyclist groups, Councils' and other agencies' suggestions and bikeway proposals contained in previous studies are also documented on these maps.

In the Newcastle and the Geelong bicycle studies cyclists supplied information on preferred routes of travel, possible off-road bikeways and an assessment of the "stress level" for the on-road routes. An example of the map prepared from these data is illustrated below.



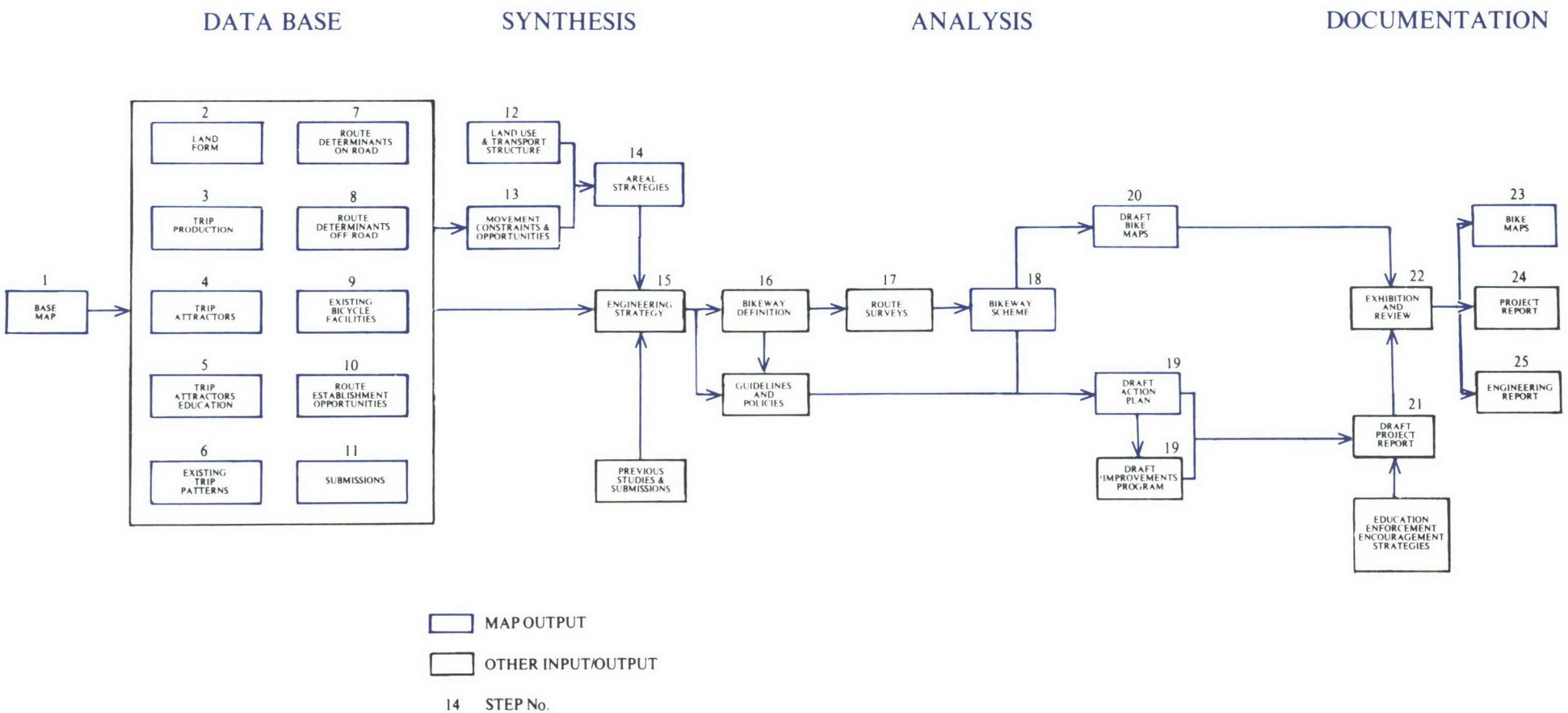
LEGEND

- MAJOR ON-ROAD ROUTE
- MINOR ON-ROAD ROUTE
- DESIRABLE OFF-ROAD ROUTE
- 2 LINK "STRESS LEVEL" ASSESSMENT
- ① INTERSECTION "STRESS LEVEL" ASSESSMENT

5. synthesis

FIGURE 1.

ENGINEERING STUDY FRAMEWORK



5. Synthesis

As shown on Figure 1, the synthesis phase of the study includes the preliminary evaluation of the pre-strategy data and the consideration of other factors to yield a framework and focus for the detail bikeway planning.

The synthesis phase comprises four main parts:

- consideration of how bicycle usage patterns may be affected and influenced by urban and transportation changes over time,
- identification of major opportunities and constraints to bicycle movement,
- identification of zonal bicycle strategies, and
- development of a composite bicycle strategy.

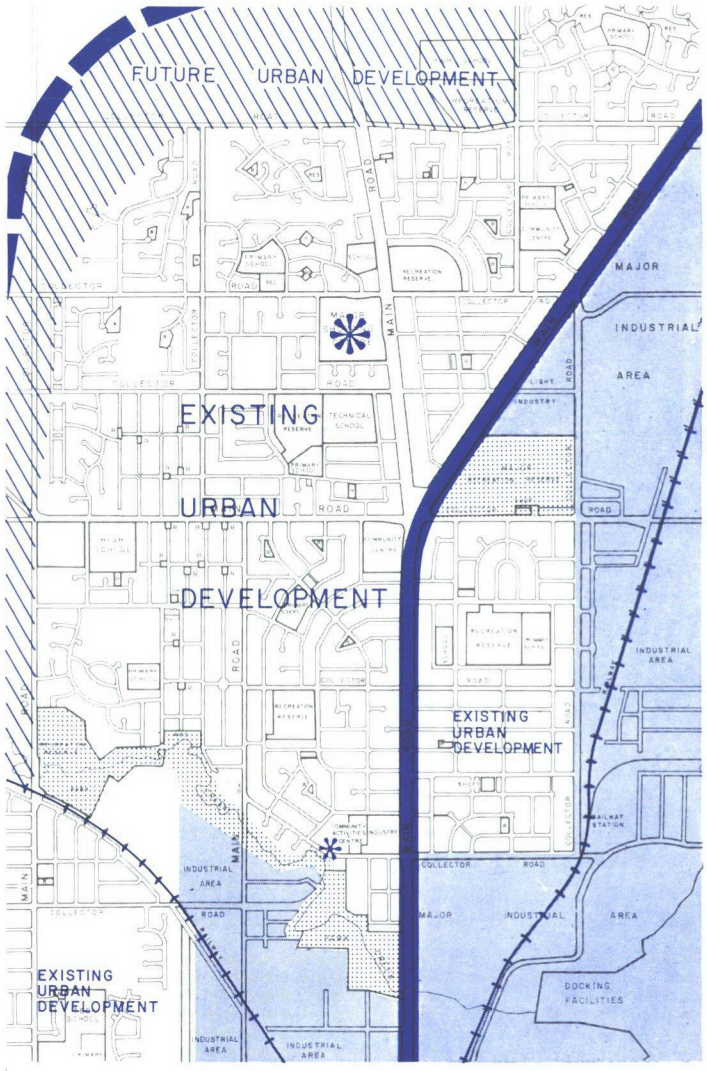
Each synthesis component is discussed below.

STEP 12: PREPARE A MAP SHOWING THE STRUCTURE OF LAND USE AND TRANSPORT

Consideration should be given to future patterns of urban development, particularly as a result of population changes, to ensure that the bikeway system caters for the needs of the community over time.

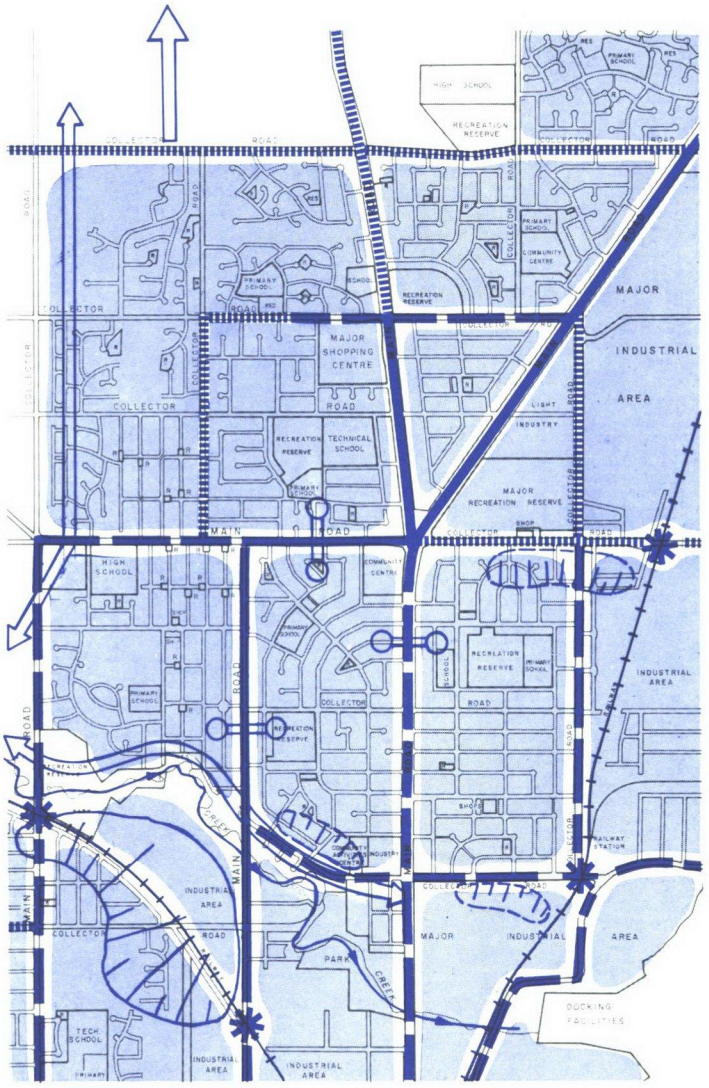
A map is prepared showing the broad land use and transport policies for the study area anticipated up to an appropriate planning horizon. These policies can be derived in consultation with officers from the relevant planning and transport authorities.

Major land uses and transportation corridors are identified including existing urban, industrial and open space areas, major roads and railways, district and regional commercial retail centres and future growth areas.



STEP 13: MAP MAJOR BICYCLE MOVEMENT CONSTRAINTS AND OPPORTUNITIES

Drawing on the "data base" information a map is prepared to show a functional road hierarchy for the study area, local traffic areas, and the major barriers to and opportunities for bicycle movement. Constraints to movement comprise steep slopes, railway lines, watercourses, freeways, and for intra-district bicycle trips, arterial roads. Opportunities for bicycle movements include major corridors of open space, pedestrian crossings, bridges and underpasses providing access across physical barriers and railway stations and other major transport nodes where dual mode use (bike-train and bike-bus) could be encouraged.



LEGEND

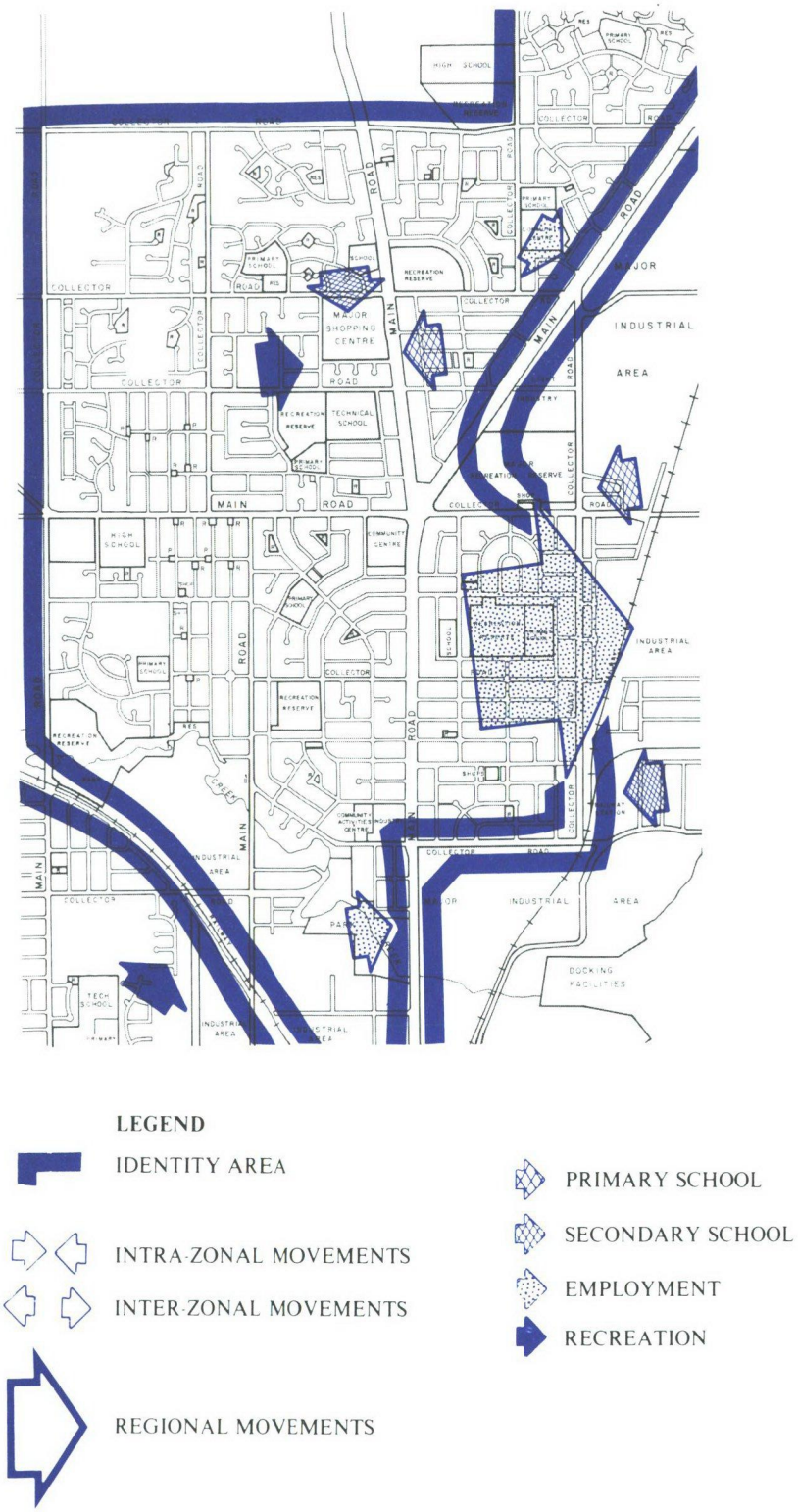
- LOCAL TRAFFIC AREA
- ARTERIAL ROAD
- SUB-ARTERIAL ROAD
- COLLECTOR ROAD
- RAILWAY
- WATER COURSE
- AT-GRADE RAILWAY CROSSING
- STEEP "PINCH"
- MID-BLOCK SIGNALISED CROSSING
- OFF-ROAD ALIGNMENT OPPORTUNITY

STEP 14: DEVELOP LOCAL BICYCLE STRATEGIES

With reference to the "data base" and synthesis information, the study area is divided into a number of homogenous zones. The division can be based on one or a number of factors including existing or anticipated patterns of bicycle movement, populaton structural chatacteristics, proximity to regional employment centres and accessibility to public transport. For each zone or "identity area" specific strategies are formulated to provide a framework and guide for the detail bikeway planning work. The schedule below outlines the factors considered in the formulation of areal bicycle strategies for four of the "identity areas" in Geelong.

As shown, the various areal strategies are graphically depicted on a map and where necessary adjusted to form an integrated bicycle strategy for the entire study area.

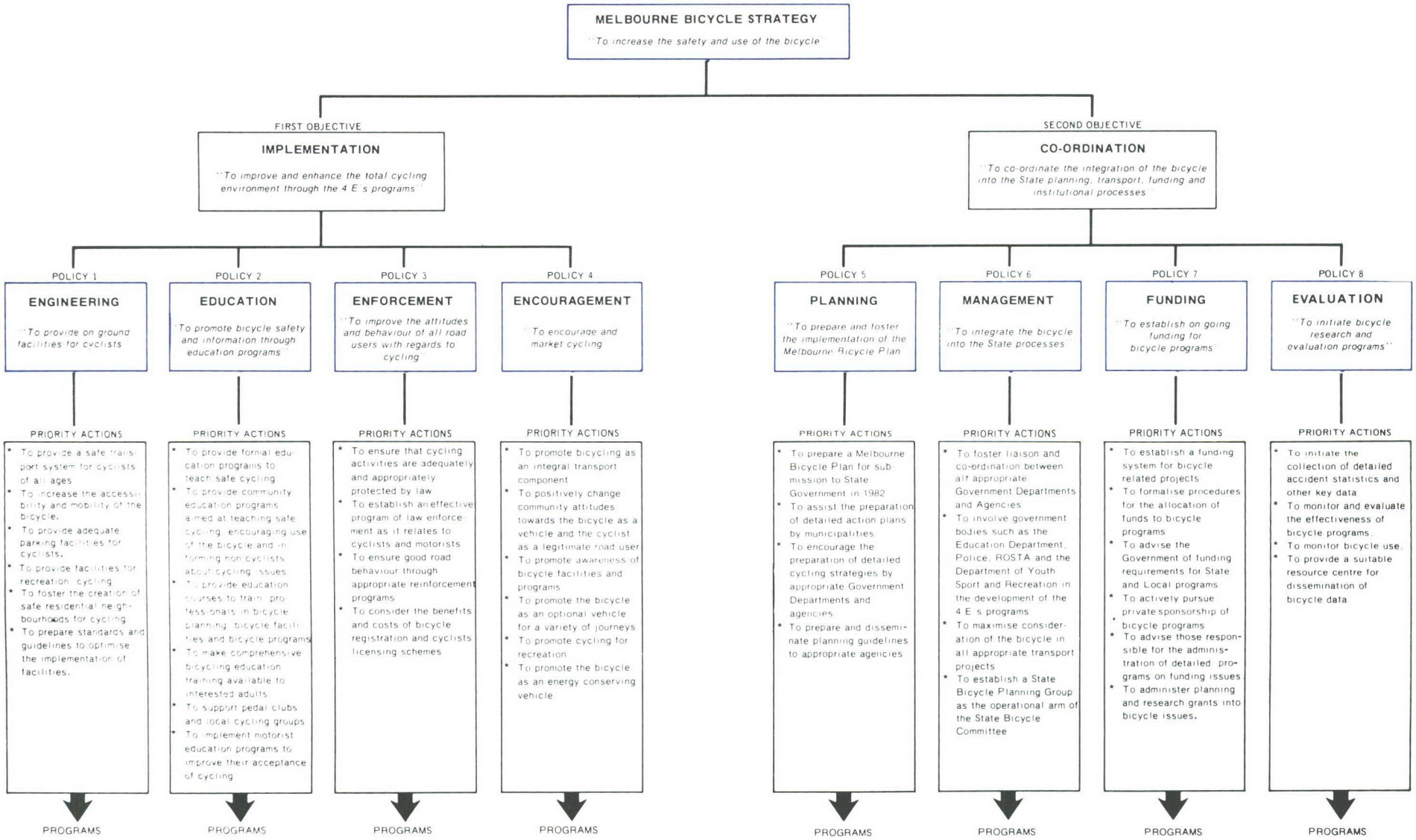
IDENTITY AREA	LOCATION	LAND USE AND POPULATION	SPECIFIC FEATURES	STRATEGY	SPECIFIC STRATEGY
A	Located south of Aberdeen Street between Barwon River and Moorabool Street	Contained residential area with neighbourhood shopping facilities, schools, and few parks, Kardinia Park, swimming centre. Pop. 10,400. Experiencing declining growth rate. No increase in population anticipated.	Physically separated from Geelong by river and major traffic routes.	Provide internal links with external routes for employment, shopping, and recreation.	Some activities catered for internally, i.e. school, neighbourhood shopping, need to provide external links to CBD for shopping and employment. Opportunity to develop main off-road recreational route along river foreshore from cement works to Moorabool Street bridge.
B	West of Geelong CBD, western bank of Barwon River and north of Roslyn Road	Residential area including Queens Park and river front recreation area. Part of Belmont experiencing low growth rate.	Physically separated from Geelong by river and major traffic routes.	Provide external links to retail facilities, schools and develop river front recreation route.	Mostly residential land uses require links to primary and high schools, retail facilities in Belmont, parks and recreation activities. Bridge link across Queens Park Rd. Opportunity to develop off-road recreation path along river frontage from Queens Park to Shannon Avenue.
C	Located south of Barwon River between Barwon Heads Rd. and Roslyn Road.	Contained residential area with district shopping facilities, and major institutional uses including Deakin University, swimming centre. Pop. 15,048. Experiencing low growth rate. Forecast pop. 16,048.	Majority of bicycle trips take place within the area, few external trips except for recreation along river and for employment purposes.	Focus on internal links with external links for employment and recreation trips.	Emphasis on internal links from residential areas to retail facilities, schools, institutional uses and recreation areas. External links north to CBD for employment and regional shopping. Link to Deaking University. Opportunity to develop major recreational link along river foreshore and through Belmont Common. Also other recreation route along Waurn Ponds Creek.
D	Located south of Waurn Ponds Creek.	Contained residential area with neighbourhood shopping facilities, primary schools, parks. Part of Belmont, experiencing low growth rate.	Physically separated from urban Geelong by Waurn Ponds Creek open space corridor.	Focus on internal links with external links to high schools, district retail and employment activities.	Develop internal links from residential areas to neighbourhood shops, schools and Burdeo Recreation Reserve. External links required for high schools in Belmont and employment. Opportunity to link Grovedale with Belmont, Deakin University and Belmont Common recreation area by off-road paths.



STEP 15: FORMULATION OF A COMPOSITE BICYCLE ENGINEERING STRATEGY

Having regard for all data collected and analysed thus far in the study, previous bicycle studies and related research and submissions and with particular reference to the adopted areal bicycle strategies, an engineering philosophy is developed for the study area. This philosophy should embrace such issues as the definition of parameters for the planning of bikeway system, preliminary bicycle facility design guidelines, traffic management considerations, criteria for determining construction priorities, bicycle parking and dual mode facilities, funding, responsibility for implementation and matters of a policy nature.

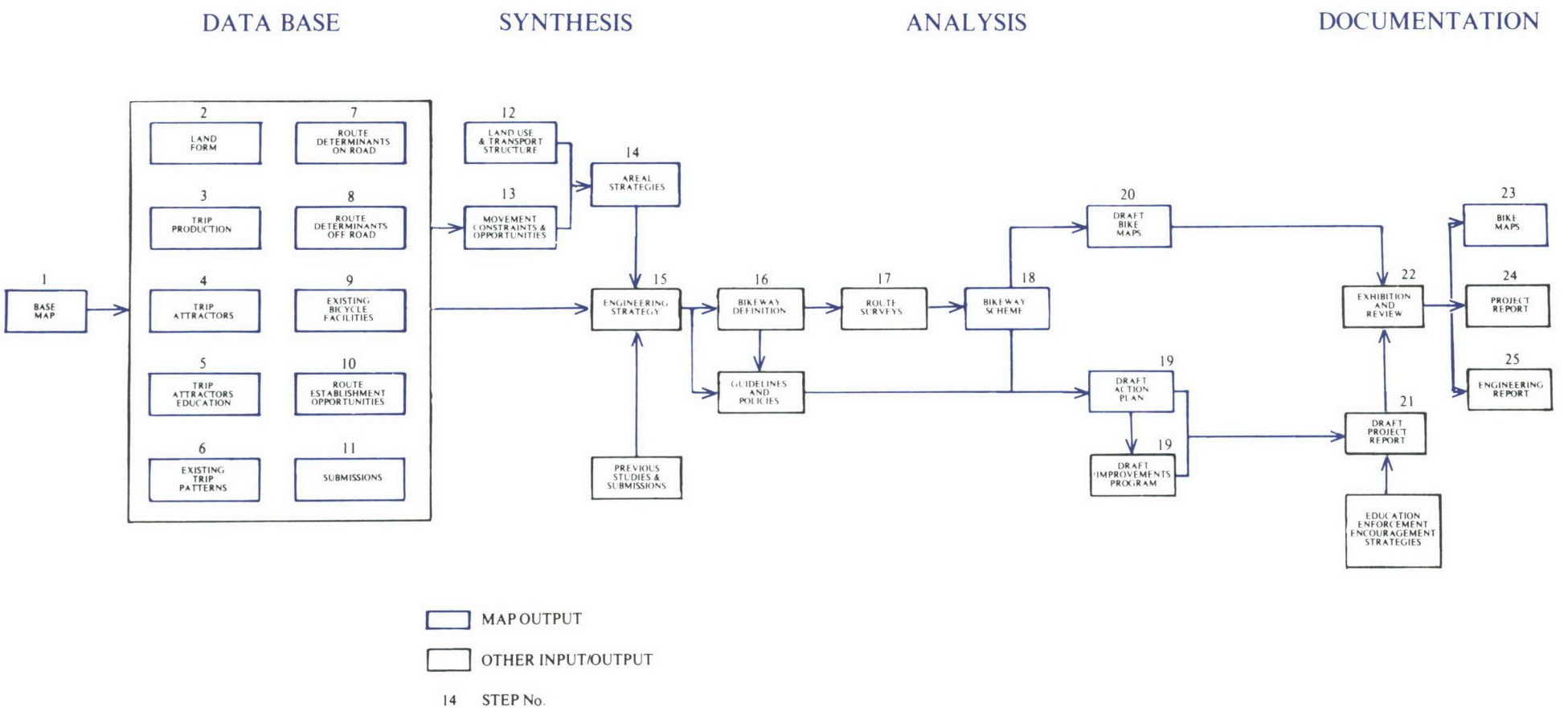
An example showing the goals and objectives of the Melbourne Bicycle Strategy is shown on the following page.


MELBOURNE BICYCLE STRATEGY
"To increase the safety and use of the bicycle"
FIRST OBJECTIVE
IMPLEMENTATION
"To improve and enhance the total cycling environment through the 4 E's programs"
SECOND OBJECTIVE
CO-ORDINATION
"To co-ordinate the integration of the bicycle into the State planning, transport, funding and institutional processes"
POLICY 1
ENGINEERING
"To provide on ground facilities for cyclists"
PRIORITY ACTIONS
* To provide a safe transport system for cyclists of all ages
* To increase the accessibility and mobility of the bicycle.
* To provide adequate parking facilities for cyclists.
* To provide facilities for recreation cycling
* To foster the creation of safe residential neighbourhoods for cycling
* To prepare standards and guidelines to optimise the implementation of facilities.
PROGRAMS
POLICY 2
EDUCATION
"To promote bicycle safety and information through education programs"
PRIORITY ACTIONS
* To provide formal education programs to teach safe cycling
* To provide community education programs aimed at teaching safe cycling, encouraging use of the bicycle and informing non cyclists about cycling issues
* To provide education courses to train professionals in bicycle planning, bicycle facilities and bicycle programs
* To make comprehensive bicycling education training available to interested adults
* To support pedal clubs and local cycling groups
* To implement motorist education programs to improve their acceptance of cycling
PROGRAMS
POLICY 3
ENFORCEMENT
"To improve the attitudes and behaviour of all road users with regards to cycling"
PRIORITY ACTIONS
* To ensure that cycling activities are adequately and appropriately protected by law
* To establish an effective program of law enforcement as it relates to cyclists and motorists
* To ensure good road behaviour through appropriate reinforcement programs
* To consider the benefits and costs of bicycle registration and cyclists licensing schemes
PROGRAMS
POLICY 4
ENCOURAGEMENT
"To encourage and market cycling"
PRIORITY ACTIONS
* To promote bicycling as an integral transport component
* To positively change community attitudes towards the bicycle as a vehicle and the cyclist as a legitimate road user
* To promote awareness of bicycle facilities and programs
* To promote the bicycle as an optional vehicle for a variety of journeys
* To promote cycling for recreation
* To promote the bicycle as an energy conserving vehicle
PROGRAMS
POLICY 5
PLANNING
"To prepare and foster the implementation of the Melbourne Bicycle Plan"
PRIORITY ACTIONS
* To prepare a Melbourne Bicycle Plan for submission to State Government in 1982
* To assist the preparation of detailed action plans by municipalities
* To encourage the preparation of detailed cycling strategies by appropriate Government Departments and agencies
* To prepare and disseminate planning guidelines to appropriate agencies
PROGRAMS
POLICY 6
MANAGEMENT
"To integrate the bicycle into the State processes"
PRIORITY ACTIONS
* To foster liaison and co-ordination between all appropriate Government Departments and Agencies
* To involve government bodies such as the Education Department, Police, ROSTA and the Department of Youth Sport and Recreation in the development of the 4 E's programs
* To maximise consideration of the bicycle in all appropriate transport projects
* To establish a State Bicycle Planning Group as the operational arm of the State Bicycle Committee
PROGRAMS
POLICY 7
FUNDING
"To establish on going funding for bicycle programs"
PRIORITY ACTIONS
* To establish a funding system for bicycle related projects
* To formalise procedures for the allocation of funds to bicycle programs
* To advise the Government of funding requirements for State and Local programs
* To actively pursue private sponsorship of bicycle programs
* To advise those responsible for the administration of detailed programs on funding issues
* To administer planning and research grants into bicycle issues.
PROGRAMS
POLICY 8
EVALUATION
"To initiate bicycle research and evaluation programs"
PRIORITY ACTIONS
* To initiate the collection of detailed accident statistics and other key data
* To monitor and evaluate the effectiveness of bicycle programs.
* To monitor bicycle use.
* To provide a suitable resource centre for dissemination of bicycle data
PROGRAMS

6. analysis and documentation

FIGURE 1.

ENGINEERING STUDY FRAMEWORK



6. Analysis and Documentation

The third phase of the Planning Method comprises the detail bikeway planning from which the recommended system is developed, the identification of the engineering action required to upgrade or establish each link in the bikeway scheme, and the preparation of an implementation program and a draft bike map. These items, together with the draft Project Report are placed on public exhibition and circulation to government agencies and Councils for review and comment prior to the final documentation. Each of the Analysis phases of the Method are described below.

STEP 16: DEVELOP A PRELIMINARY BIKEWAY NETWORK

All data base and synthesis information is mapped onto transparent material to permit overlay techniques to be used in the assessment of individual data items or items in combination. Guided by the areal and composite strategies defined previously, a preliminary bikeway network covering the whole study area is developed by "sifting" all data shown on the various pre-strategy and synthesis maps with weightings being assigned to different items based on the specific characteristics of each "identity area". The bikeway system so defined represents bicycle trip "desire lines" rather than specific route proposals. These "desire lines" are translated into concrete proposals in the field.

STEP 17: CARRY OUT "SADDLE" SURVEYS

All links in the preliminary bikeway scheme are cycled and alternatives investigated. During the course of the saddle surveys, an assessment is made of the "rider stress level" of each on-road segment. These measures are then compared with those objectively determined in Step 7 and where major discrepancies exist, the stress level is reassessed in the field. The final results are used to grade the on-road routes into good, medium and poor cycling conditions.

In addition to the stress level assessment, all deficiencies in the proposed bikeway system are noted together with the possible remedial actions required to upgrade or establish each route. The following is a guide to the type of information which should be considered or collected when undertaking the "saddle" surveys:

LOCATION : *Reference each route segment on a map.*

GRADE : *Indicate all on-road sections that are steeper than 4° for a length of 100 metres.*

STRESS : *On a scale of between 1 and 5 (low and high stress respectively) assess the "rider stress" of each on-road segment.*

REMEDIAL ACTION(S) HIGH STRESS ROADS : *Where a route is considered to have a high stress level, the reason for this assessement should be given to assist in the identification of actions to moderate the "stress". Factors to be considered include:*

- *traffic volumes*
- *traffic speed*
- *adequacy of road sharing space*
- *parking*
- *commercial vehicular traffic*
- *visibility and/or sight distance*
- *vehicular access from abutting land uses*
- *lane marking*
- *grade*
- *pavement condition*
- *presence of "squeeze points"*

REMEDIAL ACTION(S) MID BLOCK :

The following is a list of possible on-road remedial actions to improve cycling conditions:

- *repair potholes*
- *resurface uneven section of road*
- *remove loose material in kerbside lane*
- *improve road alignment*
- *restripe lane markings*
- *restrict parking*
- *improve visibility by.....*
- *moderate "squeeze point" by.....*
- *provide segregated bikeway*
  — *on-road*
  — *off-road*
- *upgrade railway crossing*
- *improve mid block intersections by.....*
- *provide bicycle refuge or crossing at arterial road*
- *widen carriageway*
- *reset service cover or stormwater grate*
- *seal road shoulders*
- *improve signing (motor traffic, bicycle traffic).*

REMEDIAL ACTION(S) INTERSECTIONS

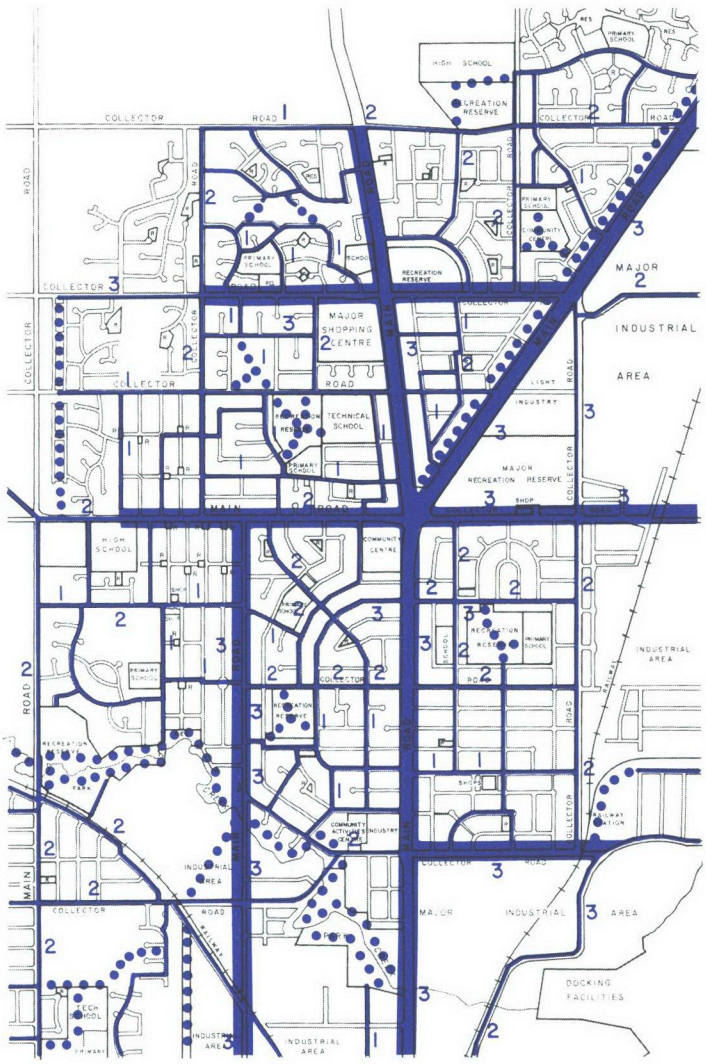
- *improve channelisation*
  — *approach*
  — *at intersection by.....*
  — *exit*
- *adjust signal phasing*
- *realign (prepare sketch of proposal)*
- *restrict parking in approaches and/or exits*
- *restrict turning movements*
  — *motor traffic*
  — *bicycle traffic*
- *improve pavement surface*
- *provide off-road bicycle facility*
- *provide pedestrian crossing*
- *change or upgrade traffic control device.*

REMEDIAL ACTION(S) OFF-ROAD FACILITIES :

- *provide bike path*
- *provide link path*
- *widen existing footpath and sign for shared use*
- *provide pram crossing.*

STEP 18: FINALISE BIKEWAY SCHEME

Following the field investigations, the bikeway scheme is finalized and all "action" proposals together with deficiency statements documented in tabular form. A map is prepared to show the recommended on-road and off-road bikeways and the existing "rider stress" levels of all on-road routes. This map which is subsequently used for the preparation of the bike maps is circulated to all relevant agencies and organizations for review and comment.



LEGEND

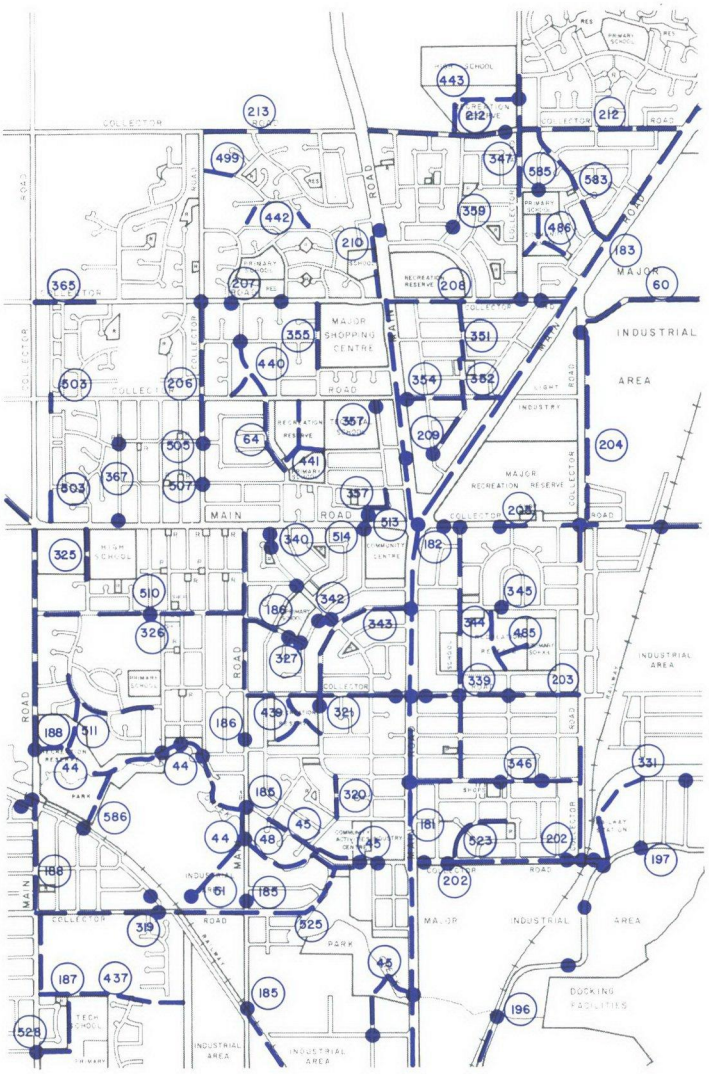
- MAIN ON-ROAD BIKEWAY
- MINOR ON-ROAD BIKEWAY
- BICYCLE PATH

"STRESS LEVEL"

1. LOW
2. MEDIUM
3. HIGH

STEP 19: PREPARE DRAFT ACTION PLAN AND IMPROVEMENTS PROGRAM

Paralleling the detail route planning work and "saddle" surveys, a subject plan is prepared to reference the recommended engineering action required to establish the recommended bikeway scheme. The recommended measures are determined from the "saddle" survey data and, where necessary, further field investigations. In line with the engineering philosophy the "actions" are based on the attainment of the desired improvement in cycling conditons through low cost engineering solutions. Descriptions of the "action" recommendations are tabulated and the cost of each item estimated.

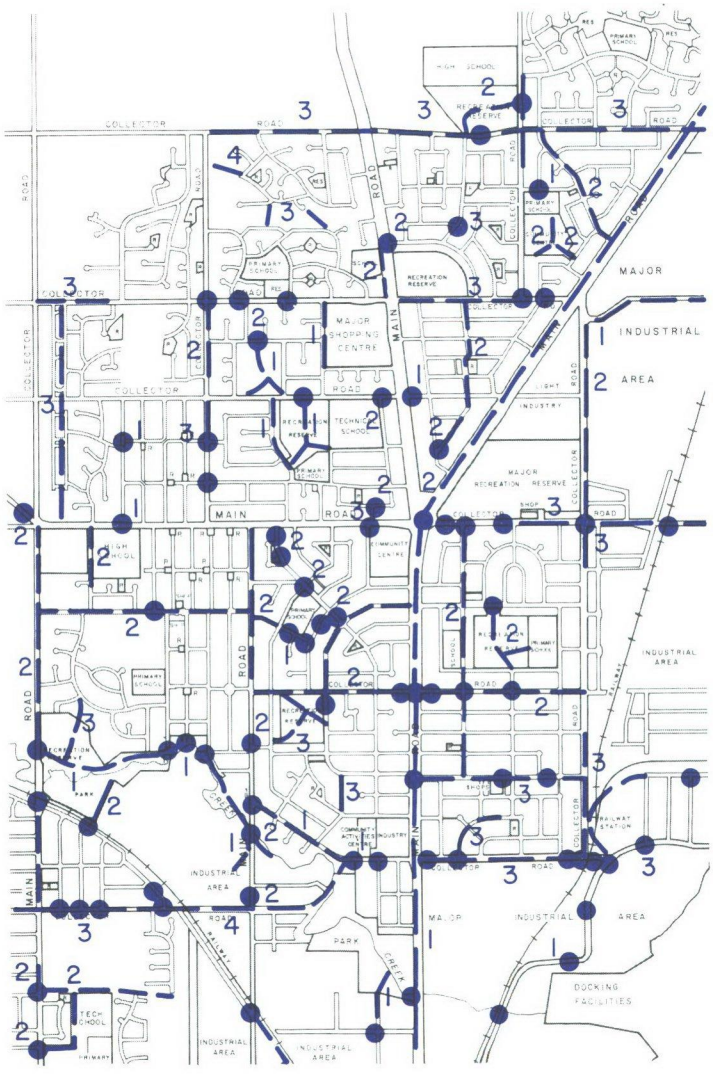


To facilitate the preparation of an implementation program, action items are assigned a priority ranking. The following factors are considered in the allocation of priorities.

- all main school routes should be included in the priority 1 works,
- deficiencies in the existing bicycle facilities should be rectified immediately,
- high priority should be given to the improvement of high stress on-road routes and potentially hazardous locations,
- priorities should be assigned to achieve a logical and sequential development of the recommended bikeway system,
- priorities should be allocated such that each area or municipality is provided with a balanced work program (in terms of types of bicycle facilities established in each implementation period).

A map is prepared to show the priority assigned to each link in the adopted scheme and the priority ranking of each "action" item noted on the action schedules. Based on the cost estimates, the priority rankings and having regard to the expenditure limitations of Councils and other construction authorities, a draft implementation program is developed and circulated to the appropriate organizations for review and comment.

LGA	MAP REF.	LOCATION	DEFICIENCY	RECOMMENDED ACTION	$APPROX.	PRIORITY
BOX HILL	2097	Dorking Rd. between Whitehorse Rd. & Brum Rd.	• Squeeze point at Springfield Rd. going north	• Adjust lanemarking and sign to taper road	200	1
			• Too narrow for lane sharing between Springfield Rd. & Eram Rd.	• Traffic Management	500	1
			• Difficulty in entering Whitehorse Rd.	• Provide connection to service road via pedestrian crossing	1,000	1
	2099	Woodhouse Ave. between Station St. & Dorking Rd.	• Too narrow for lane sharing	• Traffic management	500	1
	2101	Albion Rd. between Middleborough Rd. & Station St.	• Too narrow for lanesharing	• Traffic management	500	1
	2107	Andrew St. between Eley Rd. and Burwood Hwy.	• No ramps at footpath and pedestrian crossing for crossing Burwood Hwy.	• Construct kerb crossing and short length of shared bicycle/pedestrian path. Sign for cyclists to dismount to use crossing.	500	2
	2204	High St./Beresford St. between Mont Albert Rd. and Moorandah Hwy.	• Fast traffic dangerous	• Adjust lanemarking to provide wider kerbside lane	500	2
	2254	Glengarry Ave. between Station Street & primary school	• Ramp needed to connect unmade path through Primary School to Bike track going north to Frank St.	• Construct ramp and seal path	10,000	2
			• Barrier needs removal at gate into school	• Remove Barrier	100	1
			• Footbridge over Gardiners Crk. too narrow	• Sign for cyclists to dismount to use pedestrian facility	100	1
	2260	Wattle Park off-road facility	• Path through Park unsealed and steps at north end pose a barrier	• Seal path	12,500	2
				• Provide ramp	200	2
					$26,600	



LEGEND

1. HIGH PRIORITY
2. MEDIUM PRIORITY
3. LOW PRIORITY

STEP 20: PREPARE DRAFT BIKE MAPS

The production of a bike map is seen as an important part of the Engineering strategy. The map serves a number of purposes:

- it is of immediate benefit to cyclists in the selection of appropriate routes for their trips,
- it directs cyclists away from unsafe or high "stress" routes,
- it serves as a master reference plan for use in land use and transport planning,
- it serves as a publicity document to create greater community awareness of cycling, and
- it encourages Councils and other construction authorities to implement measures for cyclists.

Copies of the bike map produced for Newcastle and Geelong are included at the back of this Bulletin.

Using the "data base" information and the adopted "Bikeway Scheme" a hand coloured bike map(s) are prepared for the study area. Following public exhibition and review, the draft map(s) is revised for the preparation of the final art work.

STEPS 21 — 25: DOCUMENTATION

A report setting out the background to and the recommended bicycle strategies and programs (including the non-engineering E's) for the study area is prepared. This draft report is submitted to all agencies and organizations participating in the study for comment.

In parallel with the review of the Project Report, an exhibition is staged. The exhibition should include the draft bike maps, relevant support and background material drawn from the "data base", "synthesis" and "analysis" mapping and a summary of the principal study recommendations.

Incorporating comments received from the exhibition and participating organizations, the draft bike maps are revised and the final art work prepared. The Project Report and other support documents are edited and finalized.

other bicycle planning considerations

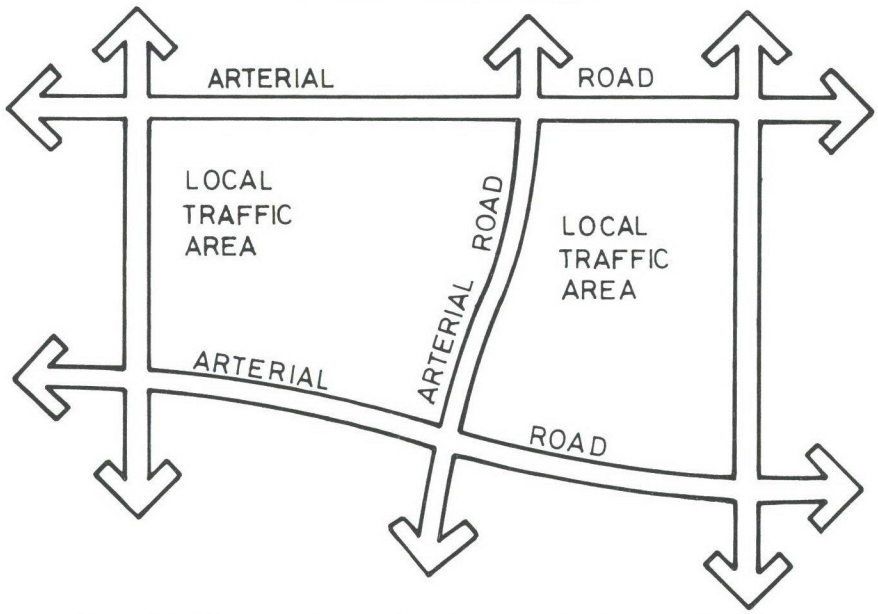
7. Guidelines for Improving Local Traffic Areas for Cyclists

7.1 introduction

Road classifications distinguish between arterial roads and the local streets within Local Traffic Areas bounded by those arterial roads. By definition, all streets within a Local Traffic Area should have a traffic function predominantly or exclusively concerned with providing access to properties within that area. In contrast to arterial roads, the movement function can be given a low priority. Traffic volumes on any local street should be low and traffic speeds should also be low.

FIGURE 2.

LOCAL TRAFFIC AREA



In practice, many Local Traffic Areas do not function as such in a traffic management sense. Local streets may be used by heavy and fast traffic to avoid congested arterial roads; wide, gently curving collectors encourage fast travel by local and through traffic; peripheral commercial or industrial land users can generate considerable traffic through Local Traffic Areas.

Cyclists are amongst those who suffer when a Local Traffic Area does not enjoy appropriate traffic conditions. Young cyclists with limited experience and little or no training in on-road cycling are particularly at risk.

Guidelines for improving conditions for cyclists in Local Traffic Areas are presented in this chapter. They are discussed under the following headings:

- Area-wide Traffic Management Programs
- Individual Traffic Engineering or Traffic Management Actions
- Specific Actions to Aid Cyclists

7.2 area-wide traffic management programs

Fast and/or heavy intrusive traffic in Local Traffic Areas has led in recent years to a substantial number of Local Area Traffic Management Studies aimed at reducing or removing the impact of that traffic. Where such a reduction or removal is achieved, the cycling environment within the area can benefit greatly. However the benefit can be diminished by failure to recognise bicycles as part of the area's traffic mix when selecting the specific measures to be implemented and in preparing their design. For example, introduction of one-way street provisions can create barriers to convenient cycling to local facilities.

The optimum process within which to improve cycling conditions in a Local Traffic Area is the implementation of a Local Area Traffic Management Scheme which takes into account the needs and impacts of all components of the traffic mix including cyclists and pedestrians. Such an approach avoids the risk that attention to one particular component of the traffic mix will create unforeseen problems for other components or that solving one particular problem spot will transfer the problem to another street.

In theory, application of a low speed limit, e.g. 40 km/h, through-out a Local Traffic Area would enhance both safety and environmental amenity by discouraging through traffic and slowing local traffic. In practice, substantial observance of such a control in Australian cities would require levels of enforcement and/or changes in driver attitudes unlikely to be achieved in the next decade at least. Other traffic engineering and traffic management measures are needed. The most commonly used measures are listed below with comments on their implications for cyclists.

	TRAFFIC ENGINEERING OR MANAGEMENT MEASURE	IMPLICATIONS FOR CYCLISTS
1.	Stop of Give Way Sign.	Some motorists fail to observe these signs when the vehicle on the priority road is a bicycle.
2.	Turn bans by signing (sometimes during specified hours).	Exemptions for specific classes of vehicles, e.g. bicycles and buses.
3.	Mid-block street closure.	Traffic management objective can usually be achieved without the need to close street to bikes. Detailed design should therefore provide for movement through the closure by bikes and permit or discourage through movement by motor-bikes as appropriate.
4.	Street closure at intersection.	As for No. 3. In addition detail design must recognise that motorists using intersection will not anticipate vehicles entering the intersection from the closure, therefore prevent cyclists entering quickly from the "closed" leg(s).
5.	Diagonal closure of intersection.	As for No. 4.
6.	Closure of median.	As for No. 3.
7.	Half-closure of street at intersection.	This measure prevents two-way movement into or out of a street whilst allowing two-way movement over the remainder of the street. Implications for cyclists are as for No. 4.
8.	One-way street.	This measure can significantly inconvenience local bike travel unless an adjacent street is close by. Cyclists will normally continue to use the street by riding illegally on the footpath or the road. Unless there is some traffic management reason to prevent two-way cycling, provision should be made by providing a contra-flow lane or provision on the footpath for cyclists.
9.	Pavement narrowing for a short length of street with two-way traffic flow.	Where low traffic speeds and volumes can be achieved in the street, no special provision for cyclists in necessary. If low speeds and volume cannot be achieved, an alternative measure should be sought.
10.	Pavement narrowing to one lane width with passing bays at intervals.	Only appropriate in low volume/low speed streets. Width of narrow section should consciously be selected to either permit a slow car to safely pass a bike (approx 3 m.) or prevent a car from passing a bike (approx. 1.8 m.), but not fall between the two and create "squeeze" conditions. Motorists and cyclists using the street should be educated to use it as planned.
11.	Pavement narrowing for a short length of street with only enough width for one vehicle at a time.	In low volume streets no special provision is needed for bikes. Current trials in Sandringham, Victoria suggest that, where volumes are of the order of 1,000 vehicles per day or more, some cyclists will tend to avoid the narrow section of pavement by riding around it on the footpath. Separate paths for cyclists either side of the narrowing should be considered therefore if volumes are not below 1,000 vehicles per day.
12.	Restrictive (mini-) roundabouts.	Restrictive roundabouts at the intersection of local streets structure traffic movements to the benefit of all types of traffic including bikes. Kerb extensions to narrow the entry to the roundabout require bikes and other vehicles to enter and traverse the roundabout in a nose-to-tail pattern rather than the more vulnerable side-by-side pattern.
13.	Speed humps.	Speed humps, in contrast to speed bumps, can be comfortably crossed by cyclists. Where the hump is used in conjunction with a pavement narrowing, the comments under Nos. 9 and 11 above also apply.
14.	Exemptions from traffic controls, e.g. No Entry Buses Excepted.	This provides a traffic management mechanism which can be used to exempt bikes from restrictions otherwise imposed, for example turn bans or entry bans, where it is not appropriate to restrict bike movements.
15	Intersection realignment.	Realignment of inappropriate intersections, for example where roads intersect at an acute angle or form cross-roads, can improve the safety of an intersection for all uses. Cyclists particularly benefit from the restructuring of intersections to prevent left high-speed sweep turns.
16.	Signalisation.	This is a measure generally applied to arterial roads but may occasionally be justified in Local Traffic Areas. Some cyclists will use "Box Turns" rather than centre-of-the-road turns. Where loop detectors are installed to operate the signals they should be responsive to bike traffic.
17.	Intersection channelisation.	This measure is also normally applied on arterial roads. Where application is justified on local streets it can structure traffic movements to the benefit of all users. Designs should ensure that cyclists will not be squeezed when traversing the intersection.
18.	Lane marking.	Usually applied on arterial roads but may be warranted on some streets within Local Traffic Areas. Lane widths can dramatically influence the riding environment. They should be chosen in the light of the guidelines for kerb-side lanes in this manual.

A recent variation to the Local Traffic Management Scheme has arisen with the desire of some people and authorities to seek a return to the original pre-car image of streets as spaces shared by everyone -pedestrian, cyclist, child and car. This is fully compatible with the basic objective of traffic management schemes which seek to reduce and slow vehicular traffic but seeks to achieve extra gains. It therefore tends to require a higher density of actions and more restrictive measures than the more traditional traffic management schemes. To the extent that all measures are designed with the cyclists in mind, the more extensive action is to the advantage of cyclists in the area.

A design for a Local Traffic Area based on this approach is illustrated in Figures 3 and 4. These show the traffic management context of a Local Traffic Area and the resulting Design Plan.

FIGURE 3

TRAFFIC MANAGEMENT CONTEXT

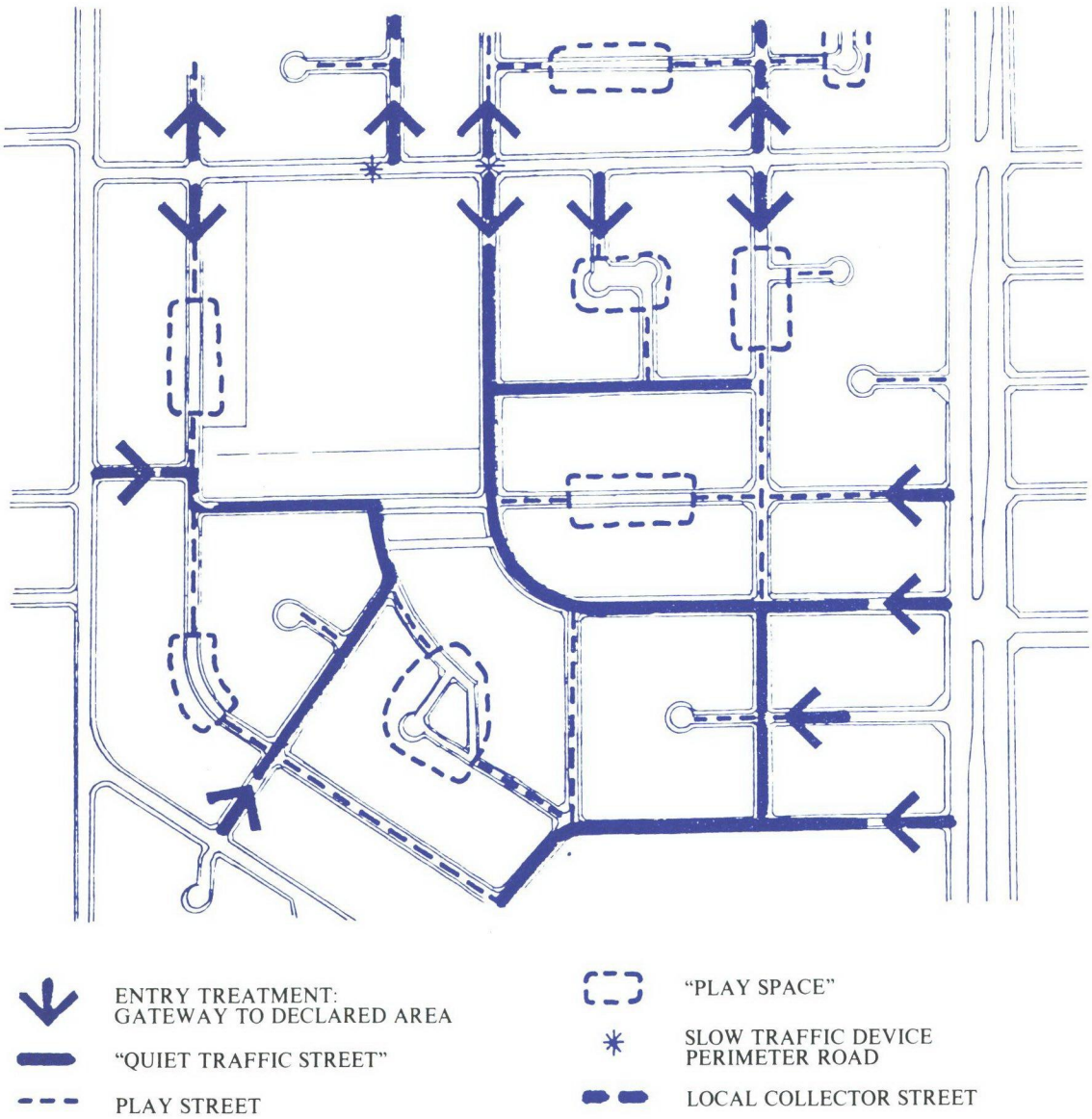
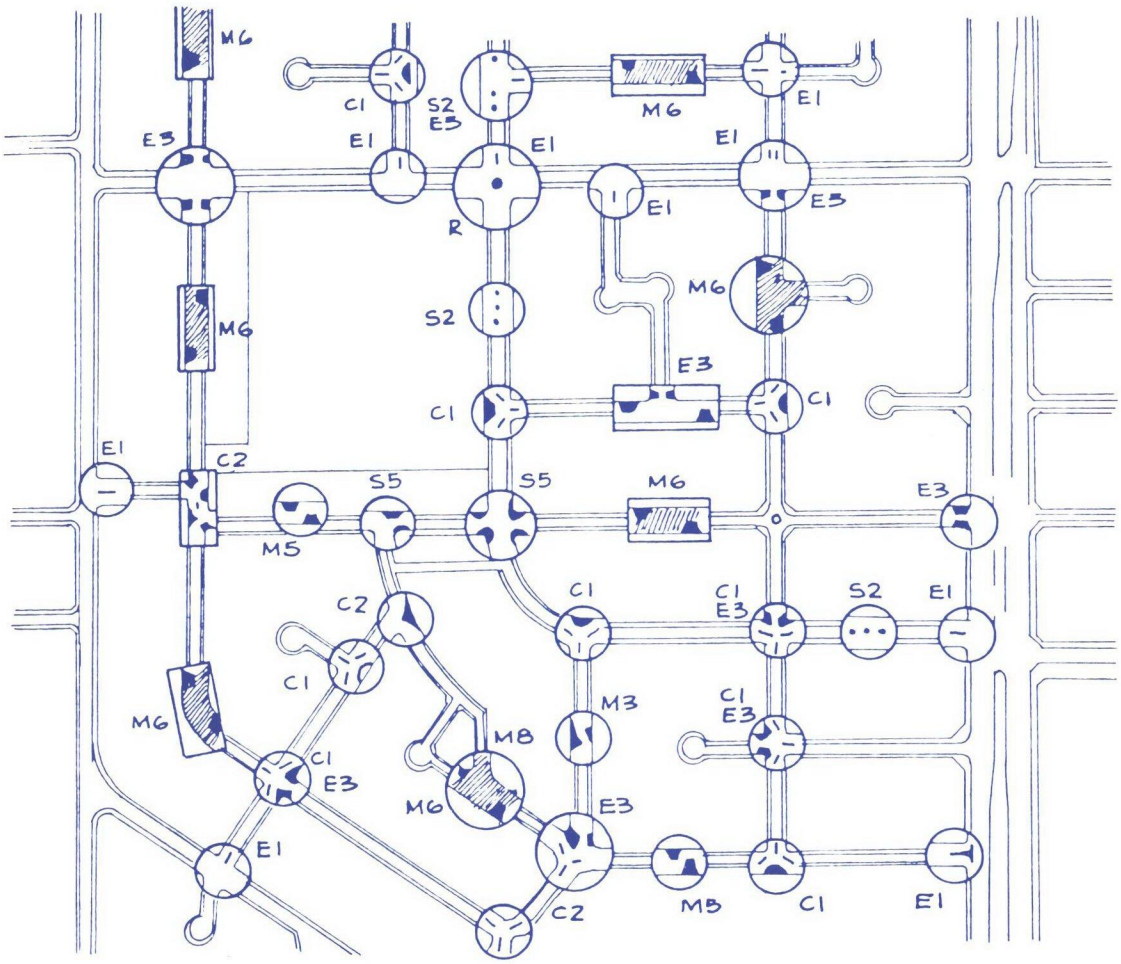


FIGURE 4

"DESIGN PLAN"



S1 NARROWING: 2 DIVIDERS, BIKE LANES

S2 CENTRE MEDIAN PLANTING

S3 CENTRE MEDIAN PLANTING & BIKE LANE

S4 SERVICE RD. INTERRUPTION

S5 NARROWING (ROAD &/OR CARPARK)

S6 2 LANE NARROWING

E1 ENTRY DIVIDER

E3 DRIVEWAY ENTRY

C1 INTERSECTION DEVIATION

C2 INTERSECTION REALIGNMENT

R ROUNDABOUT

M1 SINGLE SIDE LANE

M5 DOUBLE OFFSET

M6 PLAY SPACE

M7 EFFECTIVE CLOSURE

M8 CLOSURE

The comprehensive traffic management scheme, as outlined above, is the ideal way to develop traffic management proposals for Local Traffic Areas. The initiative for action can sometimes come from a narrower perspective. In recent years the preparation of a bike plan has been a frequent catalyst for local traffic management action. Where it has been developed in a traffic management context and with a knowledge of both motor vehicle and bicycle movement characteristics, it can lead to a responsible local traffic management scheme, which brings benefits to residents, motorists, as well as cyclists.

7.3 individual traffic engineering or traffic management action

Action is often taken at a particular intersection or on a particular section of street to solve a particular traffic problem such as an accident black-spot or congested intersection. As for area-wide programs, any single action should be designed to work effectively for cyclists as well as all other types of traffic. The choice of appropriate action should take into account the implication for cyclists as listed in the schedule above.

7.4 specific actions to aid cyclists

Even with the fullest consideration of cyclists' needs when planning, comprehensive actions in the streets and roads of a Local Traffic Area are essential factors to check on the existence of any major barriers to bike tracks within the area.

Barriers to the movement of motor traffic from one side of a Local Traffic Area to the other may be a positive feature in terms of traffic management within the area. A barrier to easy cross travel for cyclists can be a serious constraint. Not only can it add significantly to the trip time of local bike trips but, more importantly, it may force cyclists to ride on a heavily trafficked arterial road for part of their trip.

Such barriers are typically creek valleys, railway lines, large hand holdings such as a golf course or major factory, lakes and reservoirs, and residential areas without connective streets. Breaching of a barrier for cyclists should be planned in conjunction with pedestrian and other traffic flows, as well as the specific needs of cyclists for good route connectivity.

8. Municipal Bicycle Planning

As mentioned, the foregoing planning method is generally designed for the development of a bicycle Engineering strategy for a metropolis or a large provincial town. The same method can, however be used for the preparation of a bicycle scheme for a municipality or small town with some slight modification. For example, various components of the "data base" and "synthesis" phases of the planning approach can be deleted or at least substantially reduced in scope. These include "Trip Production" (Step 4), "Areal Strategies" (Step 14), and the formulation of Guidelines and Policies. In addition, the level of involvement of government agencies and the public in the study can be reduced. However, it is considered to be both necessary and beneficial to encourage interested sections of the community to participate in the preparation of the scheme.

One significant benefit of preparing a municipal bicycle scheme is that greater attention can be given to developing specific area-wide Traffic Management programs than is possible with larger study areas. Since most bicycle trips are localized, the introduction of local traffic management measures to improve the safety of the residential street network has obvious advantages.

While several steps in the planning method used to prepare a municipal bikeplan can be deleted, it is recommended that neither the scope of the strategy nor the study output is reduced. This is particularly so in relation to the non-engineering aspects of bicycle planning. In many respects these types of programs can be more cost-effective in improving cyclists' safety than engineering measures.

9. Bicycle Planning and Subdivision Design

9.1 introduction

The planning method described in this Bulletin is largely oriented to the establishment of facilities for cyclists in existing built-up urban areas. The procedure aims to seek ways to safely integrate the bicycle within the constraints of the existing transport infrastructure by the modification and improvements to this structure and where appropriate the establishment of a supplementary off-road bikeway system. In other words, facilities for cyclists are superimposed on the existing urban situation.

However in the design of new towns and large residential estates, there is the opportunity to incorporate facilities for cyclists at the outset. This is not to say that the bicycle should be the main consideration of the urban design but can be planned for as an integral component of the total transport system. Based on this principal and current bicycle facility design practices, this chapter describes ways of catering for the bicycle in the design of new residential areas.

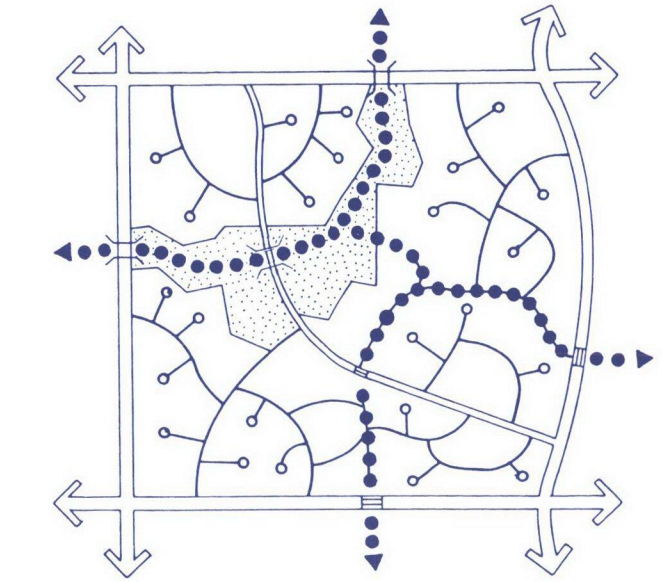
9.2 bicycle planning parameters

At the strategic level, account must be taken of the different bicycle user groups and the level of service required for each. First and foremost it should be recognised that there exists a wide variation in the riding capabilities, road sense and riding behaviour of different age groups. Thus in the design of a bikeway system a "design cyclist" cannot be assumed. Secondly, the requirements of different user groups should be reflected and accommodated in the urban layout. Based on trip purpose, cyclists can be divided into three broad categories. These, together with the specific requirements of each are described below.

- Inter-district trips e.g journey to work, tertiary education institutions and regional commercial and recreational centres. The majority of cyclists undertaking inter-district trips are experienced adult riders and their principal requirements are for direct high speed routes of travel. Ideally a system of off-road trunk commuter bike paths, paralleling but not necessarily adjacent to, the arterial road network should be developed to cater for these long distance trips. Where this is not practical, the residential layout should provide for direct bicycle access through each residential cell via streets and link paths with special crossing facilities at arterial and sub-arterial roads to facilitate inter-cellar movement. These two types of treatment are illustrated in Figure 5.

FIGURE 5.

TRUNK BIKEWAY SYSTEM



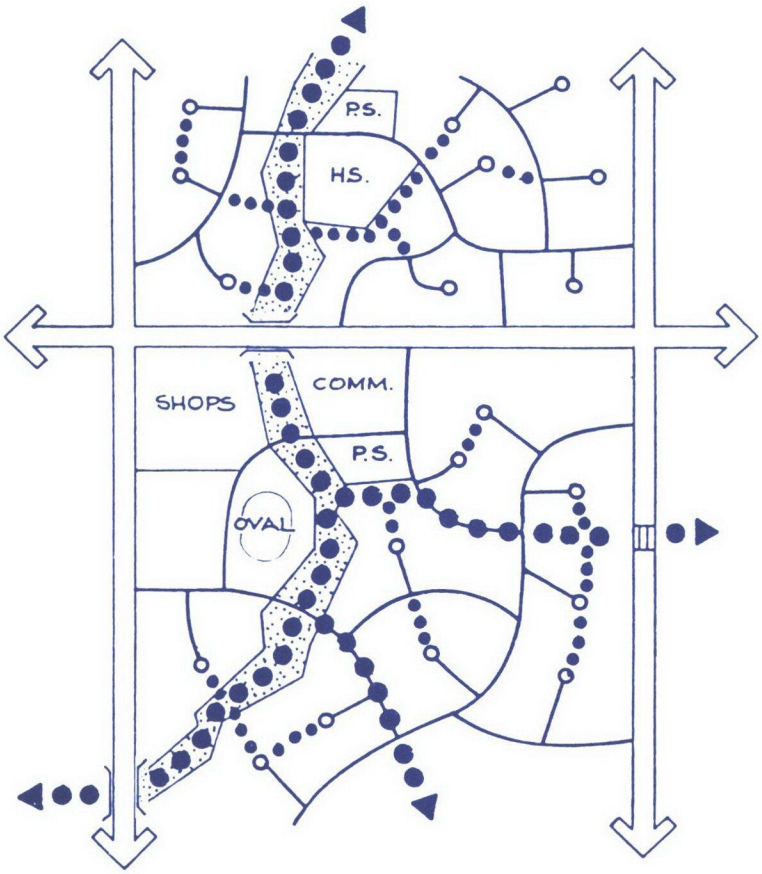
LEGEND

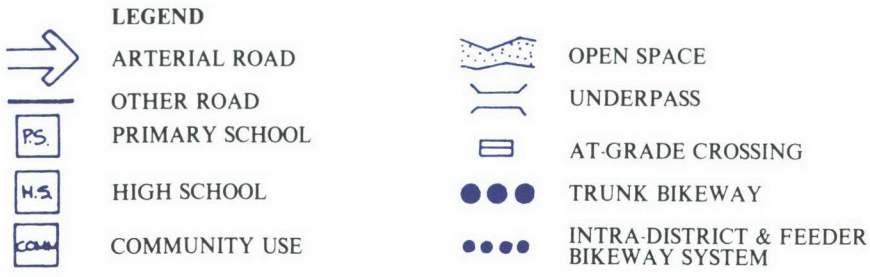
ARTERIAL ROAD
SUB-ARTERIAL ROAD
COLLECTOR/ACCESS ROAD
OPEN SPACE
TRUNK BIKE PATH
TRUNK ON-ROAD BIKEWAY
UNDERPASS
AT-GRADE CROSSING FACILITY

Intra-district trips, e.g. journey to school, local shops, local recreation venues and other localized trips such as visiting friends. The bulk of this user group comprise school age children ranging in age from 8 to 17 years with varying riding capabilities. Because of the diverse nature of intra-district trips it is neither practical nor economically feasible to provide facilities for the exclusive use of cyclists to satisfy all trip needs. While the trunk bikeway system may serve as a framework for intra-district movement, the majority of local trips will occur in the residential street network. In other words, it should be assumed that all collector and access roads will be used by cyclists. Thus the residential street system should be designed to achieve the safe integration of bicycles with other road traffic. To encourage the maximum utilization of the access roads within each residential cell, short link paths should be provided throughout the subdivision and in areas of open space. The intra-district bikeways should also serve as a feeder system to the trunk bicycle facilities. Figure 6 shows a typical subdivision layout with provision for inter and intra-district bicycle movements.

FIGURE 6

TYPICAL SUBDIVISION LAYOUT





- Recreation trips. Recreation riders comprise all age groups and the main considerations in the design of recreational bicycle facilities are that they are safe, gently graded and aligned to achieve maximum recreational amenity. Where possible these facilities should be provided off-road, traversing landscaped reserves and service corridors. As with the intra-district system where trunk bicycle commuter paths are provided they can also serve a recreational function. If recreational bicycle facilities cannot be established in each residential cell, access to the regional facilities should be via safe routes.

Third, the dual use of pedestrian infrastructure by cyclists should only be contemplated where the likelihood of conflict is low. Generally, dual or shared use of footpaths should only be permitted where low volumes of both pedestrian and bicycle traffic are anticipated. In some instances, because of financial constraints, it may not be possible to provide separate infrastructure for cyclists, for example at arterial road crossings. In these cases cyclists could be permitted to use the pedestrian facilities provided that they dismount before doing so. Under no circumstances should a mix of pedestrians with fast moving bicycle traffic be contemplated.

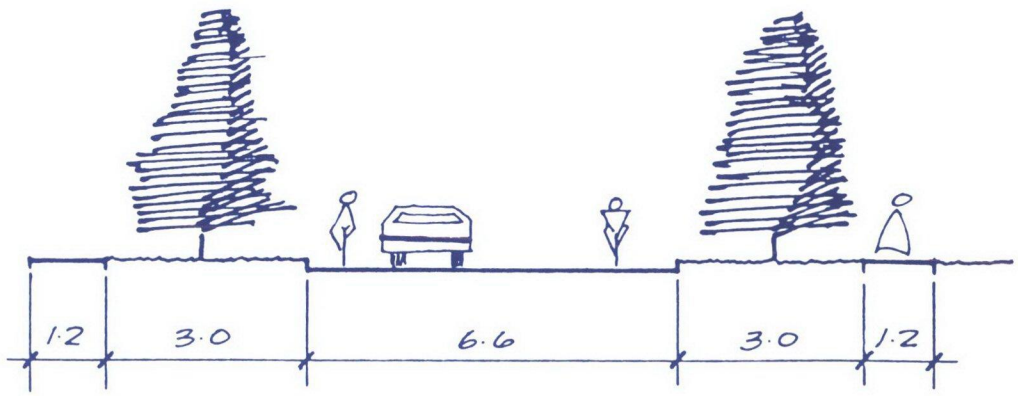
In summary, in the design of new residential estates it should be assumed that all roads will be used by cyclists. Because of traffic volumes and speed it is desirable to discourage the use of the arterial and sub-arterial road system by cyclists by the provision of alternative arterial (inter-district) routes with each residential cell. Where the use of the arterial road system is unavoidable, adequate lane sharing width should be provided in the kerbside lane and intersection designed to accommodate bicycle traffic. For intra-district bicycle trips the overriding objective is to create a road environment which acknowledges the needs of cyclists.

9.3 specific design requirements

It is common practice in the design of new residential estates to establish a well defined road hierarchy, each designed to serve a distinct transport function. Within each residential cell the road layout is generally such that non-essential and through traffic is excluded. Thus, in most cases, the collector and access roads are safe for integrated bicycle traffic.

FIGURE 7.

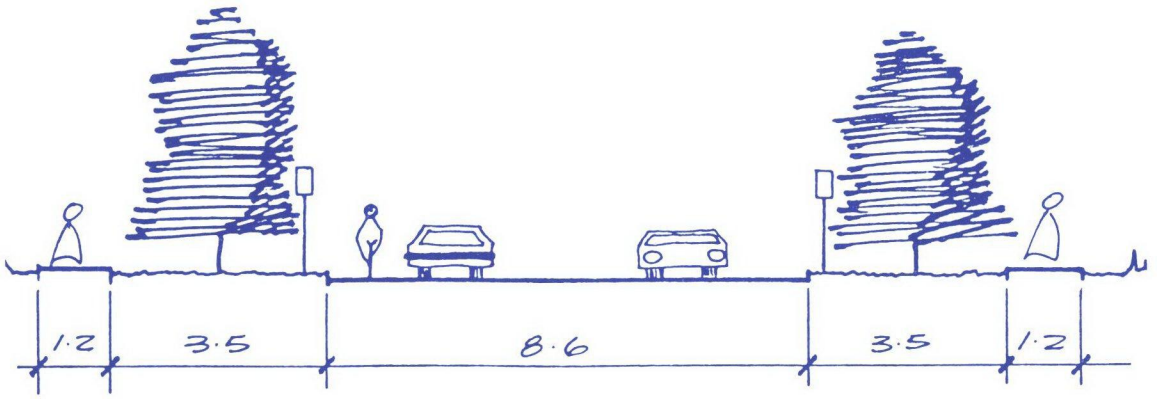
ACCESS ROAD WITH INTEGRATED
CYCLE TRAFFIC



However, where the residential streets are expected to carry volumes in excess of 4,000 motor vehicles per day, the carriage-way should be widened to provide adequate lane sharing width.

FIGURE 8.

COLLECTOR ROAD WITH PROVISION FOR CYCLE TRAFFIC



The standard engineering practices in subdivision design such as staggered intersections and curved road alignments with frequent intersections to reduce traffic speeds are compatible with the creation of a safe on-road cycling environment.

The width of bike paths will depend on their function and the expected volumes of bicycle traffic. The pathway width should range from a minimum of 1.2 metres for lightly trafficked link paths to 3.0 metres for high speed commuter bikeways. It is important that adequate sight and stopping distances are provided at all bike path/road intersections to minimize the likelihood of conflict.[1]

[1]. Refer to "Bicycle Facilities : Engineering Design Guidelines" Traffic Authority of N.S.W. for further information on design criteria for bikeways.

References

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Scott M. *Development of the Geelong Bike Plan Engineering Plan.* Paper presented to the Forum on Planning for Bicycle Facilities, Sydney 1978.

Other Manuals

Traffic Authority of New South Wales.

Bicycle Facilities: Engineering Design Guidelines

This manual currently being prepared by the Traffic Authority of New South Wales presents design criteria and parameters for use in the design of a range of bicycle facilities. The information contained in the manual has been drawn from both Australian and overseas sources.

Geelong Bike Plan

Bicycle Signs

This bulletin developed in conjunction with the Road Safety and Traffic Authority (RoSTA) presents standard designs for bicycle signs. These standards are currently being revised by RoSTA for application throughout Victoria and possibly Australia.

Bicycle Accidents

The bulletin presents the first in-depth analysis of the frequency, location, causes, times and types of bicycle accidents undertaken in Victoria.

School Bicycle Touring

The bulletin is a manual for teachers planning school bicycle tours.

Bicycle Enforcement

Bicycle enforcement issues and the results of enforcement trials undertaken in Geelong are presented in this bulletin.

Bicycle Surveys

This bulletin includes much of the detailed bicycle survey information collected and used to develop the Geelong Bike Plan programs.

Bicycle Racks

Designs for 12 bicycle racks and enclosures and advice on location criteria, costs and manufacturers are contained in this bulletin. The information is based on research undertaken as part of the Melbourne Bicycle Strategy Study.