VICTORIA

Report

of the

COUNTRY ROADS BOARD

for the

Year ended 30 June 1982

Ordered by the Legislative Assembly to be printed

MELBOURNE
F D ATKINSON GOVERNMENT PRINTER
1982

No. 76

30th September 1982

The Honourable S M Crabb MP
Minister of Transport
35 Spring Street
MELBOURNE 3000

Sir
In accordance with the requirements of Section 128 of the Country Roads Act 1958, the Board submits to you for presentation to Parliament the report of its proceedings for the year ending 30th June 1982.
The Board wishes to thank you and the Government for the support and interest in its activities and wishes to place on record its appreciation of the continued co-operation and assistance of State Ministers, Government departments, State instrumentalities and municipal councils.
The Board also pays tribute to the continued loyal co-operation of, and work done by, its staff and employees throughout the year.
Yours faithfully

T H Russell
M Eng Sc(Hons), BCE(Hons),
Dip CE, CE, FIE Aust, FCIT
Chairman

W S Brake
BCE, CE, MIE Aust
Deputy Chairman

N L Allanson
AASA (Senior), JP
Member

G K Cox
LLB, AFAIM, JP
Secretary

Country Roads Board Annual Report

This Annual Report is for the year ended 30th June 1982. It is the Board's sixty-ninth Annual Report and is presented to both Houses of Parliament pursuant to the Country Roads Act 1958.
The Country Roads Board is the State Road Authority for Victoria.
There are approximately 160,000 km of public roads in Victoria, of which 23,763 comprise the State's principal road network of Country Roads Board declared roads.
The lengths of roads declared or proclaimed under the Country Roads Act are State highways 6,974 km, freeways 376 km, main roads 14,585 km, tourists' roads 798 km, and forest roads 1,030 km.

Objectives of the Country Roads Board

Principal objective

The Board's principal objective is to create an efficient road system throughout Victoria, within the context of the overall transportation needs of the community.

Other objectives

The road system

- Provide the more important roads that will permit the safe, reliable, efficient and comfortable movement of people and goods
- Encourage and assist municipal councils to provide other roads
- Ensure that road and bridge works have full regard for engineering, economic, social and environmental aspects and that they make the best use of financial, energy and other natural resources, compatible with society's desires for social and economic betterment
- Keep under review and make reasonable provision for the protection of options for longer term road requirements
- Ensure that development of the road system has full regard for, and is compatible with, the requirements of other modes of transport.

The Board and the community

- Ensure that decision making takes into account the requirements and views of the community
- Keep the community informed of objectives, plans, works and other activities and matters related to roads, and to respond promptly to community queries in a helpful and courteous manner
- Ensure that road and bridge works cause a minimum of interference with the community
- Ensure that those who are adversely affected by road and bridge works are fairly compensated within the limits of statutory provisions.

The Board's organisation

- Develop as an efficient, effective, progressive and dynamic organisation serving the overall interests of the people of Victoria as they relate to the State's roads
- Ensure the organisation anticipates and meets changing circumstances, and implements technological and other changes in a way that is in the best interests of the people of Victoria
- Maintain a decentralised organisation that enables decisions affecting particular regions to be made at the regional (Divisional) level
- Ensure, by support of learning and research both within the Board and in external organisations, that knowledge and skill in highway engineering and related aspects are advanced in Victoria.

The Board's personnel

- Maintain harmonious relations and ensure effective communication between management, staff and employees and staff and employee organisations
- Train and develop all personnel to carry out their given duties effectively and efficiently, and to provide opportunity for career development and job satisfaction
- Maintain a high level of motivation, performance, teamwork and safe working
- Ensure the effects on people of organisational and technological changes are taken into account in decision making.

Summary of Activities

During 1981/82 the Board:

- Expended $262.9 million on new roads and bridges and the maintenance and improvement of existing roads and bridges
- Completed, and opened to traffic, 22.8 km of freeway
- Surfaced or resurfaced 4,837 km of road
- Commenced the construction of 69 new bridges (including 31 commenced by municipal councils with financial assistance from the Board) with an estimated total cost of $22 million
- Linemarked 33,847 km of roads at a total cost of $3.6 million
- Entered into 329 contracts with a total value of $67.3 million
- Allocated $112.4 million to municipal councils for works on main roads and unclassified roads
- Linked 112 traffic signals under the SCRAM project
- Handled 27,268 emergency service calls from motorists
- Handled 121,170 requests for information on the effect of the Board's road proposals on particular properties
- Paid $20.9 million in compensation and associated costs for land required for roadworks
- Planted 96,450 trees as part of landscaping
- Published 17 technical papers
- Employed 14 new apprentices, making a total of 80 apprentices
- Provided work experience for 127 students
- Held 65 internal training courses

The Board

T H Russell
M Eng Sc (Hons), BCE (Hons), Dip CE, CE, FIE Aust, FCIT
Chairman

W S Brake
BCE, CE, MIE Aust
Deputy Chairman

N L Allanson
AASA (Senior), JP
Member

Branch Heads

K G Moody
BCE, M Eng Sc, Ph D, MIE Aust
Engineer in Chief

G K Cox
LLB, AFAIM, JP
Secretary

R J C Bulman
AASA
Chief Accountant

From left to right: Mr GK Cox, Mr WS Brake, Mr TH Russell, Mr NL Allanson, Dr KG Moody, Mr RJC Bulman

Structure of the Country Roads Board

The Board, with its Head Office located at Kew, is organised functionally into three Branches—the Engineer in Chief's Branch, the Secretary's Branch and the Chief Accountant's Branch.

Engineer in Chief's Branch

The Engineer in Chief's Branch carries out the engineering activities of the Board including road construction and maintenance. Specialist Chief Engineers have been appointed with the titles Planning, Road Design, Works, Bridge, Mechanical, Urban Projects and Management Services.

To facilitate close contact with municipal councils and to decentralise supervision of works under the direct control of the Board, ten regional divisions, each headed by a Divisional Engineer, have been established. Divisional offices are located at Bairnsdale, Ballarat, Benalla, Bendigo, Nunawading (Dandenong Division), Geelong, Horsham, East Kew (Metropolitan Division), Traralgon and Warrnambool. Materials testing laboratories and depots are also established at each of the rural divisional offices.

Secretary's Branch

The Secretary's Branch carries out general administration matters and the promulgation of the Board's decisions and directions as well as a number of specialist activities relating to correspondence, personnel, land purchase, control of overweight and overdimensional vehicles, legal and contractual matters, manuals, methods studies, and public relations.

Chief Accountant's Branch

The Chief Accountant's Branch carries out the recording of the Board's receipts and expenditure, the co-ordination of accounting records with the State Treasury and municipal councils, the operation of the Board's costing system, and the control of and accounting for stores.

Front cover: The newly duplicated section of the Princes Highway East at Mt Ararat, east of Pakenham. Inset: the highway prior to duplication

Back cover: New bridge carrying the Heathcote-Redesdale Road over Wild Duck Creek. Inset: the same location, showing the old bridge

CONTENTS

Victoria is the most densely populated State of Australia with 3.8 million people living in 227,600 square kilometres. Over the years an extensive road system has been developed to serve the State and link Victoria with the road systems of neighbouring States.

Development of the Board

The Country Roads Board is a statutory corporation, first constituted under the Country Roads Act 1912. The Board consists of three Members appointed by the Governor in Council, and the powers and responsibilities of the Board are outlined in the Country Roads Act 1958.

Prior to the Board being constituted, local government bodies were generally responsible for the construction and maintenance of roads. However, experience in Victoria and overseas had indicated that if the problems associated with road construction and maintenance in a rapidly developing country were to be adequately planned and overcome, it would be necessary to appoint a central authority with wide discretionary powers to work in close co-operation with the existing machinery of local government. The Country Roads Act 1912 was framed with these requirements in mind, and the Board was constituted and financially endowed in such a way as to preserve its independence, and to enable it to discharge its duties to the greatest benefit of the State as a whole.

The Country Roads Act 1912 was proclaimed to come into operation on 1st January 1913. At that time, the roads in Victoria were generally in a deplorable condition. Many of them, particularly in various hilly areas of the State, were little better than primitive tracks and even those roads which had been well constructed as the principal coach routes before the advent of railways, had been allowed to deteriorate to a very serious extent. The first task that the Board undertook was an inspection of every municipality to determine the state of roads in Victoria and to advise municipal councils on methods of constructing and maintaining roads. As a result of the investigation, the Board nominated some 8,047 km of roads for declaration as main roads, being the major road classification provided for under the Country Roads Act 1912.

Since those early years, the types and classifications of roads have increased. In 1924, legislation providing for the declaration of State highways was enacted.

In 1955, the Board commenced the duplication of the pavements of certain heavily trafficked sections of State highways, notably on the Princes Highway East between Oakleigh and Dandenong and between Brooklyn and Norlane on the Princes Highway West. With the considerable growth in motor vehicle ownership and the large increase in the volume of traffic using roads, the advantages of high capacity roads with limited access soon became apparent. The first freeway (originally referred to as a bypass road) to be constructed was the Maltby Bypass Road which was completed in 1961.

Tourists' roads and forest roads are other classifications now provided for in the Country Roads Act as being the Board's responsibility.

The Board works in close co-operation with municipal councils in the maintenance and development of the network of regional and local roads. In addition to financial assistance, the Board is able to offer expert technical knowledge and specialist services to municipal councils and staff.

REVIEW

New Minister of Transport

In April 1982, the Honourable S M Crabb MP was appointed Minister of Transport. The Board takes this opportunity of welcoming Mr Crabb as its new Minister.
The Board also wishes to record its appreciation of the support and interest in its activities shown by the previous Minister of Transport, the Honourable R R C Maclellan MLA.

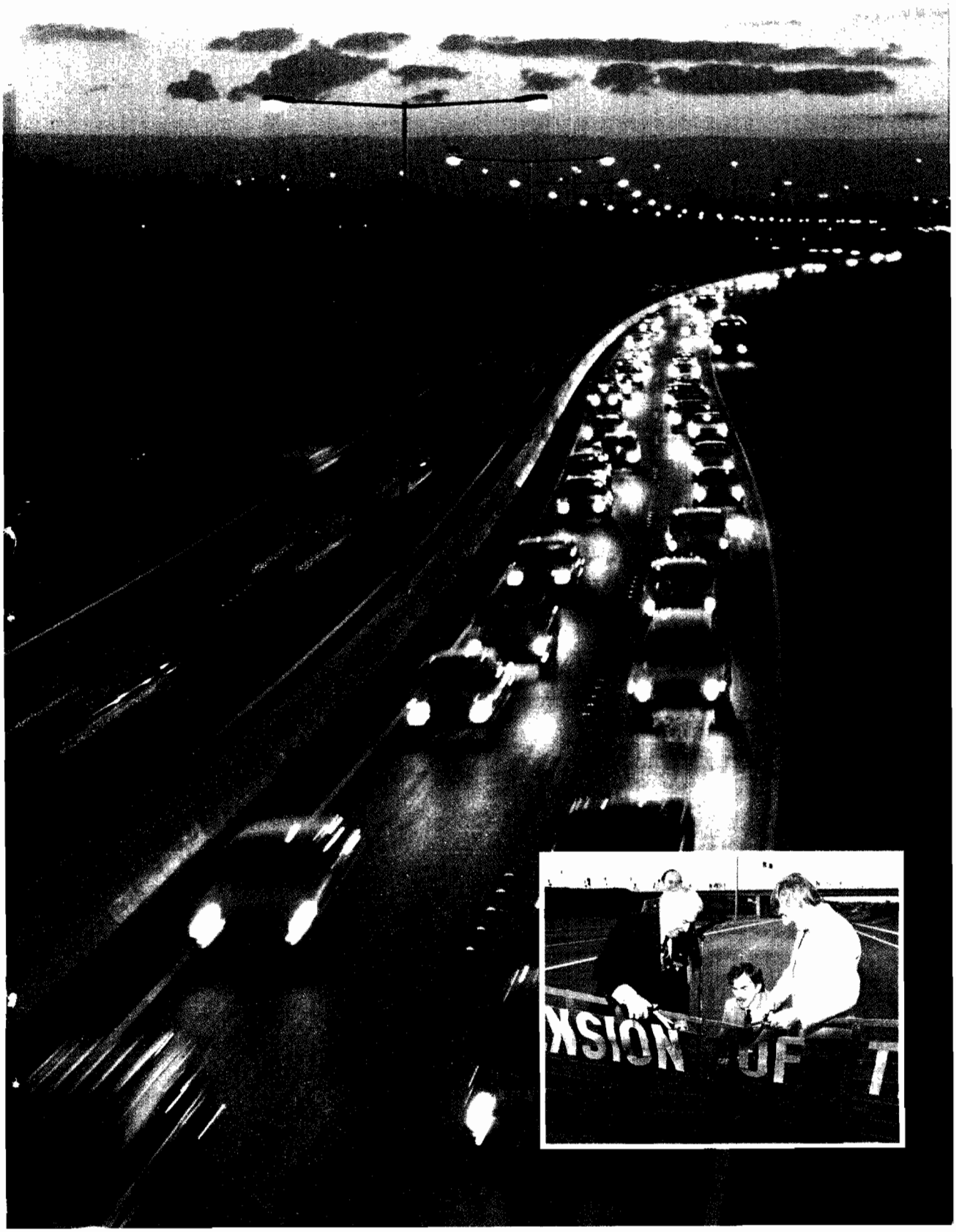
Restructuring of Transport Authorities

On 1st June 1982, the Honourable S M Crabb MP, Minister of Transport, announced that a major restructuring of the Ministry of Transport and the existing Transport Authorities would take place.
Task forces and project teams were formed to consider broad objectives, functions, responsibilities, structure and establishment of four new Transport Authorities to replace the eight existing Authorities. Some officers of the Board were appointed to the task forces and project teams together with representatives of other Transport Authorities, unions, staff associations and other interested organisations.
The government expects that the four new Authorities will become operational on 1st July 1983.
One of the new Transport Authorities will be responsible for the construction and maintenance of roads and most of the present functions of the Board.
As part of the restructuring, the West Gate Bridge Authority (Transfer of Functions) Act 1982 was enacted in the 1982 Autumn Session of State Parliament. Pursuant to this Act, details of which are set out on page 50 of this report, the West Gate Bridge Authority was abolished as from 1st July 1982 and its powers and functions transferred to the Board.

Increase in State road funds

The level of funds available from State sources for expenditure on roads relies heavily on the amount of revenue obtained from fuel franchise fees and motor registration fees. In an endeavour to maintain the real levels of funds available for roads the State Parliament passed legislation during the 1981 Spring Session which resulted in an approximate increase of 20% in fuel franchise fees and motor registration fees as from 1st November 1981 and 26th November 1981 respectively. Details of the relevant legislation, being the Business Franchise (Petroleum Products) (Fees) Act 1981 and the Transport (Fees) Act 1981 can be found on page 49 of this report. Motor registration fees were last increased as from 1st January 1980 and fuel franchise fees were first levied as from 1st September 1979.
The increase in fuel franchise and motor registration fees will produce approximately $43 million in a full year of which approximately $37 million will be available to the Board for road works. During the 1981/82 financial year, additional revenue of approximately $21 million became available to the Board as a result of the increases. This revenue was used by the Board to accelerate the completion of projects already commenced, to enable the commencement of other urgently needed road projects throughout the State and to provide additional funds to municipal councils for urgent works.
The additional revenue was essential in order to provide some relief against the increased costs of carrying out road construction and maintenance works. Such costs increased in 1980/81 by 15.9% and in 1981/82 by 12.5%.

Right: The newly-opened extension of the Eastern Freeway, Balwyn.
Inset: the Minister of Transport, the Honourable SM Crabb, assisted by the Mayors of Camberwell and Doncaster & Templestowe, officially opened the extension of the Eastern Freeway by cutting through parawebbing. Pictured here, from left to right, are: Cr GTN Gaffney, Mayor of Camberwell; the Honourable SM Crabb, Victorian Minister of Transport; Cr EAM Ajani, Mayor of Doncaster & Templestowe. The Board's Chairman, Mr TH Russell, is in the background


XSION OF T

Seminar—Community Benefits of Roads

In March 1982 the Board, in conjunction with the Local Government Engineer's Association, arranged the annual Municipal Engineers' Conference. As an additional facet of the Conference, the Board, in conjunction with the Local Government Engineer's Association of Victoria and the Victoria Division of the Institution of Engineers Australia, held a Seminar on "The Community Benefits of Roads". Over 500 people, including Members of Parliament, municipal councillors, municipal engineers and representatives of government authorities and other organisations involved in roads and road transport, attended the Seminar.

The Seminar was aimed at improving awareness and understanding of the wide ranging benefits of roads with particular reference to economic benefits, accident reduction, social and environmental aspects and the views of the road user.

The Seminar was formally opened by the then Victorian Minister of Transport, the Honourable Robert Maclellan MLA. In his opening address Mr Maclellan referred to the lack of forward planning for road funding and the current low contribution to roads by the Commonwealth of $600 million per year compared with its collection of some $3,000 million annually from motorists in fuel charges.

Five specialists in various road related fields spoke at the Seminar. Summaries of their presentations are detailed below:

Dr C A Gannon, Associate Professor of Economics, Monash University, outlined the economic benefits of roads and pointed out that:

- the establishment of an efficient transportation system has played a crucial role in facilitating the economic development of nations, and road networks have provided for the majority of land based movement of people, materials and freight
- current expenditure on roads in Australia is over $2,000 million a year which represents around 2% of the Gross National Product
- Australia has some 860,000 km of roads, a quarter of which are sealed, a quarter are gravel and half consist only of cleared or formed earth surfaces
- vehicle operating costs and commercial travel time savings are the most important benefits to be gained, while accident costs and private travel time are of lesser significance. These quantifiable benefits can typically be in the order of three to four times the cost of a project
- available estimates of the benefits available from road expenditure clearly demonstrate a shortfall in actual total expenditure from economically warranted levels. The magnitude of the net benefits foregone in certain road categories/regions is significant.

Mr K W Dobinson, Divisional Engineer, Parramatta of the Department of Main Roads, New South Wales, examined the contribution of road improvements to road safety in a paper titled Driving is a Health Hazard'. His paper included the following points:

- over 36,000 people were killed and nearly one million were injured on Australian roads during the 1970s
- road accidents in Australia are costing about $1,800 million per year or $260 per motor vehicle
- accidents result from a shortfall in performance of one or more of the three components of driving, namely the driver, the vehicle or the road. Measures to improve driver performance have proved largely ineffective except where accompanied by extensive enforcement through legislation. Modifications to vehicles have been successful in reducing the incidence or severity of accidents, but in the overall scene, their impact has been slight. Innumerable road improvement measures have been applied to reduce accidents and most have been successful in varying degrees and generally they prove cost effective. However road accidents overall in Australia persist at a relatively high percentage of the population
- a comparison of the accident rates in other countries shows that those with the lower fatality rates all have well developed road systems. The fatality rate in USA which is 60% of that in Australia could be regarded as a target to be achieved.

Mr J J Bayly, Chairman of the Planning Consultative Council of Victoria spoke about the social and environmental consequences of decisions about roads and mentioned the following points:

- directly or indirectly, the users and observers of roads will insist that social and environmental considerations outside the scope of the engineers' draft brief (on decisions about roads) must be taken into account
- decisions about road projects are concerned with change and involve the following phases of implementation: initiation, location, design, and management. Change can be categorised as intended or accidental, immediate or remote (in time, place or character), and permanent or temporary. The initiation and location decisions concern mainly social considerations, whereas the design and management decisions involve both social and environmental considerations

- urban people are inherently conservative about changes in their immediate environment and often cynical about the motivation and intelligence of agents of change. The sheer social and technical complexity of the modern city is sufficient to explain this
- consultation with people likely to be affected by works such as roads is therefore not merely a gesture to appease idealistic political activists, it is a necessity for engineers who recognize that attitudes are facts for the purposes of project-implementation.

Mr E Drinkwater, Chief General Manager of the Royal Automobile Club of Victoria presented the following views:

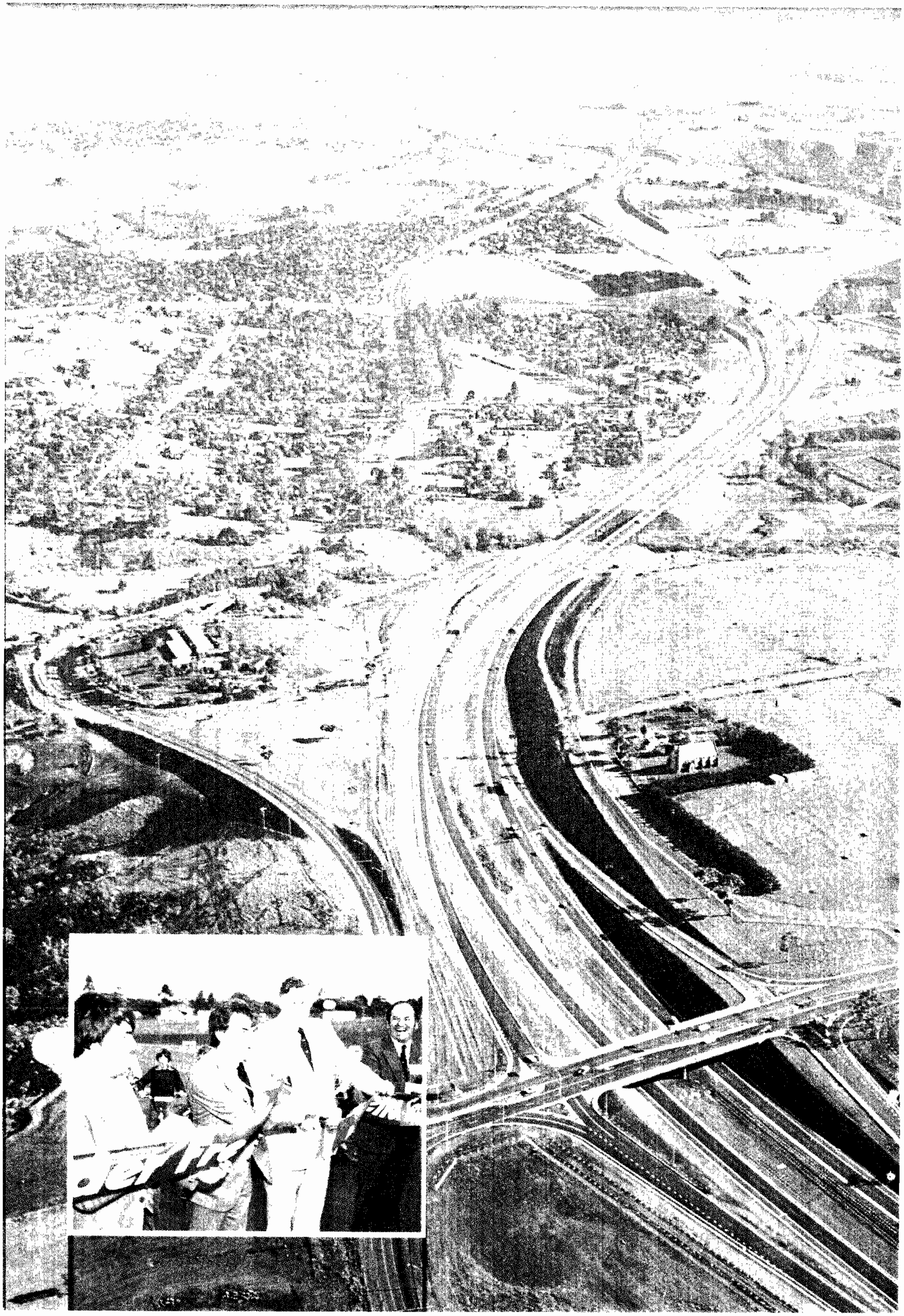
- motoring taxes are being used by the Government for increasing revenue. Road users, through the operation of their vehicles contribute nearly 10% of total Commonwealth revenue but less than 2% is returned in the form of road grants
- Australia now has over 7 million registered vehicles or one vehicle for every two persons, and there are only three countries in the world with a higher vehicle ownership (USA, Canada and New Zealand)
- over the last decade there has been a phenomenal growth in motor vehicle ownership and usage, and also high increases in road construction and maintenance costs
- over the last 10 years the Commonwealth Government's road grants have increased by only 188%, equivalent to an average annual increase of less than 7%. By comparison other Commonwealth expenditure over the same period has increased as follows: Education 862%, Social Security and Welfare 617%, Health 552% and Defence 225%
- the current system of road user charges for motor cars and heavy commercial vehicles is inequitable when considering the relative effects on roads. Roads and bridges must be built to cope with the significant increases in truck size and travel, and heavy vehicle owners should make a greater contribution towards roads rather than continue to be subsidised by private motorists.

Professor L A Endersbee, AO, Dean of the Faculty of Engineering, Monash University, delivered the concluding address to the seminar and suggested that:

- the reason for governments not placing more emphasis on roads, despite their significant benefits to the community, is due to a changing pattern of operation by governments. Politicians are now reluctant to identify with specific issues involving conflict because of the sympathetic treatment given by the media to the protests of disaffected people while the majority of the public in favour of the proposal remain silent
- the concept of public participation in major government decisions is a characteristic of modern society but there are difficulties in presenting issues to the public and in obtaining any reasonably informed discussion
- Victoria's road expenditure last year of about $450 million seems a large sum, but over the past decade, road expenditure in real terms has decreased by 15-20% while total road travel has increased by two-thirds
- despite the significantly lower accident rates on freeways, the community continues to accept the hazardous conditions of existing roads. As cars become smaller and lighter it will be even more important to control accidents by proper design and construction of road networks
- because of the social and economic priorities given to the use of the private motor car, the public will continue to hold on to private transport even though the price of oil may rise to several times its present level
- Victoria is highly dependent on road transport with 3,100 million passenger journeys being made by road per year compared with only 190 million passenger journeys by rail and tram
- in the Melbourne metropolitan area, 99.5% of the internal urban freight is moved by road
- during recent years, traffic has been increasing at the rate of 4-5% per year
- roads and railed public transport tend to be considered as competitors but much of the existing public transport is already on roads and future additions are also likely to use roads. Development of the road system will enable extension of the public transport system using diesel buses and also probably electric trolley buses.

Victoria's road system has played a significant part in the growth and development of the State in terms of personal mobility and the movement of goods and services. The limited amount of funds available for road construction and maintenance has restricted the development of the road system, which throughout Victoria carries approximately 90% of all passenger movements and approximately 95% of goods movements.

In recent years it has been necessary to direct an increasing amount of the Board's financial resources to reconstruction, rehabilitation, resurfacing and maintenance of roads and bridges. More than 50% of the Board's total revenue is expended on such works, thereby limiting the funds which can be directed towards new capital works. Unless road funds are increased to a level equal in real terms to the funds available in the late 1960s, this trend is likely to continue throughout the 1980s.



Opening of three major projects

During the year, the Board opened three major projects to traffic.

Hume Freeway, Bypass of Avenel

On Friday 11th December 1981 the then Minister of Transport, the Honourable Robert Maclellan MLA, unveiled a plaque and cut a ribbon to officially open the Hume Freeway, Bypass of Avenel.

The Hume Freeway is a national highway, and the Commonwealth Minister for Transport, the Honourable R D J Hunt MHR, was represented at the opening by Mr E C Cameron MHR, Member for Indi.

The 16 km bypass commences at the Goulburn Valley Highway interchange, north of Seymour, bypasses Mangalore and Avenel to the south and connects with the existing Hume Highway northeast of Avenel.

The bypass, which cost approximately $25 million, provides two lanes plus emergency stopping lanes for traffic in each direction. This project involved the construction of seven bridge structures and two rest areas. Approximately 18,000 trees and shrubs have been planted.

Calder Freeway, Keilor Section

The first stage of the Calder Freeway, Keilor Section was opened to traffic on Tuesday 18th May 1982 by the Minister of Transport, the Honourable S M Crabb MP.

The Keilor Section of the Calder Freeway includes a freeway bypass of Keilor, extending from Erebus Street, Keilor East to Oakbank Road, Keilor North, a distance of 7 kilometres. Stage 1 is between Erebus Street and Arundel Road. This 3.8 km section provides two lanes plus emergency stopping lanes for traffic in each direction and includes six road bridges and one pedestrian overpass. The section cost approximately $15.5 million.

The 127 metre long, four span twin bridges over the Maribyrnong River are the third crossing of the river to be constructed at this locality.

Within sight of the new river crossing are the two other bridges—the first built in 1868 and the second in 1964 on the existing Calder Highway.

The whole of the Keilor Section is expected to be completed in 1984. Work commenced on the section between Arundel Road and Oakbank Road in the latter part of 1981.

Extension of the Eastern Freeway

On Thursday 3rd June 1982, the Minister of Transport, the Honourable S M Crabb MP officially opened the extension of the Eastern Freeway between Bulleen Road and Doncaster Road, North Balwyn.

The 3 km extension, which cost approximately $24 million, provides two lanes plus emergency stopping lanes for traffic in each direction and incorporates a central median barrier wall to avoid the need for a wide central median and to provide additional traffic safety. The project involved the construction of a pedestrian overpass at Kenneth Street and noise attenuation and visual screen mounds along the Doncaster side of the extension, as well as noise attenuation fencing along the North Balwyn side.

A major part of the project was the undergrounding of the Koonung Creek. This work is expected to be completed in late 1982.

Koonung Creek has been undergrounded over a length of 2.4 km in a conduit consisting of precast reinforced concrete half arch units placed on a cast-in-place reinforced concrete base slab.

About 2,000 trees and shrubs will be planted by the Board and a further 10,000 by the Camberwell and Doncaster and Templestowe City Councils, particularly in the landscaped area on the North Balwyn side.

Left: An aerial view of Keilor showing Stage 1 of the new Calder Freeway bypass of Keilor, from Keilor Park Drive to Arundel Road, the Calder Highway, and Stage 2 earthworks in the distance.

Inset: pictured at the opening ceremony of Stage 1 of the Calder Freeway are, from left to right, Cr P Cownley, Mayor of Keilor, the Honourable SM Crabb, Minister of Transport, the Honourable JH Simpson, Minister of Public Works and Member for Niddrie, and Mr TH Russell, Chairman

Commonwealth Roads Grants Amendment Act 1982

The Commonwealth Aid Roads Act 1959 established the method of providing funds to the States for road construction and maintenance over a five year period. It was followed by the Commonwealth Aid Roads Act 1964 and the Commonwealth Aid Roads Act 1969.
However, the Roads Grants Act 1974 provided funds for only a three year period, as did the States Grants (Roads) Act 1977. The period was further reduced under the Roads Grants Act 1980 which only provided funds for the 1980/81 financial year. Similarly, the Roads Grants Act 1981 only provided funds for the 1981/82 financial year, although it also appropriated minimum levels of funds for national roads for 1982/83 and 1983/84.
The grant to Victoria for 1981/82 was $137,828,000.
In March 1982, the Honourable R J Hunt MP, Commonwealth Minister for Transport, announced details of the level of Commonwealth roads assistance to the States and the Northern Territory for 1982/83, 1983/84 and 1984/85, to be provided under the Commonwealth Roads Grants Amendment Act 1982.

The following table sets out the grants to Victoria pursuant to the Commonwealth Roads Grants Amendment Act 1982, compared with the grants under the previous legislation for 1980/81 and 1981/82.

Commonwealth Roads Grants to Victoria 1980/81 - 1984/85

	1980/81 $'000s		1981/82 $'000s	**1982/83 $'000s**	1983/84 $'000s	1984/85 $'000s
National roads	48,469	National roads	52,868	**56,645**	60,040	63,667
Urban arterial	34,040	Arterial roads	52,599	**56,362**	59,741	63,350
Rural arterial	14,182					
Local roads	29,668	Local roads	32,361	**34,664**	36,742	38,962
	126,359		137,828	**147,671**	156,523	165,979
% increase over previous year	11.15%		9.08%	**7.14%**	5.99%	6.04%

Victoria's proportionate share of the total Commonwealth grants for the period provided for in the Commonwealth Roads Grants Amendment Act 1982 will remain at 20.12%, which was Victoria's proportionate share of the total Commonwealth grants for 1981/82.
The level of grants to the States and the Northern Territory provided for in the 1982 legislation is consistent with the previously announced total levels of grants based on annual increases of 7%, 6% and 6% respectively for each of the financial years 1982/83, 1983/84 and 1984/85. However, these percentage increases are much less than the expected rises in both road construction costs and the CPI over the same period and will result in a significant decrease in real terms of Commonwealth funding.
Over the last decade, Commonwealth road grants to the States have declined from 2.8% to 1.7% of total Commonwealth outlays and from 0.7% to 0.5% of the Gross National Expenditure, whereas the Bureau of Transport Economics Report No 49 confirms that road construction costs are currently increasing at approximately 15% per year. The fact that the Commonwealth grant to Victoria for 1982/83 is based on an increase of 7% only will mean accordingly that there will be a reduction in the volume of work which the Board is able to undertake.

Major road projects

During the year the Board carried out work on many major projects throughout the State including work on the construction of divided roads which as a result of the work completed increased the total length of dual carriageways on freeways, State highways, and main roads throughout the State to 851 km. In addition work continued on many projects including 8 major projects each having an estimated cost of at least $5 million.

The more important major projects in progress or completed during the year included:

Calder Freeway

Keilor Section

Work continued on Stage 2 of the Calder Freeway, Keilor Section, between Arundel Road and Oakbank Road. Stage 1 between Erebus Street and Arundel Road was completed and opened to traffic on Tuesday 18th May 1982 (see page 11). The earthworks for Stage 2 were substantially completed during the year as well as the road approaches to the Keilor-Melton Road overpass bridge and the freeway bridges over Arundel Road. The total estimated cost of the project (Stages 1 and 2) is $27.8 million at 1982 prices and completion of Stage 2 is expected in 1984.

Hume Freeway

Bypass of Seymour

Work continued on the construction of the 9 km freeway bypass of Seymour from the south of Seymour to the Hume Freeway/Goulburn Valley Highway interchange. The earthworks were substantially completed, work on the pavement commenced and the construction of twelve bridges was well advanced by the end of the year. The total estimated cost of the project is $24.5 million at 1982 prices and completion is expected in mid 1983.

Barnawartha to Wodonga Section

Work continued during the year on the duplication of 12.6 km between Quarry Road and Parkers Road and on the earthworks for a 4.7 km bypass of Wodonga. Work on a 1.2 kilometre temporary deviation of the Hume Highway near the Murray Valley Highway intersection was completed and opened to traffic. The whole project is estimated to cost $31.3 million at 1982 prices and completion is expected in 1986.

Latrobe Terrace

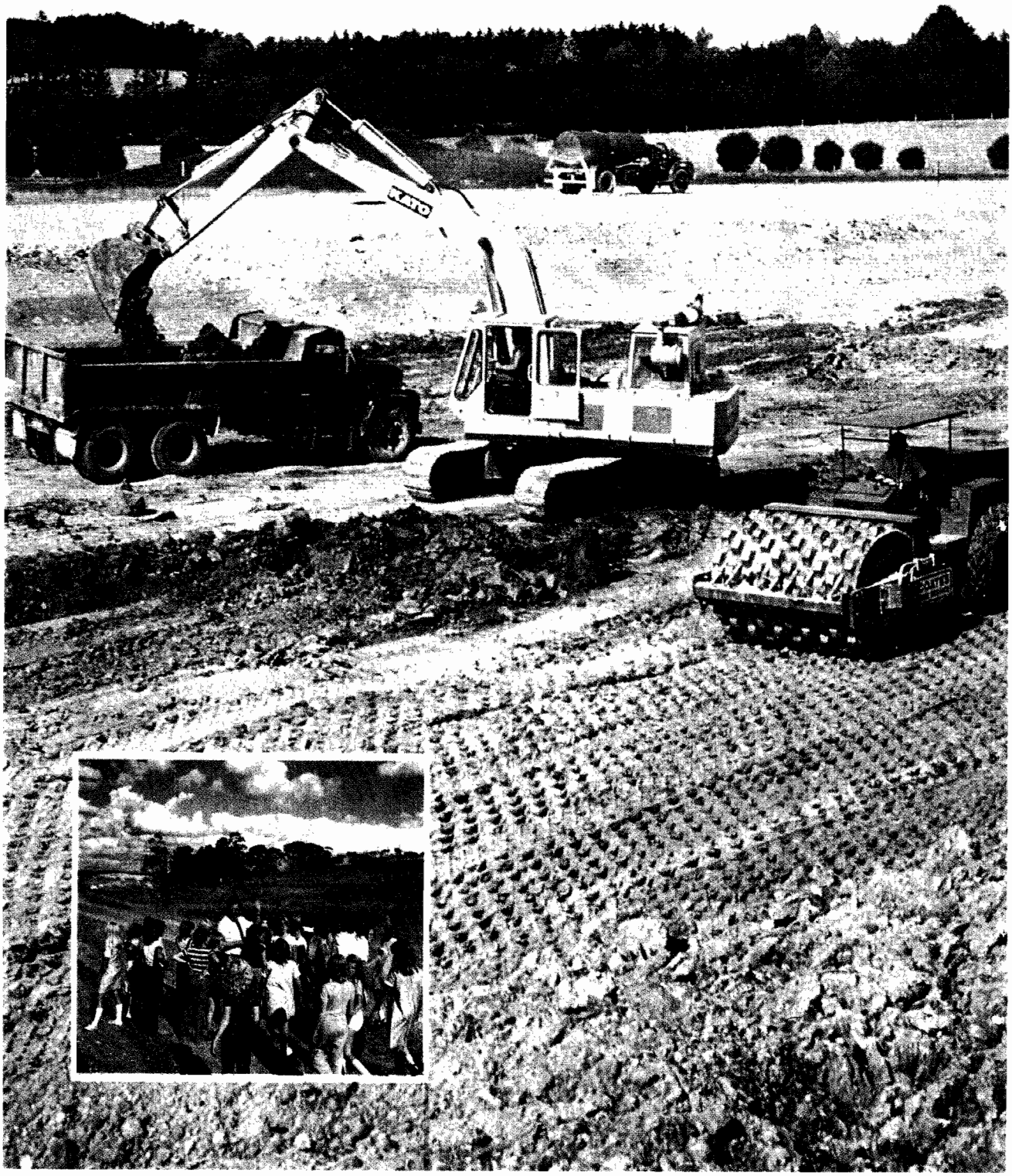
Geelong

Work continued on the reconstruction of Latrobe Terrace, Geelong to provide a high capacity arterial road between the Princes Highway West, near York Street and Fyans Street, Geelong South, a distance of 2.8 km. Apart from the final asphalt surfacing, the roadworks between Hope Street and Russell Street were completed during the year. Work continued between Russell Street and Fyans Street. The project includes the construction of twin 15 span, 269 metre long road over rail overpasses between the Princes Highway West, near York Street, and Latrobe Terrace at Hope Street. The whole project is estimated to cost $14.8 million at 1981 prices and is expected to be completed in late 1982.

Mornington Peninsula Freeway

Dromana

Work commenced on the construction of a 5 km extension of the Mornington Peninsula Freeway between its current terminal at Dromana and the Nepean Highway at Mt Martha Hill. The project involves the construction of twin freeway bridges over the Nepean Highway, Dromana, which will form part of a full diamond interchange with the highway. North of the interchange the twin freeway carriageways will converge to a single two lane, two way carriageway extending to the Nepean Highway at Mt Martha as a first stage construction. The estimated cost of the project is $7.5 million at 1981 prices and completion is expected in mid 1984.



Nepean Highway

Elsternwick to Moorabbin

Work continued during the year on the widening of the Nepean Highway between Cochrane Street, Elsternwick and South Road, Moorabbin. The project involves the construction of new duplicate carriageways along the west side of the existing highway over a distance of 6.0 km. The existing highway carriageway will be converted into a service road. Work was completed between Cochrane Street and Ferguson Street, including the Spink Street pedestrian overpass, and construction continued on the section south from Ferguson Street to Marriage Road. The estimated cost of the project is $60 million at 1982 prices and upon completion of the project in 1984, a continuous divided highway facility will be available from St Kilda Junction to Mordialloc.

Princes Freeway

Bypass of Berwick

Work continued on the construction of a 7.3 km freeway bypass of Berwick between Narre Warren and May Road, Beaconsfield. The work involves the construction of dual carriageways separated by a wide median bypassing Berwick and Beaconsfield, and the construction of seven bridges and three large culverts. Earthworks were substantially completed and pavement construction works commenced during the year. The project is estimated to cost $16 million at 1982 prices and is scheduled for completion in early 1984.

Bypass of Warragul

Work continued on the construction of the 7 km freeway bypass of Warragul between the eastern terminal of the Princes Freeway bypass of Drouin and the existing Princes Highway east of Warragul. The project includes the construction of bridges at the Railway Interchange (western terminal), Lardners Track, King Street and the Warragul-Korumburra Road. The construction of 4.5 km of earthworks and drainage between the Princes Highway, Drouin East and King Street, Warragul was commenced. The project is estimated to cost $18 million at 1982 prices and completion is expected by 1985.

Western Freeway

Wallace to Bungaree Section

Work continued on the construction of the 11.9 km freeway section bypassing the towns of Wallace and Bungaree. During the year, all bridge and culvert works were completed, earthworks and drainage substantially completed and pavement construction for the carriageways continued. The project is estimated to cost $23 million at 1981 prices and is expected to be completed in early 1983.

West Gate Freeway

South Melbourne Section

Work continued on the 3.6 km West Gate Freeway between Graham Street, Port Melbourne and Grant Street, South Melbourne. This work included the construction during the year of 49 foundation piles and at the end of the year, a total of 324 piles had been completed to carry the 1.85 km elevated section of the freeway.

The following three major projects were opened to traffic during the year:

Hume Freeway

- A 16 km bypass of Avenel between the Goulburn Valley Highway and north of Avenel.

Calder Freeway

- A 3.8 km bypass of Keilor between Erebus Street and Arundel Road.

Extension of the Eastern Freeway

- A 3.0 km section between Bulleen Road and Doncaster Road, North Balwyn.

A more detailed account of the opening of these sections of freeway is on page 11 of this Report.

Left: Construction work on the Princes Freeway, bypass of Berwick.
Inset: a group of schoolchildren being shown over the site by a Board engineer

Bituminous surfacing

Bituminous surfacing forms an important part of road construction and maintenance work. A total amount of $45 million was spent on surfacing 4,837 km of road during the year. Approximately 96.8% of the total length of bituminous surfacing done was of the sprayed seal type. The sprayed seal process involves the spraying of a thin hot bituminous layer on to the road surface, followed by spreading a layer of aggregate which is rolled into the bitumen by pneumatic tyred rollers and controlled traffic. In spite of increases in the cost of bituminous materials, the sprayed seal process provides an economical, safe and skid resistant surface. The Board's 17 mobile bituminous surfacing units together with plant owned by municipal councils and contractors, completed 4,348 km of sprayed work at a cost of $29.9 million. The balance of bituminous surfacing work was asphalt surfacing which is plant mixed and spread in a layer with a mechanical paver.
Contractors operating from fixed asphalt plants completed 143 km of plant mix work at a cost of approximately $12.9 million using 284,900 tonnes of asphalt.

The lengths of the various types of work completed during the year were:

- 186 km of sealing widened pavements
- 31 km of initial sealing on dual carriageways
- 602 km of restoration of seal coats on reconstructed sections
- 523 km of final sealing on initial treatments
- 2719 km of maintenance retreatments
- 430 km of extensions to the bituminous sealed road system including 49 km of roads declared or proclaimed under the Country Roads Act
- 346 km sealed on behalf of other State and municipal authorities.

The following quantities of materials were used by the Board and by contractors during the year on bituminous surfacing works:

Material	Quantity
Bitumen for sprayed work	44,000 tonnes
Bitumen for asphalt	15,000 tonnes
Aggregate for sprayed work	299,000 cubic metres
Aggregate for asphalt	200,000 cubic metres
Other bituminous materials for sprayed work and maintenance	10,000 tonnes

Contracts

Details of the types and numbers of contracts carried out under the Board's direct supervision and for which formal tenders were called, showing respective values together with a comparison with those in financial year 1980/81, are shown in the following table:

	1980/81		1981/82	
Type of contract	No. of contracts	Value $	No. of contracts	Value $
Road construction				
Over $1 million	1	3,670,194	6	9,089,702
$100,000 to $1 million	5	2,447,047	5	1,077,349
Under $100,000 (not including quotation contracts)	Nil	Nil	1	20,454
Bridge construction				
Over $1 million	1	2,294,113	1	1,761,871
$100,000 to $1 million	6	1,355,969	6	1,801,027
Under $100,000	1	24,975	6	295,826
Supply of roadmaking materials	148	10,070,577	130	12,134,732
Bituminous treatment and supply of materials	51	17,713,976	49	17,125,962
Bridge components and fabricated steel	21	2,240,055	20	3,173,539
Building construction	3	99,297	2	91,386
Construction equipment	12	712,787	40	4,367,502
Divisional facilities	Nil	Nil	2	861,256
Miscellaneous stores	12	1,241,651	11	12,878,176
Miscellaneous services	21	677,946	50	2,601,944
Total	282	42,548,587	329	67,280,726

Land purchase

During the year the Board paid compensation and associated costs totalling $20,875,000 for land required for the construction of new roads and the widening or deviation of existing roads.

The following table shows expenditure incurred during the year on land purchase in relation to the Board's road classifications and the Commonwealth road categories.

CRB road classification	Commonwealth road category: National roads	Arterial roads	Local roads	Total
	$'000s	$'000s	$'000s	$'000s
Freeways	2,026	13,796		15,822
State highways	469	1211		1680
Tourists' roads		7	2	9
Forest roads			9	9
Main roads		2426	140	2566
Unclassified roads		438	351	789
Totals	2,495	17,878	502	20,875

The table below shows the number of land purchase transactions completed and the amount of compensation and associated costs paid by the Board for the period 1977/78 to 1981/82.

	1977/78	1978/79	1979/80	1980/81	**1981/82**
Number of land purchase cases settled	786	629	558	527	**489**
Compensation and associated costs paid by the Board	$23.44m	$22.43m	$17.31m	$17.80m	**$20.88m**
Land purchase expenditure on unclassified roads under council supervision	$1.26m	$1.70m	$0.84m	$0.73m	**$0.69m**

Of the $20.88 million expended on compensation and associated costs during the year, $7.35 million was spent in purchasing properties at the request of owners who demonstrated that they were incurring hardship due to the Board's future road proposals. The Board received $2,957,000 from 1,011 rented residential or commercial properties and 581 separate areas of vacant land. During the year 86 separate areas of surplus land were sold for $1,139,000. Nine residential properties surplus to requirements were sold for $446,000 and 5 houses were sold for removal for $13,000.

Construction of new bridges

Description	1980/81		1981/82	
	No.	Est. cost $'000s	No.	Est. cost $'000s
New bridges commenced under the supervision of the Board's staff	29	16,537	38	18,476
New bridges commenced under municipal supervision with financial assistance from the Board	52	5,051	31	3,350
Miscellaneous — Sign structures, etc.		29		126
Total bridges commenced	81	21,617	69	21,952

Sixty-nine new bridges estimated to cost $21.9 million were commenced during 1981/82. The above table gives a comparison between the number and estimated cost of bridge projects commenced in 1981/82 and those for the preceding financial year.

Major bridges completed in rural areas

Major bridges completed in rural areas during the year under the direct supervision of the Board's staff included:

Hume Freeway, Bypass of Seymour

Seymour-Tooborac Road over Sunday Creek

A five span prestressed and reinforced concrete bridge, 90 metres long and 9.8 metres between kerbs.

Hume Freeway, Bypass of Seymour

Freeway bridges over Seymour-Tooborac Road

Twin, two span continuous prestressed "I" beam and reinforced concrete bridges, 53.75 and 53.74 metres long and 11.6 metres between kerbs.

Hume Freeway, Bypass of Seymour

Goulburn River crossing No. 2, south bridge

A nine span prestressed concrete "U" beam bridge, 259 metres long and 11.6 metres between kerbs.

Goulburn River crossing No. 3, north bridge

A five span prestressed concrete "U" beam bridge, 138.77 metres long and 11.6 metres between kerbs.

Goulburn River crossing No. 3, south bridge

A five span prestressed concrete "U" beam bridge, 138.87 metres long and 11.6 metres between kerbs.

Omeo Highway

Lock Up Creek

A single span reinforced concrete bridge, 18.7 metres long and 9.8 metres between kerbs.

Larger bridges constructed during the year under municipal supervision, with financial assistance from the Board, included:

Barrabool/Bannockburn Shires

Merrawarp Road

Ceres Bridge over Barwon River—a five span prestressed concrete beam bridge 92.3 metres long and 8.6 metres between kerbs.

Left: An aerial view of the Hume Freeway, bypass of Seymour, under construction.
Inset: work on one of the bridges as part of the bypass of Seymour

Huntly/Marong Shires

Epsom-Eaglehawk Road

Bendigo and Racecourse Creeks—a five span high strength, reinforced concrete "U" slab bridge, 46.14 metres long and 11.9 metres between kerbs.

Maffra/Rosedale Shires

Myrtlebank-Fulham Road

Thomson River—a three span prestressed concrete beam and reinforced concrete slab bridge, 58.84 metres long and 6.2 metres between kerbs.

Rutherglen Shire

Chiltern-Howlong Road

Murray River Flood Plain Bridge No. 3—a five span high strength reinforced concrete "U" slab bridge, 53.85 metres long and 8.6 metres between kerbs.

Shepparton Shire

Shepparton-Euroa Road

Broken River—a six span steel "I" beam and reinforced concrete bridge, 82.13 metres long and 6.2 metres between kerbs.

Whittlesea Shire

McKimmies Road

Darebin Creek—a three span high strength reinforced concrete "U" slab bridge, 31.82 metres long and 10.67 metres between kerbs.

Bridges and overpasses in the metropolitan area

Large bridges and overpasses completed in the metropolitan area during the year, under the direct supervision of the Board's staff, included:

Calder Freeway, Keilor

Arundel Road Overpass

Twin, single span, box girder bridges each 47.91 metres long and 11.6 metres between kerbs. These are the first single span, box girder bridges designed and constructed by the Board.

Maribyrnong River

Twin, four span, steel girder and reinforced concrete bridges each 127 metres long and 11 metres between kerbs.

Grade separated pedestrian crossings

Two grade separated pedestrian crossings were completed by the Board during the year, as follows:

Calder Freeway, Keilor

Collinson Street

A post tensioned and reinforced concrete pedestrian overpass, 166 metres long and 2.1 metres wide.

Nepean Highway, Brighton

Spink Street

A post tensioned and reinforced concrete pedestrian overpass, 173 metres long and 1.87 metres wide.

Elimination of railway level crossings

In 1954 the State Government established the Level Crossings Fund with a view to providing finance to assist with the elimination of dangerous railway level crossings.

Contributions were also made by the Board and the Victorian Railways Board towards the cost of projects.

Since 1st July 1974, the total cost of this work has been charged to the Transport Fund. Since the inception of the scheme, 67 road overpasses or underpasses have been constructed to eliminate railway level crossings.

Work continued during the year on twin 15 span road over rail overpasses, each 269 metres long and 8.6 metres between kerbs at Latrobe Terrace, Geelong. Construction of the overpasses, which commenced early in 1979, is expected to be completed in late 1982.

Significant works

Significant works completed or substantially completed during the financial year 1981/82:

State highways

State highways are the principal arteries forming interstate connections and links between the larger centres of population in the State. Some State highways in Victoria form part of the National Route system of highways with uniform route numbering throughout Australia. The Board bears the full cost of both construction and maintenance works required to meet the needs of through traffic. As at 30th June 1982, there were 6,974 km of State highways declared under the Country Roads Act.

Bass Highway

Woorayl Shire : Reconstruction of the intersection of the Bass Highway with the Inverloch-Leongatha Road.

Calder Highway

Korong Shire : Construction of a multi cell culvert and approaches at Nardoo Creek, north of Wedderburn.
Marong Shire : Widening 0.8 km to provide four lanes undivided at Kangaroo Flat.
Wycheproof Shire : Construction of a 2.2 km bypass of Nandaly to remove a poor alignment.

Glenelg Highway

Grenville Shire : Reconstruction of 0.8 km in Smythesdale.
Dundas Shire : Widening and resurfacing of 4.2 km west of Wannon.

Goulburn Valley Highway

Seymour Shire : Reconstruction and duplication of 1.2 km of Anzac Avenue in Seymour.

Hamilton Highway

Bannockburn Shire : Construction of a new 2 span reinforced concrete bridge and approaches over Bruces Creek, west of Geelong. Reconstruction and widening of 2.2 km west of Inverleigh.

Henty Highway

Dundas Shire : Reconstruction and resurfacing of 6.8 km between Hamilton and Cavendish.

Hume Highway

Euroa Shire : Reconstruction of 1 km in Euroa between Campbell Street and Burtons Bridge.

Loddon Valley Highway

Kerang Shire : Reconstruction of 2 km south of Tragowel.

Maroondah Highway

Healesville Shire : Curve improvements to 0.8 km between Maroondah Reservoir and Fernshaw.

McIvor Highway

Strathfieldsaye Shire : Reconstruction and realignment of 1 km at Junortoun. Construction of 2.2 km of duplicate carriageway in the vicinity of Lord's Raceway, Junortoun.

Midland Highway

Ballaarat City : Construction of 0.6 km of dual carriageways between Macarthur Street and Howitt Street.
Buninyong Shire : Widening 1.9 km between Mt Clear and Mt Helen.

Murray Valley Highway

Kerang Shire : Reconstruction of 1.4 km at Kangaroo Lake.
Rutherglen Shire : Reconstruction and realignment of 2.8 km west of Rutherglen.
Swan Hill City : Reconstruction of 1 km between Rankin Street and Rutherford Street in Swan Hill.
Swan Hill Shire : Resurfacing 6 km between Lake Powell and Bannerton.

Nepean Highway

Flinders Shire : Construction of a passing lane and improvements to the Hughes Road intersection, Blairgowrie. Reconstruction and resurfacing of 0.6 km at Dromana.

Omeo Highway

Omeo Shire : Reconstruction and realignment of 2.8 km at Tambo Crossing including the construction of a new single span bridge over Lockup Creek and new culverts over Tuckerbox and Stony Creeks. Reconstruction and realignment of 2.1 km at Bingo Munjie.
Tallangatta Shire : Reconstruction of the Omeo Highway, Murray Valley Highway intersection, east of Tallangatta. Construction of a single span reinforced concrete bridge over West Branch Creek, south of Mitta Mitta.

Ouyen Highway

Walpeup Shire : Reconstruction and realignment of 2.6 km at Boinka including realignment of the railway level crossing. Widening 19 km between Murrayville and the South Australian border.

Ovens Highway

Myrtleford Shire : Reconstruction and duplication of 1 km in Myrtleford.

Princes Highway East

Bairnsdale Shire : Reconstruction of 0.7 km to raise the road formation above flood level at Broadlands, east of Bairnsdale.
Moe City : Reconstruction, including the installation of traffic signals, of the Gunns Gully intersection at Moe.
Orbost Shire : Widening and resurfacing 1.7 km west of Cann River.
Pakenham Shire : Duplication of 6.7 km between Army Road, Pakenham and the Nar Nar Goon-Longwarry Road.

Princes Highway West

Portland Shire : Resurfacing 2.6 km east of Tyrendarra.
Warrnambool Shire : Widening and resurfacing 3.5 km between Allansford and Warrnambool.

South Gippsland Highway

Woorayl : Reconstruction and channelisation of the South Gippsland Highway/Leongatha-Yarragon Road/Inverloch-Leongatha Road intersection at Leongatha.

Sunraysia Highway

Ballarat Shire : Improvements, including the installation of traffic signals, at the Gillies Street intersection in Wendouree.
Donald Shire : Resurfacing and improvements to drainage of 0.8 km south of Donald.

Warburton Highway

Upper Yarra Shire : Widening and resurfacing 0.5 km between Wesburn and Millgrove.

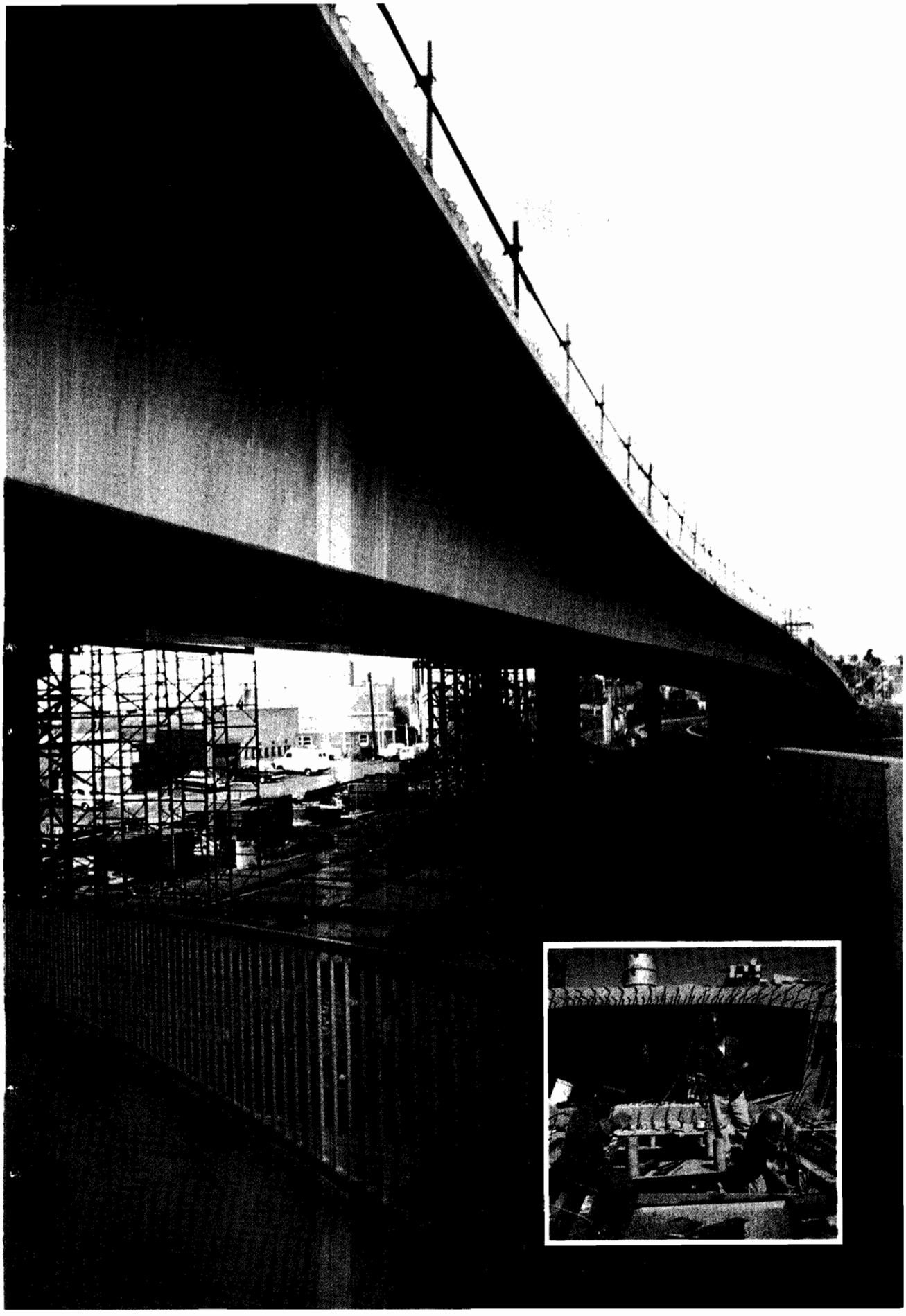
Western Highway

Ballarat Shire : Reconstruction of 2 km at Burrumbeet.
Kaniva Shire : Reconstruction of 4 km between Kaniva and Lillimur.
Wimmera Shire : Resurfacing 1.6 km north of Dadswells Bridge.

Wimmera Highway

Arapiles Shire : Widening and resurfacing 4 km east of Natimuk.

Right: Latrobe Terrace, Geelong is a major road construction project due to be completed late in 1982.
Inset: workmen involved in the construction of the road over rail overpass



Freeways

A freeway is a road having dual carriageways with no direct access from adjoining properties and side roads. All crossings of a freeway are by means of overpass or underpass bridges, and traffic enters or leaves the freeway carriageways by means of carefully designed ramps. The Board bears the total cost of all work on freeways. As at 30th June 1982, there were 376 km of freeway declared under the Country Roads Act.

Tullamarine Freeway

Coburg City : Asphalt resurfacing of 1.6 km between Moreland Road and Bell Street.

Tourists' roads

Tourists' roads proclaimed under the provisions of the Country Roads Act provide access to places of special interest to tourists, both in summer and winter. The Board bears the full cost of works required to cater for the needs of through traffic. In general the works are carried out under the direct supervision of the Board's staff. As at 30th June 1982, there were 798 km of tourists' roads declared under the Country Roads Act.

Bogong High Plains Road

Bright Shire : Reconstruction and widening of 6.4 km between Junction Spur and Turnback Creek.

Forest roads

Forest roads proclaimed under the provisions of the Country Roads Act are situated within or adjacent to a State forest or in areas which are considered by the Board to be timbered, mountainous or undeveloped. The Board bears the full cost of works required to cater for the needs of through traffic, with approximately half the work carried out on these roads being undertaken by municipal councils on behalf of the Board. As at 30th June 1982, there were 1,030 km of forest roads declared under the Country Roads Act.

There were no major works completed or substantially completed during the financial year 1981/82.

Landscaping

The landscaping of road reserves is an integral part of the Board's roadmaking and maintenance practice. The careful planting of trees and shrubs enhances the aesthetic appearance of the road and provides a pleasant and safer travelling environment.

Number and cost of trees and shrubs planted during the 1981/82 financial year:

Divisions	No. of trees and shrubs	Purchase cost $
Bairnsdale	250	130
Ballarat	3,500	2,500
Benalla	—	—
Bendigo	6,300	3,000
Dandenong	33,400	15,200
Geelong	2,400	3,100
Horsham	2,300	1,300
Metropolitan	30,100	26,500
Traralgon	1,000	500
Warrnambool	1,600	700
Projects		
Hume Freeway (Seymour)	15,600	7,000
Total	**96,450**	**59,930**

Municipal allocations

In June 1982, the Board allocated $112,445,000 to Victoria's 211 municipal councils, and French Island, for road works on main and unclassified roads for 1982/83.
This represented $15,959,000 more than the original allocations made in May 1981 for 1981/82.
The table below shows the allocations of funds to municipal councils for 1981/82 and 1982/83. The table also shows the final allocations for 1980/81 and 1981/82, the percentage increase in final allocations over these two years and the percentage increase in original allocations from 1981/82 to 1982/83.

	1980/81	1981/82			1982/83	
	Final allocations $'000s	Original allocations $'000s	Final allocations $'000s	% increase in final allocations over 1980/81	**Original allocations $'000s**	% increase in original allocations over 1981/82
Main roads	46,656	47,303	54,017	15.8	**58,671**	24.0
Unclassified roads	48,805	49,183	50,729	3.9	**53,774**	9.3
Total	95,461	96,486	104,746	9.7	**112,445**	16.5

Applications for funds for works on main roads and unclassified roads exceeded the level of allocations the Board was able to provide by many millions of dollars.

Formula approach to municipal allocations

During the year, an agreement was reached between the Board and the Municipal Association of Victoria regarding a formula for establishing a minimum total level of funds to be allocated to municipal councils for works on main and unclassified roads. This formula was adopted on a trial basis for three years and allocations for the 1982/83 financial year were made in accordance with the formula.

In general terms, the formula provides for:

(a) an estimate to be made of the total funds available to the Board from both Commonwealth and State sources.
(b) from this total the following amounts to be deducted:
- the amount of the Commonwealth National Roads Grant;
- a "Needs Provision" amounting to 2% of the total estimated funds available to the Board in order to provide the Board with some flexibility to give recognition to changing needs throughout the State for both Board and municipal works;
- a "Commitment Provision" amounting to 20% of the total estimated funds available to the Board in order to cover statutory items, capital, planning and research, management and operating expenditure, forest roads, traffic line marking, Murray River Bridges and Punts, Special Impact Works, STATCON programs, protection of low clearance railway bridges, etc.

(c) the balance of the estimated total funds to be distributed equally between:
- normal Board's works on State highways, freeways and tourists' roads, and
- normal municipal works on main and unclassified roads.

The division between Board and municipal works of the "Needs Provision" is to be determined by the Board following consideration of applications for funds submitted by municipal councils and the Board's Divisional Engineers.

The Board has reserved the right to review the formula in consultation with the Municipal Association of Victoria if:

(a) there are any major changes in respect to State and Commonwealth legislation which would have an effect on the distribution of funds to various categories of roads;
(b) there are any major changes in road declarations; or
(c) there are any government directives which would have any effect on the distribution of funds to various categories of roads.

The formula does not apply to any loan funds made available to the Board for special purposes.

Special Impact Works

In financial years 1979/80, 1980/81 and 1981/82 limited funds were available from the Board's revenue for special roadworks throughout the State where it was clearly demonstrated that the works were urgently required to assist in the implementation of, or to provide relief from, the impact of government development policies. Priority was given to applications for funds for the rehabilitation of roads which had failed through increased traffic as a result of these development policies.

The type of work for which funds have been provided generally falls within the following guidelines:

(a) improvements to the road network to assist in the development of projects of major significance to the State or where there has been a marked increase in non-local traffic as a result of government development or tourist policies; and

(b) improvements to and/or rehabilitation of the road network necessary to compensate for increased heavy traffic resulting from rail line closures, reduced train services or the development of regional freight centres by the Victorian Railways Board.

Funds provided by the Board for special impact works are in addition to the Board's normal allocations and are subject to a municipal council contribution which is no greater than the contributions for normal allocations. The allocations are made from the Board's revenue derived from State sources.

In 1981/82 the Board provided funds totalling $2,021,040 for special impact works which comprised an original allocation of $1,651,100 and supplementary allocations of $369,940. Applications for funds totalled $24,416,000.

Natural disaster restoration works

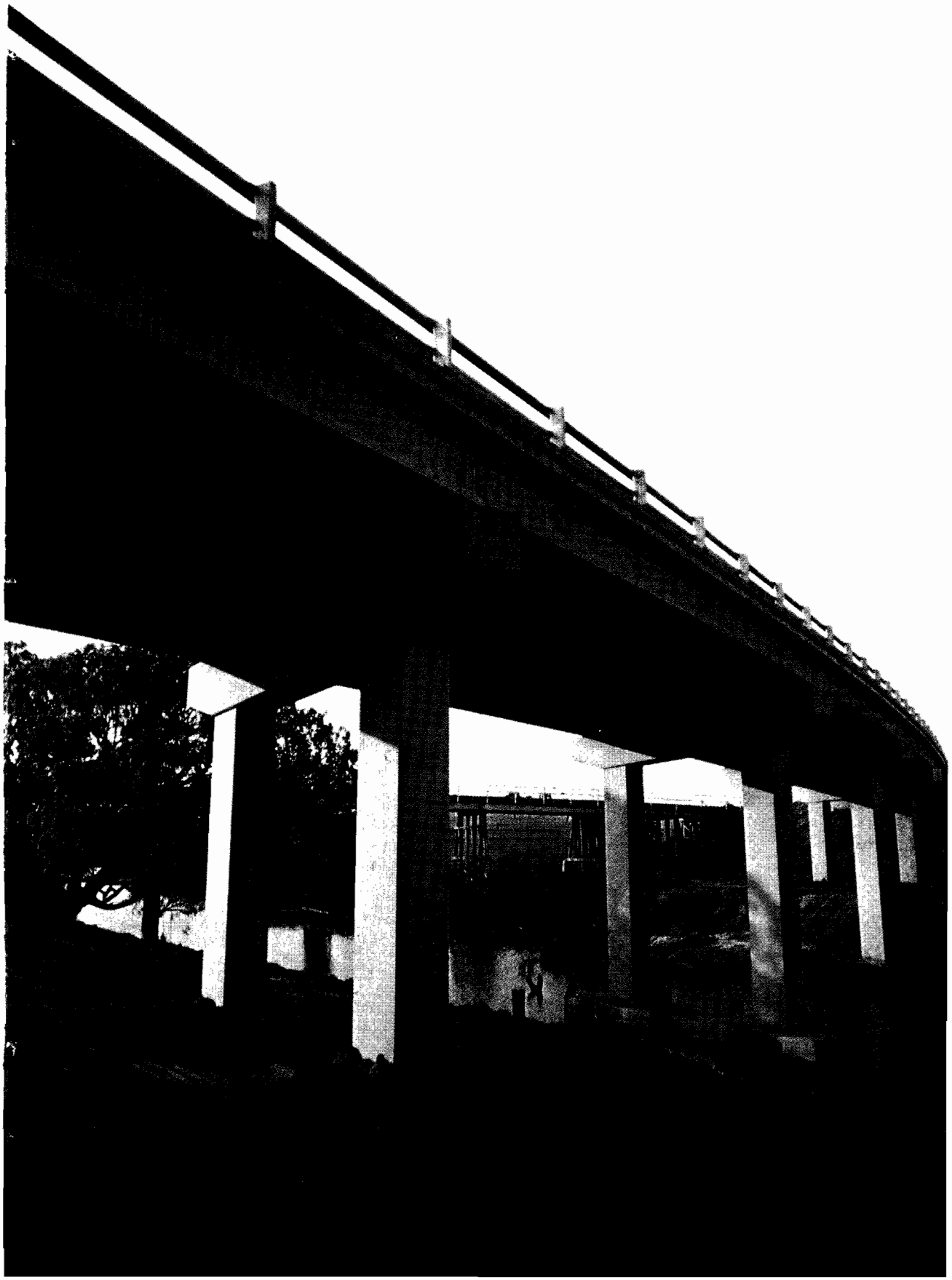
Assistance to individual authorities following natural disasters is provided by the State Government and in some instances the Commonwealth Government to cover the costs incurred in undertaking works to protect and restore public and community assets and to restore essential services, other than costs incurred in restoring assets beyond the standards which existed prior to the disaster.

Under a Commonwealth/State agreement which came into effect on 1st January 1979, where the State Government has expended more than $7 million on restoration works, Commonwealth financial assistance is provided on a $3 : $1 basis with regard to any single natural disaster for which expenditure by the State Government on restoration works exceeds $700,000.

During the 1981/82 financial year, grants totalling $6,708,309 were made by the State Government for road and bridge restoration works following natural disasters as follows:

Severe flooding in northern Victoria during June, July and August, 1981	$6,386,561
Severe wind storms in October 1981 and January 1982 in the Shires of Birchip, Charlton, Donald, Korong and Wycheproof	89,265
Wind storms in August 1979 in the Shire of Woorayl (supplementary grant)	14,550
Heavy snowfalls in June and July 1981 in the Shire of Daylesford and Glenlyon	5,000
Flood damage on the Forrest-Apollo Bay Road in the Shire of Otway in June 1978 (supplementary grant)	64,700
Flooding in the Shire of Orbost in May 1981	22,890
Bush fires in the Shire of Orbost in October 1980 and the Shire of Maldon in December 1980	9,864
Grants carried forward from previous years for the restoration of roads and bridges damaged by floods or storms	115,479
	$6,708,309

Right: The new Ceres Bridge constructed to carry Merrawarp Road over the Barwon River. The old bridge is in the background (Barrabool and Bannockburn Shires)



Access roads to schools

In January 1979, the Board invited municipal councils to submit applications for funds to construct urgently needed access roads to schools. This action was taken pursuant to Government policy that the Board should make annual allocations over the three year period 1978/79 to 1980/81 from funds made available from the Transport Fund for the purpose of providing safe access to schools. A total amount of $59,060 was allocated by the Board in 1978/79 and further allocations of $86,050 in 1979/80 and $72,300 in 1980/81 were made for this work. In order to satisfy all applications considered to be eligible, the period was extended to include the financial year 1981/82.

In the 1981/82 financial year a total allocation of $61,250 was made by the Board to assist the councils with the construction of urgently needed access roads to schools at the following locations:

Municipality	Location
Ballan Shire	Geelong-Ballan Road, Mt Wallace & Korweinguboora
Bulla Shire	School Lane, Bulla
Buninyong Shire	Olympic Avenue & Recreation Road, Mt Clear
Grenville Shire	Greenhalgh Road, Delacombe
Mornington Shire	Glenisla Drive, Mt Martha & Wooralla Drive, Mt Eliza
Narracan Shire	School Access Road, Moondarra
Newham & Woodend Shire	Owen & Buckley Streets & Calder Highway Service Road, Woodend
Romsey Shire	Gisborne-Kilmore Road, Riddells Creek
Tambo Shire	Stirling Road, Metung
Warragul Shire	Bowen Street, Warragul

38th Conference of Municipal Engineers

The 38th Conference of Municipal Engineers, convened by the Board in conjunction with the Local Government Engineers' Association of Victoria, was held at the Board's Head Office on 15th March and at the Camberwell Civic Centre on 16th March 1982. The highlight of this year's conference was the inclusion of a seminar conducted by the Board on the theme 'The Community Benefits of Roads'.

A detailed account of the seminar is contained in the Review Section of this report on page 8.

Approximately 200 local government and CRB engineers attended the Municipal Engineers Conference with representatives from some State instrumentalities and departments. Papers were presented on overseas study tours, planning, traffic signing, services on roads, the impact of heavy vehicles on roads and bridges, surface enrichment sealing, landscaping and recent developments in plant and equipment.

The Board extends its thanks and appreciation to the Local Government Engineers' Association of Victoria for its co-operation in planning the conference and seminar, to the Victoria Division of the Institution of Engineers for its part in the seminar, and in particular to those who contributed to the success of the conference and seminar by presenting papers.

Visits to Municipalities

Each year the Board Members make official visits to a number of municipalities throughout the State. This has been the practice since 1913 when the first Board Members toured the State to decide which roads should be declared as main roads and financed from central funds. Municipalities in Victoria are visited at approximately 6 yearly intervals. These visits include a tour of municipal roads and bridges with councillors and council officers, and discussions on local road problems, road works programmes and road finance. The visits provide the Board Members with valuable information on road conditions and developments in the municipalities.

During the year the Board made official visits to the following 37 municipalities:

Cities of Berwick, Caulfield, Croydon, Footscray, Geelong, Geelong West, Maryborough, Newtown, Sunshine and Wangaratta.

Towns of Bairnsdale, Camperdown and Portland.

Boroughs of Koroit and Port Fairy.

Shires of Alexandra, Belfast, Broadford, Bulla, Daylesford & Glenlyon, Hampden, Healesville, Kilmore, Melton, Minhamite, Mirboo, Newstead, Orbost, Romsey, Tullaroop, Violet Town, Wangaratta, Warragul, Winchelsea, Woorayl and Wycheproof.

The Board places on record its appreciation of the assistance given by all councillors and municipal officers during these visits.

Deputations

The Board is always prepared to discuss matters of common interest with representatives of municipal councils or other official bodies. These discussions provide a useful channel of communication between the Board and municipal administration and local interests.

During the year, the Board received deputations from the following councils: the City of Keilor, the Shires of Buln Buln, Diamond Valley, Donald, Goulburn, Heytesbury, Kilmore, Numurkah and Sherbrooke. A joint deputation was received from Gippsland municipalities in the Board's Traralgon Division. Deputations were also received from the Flemington Association, the Local Government Engineers' Association, the Australian Federation of Construction Contractors and the Municipal Association of Victoria.

The main topics raised by the councils were the general inadequacy of road grants to meet the State's road needs, the allocation of road funds to municipal councils by the Board and matters associated with road classifications, road construction and road design standards.

Municipalities Forest Roads Improvement Fund

The Municipalities Forest Roads Improvement Fund was established in the State Treasury in 1955 for the purpose of assisting municipal councils in the improvement and protection of roads adjacent to State Forest areas and to facilitate the extraction of forest produce. An amount of $50,000 was paid into the Fund during 1981/82, increasing the total contribution to $1,135,000. The Board's Divisional Engineers, in consultation with the appropriate Forests Commission Officers, determine the priority of eligible works. Allocations for particular works are made by the Board to municipal councils with the agreement of the Forests Commission but the limited funds available from the Fund only enable grants to be made for the most urgent works.

A survey was conducted by the Board during the financial year 1980/81 in conjunction with District Officers of the Forests Commission of works considered to be warranted and eligible for funding from the Municipalities Forest Roads Improvement Fund. It was estimated that an amount of $2,750,000 would be required over a five year period from 1981/82 to 1985/86 to fund these works.

Access roads to Surf Life Saving Clubs

During 1980, following representations from the Surf Life Saving Association of Australia, consideration was given to a proposal that funds be provided to improve access roads to surf life saving club buildings.

Because of the special purpose of these access roads—for emergency situations and the provisioning of club facilities—and the fact that certain of these roads would not be open for vehicular use by the general public it was decided that the need for improvements to the access roads should be individually assessed, with individual grants being made as appropriate from the Transport Fund.

Where it is decided that improvements should be made to a particular access road, the work is carried out by the relevant municipal council which also makes a financial contribution to the work.

It was estimated that an amount of $330,000 would be required over a period of four years to implement improvements considered to be necessary to access roads to surf life saving club buildings.

In the 1980/81 financial year allocations totalling $86,605 were made by the Board from the Transport Fund. Of this amount, a total expenditure of $25,489 was incurred leaving a balance of $61,116. This balance was reallocated from the Transport Fund for expenditure in 1981/82 at the following locations.

Municipality	Surf Life Saving Club	Allocation $
Barrabool	Fairhaven	12,391
	Anglesea	2,580
	Jan Juc	6,424
Belfast	Port Fairy	6,400
Bellarine	Ocean Grove	21,875
Otway	Kennett River	2,400
Queenscliffe	Point Lonsdale	7,706
South Barwon	13th Beach	1,340
		$61,116

Significant works on main and unclassified roads

Significant works completed or substantially completed during the financial year 1981/82:

Main roads

Main roads are roads linking centres of population with other centres or with areas of industry, commerce or settlement. Generally main roads are constructed and maintained by municipal councils to the satisfaction of, and with financial assistance from, the Board. In some cases, at the request of the council and with the approval of the Minister, works are carried out under the direct supervision of the Board's staff. As at 30th June 1982, there were 14,585 km of main roads declared under the Country Roads Act.

Arapiles Shire
Apsley-Natimuk Road : Reconstruction and regrading of 1.7 km near Mt Arapiles.

Ballan Shire
Ballan-Meredith Road : Construction of a five span reinforced concrete bridge over the Moorabool River at Morrisons.

Ballaarat City
Ballarat-Carngham Road : Reconstruction of 0.6 km between Ripon Street and Adair Street, Redan.

Broadmeadows City
Pascoe Vale Road : Reconstruction between Dunkeld Street and Somerton Road, Coolaroo. Improvements to Glenroy Road intersection, Glenroy.

Broadmeadows City/Bulla Shire
Mickleham Road : Construction of a three span reinforced concrete bridge and approaches over Moonee Ponds Creek.

Colac Shire
Irrewillipe Road : Construction of a three span reinforced concrete bridge and approaches over Deans Creek, Irrewillipe.

Cranbourne Shire
Berwick-Cranbourne Road : Reconstruction of 1.6 km between Pound Road and Thompson Road.

Dandenong City
Dandenong-Frankston Road : Duplication of 2.4 km between Kirkham Road and Elliott Road.

Eltham Shire
Eltham-Yarra Glen Road : Reconstruction of 1.5 km between Mt Pleasant Road and Brougham Street, Eltham.

Frankston City
Cranbourne-Frankston Road : Duplication of 1.0 km between Karingal Drive and McClelland Drive, Frankston.

Hastings Shire
Stony Point Road : Reconstruction of 1.5 km between Woolleys Road and Disney Street, Crib Point.

Healesville Shire
Healesville-Kinglake Road : Reconstruction of 0.8 km.

Heytesbury Shire
Cobden-Port Campbell Road : Construction of a single span bridge and approaches at Scotts Creek.

Knox City
Stud Road : Duplication of 1.1 km between Lakeview Avenue and Tampe Road.

Lilydale Shire
Lilydale-Monbulk Road : Reconstruction of 1.2 km between Birmingham Road and Old Hereford Road.

McIvor Shire
Heathcote-Redesdale Road: Construction of a three span bridge and approaches at Wild Duck Creek.

Left: New bridge at Morrisons to carry the Ballan-Meredith Road across the Moorabool River (Ballan Shire)

Mordialloc City
Beach Road : Reconstruction of 5.1 km at Mordialloc.

Nunawading City
Springvale Road : Duplication of 1.1 km between Springfield Road and Koonung Creek.

Pakenham Shire
Healesville-Kooweerup Road : Reconstruction of 3 km at Cockatoo.

Portland Shire
Bridgewater Road : Reconstruction including bridge widening west of Portland.

Ringwood City
Canterbury Road : Duplication of 0.6 km between Heatherdale Road and Maidstone Street.

Shepparton City
Shepparton-Dookie Road : Construction of roundabouts at Hawdon Street and Verney Road, Shepparton.

Sherbrooke Shire
Belgrave-Hallam Road : Reconstruction and realignment of 0.4 km between Belgrave-Gembrook Road and Benson Street, Belgrave.

Springvale City
Cheltenham Road : Improvements to Old Dandenong Road intersection.
Dandenong-Frankston Road : Duplication of 1.9 km between Thompson Road and Boundary Road.

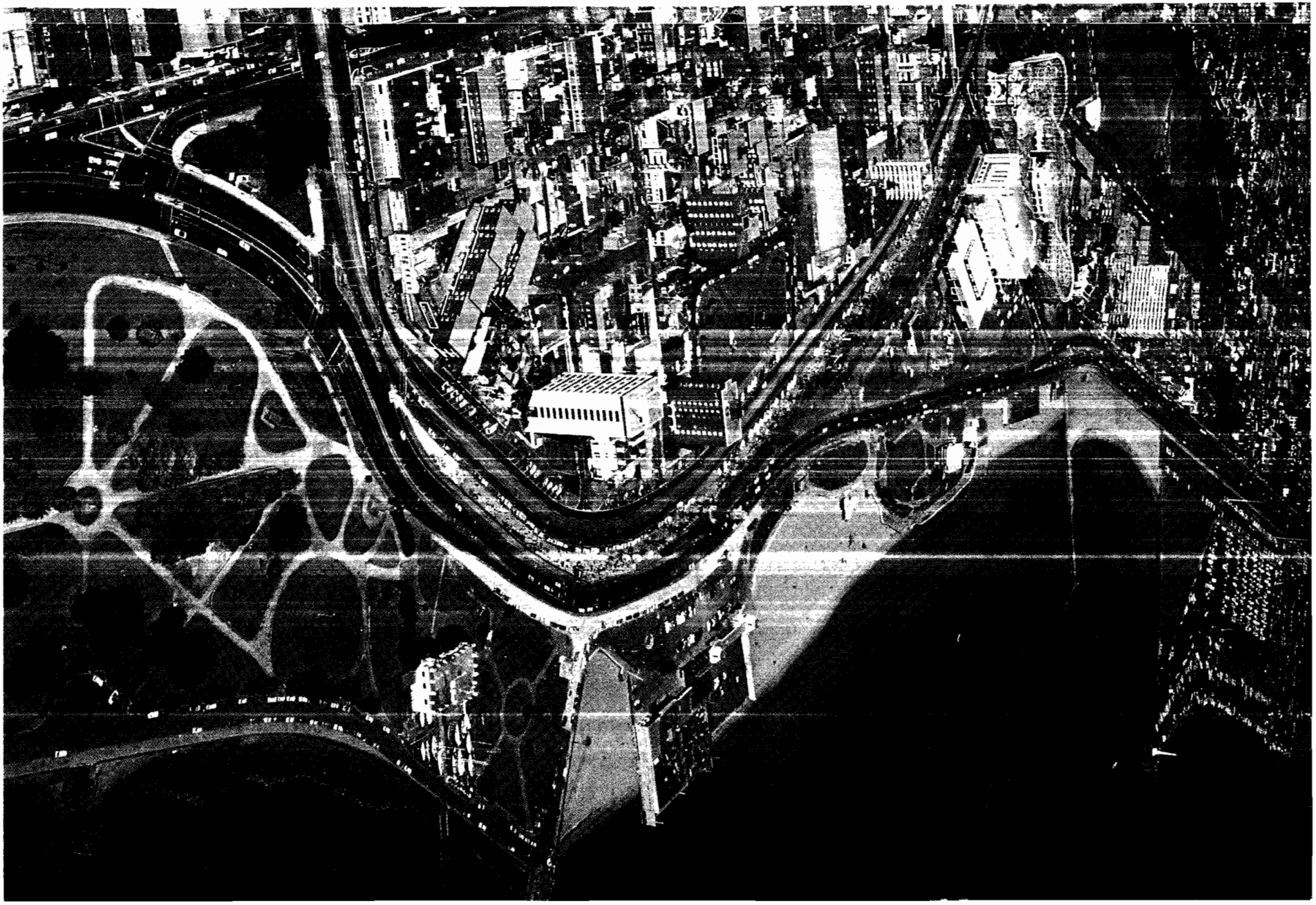
St Kilda City
Beach Road : Duplication and reconstruction of 1.5 km between Cowderoy Street and Shakespeare Grove including a channelised intersection at Fitzroy Street.

Warragul Shire
Bloomfield Road : Reconstruction and realignment of 2.9km.

Waverley City
Ferntree Gully Road : Duplication of 2.5 km between Cootamundra Drive and Dandenong Creek.
Wellington Road : Reconstruction and widening of 2.3km between Garden Road and Mulgrave Freeway.

Williamstown City
Kororoit Creek Road : Reconstruction of 1 km at Williamstown.

Right: Reconstruction and duplication by the Board of Beach Road, St Kilda between Cowderoy Street and Shakespeare Grove (St Kilda City)



Unclassified Roads

Roads which are not included in the Board's declared and proclaimed road system are referred to as unclassified roads. These roads are the responsibility of municipal councils, but each year the Board allocates financial assistance towards the cost of construction and maintenance works, generally in accordance with priorities allotted by municipal councils. Municipal contributions towards the cost of such works are determined at the time the allocation is made, and are based on many factors including the nature, extent and location of the particular work and the financial position of the municipal council concerned.

Arapiles Shire
Three Bridges Road : Reconstruction and realignment of 4.6 km north of Lower Norton.

Berwick City
Pound Road : Reconstruction of 2.4 km between Narre Warren-Cranbourne Road and the Berwick City boundary.

Cranbourne Shire
Hallam Road : Reconstruction of 1 km between Fordholm Road and Olive Road.

Diamond Valley Shire
Kurrak Road : Construction of a three span reinforced concrete bridge over the Plenty River.

Eltham Shire
Eltham-Greensborough Road : Reconstruction of 0.2 km between Bolton Street and Adam Crescent.

Footscray City
Roberts Street : Reconstruction of 0.4 km.
Eleanor Street : Reconstruction of 0.7 km.

Hastings Shire
Grant Road : Reconstruction of 0.8 km southerly from Baxter-Tooradin Road.

Hawthorn City
Burwood Road : Reconstruction of 0.8 km.

Healesville Shire
Yarra Street : Reconstruction of 0.5 km at Yarra Glen.

Keilor City
Taylors Road : Reconstruction of 1 km at St Albans.

Korumburra Shire
One Chain Road : Reconstruction and realignment of 3 km north east of Korumburra.

Lillydale Shire
Coldstream West Road : Reconstruction of 3 km between Station Street and Victoria Road.

Malvern City
Malvern Road : Reconstruction of 0.7 km.

Melbourne City
Princes Street : Reconstruction of 0.7 km between Nicholson Street and Lygon Street including improvements to Lygon Street intersection.

Mildura Shire
Kempe Road : Resurfacing 7 km at Lindsay Point on the South Australian Border.

Nunawading City
Terrara Road : Reconstruction of 0.5 km between Burwood Highway and George Road.

Oakleigh City
Burlington Street : Reconstruction of 1.1 km.
Carinish Road : Reconstruction of 0.9 km.

Pakenham Shire
Tynong-Bayles Road : Reconstruction of 2.4 km between Daley Road and Cora Lynn.

Portland Town
West Boundary Road : Construction between Portland-Nelson Road and Cape Nelson Road to provide access for development in South Portland.

Ringwood City
Loughnan Road : Reconstruction of 0.4 km between Montalbo Road and Glenvale Road.

Romsey Shire
Woodend-Wallan Road : Reconstruction and realignment of 3.2 km west of Romsey.

Shepparton Shire
Shepparton-Euroa Road : Construction of a new deck on Tudgees Bridge over Broken River.

Sherbrooke Shire
Kallista-Emerald Road : Reconstruction of 0.7 km between The Patch Road and Greenslopes Road.
One Tree Hill Road : Reconstruction of 1.1 km between Mt Dandenong Tourists' Road and School Road.

South Barwon/Newtown Cities
Queens Park Road : Reconstruction of 3 km between Scenic Road and Barwon River.

Stawell Shire
Landsborough West-Tulkara Road : Construction of a single span reinforced concrete bridge over Howards Creek, south of Tulkara.

Stawell/Kara Kara Shires
Marnoo-Kanya Road : Construction of a single span reinforced concrete bridge over Andersons Creek, north west of Kanya.

Sunshine City
McIntyre Road : Reconstruction of 0.6 km.
Station Road : Reconstruction of 1.1 km.
Sunshine Road : Reconstruction of 1.5 km.

Tambo Shire
Bonang-Gelantipy Road : Reconstruction and realignment of 2.2 km at Jarretts Hill.

Waverley City
Blackburn Road : Reconstruction of 1.6 km between Waverley Road and High Street Road.
Jells Road : Reconstruction of 1.6 km between Ferntree Gully Road and Wellington Road.

Williamstown City
Maddox Road : Reconstruction of 1.7 km.

Wodonga City
Pearce Street/Chapple Street Connection : Construction of Pearce Street extension to Chapple Street to provide a southern ring road.

Wycheproof Shire
Dumosa-Birchip Road : Reconstruction of 7.4 km.

TRAFFIC SERVICES

Traffic management studies

During the year, the Board continued with a number of traffic management studies which had the aim of increasing the efficiency and safety of the road network. These studies involved examining the road network in particular study areas in some detail with a view to recommending low cost measures which could be implemented.

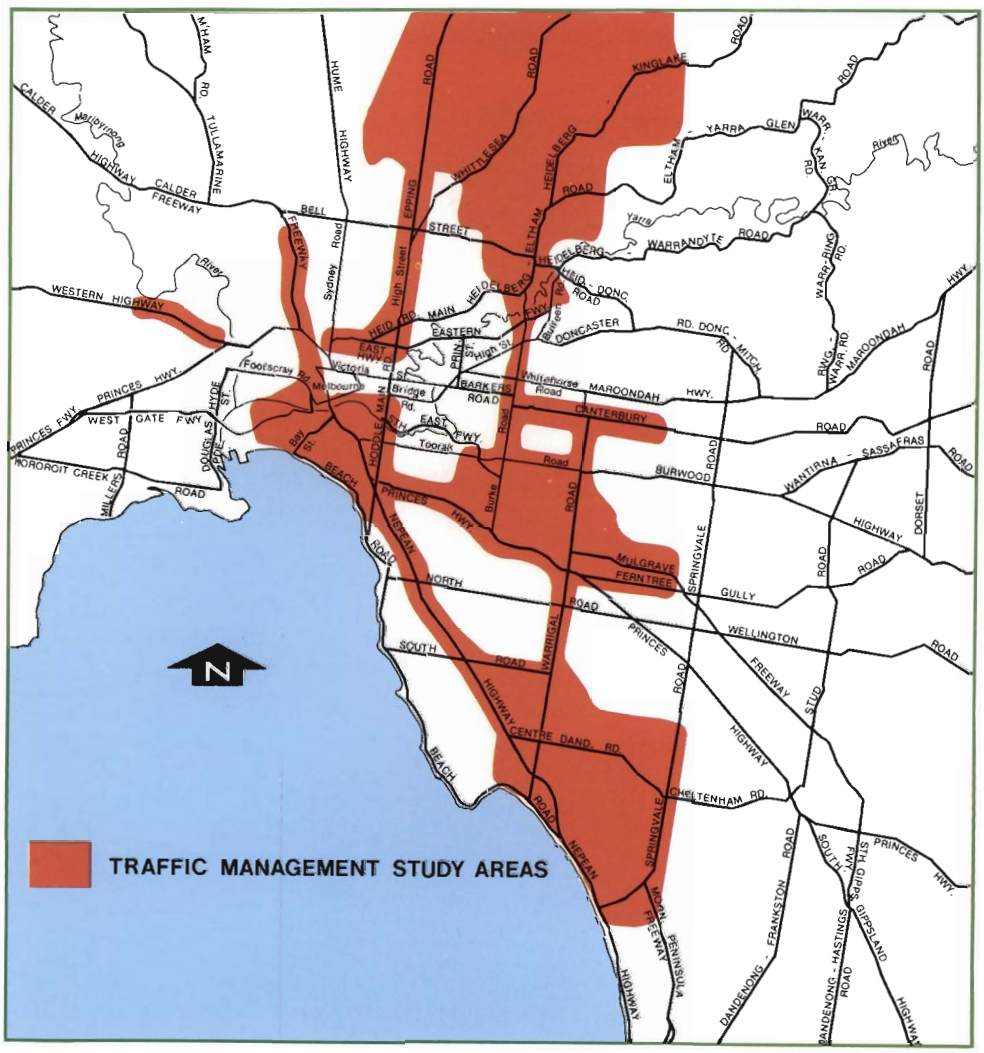
The traffic management studies were undertaken by the Board in close co-operation with the local municipal councils and with the participation, where appropriate, of other agencies such as the Road Safety and Traffic Authority and the Melbourne and Metropolitan Tramways Board.

In general, the objectives of the studies have been to:

(a) investigate the traffic problems in the areas;
(b) review any previous traffic management proposals in the areas;
(c) recommend further low cost traffic management measures that can be readily implemented to improve traffic operation, reduce delays and improve safety in the areas, while protecting the amenity of appropriate local areas; and
(d) define any other areas where further investigation may be required.

The studies also had the aim of promoting the safe and efficient flow of traffic on arterial roads and where appropriate, discouraging the intrusion of through traffic in local areas. Generally, the studies were directed at the operation of the arterial road network although significant safety problems in local areas were also examined.

Traffic management studies undertaken in recent years have covered a significant area of Melbourne (see map of study areas) and have shown that there is scope for very worthwhile improvements to the road system to be made through the use of relatively low cost measures.



Typical techniques which have been recommended in the study reports are:
- changing the type of intersection control
- the provision of exclusive turn lanes
- increasing storage in turn lanes
- adding or altering channelization
- improving sight distance
- banning turns at intersections
- changing traffic signal settings
- the provision of traffic signal linking
- improving linemarking
- improving signing.

The major investigations which were completed or underway during the financial year were:
- Burke Road Corridor Traffic Management Study
- Nepean Corridor Traffic Management Study.

Traffic signals

The Board made further progress during the year with the SCRAM (Signal Co-ordination of Regional Areas in Melbourne) traffic signal project.
The SCRAM project is designed to improve traffic flow along roads by linking traffic signals to a regional computer. Changes in traffic flow are monitored by the computer which alters the signal phases to best suit the existing traffic conditions. The system also provides reports to allow rapid detection of any faults that may occur.
During the year, the Board installed regional computers at Footscray and at Springvale in addition to the existing computers at Blackburn and St Kilda. As at the end of the year, the traffic signals at 170 intersections in the metropolitan area were connected to the SCRAM System, 112 of these having been connected during the year. These signals are connected to the four regional computers, and the monitoring computer at Kew, by the Telecom telephone line network. Fault monitoring terminals connected to the monitoring computer are located at the Board's Metropolitan and Dandenong divisional offices and in the Emergency Services Centre at Head Office to provide 24 hour monitoring and fault recording of the traffic signals.
A major study to determine the effects of implementing SCRAM in Melbourne was carried out by the Board during March/April/May 1982. The study involved the measurement of travel time, traffic delays and fuel consumption under different traffic signal control modes along the Maroondah Highway between Box Hill and Ringwood. The CSIRO, Melbourne University and the Australian Road Research Board assisted the Board in the conduct of the study and in data collection. The study was carried out as part of a major research and development project being undertaken by the Board with funds provided by the National Energy Research Development and Demonstration Council (NERDDC). The aim of this project is to provide descriptive mathematical models which will estimate vehicle performance, including fuel consumption from measured route and vehicle operating characteristics. These models will assist with traffic management projects aimed at improving route performance.
The results of the study were still being analysed at the end of the year. However, preliminary analysis indicated that savings of at least 20 percent in travel time can be achieved by implementing SCRAM traffic signal co-ordination (compared with isolated operation) and that savings in fuel of approximately 10 percent are possible.
The development of a special micro-processor based "interface device" to allow older traffic signal controllers to be linked to SCRAM was completed during the year. This device will obviate the need for the replacement of many existing controllers in Melbourne with consequent savings in implementation costs.

Traffic Information Services and Driver Education

The Board continued its practice of issuing weekly motoring bulletins to the media, police, fire brigade and ambulance services to provide information on the location of Board and some municipal works which could cause delays in traffic flow. In addition, special snow and flood reports were issued as required, describing road conditions. The Board also reprinted a Snow Driving brochure to assist motorists unfamiliar with the techniques of driving on roads in snow conditions.

Emergency services

The Board provides a free emergency telephone service and assistance to drivers of immobilised vehicles on seven major metropolitan traffic routes.

These routes are:

- Eastern Freeway
- Kings Bridge/Queens Way
- Mulgrave Freeway/South Gippsland Freeway
- Tullamarine Freeway
- South Eastern Freeway
- West Gate Freeway
- Calder Freeway.

During the year, the emergency telephone service on the Calder Freeway was extended by eight telephones on the Calder Freeway to include the Erebus Street-Arundel Road Section, Keilor, and by three telephones on the Mulgrave Freeway to extend the emergency telephone service to Warrigal Road, Chadstone.

The emergency service operates for 24 hours per day and provides assistance for minor mechanical problems, the sale of sufficient petrol to enable a vehicle to be restarted and driven clear of the freeway and a towing service so that immobilised vehicles can be cleared from the freeway.

The number of calls to the Board's Emergency Service Centre at Head Office increased by 774 calls to 27,268 calls during financial year 1981/82.

The Emergency Service Centre permits continuous radio communication with the Board's road maintenance personnel and traffic officers outside normal working hours. The Centre also enables up to date information on road conditions to be provided outside normal working hours, especially during the occurrence of floods or bush fires. The following table shows the distribution and types of calls for emergency services received during financial year 1981/82:

Emergency services — call analysis

Fault	Total	% of all calls
Roadside emergency telephone		
Petrol	3835	14.3
Tyres	1264	4.6
Radiator	1769	6.4
Mechanical	7054	25.8
Hoax	1174	4.3
Hazard	317	1.3
Accidents	402	1.4
Tows	2247	8.2
Other	1602	5.8
Sub Total	19,664	72.1
Ordinary telephone		
Hazard	242	.8
Traffic lights	1652	6.2
Other	5710	20.9
Total	27,268	100.0

Emergency services — road analysis

Road	No. of calls	%
Eastern Freeway	4613	23.4
Mulgrave Freeway	5584	28.3
Tullamarine Freeway	5596	28.4
South Eastern Freeway	2093	10.6
West Gate Freeway	1078	5.4
Kings Bridge/Queens Way	217	1.5
Calder Freeway	483	2.4
Total	19,664	100.0

Linemarking

During the 1981/82 financial year, the Board spent $3.6 million maintaining Statcon markings and extending and maintaining linemarking and pavement markers throughout the State. The length of linemarking maintained by the Board's linemarking machines was as follows:

- State highways and freeways—17,875 km or 43,560 km of equivalent standard stripe.
- Other Board declared or proclaimed roads—11,961 km or 21,217 km of equivalent standard stripe.
- Unclassified roads—4,011 km or 7,680 km of equivalent standard stripe.

A standard stripe is a solid stripe 3 m long and 80 mm wide with a 9 m gap. The term "equivalent standard stripe" is a measure of the length of all forms of longitudinal linemarking expressed as an equivalent area of paint in a standard stripe.

The cost of this work was:

- $85.00/km of standard stripe.
- $45.00/km of 80 mm wide solid stripe.

The cost of extending and maintaining the system of raised reflective pavement markers on declared roads was $243,600 and 63,917 reflective markers were laid.

During the year, the Board painted 2,642 sq m of long life markings at intersections. This increased to 142 the number of intersections wholly or partly treated in this way by the Board throughout the State. At the majority of the intersections, the markings have been painted with a cold-formed plastic, although at some intersections thermoplastic or long life paint has been used as an experimental measure. The Board intends to continue some experimental work with long life materials in 1982/83.

Control of overdimensional and overweight vehicles

In order to maintain safe conditions for road users and also protect both bridges and road surfaces from damage, limits are imposed by law on the width, height, length and mass of vehicles and their loads.

The Board has the responsibility under the provisions of the Motor Car Act 1958, for issuing permits for the movement of vehicles exceeding the mass, height, length and width limits prescribed by the Motor Car Act:

(a) on roads declared or proclaimed under the provisions of the Country Roads Act; and
(b) for a journey which includes unclassified roads in two or more greater metropolitan municipalities as defined in the Motor Car Act.

The following table illustrates the number and types of permits issued during the year compared with those issued during the financial year 1980/81.

	1980/81	1981/82
Single trip permits	23,812	23,393
Annual permits	3,537	4,222
*NAASRA permits	9,106	2,430
NAASRA height permits		306
Total number of permits issued	36,455	30,351

*This figure represents the number of permits issued in accordance with the National Association of Australian State Road Authorities (NAASRA) recommendations from the study into the Economics of Road Vehicle Limits. As from 16th December 1981, these permits became redundant (with the exception of height permits) due to the operation (in part) from that date of the Motor Car (Mass and Dimension Limits) Act 1981. This Act implemented the revised mass and dimension limits for motor cars and trailers recommended by NAASRA and adopted by the Australian Transport Advisory Council, except for the NAASRA recommended height limit of 4.3 metres.

There were 176 permits issued for loads in excess of 100 tonnes during the financial year. The most significant of these loads involved the transport of power generation equipment to State Electricity Commission sites at South Morang and Loy Yang.

In April 1982 the first of four transformers, each having a mass of 110 tonnes nett, was transported from Port Melbourne to South Morang.

The movement of very heavy items of equipment, each having a mass in excess of 500 tonnes, to the Loy Yang Power Station commenced in June 1982.

To provide for the safe movement of such loads along the Princes Highway between Melbourne and the Latrobe Valley, existing bridges have been strengthened and new high strength bridges constructed.

Prosecutions

Policing and enforcement of heavy and overdimensional vehicles is effected by the Board's twenty two traffic officers, and the six police officers seconded to the Board. The number of offences reported during the year was 5,165, resulting in over $1,072,015 in fines and costs which was paid into the Consolidated Fund.

Snow clearing

Snow clearing of roads to snow resorts was carried out during the year on the Alpine Road (Mt Hotham), Mt Buffalo Road, Mt Buller Road and Bogong High Plains Road (Falls Creek).

Snowfall conditions during the 1981 winter were heavier than any experienced during the past fifteen years. Heavy snowfalls occurred in late June and, with frequent snowfalls throughout winter, snowdepths continued to increase until early September. Snow clearing was commenced in early June and completed in early October 1981.

The unduly heavy and frequent snowfalls created difficult conditions for the Board's personnel engaged on snow clearing work.

Conditions were so severe on the Harrietville approach of the Alpine Road to Mt Hotham that the road was closed to traffic for a total of 18 days.

Snow clearing of car parks was carried out at all resorts as a charge against the respective administering authorities or against a special Country Roads Board/National Parks Service grant in the case of Mt Buffalo.

All night snow clearing was carried out at Mt Hotham on Friday and Saturday nights during the snow season. This work was financed by a special Treasury Grant.

Six 4 wheel drive Aveling Austin grader snowploughs, three Rolba R1500 snowblowers, two Rolba R400 snowblowers and a MAN truck snowplough were used to carry out snow clearing for the season. A D4 and D7 dozer were also utilised for part of the season at Mt Hotham as well as a six wheel drive John Deere grader snowplough as a trial.

Details of snowfalls recorded during the 1981 winter by the Board's snow clearing personnel together with the costs of snow clearing are shown in the following table:

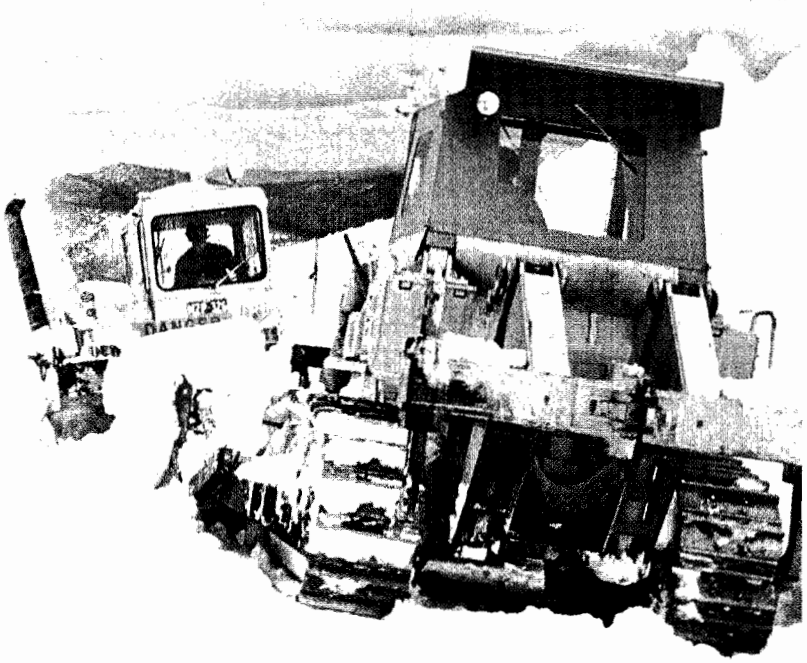
Road	Resort	Earliest snowfall	No. of snow days	Cost 1981 season
Alpine Road	Mt Hotham	4 June 1981	58	$352,009
Mt Buffalo Road	Mt Buffalo	4 June 1981	45	$82,847
Mt Buller Road	Mt Buller	4 June 1981	47	$84,590
Bogong High Plains Road	Falls Creek	2 June 1981	50	$79,895

(a) Costs do not include clearing of car parks for Committees of Management.

(b) The cost of night snow clearing at Mt Hotham for the 1981 season was $55,612 and this amount is included in the cost of $352,009. A Treasury Grant of $36,000 was received during 1981/82 towards the cost of night snow clearing.

(c) Bogong High Plains Road costs are for the first 1.6 km of the road plus 80% of the costs of clearing the balance of the length of the road. The other 20% of costs is charged to the State Electricity Commission and is included in the cost of $79,895.

Right: Snow clearing at Mt Hotham



PLANNING

The road planning function of the Board is an essential and important activity, involving many diverse skills. The staff of the Board's Planning Sub-branch bring together engineering, sociological, economic, environmental and town planning expertise in formulating and evaluating future road proposals. In addition, Board officers use specialised equipment to provide technical information on noise and air pollution, landscaping and general environmental matters.

Significant planning studies in which the Board was involved during the year are described below:

Freeway F5, Greensborough Road Connection

The concept of a "Greensborough By-pass" has been under investigation for many years. In 1962 the Melbourne Metropolitan Planning Scheme was amended to include a proposed main road reservation for the By-pass.

In the 1960s the Metropolitan Transportation Study was conducted and, among other things, it recommended the east-west freeway route known as F5 and a north-south freeway (F18) along the line of Greensborough Road extending from F5 southerly through Watsonia to the Eastern Freeway (F19). Reservations for these routes were included in the Melbourne Metropolitan Planning Scheme in 1970 and the old "Greensborough By-pass" route became part of the F5 and F18 routes.

In 1973, the Government of the day announced that the F18 route south of Lower Plenty Road connecting to Eastern Freeway (F19) would not proceed and this road reservation has now been revoked from the planning scheme.

In 1976, the reservation for an extension of F5 from Diamond Creek Road to Ryans Road was included in the Melbourne Metropolitan Planning Scheme.

During 1976 and 1977, a study was undertaken to assess the feasibility of providing an Outer Ring Road encircling much of Metropolitan Melbourne. The study concluded that such a ring road (part of which was F5) was feasible and desirable. In 1978 and 1979 a further study recommended that an arterial road connection should be provided from the eastern end of F5 at Ryans Road, Eltham connecting to Springvale Road, thus completing the ring. However, in 1981 the Government of the day decided that it would not be appropriate to proceed to reserve land in the Melbourne Metropolitan Planning Scheme for this section of the Outer Ring Road proposal.

During 1977, the Board advised the then Minister of Transport and the Diamond Valley and Whittlesea Shire Councils that it proposed to construct the F5 and F18 project in the following sequence:

Stage 1 : F5 from Diamond Creek Road to Plenty Road,
Stage 2 : F5 from Plenty Road to Dalton Road, and
Stage 3 : F 18 from F5 to Greensborough Road.

An earlier concept was to construct as a first stage those parts of F5 and F18 which bypass the Greensborough shopping area. This was changed on the basis of traffic projections showing that a new east-west route from Diamond Creek Road to Plenty Road would provide greater relief to Grimshaw Street than would an F5-F18 connection from Diamond Creek Road to Greensborough Road. More recent traffic analysis favours the southerly connection from F5 to Greensborough Road preceding the extension of F5 westwards from Plenty Road to Dalton Road.

In late 1981, the Board completed the preparation of preliminary layout plans and a Summary Report for the section of Freeway F5 between Heidelberg-Kinglake Road and Dalton Road, and for an arterial road connection from F5 southerly to Greensborough Road.

In December 1981, the Summary Report was sent to Members of Parliament, the relevant municipal councils, authorities and community groups for information and as a basis for comment. The Report covered the history of previous planning and set out information regarding the existing and expected future traffic conditions, environmental considerations and the situation in the adjacent approach areas.

In June 1982, small public displays were held in each municipality (Heidelberg, Diamond Valley and Whittlesea) for the purpose of inviting comments and suggestions.

Following an examination of any comments and suggestions received, detailed proposals for the project, including staging of construction, will be developed with a view to reaching agreement with the relevant municipal councils.

Western Highway, Princes Highway to Ashley Street

During the year, the Board commenced a preliminary investigation into the major improvements required over the 3.5 km section of the Western Highway between the Princes Highway and Ashley Street in the Cities of Footscray and Sunshine. Limited widening proposals for this section of the highway have been included for some years in the Melbourne Metropolitan Planning Scheme.

The Western Highway is the only continuous east-west arterial road in the western corridor and it carries approximately 30,000 vehicles per day. This large traffic volume includes a high proportion of commercial vehicles. The highway is also the major regional route linking the Melbourne Metropolitan area to Ballarat and the west of the State. The length of the highway under investigation comprises four traffic lanes without a central median, whilst the adjoining lengths of the highway have six traffic lanes with a central median.

The investigation will consider the need for improved traffic conditions, the options available and their major implications on the traffic patterns and the environment of the corridor. One of the options being considered is the provision of dual carriageways along this length of the highway, which would result in a development similar to the Nepean Highway widening project between Elsternwick and Moorabbin currently under construction.

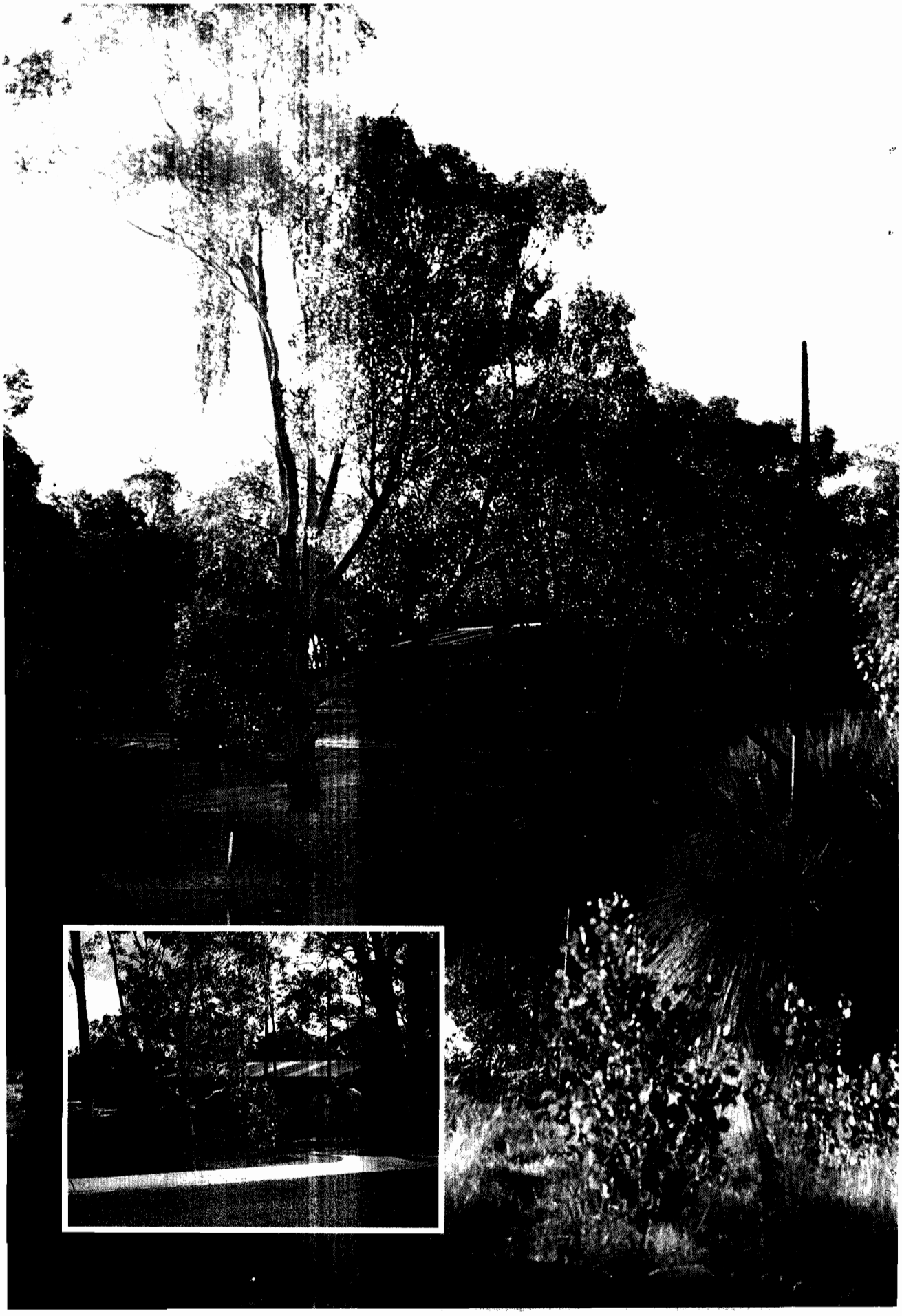
Comments will be sought from the relevant agencies and authorities and the local community at an early stage in the investigation. It is intended that the results of the initial investigation will be presented in a summary report early in 1983. An information display will be held to coincide with the release of the report to provide the opportunity for further community participation and comment.

Following this consultation phase, the proposals will be reviewed in the light of all the comments received and then, if required, a planning scheme amendment will be sought for the final proposal. The construction of an approved proposal is not envisaged until the late 1980s due to the necessary planning and design activities, and also financial commitments on other major projects. The cost of a widening scheme for this length of the Western Highway is estimated at $20,000,000 at 1982 prices.

General

In addition to the road planning studies described, other planning investigations on which work was undertaken during the year included:

- Princes Freeway, Berwick to the Bunyip River—a new route south of the Princes Highway from Berwick to east of Pakenham and initial duplication of the existing highway with provision for long term conversion to freeway standard from east of Pakenham to the Bunyip River.
- Princes Freeway, bypass of Morwell—to provide a southern bypass of Morwell.
- Princes Freeway, bypass of Traralgon—to provide a southern bypass of Traralgon.
- Midland Highway—examination of the location of the highway between Morwell and Churchill.
- Tullamarine Freeway—examination of the long term options for an extension of the Tullamarine Freeway south of Flemington Bridge.
- Road transport information for the Draft Strategy Plan being prepared by the Latrobe Valley Task Force—study of the effects of development in the Latrobe Valley on road transport.
- Mt Stirling Ski Resort development proposals and Dinner Plain project near Mt Hotham—comments and advice on the proposed development.
- Melbourne City Council's Local Development Strategy road proposals and the Melbourne and Metropolitan Board of Works' Melbourne Metropolitan Planning Scheme Amendment No 150—the conduct of investigations and provision of comment.
- Punt Road widening—proposed duplication between Bridge Road and the Yarra River.



Public relations

The Board continued to pursue its policy of informing the public of its functions and works. The Public Relations Section prepares news releases, publications, audio-visual productions, and displays as mediums for carrying out this activity.

Publications

During the year the Board issued the following publications and pamphlets:

- CRB News Nos. 47, 48
- Colouring Poster
- CRB Roadmoves Game
- Calder Freeway, Keilor Section
- Hume Freeway, Barnawartha to Wodonga
- The Hume Challenge
- West Gate Freeway, South Melbourne Section
- Highlights of 1980/81
- Financial Facts
- SCRAM (Signal Co-ordination of Regional Areas in Melbourne)
- Princes Freeway, Bypass of Berwick (reprint)
- Snow Driving (reprint).

Information bulletins were produced for the following projects:

Nepean Highway Widening, Elsternwick to Moorabbin.
Eastern Freeway, Bulleen to Doncaster.
These information bulletins were issued to Members of Parliaments, residents, councils, and the media, and outlined current progress on the projects concerned.

Displays

The Board's exhibit at the Royal Melbourne Show featured a display built to externally resemble a roadbuilding machine, with the interior designed to both inform and entertain. The interior design included a vibrating floor, viewer activated photographs and samples of materials used in roadbuilding.
The CivEnEx field display at Werribee in March 1982 featured a display by the Board on the co-ordinated traffic signal system in Melbourne (SCRAM) and the use of delineation markers and signing on road, which won the award for the Most Imaginative Display.
In addition small displays were featured at the following venues:

- Benalla Rose Festival
- Koo-wee-rup Potato Festival
- Garden State Festival, Fitzroy Gardens
- Environmental Education Teaching Resources Display.

Roads of tourist interest

The State Government provided loan funds totalling $200,000 in 1981/82 for expenditure on roads of a tourist nature other than roads proclaimed as tourists' roads under the provisions of the Country Roads Act. The loan funds are repayable by the Board.
Allocations for particular projects were made by the Board after consultation with the Ministry for Tourism. The total amount made available by the Government since 1960 is $4,494,000. Applications for financial assistance from these funds are well in excess of the amount available for expenditure.
The Board is required to make an annual payment into the Tourist Fund amounting to 2% of the amount credited to the Country Roads Board Fund in the previous year from receipts under the Motor Car Act. An amount of $1,329,806 was paid during the year. The Tourist Fund is administered by the Ministry for Tourism.

Left: The Grass Tree Rest Area on the Hume Freeway was constructed as part of work on the bypass of Avenel.
Inset: members of the public making use of the rest area facilities

National Park roads

The State Government again provided loan funds, repayable by the Board, amounting to $100,000 for expenditure on roads and associated purposes in or near National Parks. Allocations were made by the Board after consultation with the National Parks Service for maintenance and for other works in or near the following National Parks.

Beechworth Historical Park	Beechworth Shire
Brisbane Ranges National Park	Bannockburn & Corio Shires
Bulga National Park	Alberton Shire
Churchill National Park	Knox City
Croajingolong National Park	Orbost Shire
Eildon National Park	Mansfield Shire
Ferntree Gully National Park	Sherbrooke Shire
Glenaladale National Park	Bairnsdale Shire
Hattah Lakes National Park	Mildura Shire
Holey Plains National Park	Rosedale Shire
Kinglake National Park	Eltham & Whittlesea Shires
Lind National Park	Orbost Shire
Little Desert National Park	Dimboola Shire
Morwell National Park	Morwell Shire
Mount Baw Baw National Park	Narracan Shire
Mount Buffalo National Park	Narracan Shire
Mount Eccles National Park	Minhamite Shire
Mount Richmond National Park	Portland Shire
Organ Pipes National Park	Keilor City & Bulla Shire
Pink Lakes National Park	Walpeup Shire
Port Campbell National Park	Heytesbury Shire
Snowy River National Park	Orbost Shire
Tarra Valley National Park	Alberton Shire
Tingaringy National Park	Orbost Shire
The Lakes National Park	Rosedale Shire
Warby Ranges National Park	Wangaratta Shire
Warrandyte National Park	Doncaster & Templestowe City
Werribee Gorge National Park	Bacchus Marsh & Ballan Shires
Wilsons Promontory National Park	South Gippsland Shire
Wyperfeld National Park	Karkarooc Shire

The works consisted of the construction and sealing of access roads to National Parks, and roads and parking areas within National Parks, together with the maintenance of roads already constructed. The works were carried out either by the Board, the local municipal council or the National Parks Service. The Government has made loan funds totalling $1,897,000 available for these purposes since 1st July 1963.

New divisional office at Warrnambool

In May 1982, work commenced on the construction of a new divisional office and laboratory building at the corner of Jamieson Street and Canterbury Road, Warrnambool. The building is expected to be completed by mid 1983.

The new divisional office will have a single storey frontage, and car parking facilities will be provided at the rear. The design of the building, together with the landscaping, will ensure that the new divisional office and surrounds are compatible with the surrounding residential area.

The existing divisional office in Kepler Street will be sold on completion of the new office.

National Association of Australian State Road Authorities

The National Association of Australian State Road Authorities (NAASRA) is an organisation of the Road Authorities of the six States, the Commonwealth Department of Transport and Construction, and the Northern Territory Department of Transport and Works. The members of NAASRA are the heads of the various authorities.

The Association was established in 1934 as the Conference of State Road Authorities, and adopted its present name in 1959.

NAASRA aims to provide a central organisation where, by co-operative effort, a uniform approach to the development and improvement of the national road system can be achieved. Over the years, this co-operation has enabled the Association to co-ordinate and rationalise road and bridge design standards, construction and maintenance practices and road research projects, and also to gather and publish facts about Australia's principal roads and their financing. From these activities NAASRA has developed a national approach to Australia's road problems.

The technical work of NAASRA is performed by the Principal Technical Committee (consisting of the chief engineering officers of the authorities) and a number of standing and ad hoc committees on which the Board is represented. NAASRA's views on such matters as finance for roads and road design, construction and maintenance standards on national highways, and road vehicle limits are considered by the Australian Transport Advisory Council (ATAC) Road Advisers' Group. This Group comprises the heads of the State Road Authorities, and the Commonwealth Department of Transport and Construction. The Group advises ATAC, the meeting of Transport Ministers, which determines national transport policies.

The following NAASRA meetings were held during the year:

- 66th (Annual Meeting) Hobart, 3rd & 4th November 1981, attended by Mr T H Russell, Chairman.
- 67th (Intermediate Meeting) Melbourne, 11th May 1982, attended by Mr T H Russell, Chairman, Mr W S Brake, Deputy Chairman, and Mr N L Allanson, Member.

Items considered by NAASRA during the year included:

- International organisations and conferences (the XVIIth World Road Congress of the Permanent International Association of Road Congresses is to be held in Sydney in October 1983).
- Commonwealth Roads Grants legislation.
- State roads legislation.
- Standards for construction and maintenance of national highways.
- Road vehicle limits.
- Road studies.
- Road construction price indices.
- Route numbering.
- Full-scale pavement testing.
- Australian Development Assistance Bureau courses.
- Publications—technical and general information.

Australian Road Research Board

The Australian Road Research Board (ARRB) was established by NAASRA in 1960 and is the focal point of road research in Australia. The Board of Directors includes the heads of the six State Road Authorities, the Secretary of the Commonwealth Department of Transport and Construction and the Executive Director of ARRB.

In 1965 ARRB was registered as a non-profitmaking company. Approximately 50% of its annual expenditure is provided by the Commonwealth Government through the Department of Transport and Construction and the remainder is shared by the six State Road Authorities on the percentage basis adopted by the Commonwealth Government in making grants to the States under the Commonwealth Roads Grants Amendment Act 1982.

The objective of ARRB is to co-ordinate, encourage and arrange continuing research into problems associated with roads and traffic in Australia. The current research program includes projects relating to the design, construction and maintenance of roads and bridges, the planning and operation of traffic management and road safety.

The Directors of the Australian Road Research Board meet twice a year to consider management and policy matters and to review the progress of research projects. Mr T H Russell, Chairman (and then Deputy Chairman of ARRB) attended the 43rd meeting at the Department of Main Roads, Hobart on 2nd November 1981 and the 44th Meeting held at the Australian Road Research Centre, Vermont, on 12th and 13th May 1982. At the 44th Meeting Mr Russell was appointed Chairman of ARRB for the ensuing year.

Technical conferences for the wider dissemination of the results of research and the exchange of knowledge are held bi-ennially. The next ARRB conference is the eleventh such conference and will be held in Melbourne in August 1982.

A number of the Board's officers are members of the ARRB technical or specialist committees, and Board officers are also involved in an advisory capacity in some of the ARRB research projects.

Co-operation with Army Reserve

The Board continued, with other Victorian Government instrumentalities, its sponsorship of Royal Australian Engineers Supplementary Reserve units of the Australian Army Reserve. The sponsoring authorities undertake public works akin to military engineering tasks and the Supplementary Reserve units provide the means of using the civilian knowledge and skills of members to military advantage.

With complementary training in purely military subjects, a nucleus of army engineers is thereby developed capable of rapid expansion in time of defence emergency. The units sponsored by the Board are the Headquarters 22 Construction Regiment and the 107 Plant Squadron (Heavy).

The 1981 annual camp was held at Puckapunyal where the regiment participated in a "courses camp" conducted by 6 Construction Group.

The courses conducted were on a variety of topics including promotion and the use of camouflage, as well as courses for plant operators, drivers, clerical staff, storemen and forest mill/chain saw users.

In addition, a special detachment of 100 personnel, which included 35 members of the regiment, relieved a Regular Army unit at Shoalwater Bay, North Queensland and constructed 4 km of gravel access road and cleared a further 2 km. The detachment was commanded by Major P J McCulloch, an engineer in the Board's Dandenong Division.

Other activities during the year included the de-launching of a Bailey bridge on the Glenelg Highway at Skipton and the restoration of an historic gun emplacement at Fort Queenscliff.

The 22 Construction Regiment was commanded by Lt Col W F J Hardy ED, an engineer with the Melton Waterworks Trust. Until early in 1982, the 107 Plant Squadron (Heavy) was commanded by Maj E G Renton, an engineer in the Board's Works Sub-branch. As at the 30th June 1982, ten members of the Board's staff were officers of the regiment and the total strength of the regiment was some 370 personnel.

Legislation affecting the Board

Legislation enacted or in the process of being enacted during the year which affected the Board included the following:

Business Franchise (Petroleum Products) (Fees) Act 1981

This Act, which was passed in the 1981 Spring Session of State Parliament, was proclaimed to come into operation on 1st November 1981.

The Act provided for an increase in fees under the Business Franchise (Petroleum Products) Act 1979. The fee for licences for petroleum wholesalers and retailers was increased from 4.5 to 5.4 percent of the value of motor spirit sold, and from 7.1 to 8.6 percent of the value of diesel fuel sold for road vehicle use. The effect of these changes was to increase the price of motor spirit by approximately one-third of a cent per litre and the price of diesel fuel by approximately one-half of a cent per litre.

Details of the additional revenue resulting from the increases in the licence fees are outlined on page 6.

Transport (Fees) Act 1981

This Act was passed in the 1981 Spring Session of State Parliament and came into operation on 26th November 1981.

The Act provided for the rationalisation and restructuring of the distribution of the total administrative costs of the Transport Regulation Board, including those related to the registration and licensing functions of that Board. Prior to the passing of the Act, there was no provision for the total administrative costs to be recouped from the various recipients of the revenue collected or services provided by the Transport Regulation Board in connection with the registration and licensing of vehicles. All costs not recouped were met from the Country Roads Board Fund. The Act enables a more equitable distribution of these costs to be made.

The Act also provided for an increase in the various fees payable on registration or the renewal of registration of motor vehicles and trailers as from 26th November 1981. The general level of the increase in these fees was 20%.

Left: Construction of a road over rail overpass on the Pyrenees Highway in Ararat. Workmen erecting safety railing

West Gate Bridge Authority (Transfer and Dissolution) Act 1982

This Act, which was passed in the 1982 Autumn Session of State Parliament, came into operation on 1st July 1982.

The Act provides for:

(a) the West Gate Bridge Authority to be abolished as from 1st July 1982;
(b) the powers and functions formerly exercised by, and the duties and obligations formerly imposed upon the Authority, as from 1st July 1982 to be exercised by and imposed upon the Board;
(c) the cancellation as from 1st July 1982 of all existing West Gate Bridge Debentures and all existing West Gate Bridge Inscribed Stock and the issue to the holders of such debentures and stock of Country Roads Board Inscribed Stock;
(d) the Board's borrowing powers to be increased to enable the Board to borrow sums of money not exceeding in all $400 million;
(e) the Treasurer to be empowered to make available to the Board from either the Works and Services Account or the Consolidated Fund amounts not exceeding $132 million;
(f) the transfer to the Board of the personnel of the Authority; and
(g) the repeal of the West Gate Bridge Authority Act 1980.

Motor Car (Mass and Dimension Limits) Act 1981

This Act was passed during the 1981 Autumn Session of State Parliament.

The principal purposes of the Act are:

(a) to implement the revised mass and dimension limits for motor cars and trailers recommended by the National Association of Australian State Road Authorities and adopted by the Australian Transport Advisory Council;
(b) to provide for the separate registration of prime-movers and semi-trailers; and
(c) to increase the penalties relating to the overloading of motor cars and trailers.

The Act received Royal Assent on 19th May 1981. At that time it was not possible to proclaim the provisions of the Act relating to separate registration of prime-movers and semi-trailers to come into operation, pending the taking of certain administrative actions including the making of consequential amendments to the Motor Car Regulations. As at the end of the financial year, the provisions relating to (b) above had not been proclaimed to come into operation.

The provisions of the Act relating to (a) and (c) above were proclaimed to come into operation on 16th December 1981. The delay was occasioned by the need for an amendment to the Act to enable that part of Section 29 of the Act relating to (a) and (c) to come into operation, without proclaiming those parts of Section 29 relating to the separate registration of prime-movers and semi-trailers. This amendment was achieved by the Motor Car (Mass and Dimension Limits) (Amendment) Act 1981, which came into operation on 8th December 1981.

Commonwealth Roads Grants Amendment Act 1982

This Act, which was passed during the Autumn Session of the Commonwealth Parliament, came into operation on 9th June 1982.

The Act amends the Commonwealth Roads Grants Act 1981 and continues Commonwealth financial assistance to the States and the Northern Territory for all road categories after 30th June 1982 for the 1982/83, 1983/84 and 1984/85 financial years. It makes provision for the appropriation to the States and the Northern Territory of $734 million for 1982/83, $778 million for 1983/84 and $825 million for 1984/85.

Further details of this legislation are set out on page 12 of this report.

The following table sets out the Board's personnel strength (excluding personnel on secondment or extended leave) as at 30th June 1981 and 30th June 1982.

	As at 30th June 1981	As at 30th June 1982
Engineers	528	508
Administrative staff	637	635
Technical staff	498	492
Scientists	22	23
Surveyors	37	37
Other technological staff (qualified)	28	28
Printing and other General Division staff	19	19
Depot staff and employees	794	746
Field staff and employees	2262	2109
	4825	4597

During the year, the Board continued its policy of examining carefully all requests for staff recruitment and staff replacements. The recruitment and replacement of staff only proceeded where this was considered to be essential for the Board's operating requirements.
Within the limits of this policy, the Board during the year recruited 6 newly qualified civil engineers, 10 draftsmen/draftswomen and 14 apprentices.
The Board was also able to provide 127 school students with work experience under the Work Experience Act 1975, in clerical, technical and field positions. The Act was introduced by the State Government in January 1975 to enable students over thirteen years of age to be provided with work experience for up to twelve days in any one school term. The students are paid an amount of $3 per day by the Board which is subsequently re-imbursed by the State Education Department.

Training and development

During the year, the Board continued its policy of maintaining a comprehensive in-service training programme for its staff at all levels based on an assessment of training needs. Training courses covered a wide range of technical and administrative subjects including road and bridge design and construction, materials testing, traffic engineering, bituminous surfacing, a variety of computer courses and management training.
During the year officers attended the following external training courses:

- Advanced Course—Australian Administrative Staff College.
- Management Development Programme—Australian Administrative Staff College.
- Summer/Winter School of Business Administration—University of Melbourne.
- Construction Project Management Course—University of New South Wales.
- Traffic Planning and Control Course—University of New South Wales.
- Government Administrative Course—University of New South Wales.
- Graduate Course in Hydrology—University of New South Wales.

During the year, the Board also continued with its Career Development Programme to enable young engineers to gain work experience in three or four different areas of the Board's operations over a period of approximately eight years.
A CRB Bursary Scheme is also in operation which enables selected applicants to undertake some course of study, training or project which will benefit the Board's operations in terms of efficiency and effectiveness. One bursary was granted during the year to enable an officer to undertake a research project at the University of Melbourne on the development of improved methods of flood estimation for ungauged rural catchments in Victoria. The Board also conducts a study leave scheme to assist staff development.
The Board provides training attachments for engineers from South East Asia and Africa under aid programmes such as the Colombo Plan, the Australia Papua New Guinea Education Plan, the South Pacific Assistance Plan and the Special Commonwealth African Plan. These training attachments are part of Australia's aid programme and are organised by the Board following requests received from the Australian Development Assistance Bureau as part of its aid to developing countries. During the year, the Board provided training attachments for 13 engineers, 5 surveyors, and 1 construction technician.

Apprenticeships

Fourteen new apprentices were employed during the year in the trades of motor mechanic (11), electrical mechanic (1), structural steel fabrication welder (1), and cook (1).

The total number of apprentices in training at 30th June 1982, was:

Motor Mechanics	59
Structural Steel Fabrication (welder)	4
Carpentry and Joinery	3
Painting and Decorating	1
Electrical Mechanics	4
Cooking	1
Automotive Electrics	2
Landscape Gardening	2
Gardening	–
Lithographic Printing	1
Instrument Making and Repairing	–
Fitting and Turning	2
Plumbing and Gas Fitting	1
	80

Industrial relations

During the year, the Board was involved in a number of proceedings before the Australian Conciliation and Arbitration Commission. These proceedings mainly related to wage and salary claims lodged to vary the majority of Awards to which the Board is a respondent party and followed on from the abandonment of wage indexation in July 1981.

However, notwithstanding the Board's involvement in these proceedings, the Board's relationships with trade unions and staff associations continued to be satisfactory and no major stoppages of work took place during the year.

The Board was involved in extensive negotiations with the Municipal Officers' Association regarding the implementation of technological change associated with the introduction of a computerised Financial Accounting System in the Chief Accountant's Branch. As at the end of the year, these negotiations were still proceeding.

Following decisions of the Australian Conciliation & Arbitration Commission granting a reduction in working hours in a number of private industry and some public employment areas, the Victorian Trades Hall Council during the year approached the Government seeking a reduction in hours of work from 40 to 38 per week in State Instrumentalities and Departments. The Board was a party, in conjunction with the Office of Industrial Relations Co-ordination (Public Employing Authorities), to negotiations with the Trades Hall Council which are aimed at achieving agreement for the introduction of a shorter working week. As at the end of the financial year, these negotiations were still proceeding.

Details of the Federal Awards to which the Board is a respondent party and the number of its employees covered by these Awards as at the 30th June 1982 are as follows:

	No. of Personnel
Australian Workers' Union Construction and Maintenance Award	1434
Building Construction Employees and Builders Labourers Award	89
Carpenters and Joiners Award	14
Engine Drivers and Firemen's (General) Award	1
National Building Trades Construction Award	59
Metal Industry (Victorian Government Departments and Instrumentalities) Award	316
Transport Workers' (General) Award	235
Country Roads Board Salaried Staff Award	1817
Professional Engineers (Country Roads Board, Victoria) Agreement	492
Professional Engineers (Country Roads Board, Victoria) Senior Engineers Award	32
Total	4489

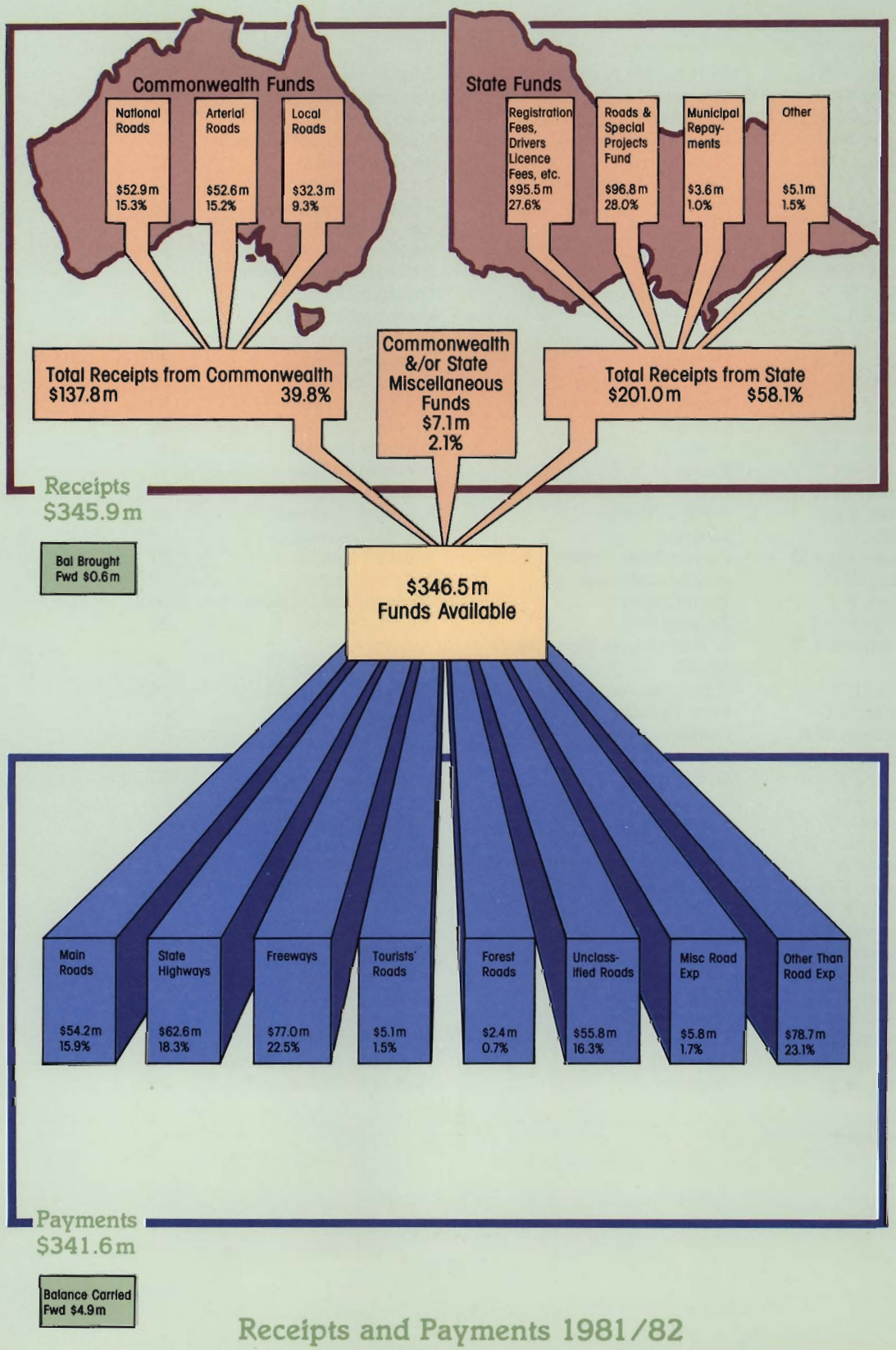
The remainder of the Board's personnel are employed under Victorian State Awards or by an industrial agreement lodged with the Registrar of the Australian Conciliation and Arbitration Commission.

Retirements

Personnel who retired after substantial service with the Board:

Name	Position	Location	Length of Service (years)
Fletcher, P N	Final Ledger Accountant	Chief Accountant's Branch	43
Keating, G	Overseer	Dandenong Division	43
Wilkinson, W M	Superintending Draftsman	Road Design Division	43
Cooper, R G	Chief Accountant	Chief Accountant's Branch	42
Maguire, O H	Truck Driver	Bendigo Division	42
Laity, K M	Instructor Driver	Bendigo Division	37
Pollock, L G	Overseer	Warrnambool Division	36
Fitzgerald, J T	Roadmaster	Metropolitan Division	35
Pryor, H F	Patrolman	Horsham Division	35
Brooks, L N	Fitter	Mechanical Sub-branch	34
Dodds, W	Superintendent of Works	Traralgon Division	34
Scott, E T	Photographer	Photographic Section	32
*Varney, K L	Engineering Assistant	Mechanical Sub-branch	31
Briggs, T C H	Patrolman	Traralgon Division	30
Clarke, S R	Principal Surveyor	Survey Division	30
Juha, F	Patrolman	Traralgon Division	30
McBain, W G	Carpenter	Bendigo Division	30
Mathews, H H	Foreman	Horsham Division	30
Stojanovic, S	Painter	Horsham Division	30
Wittwer, H A	Cost Clerk B	Benalla Division	30
Horne, N J	Clerk of Works	Bairnsdale Division	28
Walsh, J F	Overseer	Bendigo Division	28
Armstrong, A O	Owner Truck Driver	Ballarat Division	27
Fisher, W P	Builders Labourer	Ballarat Division	27
Bryant, N C	Plant Operator	Warrnambool Division	26
Sheldrick, R R	Printing Officer	Printing Section	26
Whitehand, L V	Construction & Maintenance Worker	Geelong Division	25
Batten, L R	Patrol Assistant	Dandenong Division	24
Moylan, R G	Plant Operator	Dandenong Division	24
Bormann, W K	Patrolman	Benalla Division	23
Ferguson, H K	Patrolman	Benalla Division	23
Miller, G T	Overseer	Warrnambool Division	23
Reidy, T H	Overseer	Benalla Division	23
Riaboual, O	Plant Operator	Geelong Division	23
*Wrightson, B E	Storeman	Mechanical Sub-branch	23
Beasley, A	Plant Operator	Bendigo Division	22
Homan, K D	Patrolman	Benalla Division	22
Bartlett, K W	Plant Operator	Benalla Division	21
Lehmann, L M	Draftsman	Warrnambool Division	21
*Pearson, W K	Tanker Driver	Warrnambool Division	21
Rowe, R	Field Assistant	Geelong Division	21
Stewart, A H	Owner Truck Driver	Horsham Division	21
Tuckerman, L C	Plant Operator	Bendigo Division	21
Bertram, E A	Classifier	Secretary's Branch	20
Conway, F G	Field Officer	Traffic Engineering Division	20
Thiele, W J	Engineer	Mechanical Sub-branch	20

*Deceased



Receipts and Payments 1981/82

Receipts

Total funds available to the Board during the year were $346,527,294. The funds were derived from:

		$
State sources		201,007,265
Commonwealth sources		137,840,500
Miscellaneous Funds from State and Commonwealth		7,074,777
Balance brought forward from year 1980/81		604,752
Total		346,527,294
Balance brought forward from year 1980/81 is made up as follows:		
State sources	296,965	
Commonwealth sources	–	
Miscellaneous Funds	307,787	$604,752

The Board's receipts for 1981/82 were obtained from the following main sources:

State sources

1 Motor Registration Fees
Fees payable on the registration and re-registration of motor vehicles and trailers (excluding Metropolitan omnibus registration fees and the specified proportion of registration fees paid first to the Consolidated Fund and after deduction of refunds transferred to the Roads and Special Projects Fund).

2 Registration Number Plate Fees
Fees payable for the provision and/or replacement of number plates (excluding the fees charged for personalised number plates).

3 Examiners' Licence Fees
Fees payable by persons licensed to conduct motor car roadworthiness examinations.

4 Authorised Log Book Fees
Fees payable for the purchase of log books.

5 Learner Driver Permits Fees
Seven-eighths of the permit fee and the permit extension fee payable by applicants for and/or holders of learner driver permits (one-eighth is paid to the Drivers' Licence Suspense Account).

6 Drivers' Licence Testing Fees
Seven-eighths of $4 of the fee payable for the test of proficiency of candidates for motor car drivers' licences (one-eighth of $4 is paid to the Drivers' Licence Suspense Account and the amount of each fee above $4 is paid to the Consolidated Fund).

7 Motor Car Drivers' Licence Fees and Tractor Drivers' Licence Fees
One-eighth of the fees payable for the issue of drivers' licences (one-half is paid to the Consolidated Fund, one-quarter is paid to the Municipalities Assistance Fund; one-eighth is paid to the Drivers' Licence Suspense Account).

8 Motor Driving Instructors' Appointment and Testing Fees
Fees payable by candidates for Motor Driving Instructors' Licences.

9 Motor Driving Instructors' Licence Fees
One-quarter of the fees payable for the issue of Motor Driving Instructors' Licences (one-half is paid to the Consolidated Fund; one-quarter is paid to the Municipalities Assistance Fund).

10 Unregistered Vehicle Permit Fee
A fee for the issue of a permit to use an unregistered motor car or trailer for a period of not more than 7 days.

11 Proprietorship Notification Fee
A fee payable with notification by the proprietor of a motor car or trailer of repossession of the item under the hire purchase agreement bill of sale or like instrument.

12 Fines imposed under the provisions of the Country Roads Act 1958.

13 Not less than 75% of the amount credited to the Roads and Special Projects Fund from motor registration fees [see (1) above] and from licence fees raised under the Business Franchise (Petroleum Products) Act 1979.

14 Municipal payments on account of main road works.

15 Any special moneys appropriated by Parliament.

16 Loan money raised by the issue of inscribed stock.

Items 1-16 inclusive are paid into the Country Roads Board Fund. Prior to 1981/82 amounts collected from Items 1-11 inclusive were subject to deduction of costs of collection for each item. Following the proclamation of the Transport (Fees) Act 1981 deduction of the costs of collection from revenue ceased and in substitution the Board is required to pay an amount determined by the Minister of Transport under S.41(A) of the Transport Regulation Act to meet the costs of administration of the Transport Regulation Board. This payment is shown as an expenditure item and for 1981/82 amounted to $14,995,800. An amount equal to two per cent of the total of items 1-11 inclusive is required to be paid by the Board to the Tourist Fund which is administered by the Ministry of Tourism and an amount equal to one per cent of the total of items 1-11 inclusive is required to be paid by the Board to the Traffic Authority Fund which is administered by the Road Safety and Traffic Authority.

Commonwealth sources

Receipts under the Commonwealth Roads Grants Act 1981.
Receipts under the Commonwealth Transport Planning & Research (Financial Assistance) Act 1977.

Miscellaneous Funds

Funds were also made available through the following trust accounts for the financing of particular works.

Victorian Natural Disasters Relief Account
Municipalities Forest Roads Improvement Fund
Country Roads Board Special Works Account
Commonwealth Works Account
Transport Fund.

The following table shows the funds available to the Board for the construction and maintenance of roads in 1981/82 compared with 1980/81.

Item	1981/82	1980/81
Receipts from State sources	$	$
Fees under the Motor Car Act	95,515,042	66,490,266
Municipalities' contributions	3,587,975	3,395,404
State loan funds	300,000	300,000
Loan funds - Sec 31A Country Roads Act 1958	1,200,000	1,200,000
Special grant from State treasury	124,000	77,000
General receipts	3,490,138	2,841,280
Transfer from Roads and Special Projects Fund	96,790,110	79,500,000
Advances - Sec 31G Country Roads Act 1958	-	4,000,000
Balance brought forward at 1 July	296,965	262,585
	201,304,230	158,066,535
Receipts under Commonwealth grants for roads		
National roads	52,868,000	48,469,000
Arterial roads	52,599,000	48,222,000
Local roads	32,361,000	29,668,000
Balance brought forward at 1 July	-	-
	137,828,000	126,359,000
Receipts under Transport Planning & Research (Financial Assistance) Act 1977	12,500	1,003,123
Miscellaneous Funds		
Victorian Natural Disasters Relief Account	6,235,602	153,957
Other Funds and Accounts	839,175	2,263,973
Balance brought forward 1 July	307,787	77,318
	7,382,564	2,495,248
Total funds available for expenditure by the Board:	346,527,294	287,923,906

The provision of the Commonwealth Roads Grants Act 1980 required each State to achieve a quota of expenditure from its own resources in order to qualify in full for the total amount of the Commonwealth grants. The Commonwealth Roads Grants Act 1981 did not include any provision for expenditure of a quota amount by each State.

Expenditure

Expenditure in the form of cash payments during the financial year amounted to $341,631,604 leaving a balance of $4,895,690 to be carried forward into financial year 1982/83.
The following table shows expenditure incurred by the Board in the years 1981/82 and 1980/81.

Item	1981/82	1980/81
	$	$
Construction and maintenance of roads and bridges	262,942,653	231,756,199
Capital expenditure (plant, workshops, offices, etc.)	3,909,652	3,840,731
Planning and research	4,699,929	4,965,863
Salaries, operating accounts and other administrative expenditure	45,447,249	41,143,641
Country Roads Board's proportion of cost of administration of Transport Regulation Board	14,995,800	Nil
Statutory payments to Traffic Authority Fund, Tourist Fund etc.	1,994,708	2,313,673
Interest and Sinking Fund payments	3,641,613	3,299,047
Repayment of Advance	4,000,000	-
Total	341,631,604	287,319,154

Until 30 June 1981 revenue under the Motor Car Act to the Country Roads Board fund was net of cost of collection of that revenue. From 1 July 1981 in substitution for the cost of collection deduction from revenue, the Board is required to pay an amount toward the cost of administration of the Transport Regulation Board as determined by the Minister of Transport. In 1980/81 the amount of cost of collection of fees deducted from Receipts was $16,277,958. In 1981/82 an amount of $2,505,579 has been shown as a deduction against receipts, being the balance of costs of collection relating to fees received in 1980/81. An amount of $14,995,800 was paid to the Transport Regulation Board under the Minister of Transport's determination for 1981/82.

Sharing the costs of roadworks

The Country Roads Act provides that no more than one-half of the amount expended from loan funds and one-third of the amount expended from the Country Roads Board Fund on main roads during the preceding financial year shall be apportioned between the various municipalities benefited thereby. The Act also provides that the amount apportioned to a council in respect of expenditure charged to the Country Roads Board Fund may be reduced where the cost of maintenance is excessive due either to motor traffic not of local origin or to timber traffic. The revenue, valuation, and rating of the municipality and its financial obligations for loan expenditure on permanent works are taken into account in deciding the level of contribution by a council.
In September 1981 expenditure on the normal program of main roads works in financial year 1980/81 was apportioned in accordance with the Country Roads Act, resulting in the following distribution of expenditure other than Loan Fund expenditure:

	$
Expenditure from Country Roads Board Fund	33,257,094
Expenditure from Commonwealth funds	11,586,539
Total	44,843,633
Amount of Country Roads Board Fund expenditure apportioned to councils	$3,416,803

Within the limit of funds available, the Board made allocations to municipal councils for works on unclassified roads. The expenditure incurred from the allocations made by the Board in financial year 1981/82, compared with 1980/81 was as follows:

	1981/82		1980/81	
	CRB	Contribution	CRB	Contribution
	$	$	$	$
Patrol maintenance	3,175,013	1,373,542	2,990,037	1,310,517
Construction, reconstruction and other maintenance	44,920,953	10,592,656	43,243,989	9,988,766
Total	48,095,966	11,966,198	46,234,026	11,299,283

Municipal councils were not required to contribute towards the cost of works involving an expenditure during the year of $147,091,508 on State highways, freeways, tourists' roads and forest roads.

		Country Roads Board Fund	Roads Grants Act 1981 Trust Account	Transport Plan. & Res. (Fin. Asstnce.) Act 1977 Trust Account	Vic. Natural Disasters Relief Trust Account	Other Trust Accounts (1)	Total $
Balance as at 1 July 1981		296,965				307,787	604,752
Motor Car Act 1958							
Motor Car Registration Fees	91,391,848						
Drivers Licence Fees	2,948,367						
Drivers Licence Testing Fees	528,892						
Trailer Registration Fees	2,544,741						
Learner Drivers Permit Fees	557,639						
Examiners Licence Fees	10,494						
Sale of Log Books	24,530						
Motor Driving Instructors Licence - Appointment and Testing Fees	2,835						
Motor Driving Instructors Licence Fees	11,275						
	98,020,621						
Less: Cost of Collection (2)	2,505,579	95,515,042					95,515,042
Municipalities Contributions							
Permanent Works - Main Roads	137,400						
Maintenance Works - Main Roads	3,450,575	3,587,975					3,587,975
Transfer from Roads and Special Projects Fund		96,790,110					96,790,110
General Receipts		3,485,249					3,485,249
Fines - Country Roads Act 1958		4,889					4,889
Grant - Works & Services Appropriation Act 1981 No. 9649		124,000					124,000
Loan - Works & Services Appropriation Act 1981 No. 9649		300,000					300,000
Loans - Country Roads Act 1958 Section 31A		1,200,000					1,200,000
Commonwealth Grants							
Roads Grants Act 1981			137,828,000				137,828,000
Transport Plan. & Res. (Fin. Asstnce.) Act 1977				12,500			12,500
Natural Disasters Relief Funds					6,235,602		6,235,602
Miscellaneous Funds						839,175	839,175
		$201,304,230	137,828,000	12,500	6,235,602	1,146,962	346,527,294

Road Expenditure								
Main Roads	– Construction and Reconstruction	17,750,462	13,953,804		426,580	115,410	32,246,256	
	Maintenance	20,983,861			990,740		21,974,601	54,220,857
State Highways	– Construction and Reconstruction	10,638,446	27,070,110		113,656	427,877	38,250,089	
	Maintenance	20,636,518	3,219,193		470,086		24,325,797	62,575,886
Freeways	– Construction and Reconstruction	39,935,067	32,044,090			149,314	72,128,471	
	Maintenance	3,432,955	1,422,946				4,855,901	76,984,372
Tourists' Roads	– Construction and Reconstruction	1,946,966			36,150		1,983,116	
	Maintenance	3,026,647			48,698	54,964	3,130,309	5,113,425
Forest Roads	– Construction and Reconstruction	806,535			64,700		871,235	
	Maintenance	1,546,090			500		1,546,590	2,417,825
Unclassified Roads	– Construction and Reconstruction	10,148,847	30,657,510		329,650	38,403	41,174,410	
	Maintenance	1,635,873	8,660,949		3,754,842	63,814	14,115,478	
	Tram Tracks Reconstruction (MMTB)	500,000					500,000	55,789,888
Murray River Bridges & Punts		334,244	914,031					1,248,275
Rail/Road Bridges Protection		1,033,732						1,033,732
Traffic Line Marking		2,969,393	589,000					3,558,393
Statutory Payments								
Interest and Sinking Fund – State Loans	3,093,571							
Interest and Loan Repayments – Board's Loans	538,042							
Sinking Fund Contribution – Country Roads Act 1958 Sec. 31C	10,000							
Traffic Authority Fund	664,903							
Tourist Fund	1,329,805							
Transport Regulation Fund (2)	14,995,800	20,632,121						20,632,121
Planning and Research		4,687,429		12,500				4,699,929
Capital Expenditure								
Plant Replacement and Additions	3,143,823							
Buildings, Workshops, etc.	765,829	3,909,652						3,909,652
Management & Operating Expenditure		25,963,639	19,296,367			187,243		45,447,249
Repayment of Advance Country Roads Act 1958 Sec. 31G		4,000,000						4,000,000
		$196,518,477	137,828,000	12,500	6,235,602	1,037,025		341,631,604
Balance available to the Board as at 30 June 1982		$4,785,753				109,937		4,895,690

(1) **Other Trust Accounts Comprise:**
Commonwealth Works Account
Country Roads Board Special Works Account
Municipalities Forest Roads Improvement Fund
Transport Fund

(2) The amount of $2,505,579 shown as cost of collection is the balance of costs relating to fees received in 1980/81. Until 30 June 1981, revenue collected under the Motor Car Act, and paid to the Country Roads Board Fund was net of cost of collection of that revenue. From 1 July 1981 the Board is required to pay an amount as determined by the Minister of Transport toward the cost of administration of the Transport Regulation Board in substitution for the cost of collection deduction previously made from revenue. The amount determined for 1981/82 was $14,995,800. This amount is shown in the above statement under the heading Statutory Payments.

Supplementary information and notes to and forming part of the consolidated statement of receipts and payments

(a) **Basis of Accounting**
In accordance with past practice for non-trading government authorities, the Board's accounts have been prepared on a cash basis using the historical cost convention.

(b) **Receipts**
Amounts shown in the statement for Municipal Contributions, General Receipts and Loans under Section 31A of the Country Roads Act 1958 are collected by the Board. All other amounts shown are provided to the Board by other bodies or are collected and paid by other bodies to Treasury to the credit of the various funds shown in the statement.

(c) **Provision for Accrued Charges**
No provisions have been made in the Board's accounts for entitlements of employees to accrued annual leave, long service and retirement benefits. Funds for these items are provided in each annual budget.

(d) **Treatment of Assets**
No provision is made for the depreciation of assets. Outlays on assets are not capitalized being recorded as expenditure wholly in the year of acquisition. A subsidiary record of assests is maintained.

Statement by Principal Accounting Officer

To the best of my knowledge and belief the accompanying accounts of the Country Roads Board for year ended 30 June 1982 represent a true and fair view of the financial results of the Board's transactions for that period.

R J Bulman
Chief Accountant — 21 September 1982

Statement by Board

In my opinion the accompanying statement of receipts and payments is drawn up to give a true and fair view of the financial operations of the Country Roads Board for year ended 30 June 1982.

T H Russell
Chairman — 21 September 1982

Auditor's Report

The accounts of the Country Roads Board for the year ended 30 June 1982 have been audited. In my opinion, the accompanying statement of receipts and payments, together with notes (a) to (d), fairly present in summary form the transactions during that period.

B J Waldron
Auditor-General — 4 October 1982

APPENDIX 2

Loan Liability to the Government of Victoria

as at 30 June 1982

	Main Roads etc.	Developmental Roads	Total
Permanent Works	$	$	$
Main Roads	16,730,322.16		16,730,322.16
State Highways (1)	19,604,304.20		19,604,304.20
Freeways	3,000,000.00		3,000,000.00
Tourists' Roads	227,316.44		227,316.44
Forest Roads	2,167.89		2,167.89
Unclassified Roads	900,000.00		900,000.00
Developmental Roads		12,851,515.09	12,851,515.09
Discount and Expenses	800,302.31	590,150.63	1,390,452.94
Total Amount Borrowed	41,264,413.00	13,441,665.72	54,706,078.72
Less: Redemption of Loans			
Redemption Funds	170,438.11	1,292,772.73	1,463,210.84
Main Roads Sinking Fund	571,376.76		571,376.76
Developmental Roads Sinking Fund		110,166.02	110,166.02
State Loans Repayment Fund	3,891,919.39		3,891,919.39
National Debt Sinking Fund	11,858,672.21	10,531,503.29	22,390,175.50
Consolidated Fund	114,456.70		114,456.70
	16,606,863.17	11,934,442.04	28,541,305.21
Loan Liability at 30 June 1982	**24,657,549.83**	**1,507,223.68**	**26,164,773.51**

(1) An amount of $600,000, previously shown as applicable to State Highways, has been transferred to the heading of Unclassified Roads. This amount represents Loan Funds made available in 1979/80 and 1980/81 under the respective Transport Works & Services Acts for 1979 and 1980. A further $300,000 was made available in 1981/82 under the 1981 Transport Works & Services Act bringing the total to date applicable to Unclassified Roads to $900,000 representing Loan Funds made available for expenditure on roads which provide access to areas of tourist interest and in or near National Parks.

APPENDIX 3

Loans raised by the Country Roads Board

under authority of Country Roads Act 1958 Sec 31A (Borrowing Powers)

Loan No.	Lender	Type of Loan	Interest Rate	Date Raised	Maturity Date	Amount of Loan $	Amount Redeemed	Loan Liability as at 30 June 1982
1.	State Insurance Office	Inscribed Stock	9.5%	30 Mar 79	30 March 89	500,000.00		500,000.00
3.	State Insurance Office	" "	10.8%	31 Jan 80	31 Jan 90	500,000.00		500,000.00
5.	The National Bank Savings Bank Limited	" "	9.3%	15 Jun 79	15 June 94	500,000.00	53,868.73	446,131.27
6.	The National Bank Savings Bank Limited	" "	12.6%	13 Jun 80	13 Jun 90	700,000.00	80,956.72	619,043.28
7.	State Insurance Office	" "	13%	28 Feb 81	28 Feb 88	500,000.00		500,000.00
8.	The National Bank of Australasia Limited	" "	13.9%	30 Apr 81	30 Apr 91	700,000.00	35,530.19	664,469.81
9.	State Insurance Office	" "	15.8%	30 Nov 81	30 Nov 88	500,000.00		500,000.00
10.	The National Bank Savings Bank Limited	" "	16.0%	15 Jun 82	15 Jun 97	700,000.00		700,000.00
					TOTAL	4,600,000.00	170,355.64	4,429,644.36

Sinking Fund Contribution – Country Roads Act 1958 Sec 31C

Invested with	Type of Investment	Interest Rate	Date Invested	Maturity Date	Amount $
State Electricity Commission of Victoria	Inscribed Stock	10.5%	1 Dec 79	1 Dec 89	5,000.00
State Electricity Commission of Victoria	" "	10.9%	1 Mar 80	1 Mar 90	2,500.00
State Electricity Commission of Victoria	" "	15.7%	1 Dec 81	1 Dec 91	16,500.00
State Electricity Commission of Victoria	" "	15.7%	1 Mar 82	1 Mar 92	2,500.00

APPENDIX 4

Lengths of State highways, freeways, tourists' roads and forest roads

State highways – declared as at 30.6.82

Name	Route	Length (kilometres)
Bass	Lang Lang–Inverloch	60.1
Bellarine	Geelong–Queenscliff	31.6
Bonang	Orbost–NSW border near Delegate	114.2
Borung	Dimboola–Charlton	123.3
Burwood	Burwood–Ferntree Gully	20.4
Calder*	Melbourne–Mildura	554.6
Cann Valley	Cann River–NSW border	44.9
Eastern*	Nicholson Street–Gold Street	1.2
Glenelg	Ballarat–SA border near Mt Gambier	282.2
Goulburn Valley	Eildon–Strathmerton	223.0
Hamilton	Geelong–Hamilton	231.0
Henty	Portland–Lascelles	332.7
Hume*	Melbourne–NSW border near Albury	178.6
Kiewa Valley	Bandiana–Mt Beauty	78.5
Loddon Valley	Bendigo–Kerang	123.7
Maroondah	Melbourne–Mansfield	184.6
McIvor	Heathcote–Bendigo	44.1
Midland*	Geelong–Mansfield	415.1
	Morwell–Port Welshpool	79.2
Murray Valley	Corryong–Hattah	736.5
Nepean	Melbourne–Portsea	90.5
Northern	Kilmore–Echuca	161.9
Omeo	Bairnsdale–Tallangatta	282.5
Ouyen	Ouyen–SA border near Pinnaroo	130.7
Ovens	Wangaratta–Bright	76.2
Princes (East)*	Melbourne–NSW border near Genoa	488.0
Princes (West)*	Melbourne–SA border near Mt Gambier	401.4
Pyrenees	Elphinstone–Ararat	147.1
South Gippsland*	Dandenong–Yarram–Sale	254.0
Sturt	Mildura–SA border near Renmark	113.6
Sunraysia	Ballarat–Calder Highway	340.0
Warburton	Lilydale–Warburton	34.6
Western*	Melbourne–Serviceton	371.4
Wimmera	Apsley–St Arnaud	222.7

*Lengths quoted do not include freeway sections

Freeways – as at 30.6.82

Name	Section	Length (kilometres)
Calder	Keilor	6.6
	Elphinstone	2.8
Eastern	Gold Street to Doncaster Road	11.7
Frankston	Armstrongs Road to Beach Street	5.8
Hume	Craigieburn to Kalkallo	8.3
	Beveridge to Tallarook	52.1
	Avenel	30.0
	Violet Town–Baddaginnie	20.7
	Chiltern	21.3
Midland	Yinnar	9.6
Mornington Peninsula	Springvale Road to Armstrongs Road	8.1
	Dromana to Rosebud	8.4
Princes	Mulgrave	19.5
	Drouin, Moe and Haunted Hills	25.2
	Orbost	5.9
	Laverton to Lara	47.4
	Dartmoor	3.0
South Eastern	Anderson Street to Tooronga Road	6.8
South Gippsland	Princes Freeway to South Gippsland Highway	5.6
	Whitelaw	3.8
Tullamarine	Flemington Bridge to Melbourne Airport	20.9

Freeways continued

West Gate	Bertie Street to Graham Street	.3
	Williamstown Road to Princes Freeway	5.1
Western	Deer Park to Melton	13.3
	Bacchus Marsh to Gordon	42.4

Tourists' roads – declared as at 30.6.82

Name	Municipalities	Length (kilometres)
Acheron Way	Healesville and Upper Yarra Shires	35.4
Alpine	Bright and Omeo Shires	83.0
Arthur's Seat	Flinders Shire	8.1
Bogong High Plains	Bright and Omeo Shires	66.7
Cameron Drive	Gisborne and Newham and Woodend Shires	4.3
Donna Buang	Healesville and Upper Yarra Shires	34.0
Gipsy Point	Orbost Shire	2.4
Grampians	Ararat, Dundas and Stawell Shires and Stawell Town	69.5
Great Ocean	Barrabool, Winchelsea, Otway, Heytesbury and Warrnambool Shires	208.0
Mallacoota	Orbost Shire	22.5
Mount Abrupt	Ararat and Mount Rouse Shires	24.8
Mount Buffalo	Bright Shire	39.0
Mount Buller	Mansfield Shire	27.0
Mount Dandenong	Sherbrooke and Lillydale Shires	21.8
Mount Victory	Arapiles, Stawell and Wimmera Shires	30.7
Marysville–Woods Point	Healesville Shire	18.9
Otway Lighthouse	Otway Shire	12.9
Phillip Island	Bass and Phillip Island Shires	23.4
Silverband	Stawell Shire	9.1
Sydenham Inlet	Orbost Shire	21.6
Wartook	Wimmera Shire	3.5
Wilsons Promontory	South Gippsland Shire	31.0

Forest roads – declared as at 30.6.82

Name	Municipalities	Length (kilometres)
Bairnsdale–Dargo	Avon and Bairnsdale Shires	20.8
Bealiba–Moliagul	Bet Bet Shire	9.0
Beech Forest–Mt Sabine	Otway Shire	12.6
Benambra–Corryong	Omeo, Tallangatta and Upper Murray Shires	76.5
Benambra–Limestone	Omeo Shire	14.3
Bendoc–Orbost	Orbost Shire	20.9
Brookville	Omeo Shire	15.9
Bruthen–Buchan	Tambo Shire	36.5
Bullumwaal–Tabberabbera	Bairnsdale Shire	30.3
Carrajung–Woodside	Alberton Shire	17.7
Dargo	Avon Shire	74.8
Deans Marsh–Lorne	Winchelsea Shire	22.9
Drummond–Vaughan	Daylesford and Glenlyon and Newstead Shires	20.9
Epsom–Fosterville	Huntly Shire	20.4
Forrest–Apollo Bay	Otway Shire	19.7
Greendale–Trentham	Ballan and Kyneton Shires	23.8
Heyfield–Jamieson	Mansfield and Maffra Shires	145.5
Inglewood–Rheola	Korong Shire	17.3
Kimbolton	Strathfieldsaye Shire	13.5
Lavers Hill–Cobden	Heytesbury and Otway Shires	42.7
Meredith–Steiglitz–Maude	Bannockburn Shire	20.7
Murrungower	Orbost Shire	21.3
Portland–Nelson	Portland Shire	38.6
Red Knob	Tambo Shire	7.2
Tatong–Tolmie	Benalla Shire	36.3
Timbarra	Tambo Shire	19.5
Walhalla	Narracan, Mansfield and Upper Yarra Shires	110.7
Warburton–Woods Point	Healesville, Upper Yarra and Mansfield Shires	103.4
Warrowitue	McIvor Shire	16.5

APPENDIX 5

Motor registrations

Registrations under the Motor Car Act during 1981/82 totalled 2,590,371, an increase of 5.12% over the total previous year.

Vehicle	1980/81		1981/82		Increase
Private					
New	120,256		136,679		
Secondhand:					
Re-registered	58,040		67,632		
Renewed	1,631,348	1,809,644	1,691,829	1,896,140	86,496
Commercial and Hire					
New	15,549		18,603		
Secondhand:					
Re-registered	5,262		5,791		
Renewed	147,664	168,475	149,801	174,195	5,720
Primary Producers' Trucks and Tractors					
New	5,071		5,600		
Secondhand:					
Re-registered	4,514		4,735		
Renewed	82,526	92,111*	89,404	99,739†	7,628
Trailers		327,439		343,923	16,484
Motor Cycles		65,636		75,457	9,821
Licences under the Motor Omnibus Act		925		917	−8
TOTALS		2,464,230		2,590,371	126,141

*Includes 44,702 no-fee tractors †Includes 49,048 no-fee tractors

Country Roads Board

Report of the Engineer in Chief

1981-1982

Engineer in Chief's Report

Country Roads Board
Melbourne

The Chairman

I submit herewith the Engineer in Chief's Report for 1981/82. The Report deals with those activities within the Engineer in Chief's Branch which are considered to be of general or specific technical interest.

K G Moody
Engineer in Chief

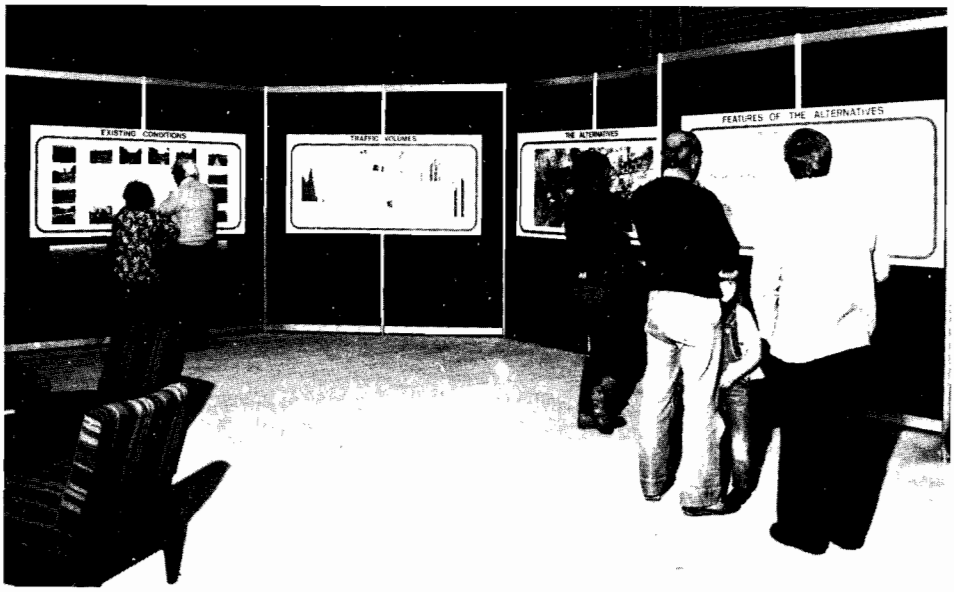
Contents

Public participation in planning investigations

Participation by the community in planning investigations during the year has been fostered by preparing public displays on four particular proposals. The aim of the displays has been to provide information and obtain local views and ideas about the proposals being developed either by the Board alone or jointly with municipal councils.

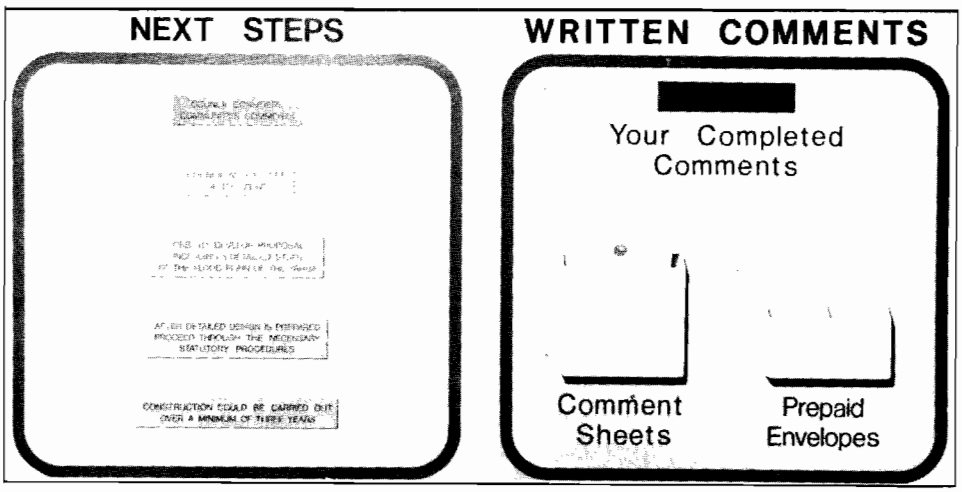
Alternative Crossing of Yarra River at Yarra Glen

The existing main road bridge across the Yarra River at Yarra Glen is obsolete and the Healesville Shire wished to obtain an assessment of local opinion on the relative merits of alternative locations for a replacement bridge. The display presented information on existing traffic conditions and described how the alternatives would connect into the existing road system and modify routes taken by through traffic. There was intense local interest in the display and a good return of constructive comments. As a result of the display, the Council will be able to take account of local opinion in supporting a particular alternative bridge location.



Above: The display at the Yarra Glen shopping centre provided the opportunity for interested members of the public to learn of the alternative proposals for a new crossing of the Yarra River at Yarra Glen

Below: Two of the display panels at Yarra Glen: one inviting comment from the public, the other indicating the process of consideration, review and project development



Punt Road Improvements—Bridge Road to the Yarra River

The results of preliminary investigations for improvements to Hoddle Main Road (Punt Road) between Bridge Road and the Yarra River in the Cities of Melbourne and Richmond were presented in a Summary Report distributed to municipal councils, other Government agencies and Members of Parliament. A display based on the Summary Report was presented at the local primary school during July 1981. The display was manned and attracted many local residents who studied the proposals closely and commented on desired additional road improvements and matters such as possible uses of remnant land.

Werribee Level Crossing Study

The Werribee Level Crossing Study is a joint study with the Werribee Shire Council to examine possible improvements to access across the Geelong railway line. The display prepared for the Werribee Shire presented information on existing and possible future traffic demands and descriptive characteristics of possible grade separation sites. This display was arranged early in the study to learn the local community's views on the traffic problems and possible solutions, and allow the study team to concentrate on the more significant perceived problems.

Freeway F5/Greensborough Road Connection Project

A Summary Report on the F5/Greensborough Road Connection Project was distributed at the end of 1981, with an offer to three municipal councils that the Board was willing to prepare an information display for use by the councils to publicise the proposals in their areas. The display, based on the Summary Report, presented information on existing traffic and future traffic demands with and without the project. The plans in the display also showed the possible long term road development that has been designed to use road reservations provided in the Melbourne Metropolitan Planning Scheme. The presentation of the display at the Greensborough shopping centre attracted much interest.

After some trial and error, staff involved in preparing the display panels have established effective ways to colour, protect and mount the material. It is important to choose and prepare material with particular attention to translating technical information into clear and concise written and graphical formats. The information is arranged to assist viewers to understand the issues and concepts of each particular study and to guide them through the display. The last panel in each display is usually a graphic presentation of the study and decision-making procedures and provides for the distribution and collection of comment forms.

Manning the displays has proved useful in offering further explanations and answers, both specific and general, to the public. A manned display also provides a more friendly and personal atmosphere even if no additional information is communicated.

Public displays at various stages of an investigation have proved effective in fostering community participation and understanding of particular proposals.

Eastern Freeway Arterial Road Extension

Precast Concrete Median Barrier

The median barrier on the Arterial Road Extension of the Eastern Freeway between Bulleen Road and Doncaster Road, North Balwyn, consists of 410 precast concrete units, each 6.2m long and 4.6 tonnes. Of the total number of units, 362 are of a standard form, 45 accommodate road lighting poles, one includes the base for a gantry sign structure, and two end units are tapered in height. The total length of the barrier is 2.5km.

The faces of the barrier follow the shape of the New Jersey barrier which was developed to deflect impacting vehicles at low levels of deceleration; at the usual angles of impact, a vehicle is redirected into the adjacent traffic lane on a path roughly parallel to the line of the barrier. Impact energy is absorbed more by compression of the suspension system of the vehicle rather than by crushing of the bodywork or deflection of the barrier. Relatively little damage is therefore sustained by the vehicle or the barrier, and the risk of injury to vehicle occupants is minimised.

Above: The concrete median barrier on the Eastern Freeway Arterial Road Extension

The units were designed to facilitate manufacture, speed of placing, and subsequent removal in conjunction with any future road widening or replacement of damaged components. The cross-section of the units is approximately 100mm wider than normally used in order to allow attachment of lighting poles to the tops of the units. The steel reinforcement in each unit consists of a sheet of fabric in each face, and some bars in the lighting pole units and the sign gantry unit to provide for connection to the foundations.

Cast-in-place shear keys were used to connect each unit to its neighbours; this connection is required to ensure that at least three units act together in resisting the overturning forces of vehicle impacts. Casting of the keys after placing the units provided a positive connection between them and facilitated easier placing in that the units were simply butted together continuously in both directions. A damaged unit can be replaced by removing the shear keys at each end of the unit and lifting it out without disturbing adjacent units. Cored holes were cast in each end of the units within the shear key recess to facilitate lifting, handling and placing operations.

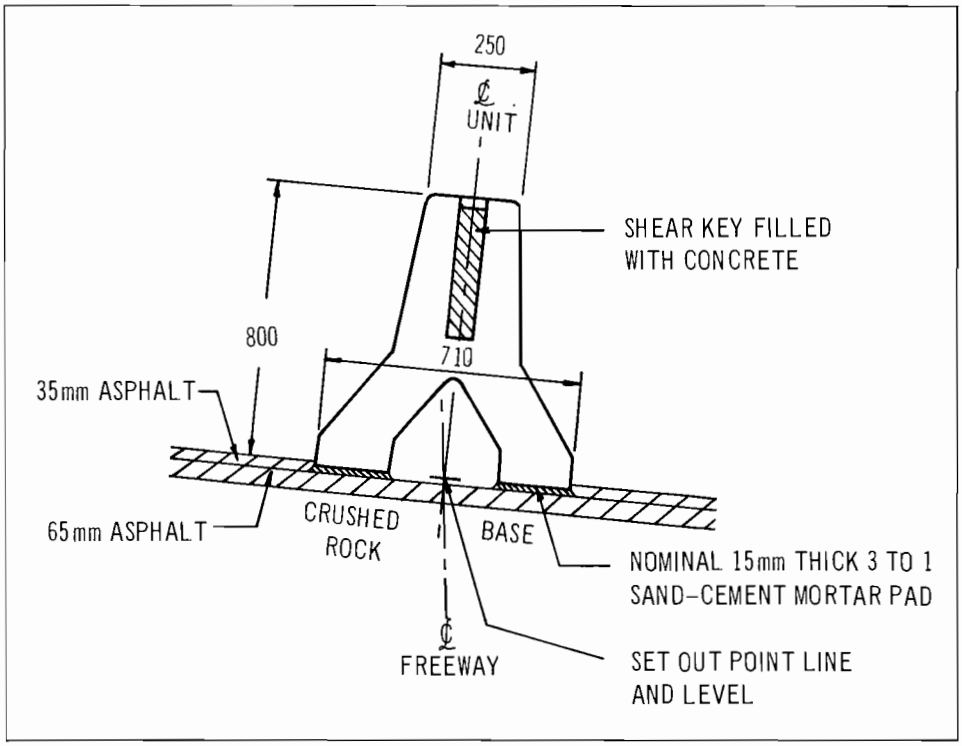


Figure 1: Cross section of a precast concrete barrier unit

In the interests of improved appearance and speed of erection, the lighting poles were located on top of units rather than on separate footings between two units. A recess with four holding bolts was cast into the top of each relevant unit; the relevant base plate fits within this recess and is covered by two galvanized steel plates matching the shape of the unit. The lighting pole barrier units were located at 56m centres straddling spread footing excavations. After placing these barrier units, the footings were cast to key into reinforcing protruding from beneath the barrier units. The wiring for the lighting was placed in the recess beneath the units.

All other units were placed on a nominal 15mm mortar pad on the first asphalt pavement layer.

The Board's Glen Waverley Precasting Yard manufactured 173 standard units and 22 lighting pole units using four moulds, and the remaining units were manufactured by the Bendigo Divisional Precasting Yard using five moulds. All units were cast upside down to eliminate the need to hand-finish the top surfaces, and to avoid trapping air or water bubbles against the sloping surfaces of the steel moulds.

A 24 hour casting cycle was achieved without the need for steam curing by using 35 MPa concrete. The units were lifted from the moulds using specially designed spreader beams which had the facility to rotate the units about their longitudinal axes to turn them the correct way up for curing and storage. All units were moist cured under hessian for seven days.

Barrier units were placed on a prepared mortar bed by means of a mobile crane; plywood packers were fixed to the pavement in advance of the placing operation to achieve the required line and level. Two men were employed in placing the units, with another man following on striking off the mortar base and cleaning up.

The whole of the placing operation was completed in 14 working days; over 200 metres of barrier was erected each day when the routine of the operation had been established.

The cost of manufacture of the units was $55 per lineal metre, or $196 per cubic metre of concrete. The total cost of the barrier in place was approximately $75 per lineal metre.

Koonung Creek Underground Conduit

Hydraulic Model Study of Inlet Structure

The construction of the Arterial Road Extension of the Eastern Freeway required that Koonung Creek be relocated between Doncaster Road and Thompsons Road over a distance of 2.5km. Several alternative methods of relocating the creek were investigated, and because of economic and environmental advantages an underground conduit was adopted (see 1979/80 Report).

The underground conduit consists of precast reinforced concrete half-arch units placed on a cast-in-place reinforced concrete base slab. The conduit is designed to carry the estimated 100 year return period flood of 120 m^3/sec at a supercritical velocity of 7 m/sec.
To ensure that this velocity is achieved before the flow enters the conduit, an inlet structure is required to accelerate the velocity of flow from 2 m/sec to 7 m/sec and to provide a transition from the natural stream cross-section to the conduit cross-section. The inlet structure is also required to contain a drop structure, a rack to collect large debris, a frangible safety gate and a vehicular access ramp. The overall length of the inlet structure is 90 metres.
Because of the complex form of the inlet structure, mathematical modelling of its hydraulic performance could not be relied upon. It was therefore decided to commission the Civil Engineering Department of Monash University to construct and test a hydraulic model of the inlet structure and a short length of conduit.
The model was constructed at one thirtieth full size and fabricated from timber, perspex, cement mortar and steel. The inlet structure section of the model included the drop structure, debris rack, and frangible gate. The conduit section of the model was constructed on a curved alignment 2.5 m long, representing 75 m of the prototype conduit. The model was constructed to very close tolerances and the invert slope set to within 0.5 mm. The volume of water flowing through the model was accurately measured by an electronic flow meter installed in a pipe carrying water to the baffle box at the upstream end of the model.
The model was tested for flows of 25, 50, 75 and 100 per cent of the 100 year flood. The volume of water required to simulate the 100 year flood was 0.024 m^3/sec or one five-thousandth of the prototype flow. Debris collecting on the frangible gate was modelled and the force applied to the gate by the water impinging on the debris was measured to enable design of the frangible connections to be carried out.
Flow velocities throughout the length of the model of the inlet structure were measured during the tests and photographs of flow patterns were taken. Water surface profiles were also measured. Because of the high velocities of flows involved near the entrance to the conduit the effect of minor changes to the model on crosswaves was closely observed.
During the tests, it became apparent that modifications to the model were required to achieve a satisfactory solution. The transition fillets at the entrance to the conduit were doubled in size and an entraining wall was included adjacent to the vehicular access ramp. Other minor modifications were carried out to the model until crosswaves were reduced to a minimum and the flow pattern at the entrance to the conduit was acceptable. Measurements taken just outside the entrance to the conduit confirmed that the velocity was slightly over 7 m/sec.
The geometry of the final configuration of the hydraulic model was used to establish the geometry of the prototype inlet structure and the structural design was carried out.
Construction of the inlet structure is proceeding and is programmed for completion in September 1982. The cost of the hydraulic model study was $17,000. The estimated cost of the inlet structure is $200,000.

Princes Freeway (Berwick Section)

Cardinia Creek culvert

The Princes Freeway (Berwick Section) crosses the Cardinia Creek flood plain immediately south-east of Beaconsfield on an embankment of height varying from 7 to 11 metres above natural surface.
The Dandenong Valley Authority (DVA) proposed the construction of a retarding basin at this location as part of its works to control flooding downstream of Beaconsfield.
The concept developed by the Authority involves using the freeway embankment to form a retarding basin with a low-flow pipeline (1500 mm reinforced concrete pipe) providing the only creek discharge (7.6 m^3/sec maximum) until the impounded water level reaches the sill of the high-flow structure inlet, which is some 2.9 m above the flood plain level.
The high flow structure consists of a fan-shaped inlet leading to a 4 m x 4 m reinforced concrete culvert (with water flowing at supercritical velocity of up to 8.4 m/sec) and an outlet structure incorporating a 'ski-jump' type energy dissipator designed to restore normal flow velocity downstream. Figure 2 shows an isometric view of the proposed structure.
An emergency spillway is provided by a nearby road which is overpassed by the freeway. The high flow culvert would operate at least once every two years and could be expected to operate for at least 18 hours during the critical duration of 100 year return period flood (64 m^3/sec discharge). Under the same conditions, the emergency spillway provided by the nearby road could operate for about 3 hours with a very small discharge.

Substantial savings to both the Board and Dandenong Valley Authority are expected with the adoption of this scheme. The estimated saving to the Board is approximately $350,000 when compared with a bridging alternative. The saving to DVA has been estimated at $150,000 compared with the cost of providing a retarding basin independent of the freeway.
The hydraulic design of the structure was carried out by DVA using model testing techniques. The inlet structure and culvert were designed to provide a hydraulically smooth flow with a culvert of minimum dimensions and low susceptibility to debris blockage.
The outlet structure (or energy dissipator) was designed to be wholly within the freeway reserve with exit flows compatible with existing tailwater conditions. The other design criteria were minimized interference to flow conditions within the culvert and low susceptibility to debris blockage.
The culvert has a 4m × 4m reinforced concrete barrel consisting of precast RC crown units on an RC cast-in-place base slab. Each precast unit is 2m long and 20 tonnes mass. The inlet structure consists of a 'fan' comprising a curved RC floor, RC retaining walls and cutoff walls. The outlet structure is an RC energy dissipator of the ski-jump type which is partly recessed into the embankment and incorporates a ramp and stilling basin with a head wall and side retaining walls.

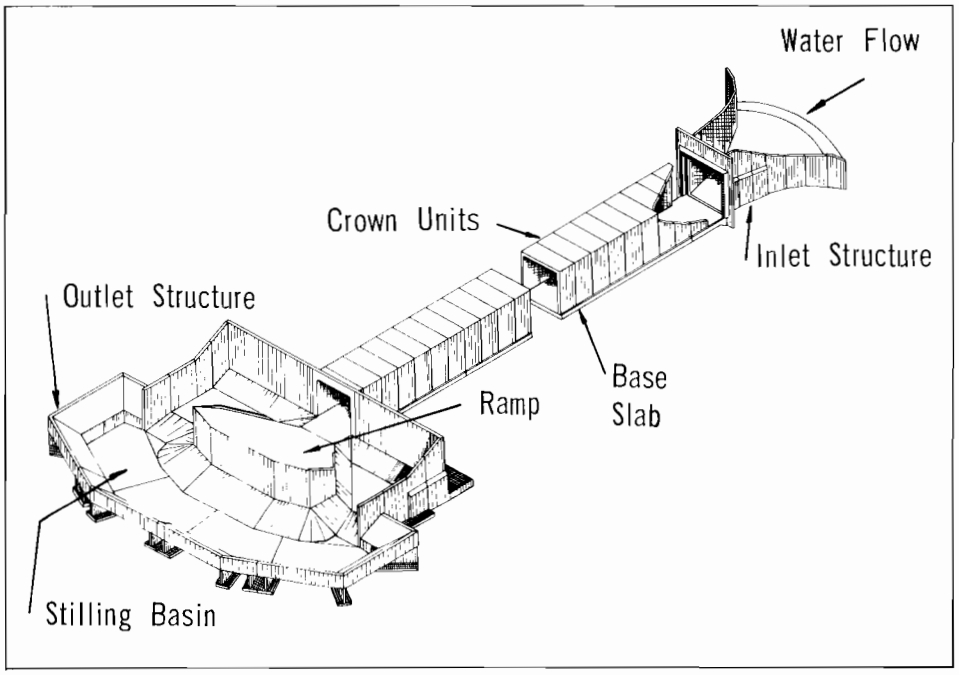


Figure 2: Isometric view of the proposed Cardinia Creek culvert on the Princes Freeway, Berwick Section

The maximum height of the embankment at the site of the proposed structure is 10m and the expected settlement is calculated to be 150mm under the full embankment fill reducing under the batters to be negligible at the batter toes.
To limit the differential settlement for the structure and to monitor settlements, the full embankment will be constructed to the finished level at the site of the high flow structure. After a minimum of three months (or on completion of settlement as monitored) some of the embankment will be removed for the construction of the structure, which is planned to commence late 1982.

"Reinforced earth" approaches to bridge abutments

Details of the reinforced earth walls constructed for the northern and southern approaches to bridges over the railway at Latrobe Terrace, Geelong were included in the 1979/80 Report. Reinforced earth has since been used for construction of retaining abutments for the twin bridges over the railway on the Princes Freeway (Berwick Section) at Narre Warren and for the Frontage Road bridge over the railway on the Princes Freeway (Warragul Section) near Drouin. Reinforced earth retaining abutments are also to be constructed for the temporary bridge at the Western Interchange of the Princes Freeway (Berwick Section) and for the Lowe Street bridge over the railway at Ararat.

Princes Freeway, Narre Warren

The Princes Freeway bridges at Narre Warren comprise steel plate girders continuous over two spans with composite concrete decks. Alternative forms of bridging using conventional spill-through abutments were considered but the arrangement incorporating reinforced earth retaining abutments was estimated to cost approximately $150,000 less than the other alternatives.

The reinforced earth retaining walls could not be relied upon to support the abutment crossheads because of estimated settlements of up to 40mm beneath the approach embankments. The abutments were therefore supported on piles. The reinforced concrete and prestressed concrete piles were driven prior to construction of the reinforced earth walls. The piles were bitumen coated before driving to minimize down-drag effects accompanying settlement. The pile layout was arranged to allow the steel reinforcing strips for the reinforced earth structures to pass between the piles. Compaction of the fill material around the piles required the use of small compaction equipment but satisfactory results were achieved.

The cost of the reinforced earth retaining abutments was within estimate at a final cost of $342,000 (equivalent to $345 per square metre of face area).

Frontage Road, Drouin

The Frontage Road bridge over the railway near Drouin is a single span structure with steel beams and composite concrete deck. The railway tracks at this site are in a cutting and, because settlement of abutment filling was not a problem, the superstructure was supported on concrete abutments cast directly onto reinforced earth embankments.

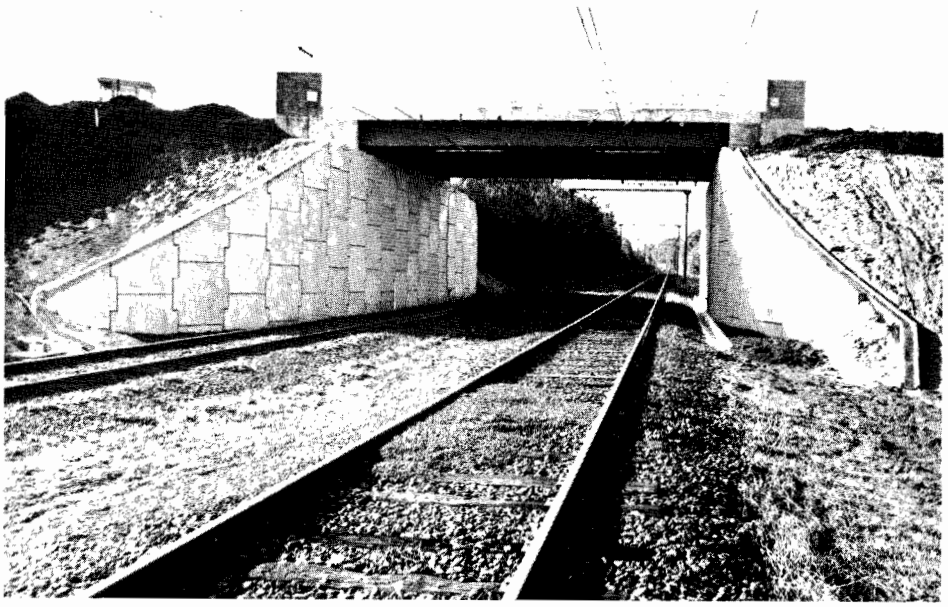
Reinforced earth wall construction is particularly suited to locations where access to the face side of the wall is restricted by road or rail traffic because the construction may be carried out from behind the concrete face panels. At the Frontage Road bridge, both abutments are close to rail tracks where electric trains operate throughout the day. The construction of the walls was carried out with minimal interference to rail traffic using safe construction methods which maintained the necessary lateral clearance from the rail tracks.

The ends of the reinforced earth walls were flared away from the railway providing additional safety in the event of accidents resulting from derailments or dislodgement of loads from rail vehicles. It was not necessary to provide the massive piers which are often required adjacent to rail tracks to protect bridges from possible damage from rail traffic.

The use of a single span bridge with reinforced earth retaining abutments provided a structure competitive in cost compared with a longer bridge incorporating spill-through abutments.

Reinforced earth construction has proved to be a viable alternative to other forms of construction. It continues to be necessary to make a careful appraisal of suitable alternative forms of construction for all new projects bearing in mind rapid changes in costs and the sensitivity of the cost of reinforced earth construction to the cost of the granular filling it requires.

Below: Reinforced earth retaining abutments on the Frontage Road Bridge over the railway at Drouin



Construction of Arundel Road bridges, Calder Freeway

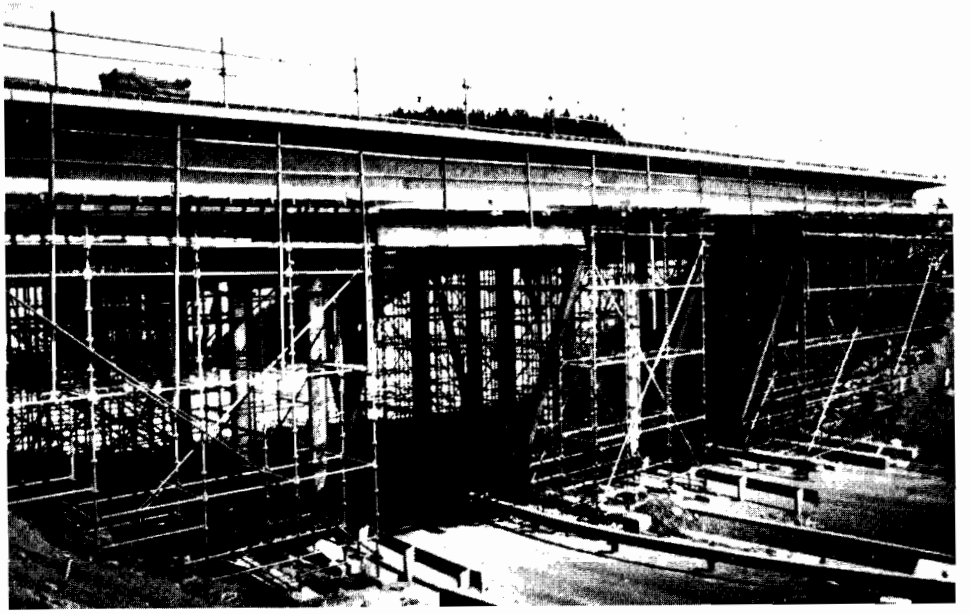
Twin single span box girder bridges each 48m long and 11.8m between parapets were constructed over Arundel Road at Keilor as part of the Calder Freeway (Keilor Bypass project). The bridges were constructed by direct labour at a cost of $870,000.

The 1.8m deep two-cell box girders of each bridge were cast full cross-section with no joints between the webs and the base slab or between the webs and the deck slab. Longitudinally, each bridge was cast in three separate sections each 16m long. The 16m long sections required 110m³ of concrete each, and each section was fully cast in about six hours. A superplasticizer (Melment L10, at 5 litres per m³ of concrete) was added to each agitator truck load of premixed concrete before it was pumped into place. Concrete slump was 50mm before, and 175mm after the addition of the superplasticizer.

There were 12 post-tensioned tendons in each bridge, each consisting of 115 7mm diameter stress relieved low-relaxation wires. Each tendon was stressed to a jacking force of 6030 kN. Single lane openings were provided through the falseworks of the bridges for traffic using Arundel Road.

The falsework of both bridges was a mixture of steel beam spans supported by temporary fabricated steel piers, and modular falsework systems. Two different modular systems were used: Kwikstage under the north bridge and Acrow Shorebrace under the south bridge. Both systems have a basic grid of 1800mm × 1200mm, but a closer grid of 1800mm × 760mm was used under the lines of the box girder webs. The foundations under the modular systems were 450mm diameter by 1.5m deep cast-in-place concrete bored piles on the 1.5:1 batters of the Arundel Road cutting, and cast-in-place concrete strip footings on the flat ground at the bottom of the cutting. The batters of the Arundel Road cutting under and between the two bridges were faced with Monier precast concrete Unipave interlocking blocks.

Below: The northern bridge of the Arundel Road bridges under construction. The falsework is Kwikstage Scaffold



Computer aided drafting

Since June 1981 the Bridge Design Division has been leasing a Computer Aided Drafting System to produce final drawings for the West Gate Freeway Project and to evaluate the benefits of such a system in relation to present and future design and drafting needs of this Division.

A computer aided drafting (CAD) workstation consisting of a graphics terminal (Tektronix 4014), a hard copy unit (Tektronix 4631) and a video display terminal (Tele Video TVI 9128) is installed in the Division's drafting section. This workstation is connected to a computer bureau via two dedicated Telecom lines.

At the CAD workstation a trained operator can produce on the graphics screen a complex drawing with considerable ease and store this drawing whole or in parts on tape or disc. The stored details can easily be recalled, amended, repositioned and rescaled on the screen. The newly created drawing can then be plotted very accurately at high speed with a pen or photo plotter.
Some drawings for the West Gate Freeway project were produced on the CAD system. The Launching Girder Movement drawings for the North Structure were the first to be produced. This proved to be an ideal introductory exercise because of the large number of drawings consisting of fairly simple objects repeated in different combinations.
Prior to commencing work with the CAD equipment two draftsmen and their supervisor received 10 days training in the use of the system. In the first 12 weeks of production work 503 drawings of varying complexity were produced using CAD.
The successful use of the equipment for the relatively simple drawings led to application of the system to the more complex task of producing the tendon profile drawings for the South Structure. Although these drawings entail some of the most complex drafting done on this project, the details incorporate significant standardization of tendon profile shapes. Approximately 100 such drawings were successfully completed at a rate of up to 2.5 drawings per day when production was fully mobilized. During this exercise the operators became very proficient and successfully trained another member of the staff.
The capability of the CAD systems to produce perspective views of structures was also investigated. Although the software currently being used is not a true 3-D system it is possible to draw perspectives of bridge structures from various viewing positions.
Some drawings were produced with a photo plotter which is capable of producing drawings of a superior quality at a speed approximately 10 times faster than a pen plotter and at a cost reduction of 40 per cent.
It is proposed to investigate the application of CAD to routine design work in Bridge Design Division within the coming financial year. It is envisaged that the procedures will be developed to facilitate both drafting tasks and the preparation of design details and sketches by design engineers.

From the work that has been produced on the CAD system to date it would appear that the benefits to be gained are:

- Increased productivity—High productivity gains can be achieved. The gains vary with the number of drawings and their types, the management of the CAD system and how well the system software caters for the user's requirements.
- Reduced lead times—This is a very useful benefit when drawings need to be completed to tight time schedules.
- Quality and accuracy—The benefits are standardization and quality of format, reduction in checking times, reliable cross referencing and reduction of errors.
- Integrated design—Data that is stored in a computer can be recalled and used in various formats. The aim is to minimize input and maximise output. The benefits are standardization of drawings, complete material lists, automatic clash recognition and critical clearance checks, and consistency checking in component selection.

West Gate Freeway (South Melbourne Section)

Construction of Rock Sockets Using the Ream and Line Technique

During the construction of mudstone socketed piles on the West Gate Freeway project, extremely unstable mudstone was sometimes encountered in the socket walls below the bottom of the steel casing.
In certain instances, it was necessary to resort to a technique called the 'ream and line' method of construction to minimise the risk of major collapse of the socket walls. The method involved the progressive excavation and concrete lining of the socket in stages, without the need for dewatering. The concrete lining was formed by over-reaming the partly excavated socket, filling with concrete and, after initial hardening, drilling through the concrete at the specified socket diameter, thus leaving a residual concrete annulus or 'liner'.
In one case, that of pile 422/2, foundation investigation revealed that the socket would be located in fault zone material and that the founding mudstone was of an unstable and extremely jointed nature, the jointing being steeply dipping and slickensided. Accordingly, the pile design required the steel casing to be driven 14m into mudstone, instead of the normal 1 to 2m, resulting in an installed length of casing of 43m with a socket length of 21m.

Unfortunately, attempts to install the casing to the design toe level had to be abandoned 5 m above this level when the cutting edge of the reamer was found to have distorted into an oval shape. Excavation of the socket to the final base level in one operation was unacceptable because of the instability of the socket material and the risk that the capacity of the adjoining piles 422/1 and 3, which were under construction could have been affected by a major collapse of the socket (see Figure 3).

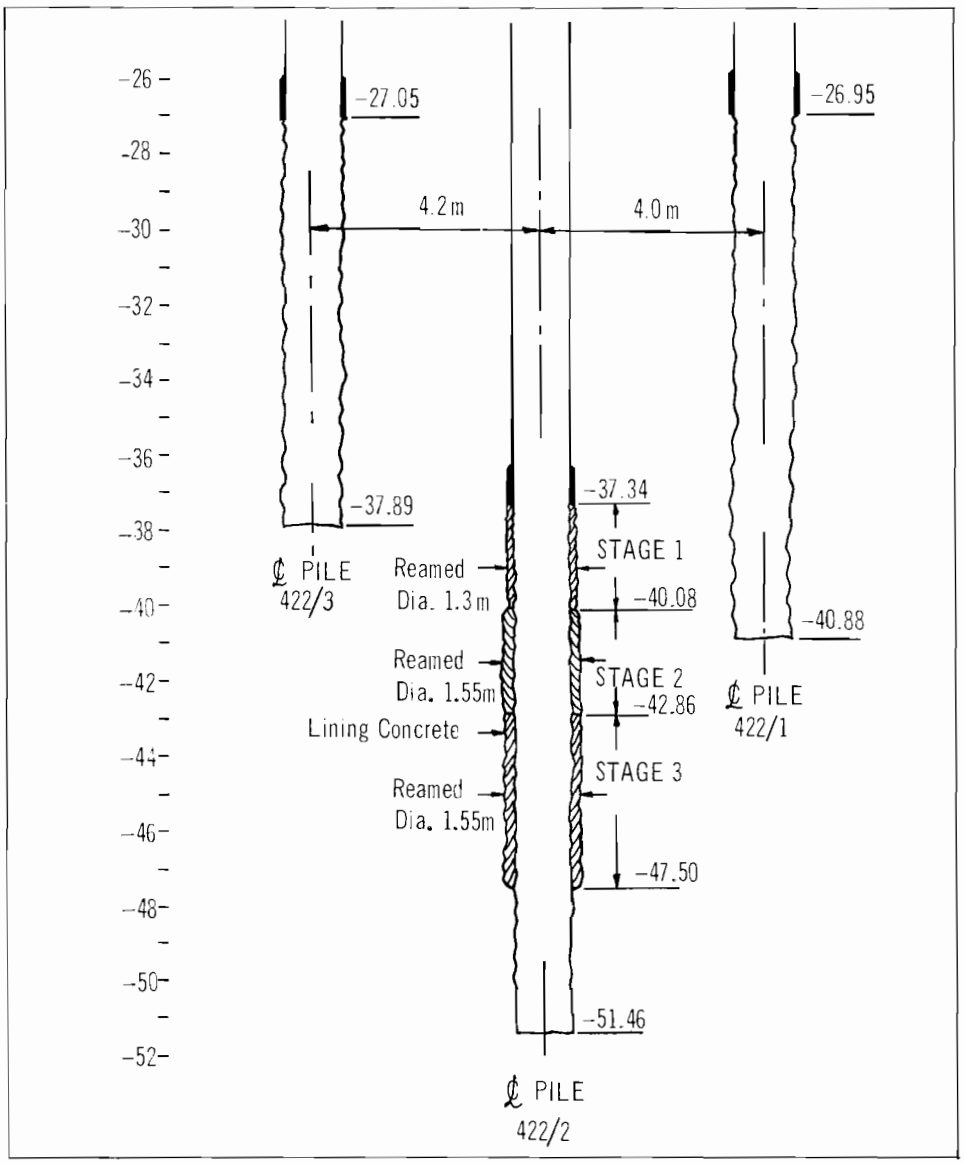


Figure 3: Pier 422 piles on the West Gate Freeway. Construction of Pile 422/2 required a three stage ream and line treatment to minimize the risk of major collapse of the socket walls

The construction of the socket in stages using the ream and line technique was considered to offer the best solution. Commencing from the bottom of the casing, each stage was completed using the following construction sequence:

(a) Excavate 3 m socket length to the nominal pile diameter of 1.3 m.
(b) Ream out excavated socket to a nominal diameter 200 mm larger than the pile diameter.
(c) After reaming, immediately place 20 MPa concrete, using the under water tremie method.
(d) After a period of 36 to 48 hours, drill through the partly hardened concrete to the required pile diameter of 1.3 m, leaving a socket lining of 100 mm nominal thickness.

Concrete rather than mortar was chosen because it was considered that the presence of coarse aggregate would facilitate drilling and provide a rougher surface for the keying of the final socket concrete to the lining.

Conventional rotary drilling equipment was used, however the drill bucket was modified to incorporate retractable side reamers. The reamers were pivoted to swing back inside the circumference of the bucket when the bucket was rotated in a reverse direction, thus allowing withdrawal of the bucket in the normal manner after reaming.
This method of construction was also successfully used for the completion of pile 418/3E where similar problems were encountered and has been subsequently specified for construction of several mudstone founded piles in the third foundation contract. The method is regarded as a relatively economical and positive solution when compared to alternative methods such as grouting, ground freezing or air lock systems.

Load testing of piles using built-in flat jacks

Test loading of basalt-founded piles was carried out to establish a design method for socketed piles in variably weathered basalt layers with underlying sands and clays. This work was for the design of approximately 80 piles in basalt thus avoiding the very significant cost of excavating the basalt and founding in the mudstone below. In two of the test piles, a nest of four flat jacks was installed as a prefabricated assembly attached to the lower end of the conventional steel reinforcement cage.

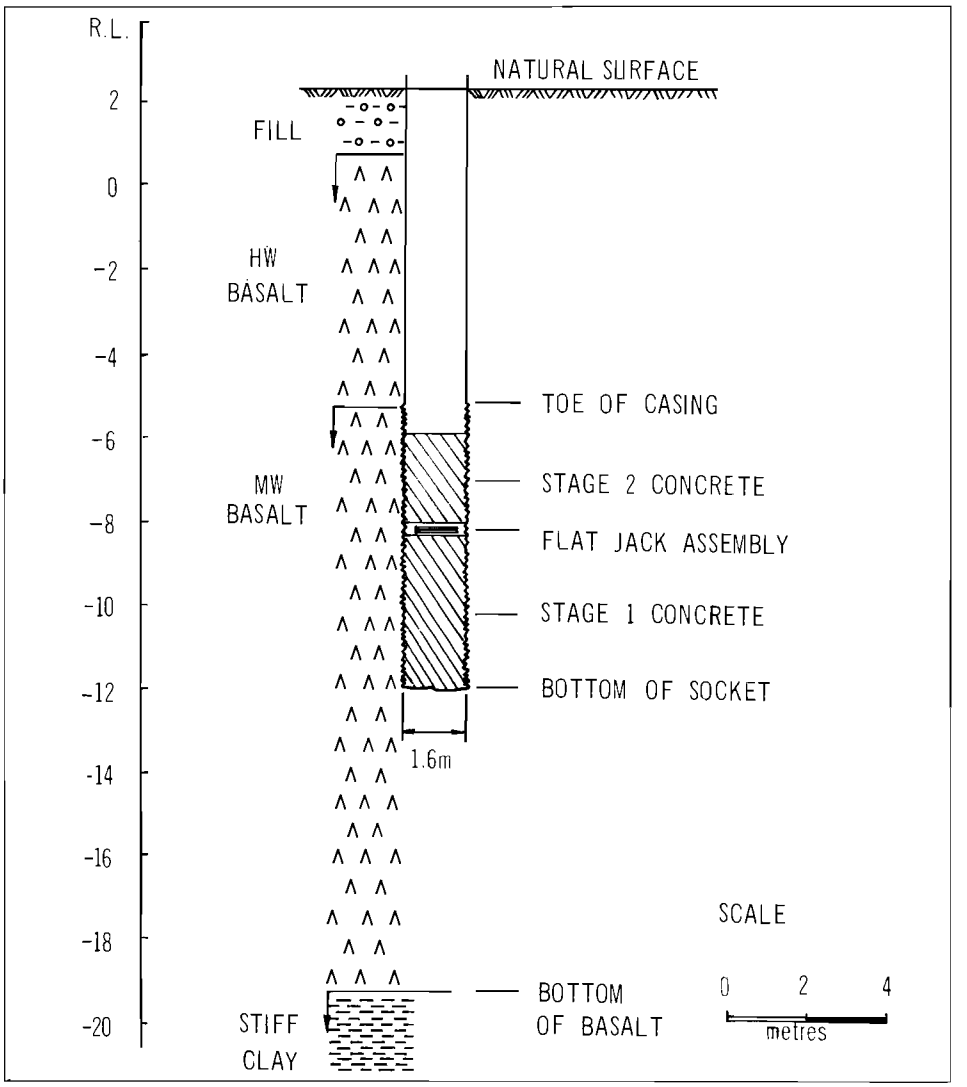


Figure 4: Flat jack assembly in Pile 325/2

The aim of one such test, on Pile 325/2, was to load to failure a 2m long concrete plug in medium quality basalt. Loading was facilitated by the inflation of each of the four flat jacks in turn, which were installed mid-way down the rock socket (see Figure 4). As each jack was inflated, the concrete plug (Stage 2 in Figure 4) moved upwards; the reaction being provided by the lower Stage 1 concrete section. Testing was followed by grouting of the jacks to ensure that they would act as structural members during subsequent use as part of the inservice pile.

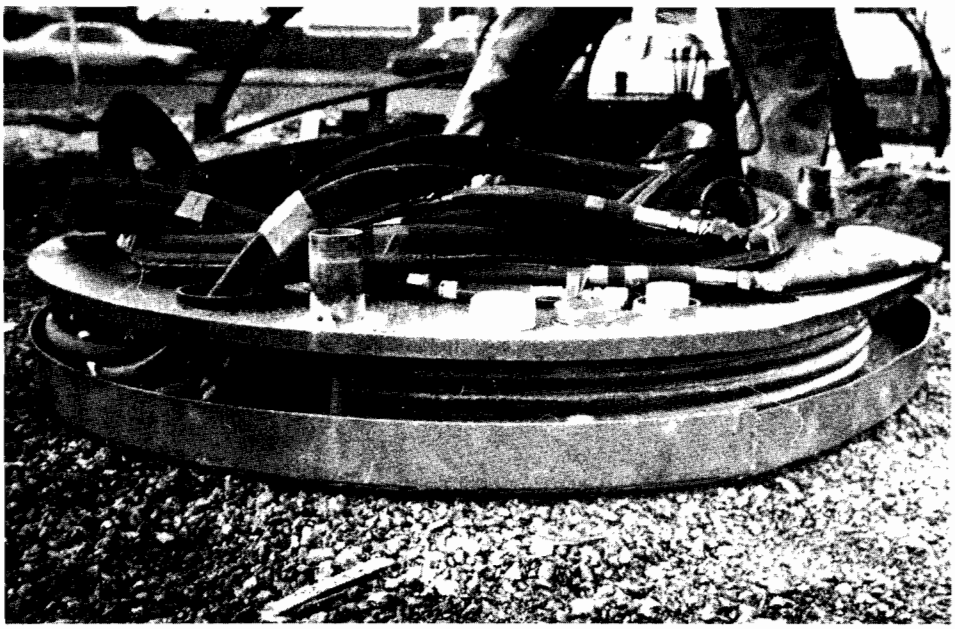
In a separate exercise before commencement of the pile construction, field trials were used to select the optimum method of grouting. The uncertainties associated with displacement of the 30 litres of hydraulic oil from each jack by a grouting fluid led to trials using epoxy resin and cement grout. The procedure adopted as a result involved flushing the oil from each jack with 140 litres of a water/detergent mixture, followed by pumping 240 litres of cement grout containing an anti-shrink additive. The grout mixture was varied initially with a water-cement ratio of 1:1 and gradually increased to a final value of 0.45:1. The field trial jacks, when cut open for visual inspection, were found to be filled with the hardened grout mixture, which had fully displaced all hydraulic oil.

Piles were constructed with conventional equipment; i.e. diesel hammer for casing installation; basalt excavation by chopping and grabbing and handmining; and concrete placement by tremie tube with the pile filled with water.

In the load testing of the pile, all four flat jacks were inflated to their maximum rated pressure, resulting in a load of 14MN to the pile (compared with a design load of 3.3MN). This displaced the concrete plug upwards a distance of 17mm. The load-carrying capacity continued to increase at the maximum deflection.

Generally, the test pile behaved as expected, and among other things confirmed the previously adopted values of allowable side resistance for a socketed pile in medium quality basalt. At the completion of the test, the flat jacks were cement grouted in place and concreting of the pile stem completed.

The principal advantage of this form of testing is that the test loading can be performed without a conventional reaction force, such as by the use of rock anchors or kentledge. Consequently, the flat jack method is considerably cheaper than other forms of test loading. In the case of Pile 325/2, a cost saving of approximately $33,000 was achieved by adopting the flat jack method instead of the alternative rock anchor system.



Above: The flat jack rig showing the hydraulic hoses, nest of four flat jacks and top and bottom plates with settlement rod guides

State highway standards and the economic use of design resources

During the year, the 1978 road design standards for rural State highways were reviewed to identify and achieve more cost-effective and appropriate road design solutions for highway improvement works, thereby maximising the effective use of road design resources.
The review arose from the need to bring the standards and their application in line with current design aims and objectives. The main underlying intention was to increase and make more uniform the engineering consideration given to road design geometric solutions and so maintain operating speed conditions consistent with driver expectations along all generally similar sections of highways throughout the State.

The main recommendations arising from the review were that:

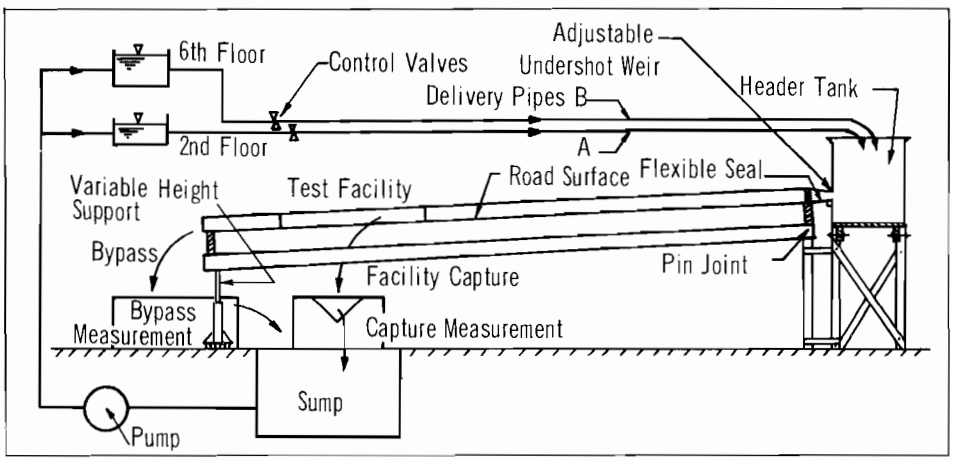
- each section of State highway, with the exception of those designated as mountainous, should have nominated for it a 20km/h range of design speeds appropriate to the desired geometric standards.
- seal and carriageway widths need to be amended to reflect current practice and recent changes in traffic volumes and abutting development.
- the sections described as mountainous in the 1978 review should be redefined.
- guidelines for the use of standards in long term planning investigations should be adopted.

The review specifically excluded the standards appropriate to townships, outer-urban areas, national roads and freeways, and staging options, as these require detailed examination for each individual case.
In conjunction with the review of design standards, an analysis was made of the basic design procedures and criteria being used for rural roads, including State highways, in order to produce more cost-effective design solutions. As most of the current rural roadworks are on or adjacent to the present alignment it was considered that a basic element of the design philosophy should be to maximise the use of the existing road asset. It was concluded that not only is there a need to apply design standards appropriately, but it is also essential to define closely the purpose and objectives of the proposed improvement works, to investigate alternative proposals in depth, and to identify the need for additional design information.
The design standards and criteria proposed for implementation are consistent with those adopted by NAASRA in its recent review of Australian rural road design standards, especially with regard to the need to maintain a safe and consistent driver environment.

Results of research on the capacity of stormwater pits

Over the past two years, a research project has been in progress to develop design capacity charts for a number of the stormwater pits currently used by the Board. Measurements were also taken to check the validity of using Izzard's formula for determining width of flow for a given discharge.
The tests were carried out on a wooden roadway model 8.5m long by 2.5m wide situated in a laboratory at the Royal Melbourne Institute of Technology. The longitudinal grade of the model could be varied from 0.5 per cent to 9 per cent and the crossfall could be varied from 0.5 per cent to 6 per cent. An artificial surface of plastic sheet overlain by one layer of 10mm birdwire was used to simulate a pavement surface roughness with a Manning's 'n' value of 0.015. The model layout is shown in Figure 5.

Figure 5: Layout of the model used in the research project to develop design capacity charts for stormwater pits used by the Board



Water was introduced onto the model via a header tank incorporating an undershot weir. The test facility was located some four metres from the header tank. Capture (the volume of water entering the pit) and bypass (the volume running past it) were measured using vee-notch weirs.
Results were measured for a number of stormwater pits to cover a full range of combinations of longitudinal grade and crossfall. All pits were tested up to failure, which was defined as a bypass of 20 per cent. Multiple regression analysis was used to produce curves of best fit to the data.

Analysis of results has indicated the following trends:

- For a given discharge, Izzard's formula underpredicts the resulting width of flow by about 10 per cent, but this accuracy is considered satisfactory for the purpose of predicting flow width (conversely, Izzard's formula is unsatisfactory to determine a discharge from a given measured flow width).
- At 95 per cent capture, the pits tested have greater capacity than indicated in the Board's Road Design Manual 1974.
- Increasing the allowable bypass to 20 per cent results in markedly increased pit capacity.

As a result of these findings, a revised surface drainage design procedure is being developed to design deliberately for greater bypass flow to take advantage of the increased pit capacity.

Visual models for the planning and design of highways

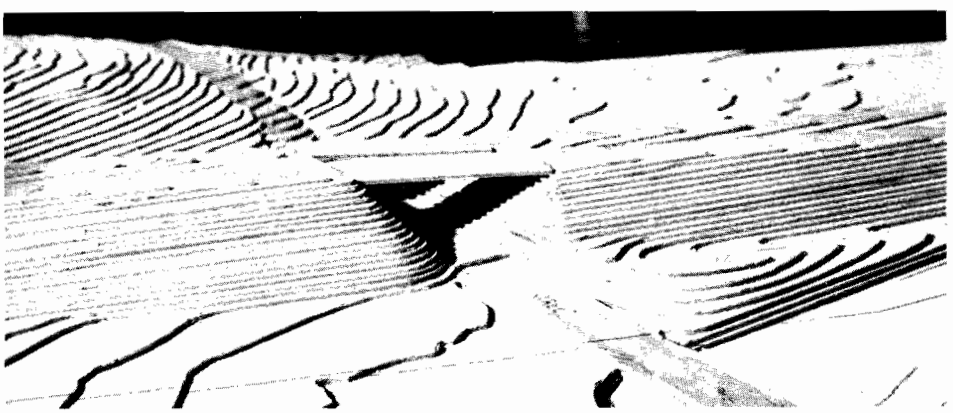
Research has been carried out into the development and use of visual models for the planning and design of highways. Various types of models were constructed for particular projects to assess their suitability in terms of ease of construction, ability to depict particular design features which needed to be considered, and ease of adjustment to provide alternative designs on the same base model.

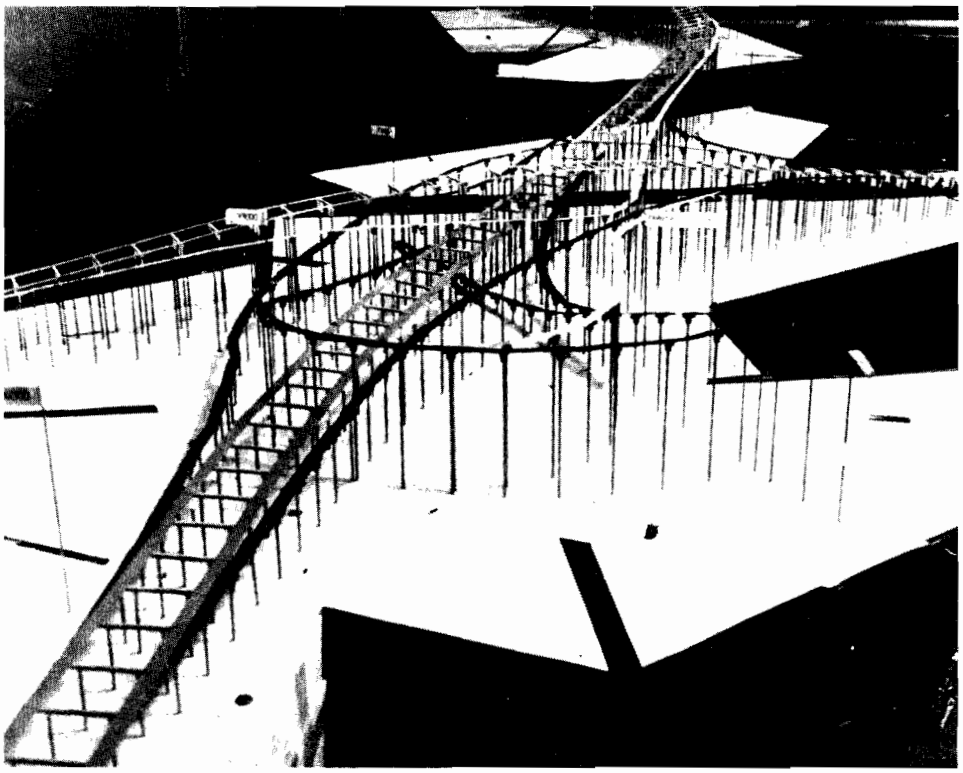
Five types of model were investigated in the course of the research.

They were :

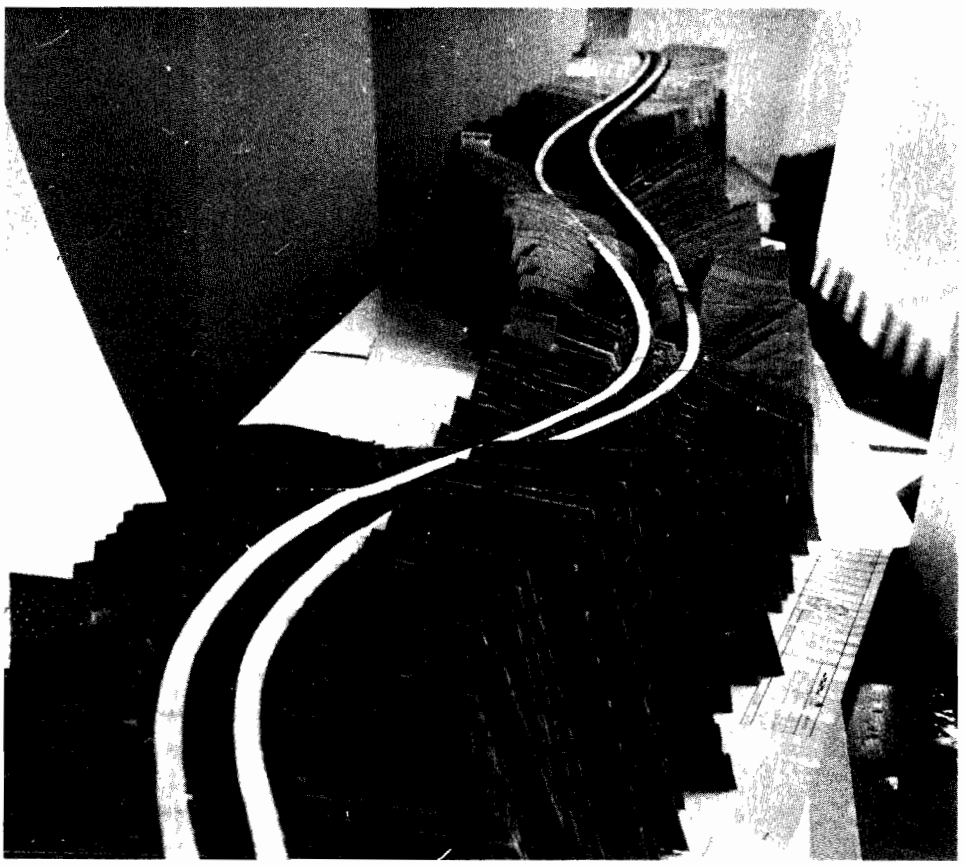
- 'T' peg models (e.g. Abbot type)—rather time consuming to construct.
- Alignment profile models—economical and easily constructed with corrugated cardboard.
- Cross-section models—relatively easy to construct and able quickly to provide much useful information.
- Contour models—slow to construct but useful for examining complex shapes as at interchanges.
- Hybrid models—used to obtain a more realistic surface finish by using plaster or modelling compound in conjunction with contour or cross-section models.

The main uses to which models have been put are for checking stopping sight distance and sight triangles at intersections, improving the relationships of carriageways to terrain, including adjustment of batter slopes and development oflandscaping proposals, and as a means of explaining complex three-dimensional problems to people with an interest in the subject project.
Alternatives to physical models were also investigated, e.g. computer drawn perspectives and photo plot montages. These are sometimes used in conjunction with models to check a perceived design problem quickly or to try alternative approaches before altering a model. In future it is expected that the use of interactive computer programs with Visual Display Units will considerably increase the designer's ability to check design details quickly by using perspective views. This development may reduce the need for physical models.





Three of the more common visual model types used in the planning and design of highways: above, 'T' peg (Abbot); opposite, contour; and below, cross section



Unbound pavement bases on rural freeways

Although unbound bases are cheap to provide compared with other pavement types, they have to be placed with a great deal of care and attention to detail. While there is little benefit in increasing the thickness of base layers to more than 200mm, there is much to be gained in making the unbound base as stiff as possible. Therefore, stringent quality control and very high standards of compaction are essential. Proper compaction is most important in producing stiffness, measured by Benkelman beam deflection testing, and in creating a reasonably impermeable base.

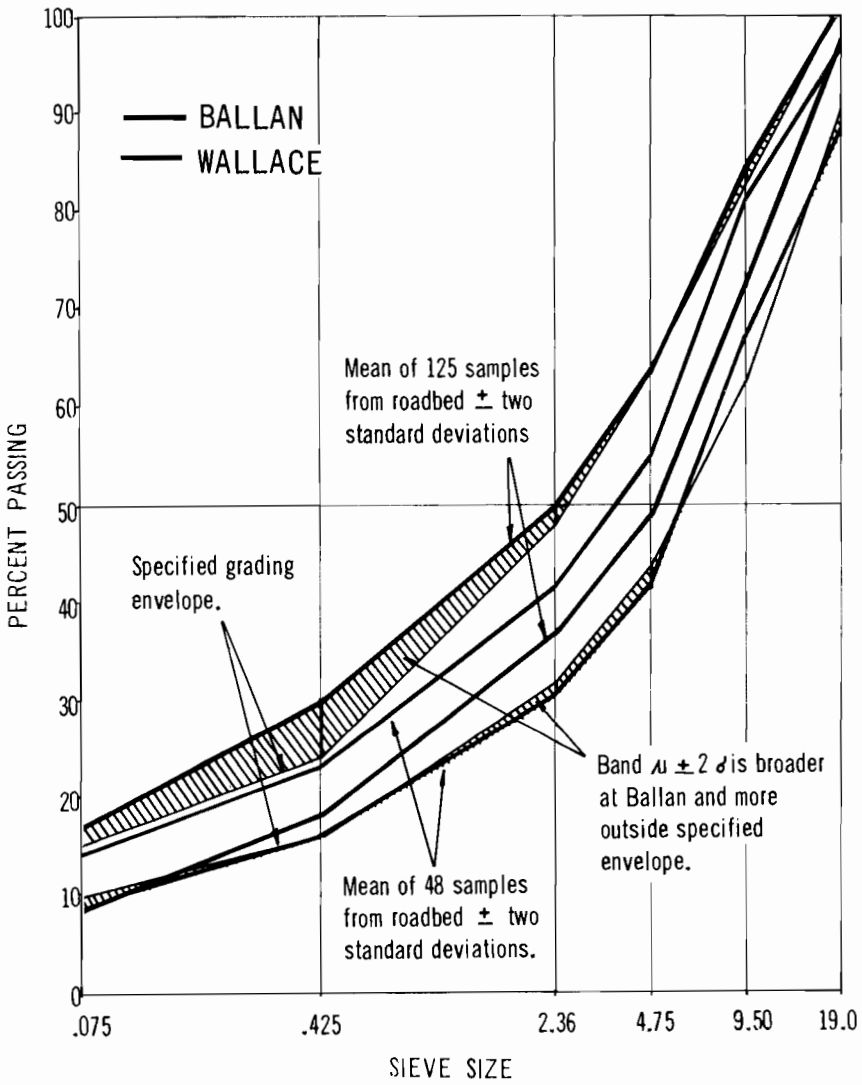


Figure 6: Comparison of construction results: sieve analyses after compaction

In 1977/78, an unbound base of crushed basalt with 2.5 percent crushed sandstone additive was successfully placed on the Western Freeway Ballan Section, by roadmixing with conventional plant. A stiff and reasonably impermeable pavement was produced which, with a sprayed surface seal, has performed well and has allowed expensive asphalt surfacing to be postponed.

Recently, unbound bases on rural freeways have been constructed using more sophisticated equipment with high output. In 1981/82, source materials identical to those used at Ballan were combined in an unbound base of the same thickness on a nearby section of the Western Freeway at Wallace. This time, blending was by pugmill mixer, spreading was by Autograde, and compaction was by a train of heavy vibrating-drum smooth rollers. The mechanised method was quicker and a more uniform standard of work was achieved than is practicable with roadmixing. Test results are summarized in Table 1. Both sections are being monitored regularly with a Lacroix Deflectograph.

It can be concluded that the big improvements in speed of construction and control of levels, the small but significant gains in uniformity of grading, compaction, base thickness and stiffness, and the overall cost savings justify not only the continued use of unbound bases on rural freeways but also their placement with a plant mix/Autograde process. This requires at least 4-5km of rural freeway to be paved at one time to justify the transport and setting up of the equipment.

Table 1
Comparison of construction results

	Ballan–Grader placed	Wallace–Plant mix/Autograde
1 **Production Rate** – blend, spread, compact and prepare for seal.	20,000 tonnes/month	42,000 tonnes/month Work completed in favourable summer months.
2 **Level Control** (a) Mean difference from RL's.	Conventional use of pegs –	Double stringline for Autograde sensors. 3.5 mm low
(b) Standard deviation of departures.	–	4 mm
3 **Sieve Analysis** (a) Uniformity	See Figure 6. A plot of mean grading ± 2 standard deviations fits into a narrower band at Wallace.	
(b) Breakdown during spreading and compaction.	6-7%	3-4% – Less due to bigger lifts and minimum working during spreading.
4 **Compaction** – (Top 100 mm layer)		
(a) Mean	101.6% Mod AASHO	101.1% Mod AASHO
(b) Standard Deviation	1.4%	0.9%
(c) Lab Density	2.38 tonnes/m^3	2.39 tonnes/m^3
	Wallace result is statistically better because of its uniformity. On both jobs compaction was controlled by lot acceptance using statistical formula and 6 or 10 tests per lot.	
5 **Base Thickness** – (200 mm design)		
(a) Mean	213 mm	204 mm
(b) Standard Deviation	26 mm	7 mm
6 **Benkelman Beam** Deflections – (top 100 mm layer)		
(a) Mean	0.45 mm	0.30 mm
(b) Standard Deviation	0.10 mm	0.08 mm
7 **Permeability**		
(a) Laboratory Test	Average 4.7×10^{-5} cm/sec	Maximum 4.0×10^{-5} cm/sec
(b) Field Test	Moderate	Moderate
8 **Economy** Cost of blending, spreading, compacting and preparation for seal, per tonne of wetmix.	$3-39 in 77/78 dollars adjusts to $5-15 in 81/82 dollars.	$5-04 in 81/82 dollars. Less material used per square metre because of better thickness control gives added economy.

Roadworks Signing Code of Practice

A Roadworks Signing Code of Practice has been drafted with the aim of achieving a uniform standard of signing and delineation on Board's works throughout the State using the best current practices. Every attempt has been made to produce a concise, self contained, cross referenced and suitably illustrated document and, as far as possible, the relevant requirements of Australian Standard Manual of Uniform Traffic Control Devices (AS 1742-1975) have been met in compiling the code of practice.

An ad hoc Roadworks Signing Committee was formed in January 1979 and a first draft of the Code was circulated for comment in May 1980 to all regional divisions, projects and specialist divisions undertaking field activities. Over 1000 individual comments were received from a wide range of the Board's personnel including engineers, overseers and patrolmen. The document, together with recommendations involving a phasing-in period, a training programme and a regular review committee, was submitted for approval in March 1981. In December 1981, the Board approved the Code in principle and requested the agreement of various authorities to make use of the Code and/or constructive comments on the draft Code of Practice prior to the publication of the document. The Code is now being reviewed and comments are being considered and incorporated where appropriate with a view to its issue as an interim document by late 1982. After about one year's use in the field the Code will be further reviewed.

The preparation of the Code of Practice necessitated a critical appraisal of the number, types and legends of the signs currently used by the Board. As a result, it is proposed to delete some signs, alter the shape, colour or legends of others and to introduce some additional signs. The net effect is that sixty-seven temporary signs replace eighty-three which are in current use.

Devices currently used by the Board for traffic guidance at roadworks sites were also appraised. The existing delineation devices were considered to be inadequate and a new temporary delineator was developed consisting of a black plastic flag with yellow reflective material attached and with suitable support systems for urban and rural works.

The Code of Practice properly used by Board personnel should provide an appropriate and uniform standard of signing and delineation on Board's work throughout the State. In the interests of uniformity, municipal councils and other authorities are invited to apply the same system to all works on roads.

The Code has been used as a basis for a similar National Association of Australian State Road Authorities' publication to be issued in the future.

Autograde manual

A CMI Autograde was commissioned in February 1979, as noted in the 1978-79 Report.

Since its commissioning, there has been considerable experimentation with trimming and placing procedures for granular pavement construction. Successful techniques have been developed while efficiently placing over one million tonnes of pavement material on various rural road projects throughout the State.

The Autograde and the associated use of a pugmill to introduce moisture to the pavement materials have resulted in the construction of pavements built to uniformly high levels of compaction and complying with tight specification tolerances on pavement material quality, depth and level.

The use of the Autograde has required some modification to geometric design details, e.g. by adoption of a continuous one way crossfall on through lanes and shoulders. Drainage pits with flared trays extending into the pavement have been replaced with set back side entry pits as the previous pits caused the mould-board extension to be fouled and interfered with trimming and rolling operations.

An operational manual for the Autograde was published in an interim form in March 1982. The manual draws on experience to date and on material published by the CMI Corporation. It covers machine details, road design requirements, programming, material control, construction control and industrial relations aspects.

West Gate Freeway (South Melbourne Section)

Inspection of abutting properties

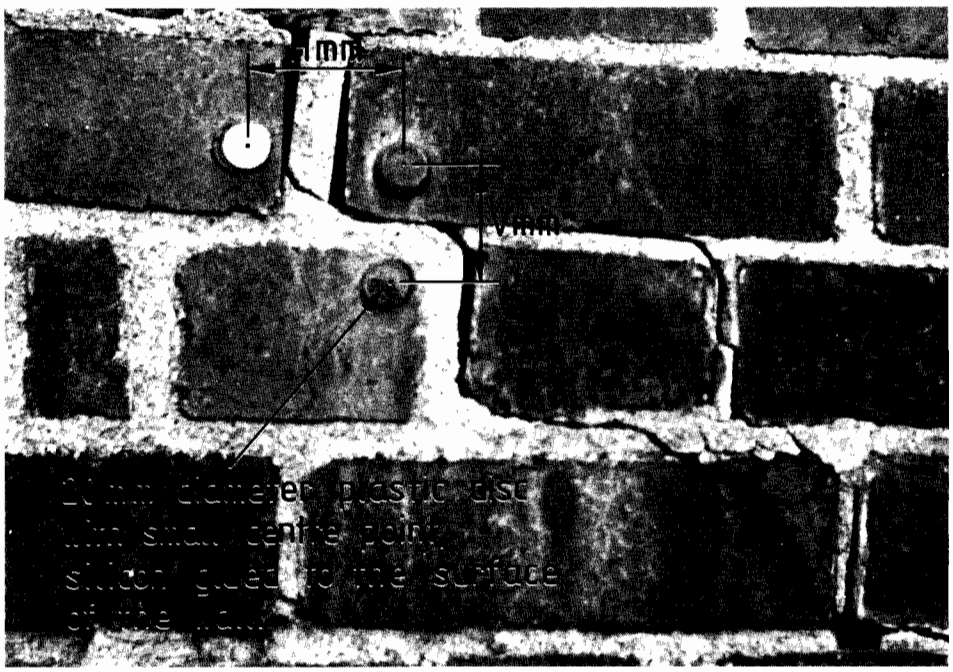
All properties adjacent to the freeway reserve are inspected and monitored during the construction of the West Gate Freeway which is in a built-up area on deep alluvial material. All masonry buildings and buildings containing sensitive equipment on 39 properties located partly or wholly within 30 metres of the freeway have been inspected by a consultant architect on the Board's behalf.

The original and a copy of the inspection report are signed by the Board's engineer present at the inspection and by the architect, and are forwarded to the owner. The owner is requested to retain the copy and return the original report, signed, within 30 days. Each report contains a photographic record of all cracks and other defects and a detailed description of all relevant buildings on the property.

Supplementary reports on the buildings are prepared when one phase of construction work has been completed and prior to a new phase commencing. Levels are taken at two-monthly intervals on the corners of all buildings to check for any movement in foundations. Widths of selected cracks in each building are monitored for any movement that can be related to construction activities.

Limits on vibrations emanating from construction activities have been specified and enforced on all works on the project. The peak ground particle velocities have been specified as 5mm/second or less for buildings and 10mm/second or less for services. The use of vibrating rollers has not been permitted for street widening and reconstruction works. Monitoring of the vibrations is carried out by project staff using a Vibration Monitor.
On receipt of a complaint from an owner alleging damage resulting from works on the project, the subject building(s) is inspected immediately by the consulting architect and, where applicable, traffic vibrations are monitored. The owner is subsequently interviewed to explain the findings of the inspection and vibration monitoring.
There have been complaints that special work processes are affected by small vibration levels and that these situations require work on the project to be limited to specific hours or that the processor has to make alternative arrangements during the construction period. Except for the case of a photographic laboratory, where optical enlarging equipment was sensitive to very small vibrations, the complaints have not been found to be justified.
The effort and cost involved in taking these measures have been of benefit to both the Board and the abutting property owners and have also been welcomed by the Board's contractors.

Below: Typical photographic record of building cracks



Survey techniques

Present survey control methods on the project

Survey work for the project was commenced in 1976. The basic framework of survey control was established over a wide band, extending from Graham Street, Port Melbourne to St Kilda Road, South Melbourne. Three Project Control Survey Plans were produced from this work and all subsequent survey work has been based upon this survey.
Much of the South Melbourne and Port Melbourne area is subject to natural settlement and the establishment of stable level control was considered essential. As acquired properties were cleared of buildings, 15 stable bench marks (SBMs) were established over the length of the project. Each mark consisted of 38mm diameter threaded steel one metre long rods screwed together progressively and installed by the Materials Division penetrometer truck. A maximum load of five tonnes was applied, which did not necessarily take the bottom of the mark into the Silurian mudstone bedrock. Marks varied in length from 0.5m to 25m depending upon the underlying soils. Each mark is re-levelled every six months, using precision levelling equipment consisting of an automatic level, parallel plate micrometer attachment and calibrated pair of levelling staves. After three and a half years of monitoring, the maximum movement of any one SBM has been 4mm. Settlement of surface bench marks not having such support has been as great as 37mm in one and a half years.
A complete horizontal construction control survey could not be commenced prior to the start of construction works. As demolition of buildings progressed, construction control marks were established. Each construction control mark (designated WG mark) consisted of an iron

rod 450mm long, set in concrete and covered with a cast iron cover. WG marks have been located so that no pile is more than 45 metres from a mark. A network of horizontal distances and angles were measured using Electronic Distance Measuring (EDM) equipment, a precision one second theodolite and force centering of targets and tripods. Measurements were processed using a computer program and Australian Map Grid co-ordinates on all WG marks were obtained.

The WG network is checked before any major new works commence. Re-measurement of the network has shown the horizontal position of marks relative to one another to vary by a maximum of 10mm.

Programme and Expenditure Control

The project management team at West Gate Freeway includes a section responsible for programme and expenditure control which has the responsibility of maintaining formal reporting of activity progress and time problems, and monitoring expenditure.

Programming

The programme for the project was put into critical path network form in 1977 shortly after the project commenced. Over 800 activities were defined in the network as having significant effect on the project programme. This programme was subdivided and presented as a series of individual but interrelated networks, one for each major work section involved. These were used to monitor progress of project activities. Co-ordination and reporting of project activities has been through a formalised system of co-ordinators nominated by each specialist division involved. Each co-ordinator has a copy of the programme relating to his division to update as and when necessary. Where changes to the programme occur within the division, the divisional co-ordinator advises the project management team.

Reporting of progress to project management is done by the co-ordinators each fortnight. Activity reports are issued to each divisional co-ordinator listing currently scheduled activities and activities presently in progress. Each co-ordinator completes his activity report by showing the current status of listed activities and returns the completed report to the project management team.

With activity reports from all sections in hand, the project team reviews the project programme revising the schedules to show altered timings of non-critical activities, advising the Project Engineer of near-critical activities, and taking action on activities which have become or remain critical.

Action on critical matters is effected by the issue of a Problem Report which states the basis of the problem and requests the appropriate officer concerned to advise what corrective action will be taken to return the programme to schedule. Once action is decided upon, the reporting officer completes an Action Report to formally advise the project what action is being taken, where and by whom. Where all possible action has been taken to bring the programme back to schedule and a delay is unavoidable, the Project Engineer notifies the Engineer-in-Chief and the Board via a Completion Date Delay Report of the revised project completion date.

Expenditure Control

Expenditure control is achieved in the short term by the preparation of three types of reports:

- Monthly Expenditure Report,
- Cash Flow Projection Report, issued monthly,
- Expenditure Control Estimates, issued quarterly.

The Monthly Expenditure Report provides an overview of previous years' expenditures and highlights significant variations between anticipated and actual expenditure in the current year. Actual job expenditures are obtained from the project cost ledger and anticipated figures from the latest information available. The anticipated figures are normally taken direct from the Cash Flow Projection Report. This report gives the cash flow estimates of all supervising engineers and shows expected total expenditure, month by month, for each individual job number. The report operates not only as an overall project financial cash flow planner, but assists in highlighting major variations in the pattern and timing of spending within the project.

In September, December and March, supervising engineers are requested to update their job estimates for spending over the financial year on Expenditure Control Estimate proformas.

Table 2

Financial Year	Total Works Expenditure (A)	Total Works Allocation (B)	Difference (A-B)
1978/79	$4,894,000	$4,865,000	+$29,000
1979/80	$6,829,000	$6,805,000	+$24,000
1980/81	$8,915,000	$8,948,000	-$33,000

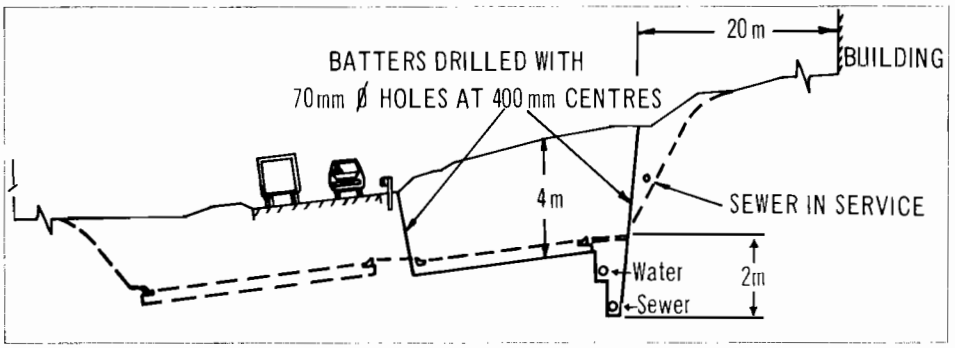
These estimates are used to update estimate figures shown on the Cash Flow Projections Report and the Monthly Expenditure Report.
In May and June, as the end of the financial year approaches, expenditures and estimates are monitored more frequently, usually daily over the last two weeks.
Table 2 shows the effectiveness of this expenditure control system in terms of actual results achieved over the past three financial years.
The project cost estimate is revised in July each year and the revised total project estimate is reported to the Board in July. Once approved by the Board, this estimate is used as the basis for reporting in the current financial year. The system has shown its real value in identifying items of significant cost increase and controlling the annual project expenditure.

Maroondah Highway

Controlled rock blasting

Earthworks on the Maroondah Highway between Anderson Street and Cyril Street at the eastern end of the Lilydale urban area included the removal of approximately 7500 cubic metres of rock from a box cutting four metres deep in close proximity to buildings and between the existing carriageway and a live sewer (see Figure 7).

Figure 7: A section through the cutting on the Maroondah Highway at Lilydale



Approximately 3500 cubic metres of this Rhyolite rock required blasting as prior testing indicated seismic velocities up to 5000m/sec. The aim during blasting was to keep ground vibration levels below 20mm/sec and air vibration levels below 120 dBL at the nearest building.
The ground vibration objective corresponds with the SAA Explosives Code recommended limit, set so that even minor damage should not occur in structurally sound buildings. The air vibration objective corresponds with a regulatory limit imposed by the Mines Department in Victoria based on investigations of a safe level by the United States Bureau of Mines. These aims were generally achieved and no significant complaints or reports of structural damage were received during or after the work.
Flyrock was eliminated by leaving the overburden in place during blasting and using blasting mats over a woven fabric covering. Measures taken to restrict ground vibrations included blast design based on test blast results, the drilling of 70mm diameter holes at 400mm centres along the batters as a pre-split to cushion the vibration and blasting to a face. Air vibrations were reduced by placing detonators about 300mm down the hole and filling the top of the hole with sand.
Blasting using delay detonators (up to 30 per blast) commenced with an initial pattern of 1.2m burden x 1.5m spacing and explosive charge of 1200gm per detonator spaced at three levels in each hole. The effectiveness of each blast and the vibration control measures led to the initial pattern being reduced to 1.0m burden x x 1.2m spacing and an explosive charge of 810gm per delay detonator when the blasting operation was at the closest point (approximately 20m) to the nearest building.
Safety of the operation was increased by the use of Watergel explosives (i.e. either Molanite 110 or Tovex 200) in preference to gelignite because these have a much lower level of impact sensitivity. The chance of any unexploded Watergel being detonated by impact during digging out is very low.
Ground vibrations from each blast were monitored using a CES Peak Vibration Monitor Type PVM 3 which immediately displays and reads out the peak vector sum of the three dimensional components of ground vibration. A consultant was employed to monitor air and ground vibrations for each blast at specific locations adjacent to a number of adjoining buildings. Air vibration monitoring was carried out using a Bruel & Kjaer Precision Sound Level Meter Type 2218.

MATERIALS

Bitumen Treated Crushed Rock

In 1979 and 1980, some trial pavement sections were constructed on the Hume and Princes Freeways to evaluate the properties of Bitumen Treated Crushed Rock (BTCR). This material is manufactured by adding small quantities (2-3 per cent by mass) of bitumen to a mixture of graded crushed stone and water (4-6 per cent by mass). The bitumen is added as a foam which assists in uniform distribution throughout the mix.

The crushed rock is similar to that used generally in heavily trafficked pavements with minor modifications to the distribution of particle sizes (the grading) to allow for some anticipated replacement of fines by bitumen.

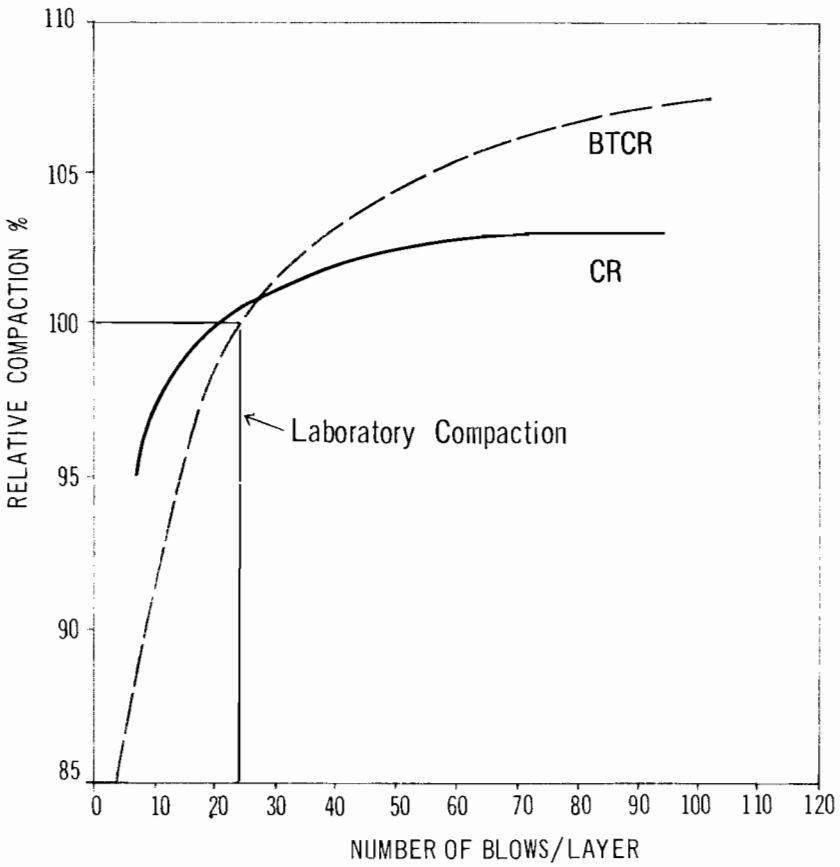
The grade of bitumen used in the trials was either class 170 (viscosity of 140-200 Pascall-seconds) or the softer class 80 (visc. 60-100 Pas), the latter being chosen to improve mix workability.

To provide comparisons with untreated materials adjacent, control sections were established containing conventional crushed rock bases. The primary purpose of constructing and studying the performance of the trials was to establish if bitumen treated base courses provide superior long term benefits compared with untreated bases. A secondary objective was to compare the workability of the two materials to provide data for establishing the overall relative costs of the alternatives.

During construction of the trial sections, tests were carried out to determine the density which was produced by a controlled sequence of rolling. This density was compared with that produced in the laboratory using a standard compaction procedure. The permeability of the material was measured at different densities. Testing led to the following conclusions.

- Bitumen Treated Crushed Rock appears to compact more readily than untreated crushed rock to the specified compaction level (relative to the laboratory standard) and it is also possible to compact it to greater densities without too much difficulty (see Figure 8).
- For a given compactive effort, Bitumen Treated Crushed Rock is much more permeable than untreated material because its actual density is lower (see Figures 9 and 10). The significance of higher permeability is that care must be taken during design and construction to ensure that water does not enter the BTCR layer and become trapped in it by less permeable material.

Figure 8: Relative compaction/number of blows/layer



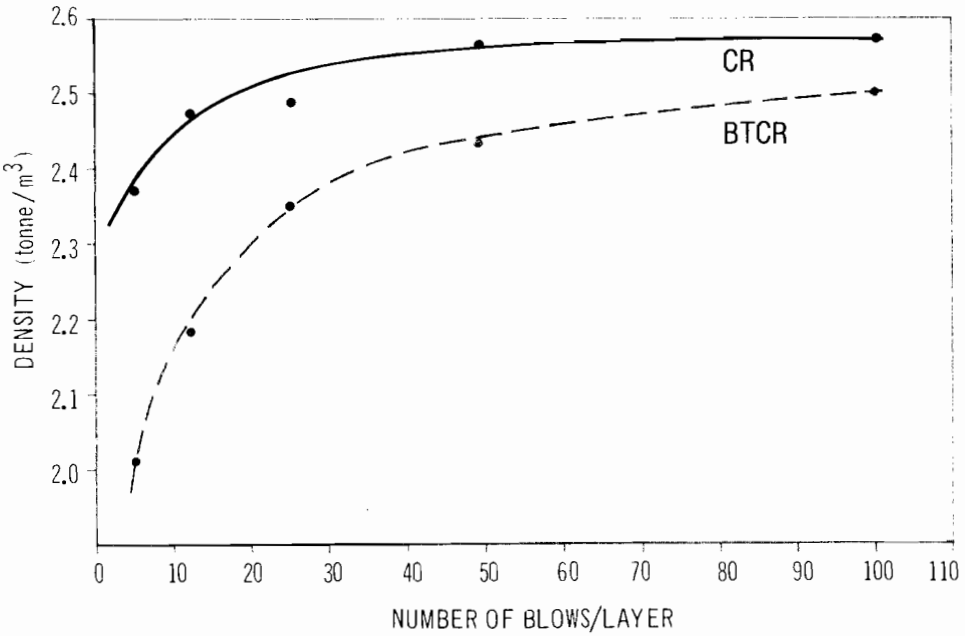
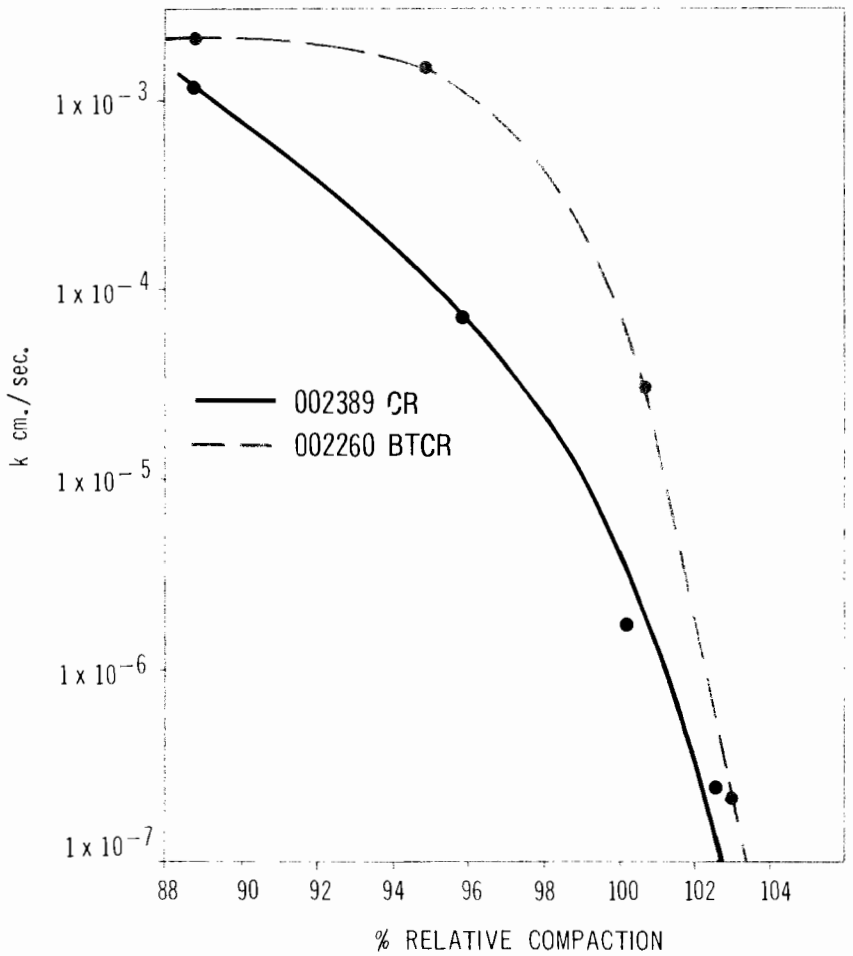


Figure 9: Density vs number of blows/layer

Figure 10: Permeability vs relative compaction



Since the trials and control sections were completed, their performance has been monitored at least once per year.

Monitoring includes:

- deflection testing to assess the pavement strength,
- roughness testing,
- precise levelling of metal pins placed in the pavement to determine the rate of rutting (if any) which occurs in time,
- visual observations.

To date there are no measurable differences in performance of the BTCR and control sections, and therefore the additional cost of using treated material has not yet been justified for construction of this type. One of the advantages of BTCR is its ability to withstand traffic wear for some time in an unsealed state. This benefit can be put to greatest effect when roads have to be constructed or rehabilitated under traffic.

Testing of large elastomeric bridge bearings

The design of the elevated section of the West Gate Freeway in South Melbourne incorporates large elastomeric bearings which are designed to support vertical loads of up to 10 MN and allow shear deflections of up to 120mm. The bearings consist of alternate layers of natural rubber (16mm thick) and 5mm steel plates. The largest bearings have a plan area of 1020 x 670mm, are 336mm thick and weigh about 600kg. Two hundred and seventy-four large bearings are required and each needs to be tested under full design compressive and shear forces.

No test machine is available in Australia which can apply compressive forces up to 16 MN on such large bearings. Initially, conversion of a large industrial hydraulic press to make it capable of measuring to the accuracy required was investigated but was rejected in favour of designing and constructing a special purpose test machine. The test machine now constructed consists of two large reinforced concrete end blocks separated by a reinforced concrete base slab and two upper hollow steel columns. Four high capacity post tensioning cables stressed to 7 MN each pass through the end blocks, providing a total reaction capacity of 28 MN.

Four 5 MN hydraulic jacks, each with its own strain gauged load cell, are attached to one end block and act through a central steel platen. The bearings are placed between this platen and the other end block using an overhead crane, and compressive and shear forces are adjusted using a hydraulic control system.

The performance of the bearings under any set of design loadings can then be assessed by recording the 4 jack load cell readings and the corresponding bearing deflections as shown on displacement transducers.

Epoxy resin adhesives

Epoxy resin adhesive will be used during the erection of the elevated sections of the West Gate Freeway to fill the joints between the match-cast box girder segments. The design requires that the epoxy resin develops sufficient strength to allow uniform distribution of stresses so that the structure can act monolithically. The epoxy resin must also act as a moisture seal in the joints to prevent ingress of moisture and subsequent corrosion of the prestressing cables.

Although epoxy resin adhesives are widely used as jointing materials because they can be applied in thin layers (1-2mm) and quickly gain strength enabling rapid erection procedures to be used, the Board's experience with them is limited. A comprehensive testing programme has therefore been undertaken to determine the properties of these adhesives, to develop and standardise appropriate test methods and to evaluate the effect of matters such as the surface condition of the concrete, the ambient temperature and the method of application of the adhesive to the joint.

The 'pot life' of the epoxy, which is the usable time over which the epoxy can be effectively applied to the joint surfaces, has been found to be influenced by the thermal insulation characteristics of the mixing container, the amount of epoxy mixed and the relative temperatures of the adhesive and its surroundings. Another important characteristic which had to be determined was the 'open time', which is the maximum time which could elapse after the epoxy was applied to a concrete surface before the joint with the matching surface had to be made. Both properties must be known so that construction programmes can make allowances for the range of application and mixing conditions which will occur.

The strength of epoxy joints was assessed using various surface preparation, environmental and application conditions by determining the flexural strength and modulus of rupture of joints in concrete beams.

As a result of the investigation, the specification documents will contain such information as the range of temperature and weather conditions in which jointing can proceed and the required treatment of the joint faces prior to application of the adhesive. The required test properties of the adhesive will be specified.

Pavement dimensional tolerances

A research project is in progress with the aim of establishing specifications for dimensional tolerances of pavement placed with Autograde.

Differences between design and achieved levels and thicknesses of pavement courses have been examined on the Hume Freeway bypass of Avenel, the Princes Highway East duplication east of Pakenham and the Western Freeway, Wallace to Bungaree Section.

The first project examined was the Hume Freeway, bypass of Avenel. In a 200m test section the results indicated the following:

- The existing level and thickness specifications were not being met.
- Levels and thicknesses of the central 8.5m wide region of pavement placed and trimmed by Autograde were less variable than those of the shoulders, the shoulders being trimmed by grader rather than Autograde.
- The mean levels and thicknesses of randomly sampled data between pegged cross-sections and of that taken at fixed offsets at pegged cross-sections are similar.
- The present method of obtaining levels by measuring the height of the pavement below a stringline held at a known level (dippings) was shown to be inadequate. To obtain reliable results, testing needs to be undertaken with an engineer's level and staff.

The data obtained on the Hume Freeway test area were used to form a draft specification on dimensional tolerances. The main differences between this draft specification and the existing specification are as follows:

- Levels are tested on a lot basis with the results of the shoulders and through lanes being evaluated separately.
- Levels are taken with an engineer's level and staff.
- Level tolerances are combinations of level limits and maximum percentage defectives (levels outside the limits).
- Layer/course thicknesses have been changed to allow the mean thickness to be slightly less than the design thickness.

This draft specification was recently used on two test sections on each of the Princes Highway East and the Western Freeway. Of these four test sections, one on the Western Freeway passed all the level and thickness specifications. Most of the thickness specifications were met on the other three sections, but about half of the pavement layers were outside the level specifications.

The results of these test sections will enable an appropriate dimensional tolerance specification for Autograde placed pavements to be produced.

Use of chemical industry by-products in road making

Two by-products of the chemical industry have been investigated in an attempt to find cheap road making material and to assist with the ever present problem of disposing of waste products from that industry.

In the first case the replacement of 10 per cent of the bitumen in an asphalt mix with a paint residue by-product produced during the manufacture of acrylic paint has been found to make the mix impermeable to water with little effect on the mechanical strength. A possible disadvantage of the use of this material is the production of a strong formaldehyde smell during mixing.

The second by-product investigated was atactic polypropylene (APP). This material is a waxy, slightly tacky solid at room temperature but becomes a viscous liquid when heated to 150°-165°C. When added to bitumen, APP has been found to reduce the temperature susceptibility of the bitumen, increase the strength and most importantly impart elasticity to the bitumen. A mixture of 20 parts APP to 100 parts bitumen has an elastic recovery value of at least 20 per cent—similar to that of rubberised bitumen. Consequently APP could be used as an alternative to scrap rubber in bitumen.

Asphalt mixes where one fifth of the bitumen was replaced with APP have also been tested in the laboratory and show good mechanical properties. It is conceivable that APP bitumen mixes could be used to advantage at heavily trafficked intersections. APP has also been tried in the laboratory as a precoating binder for Mildura aggregates which characteristically have poor adhesion and mechanical properties, the aim being to replace the tar which is being used for precoating in the Mildura region. The laboratory trials have been encouraging and it is hoped that an APP enriched sprayed seal with Mildura aggregate will be laid next spraying season as a field trial. Experimental patches of sprayed seal using APP enriched bitumen have already been laid on the Calder Highway.

The main disadvantage of APP is that it contains between 8 and 16 per cent of a hydrocarbon solvent which has a 26°C flash point and it is therefore not safe to liquify it in an open bowl because of the fire hazard. Large scale field trails therefore await the availability of suitable equipment.

Hume Freeway, Barnawartha to Wodonga

Experimental partly-crushed river gravel pavements

Mechanically stabilized river gravels have been used in freeway pavements to only a limited extent because of doubts as to their adequacy and problems in achieving stability. To date, river gravels have not been used for a comprehensive autograde programme where stockpiling, wet-mixing and spreading are involved.

The abundance of river gravel in the Albury/Wodonga area contrasts with the scarcity of hard rock sources. By its availability, proximity and relatively low cost, river gravel provides an attractive alternative to crushed rock for pavement construction on the Hume Freeway between Barnawartha and Wodonga, provided that its stability can be assured.

The recent construction of a 1.2 km temporary deviation of the Hume Highway, to allow construction of adjacent dual carriageways to commence, provided an ideal opportunity to lay experimental pavement sections using partly-crushed river gravel with various fine additives. Six different materials, totalling 6000 tonnes, were laid in three pavement layers extending over 800 lineal metres. Five materials were subject to trial in the subbase layer from which the best two materials were selected for further trial in the two base layers.

River gravels are extracted from the Murray River flood plain, having been deposited in the ancestral river system in relatively recent geological times when climatic conditions were much wetter than they are today. The gravels are extracted from beneath the water table, to depths of up to 30 m, by means of fixed and mobile draglines. The nominal maximum size of the river gravel is usually 37 mm. Typical test properties of material extracted from various pits are shown in Table 3.

Table 3 Properties of partly-crushed Murray River Natural River Gravels

Sieve Analysis (mm) % Passing										PI
53	37.0	26.5	19.0	13.2	9.50	4.75	2.36	0.425	0.075	
100	95-100	90-100	75-95	65-85	55-75	45-60	35-50	10-15	0-3	NP

The deficiency of fines in river gravel necessitates the use of a fine additive to correct the grading and provide some cohesion. Granitic sands, similar to those used elsewhere for mechanical stablization, are too coarse as a sole additive in Wodonga river gravels. Other locally available additives are either too fine or too plastic. To overcome these problems, additives were blended to achieve the desired grading and plasticity characteristics. The test properties of the available fine additives, and additive mixtures, are summarized in Table 4.

In order to achieve a suitable grading the fraction of raw river gravel over 19 mm was crushed, screened into component sizes and recombined to a specified 20 mm coarse grading compatible with the intended additive. Front-end loaders were used to blend aggregate and sand components into coarsely graded river gravel stockpiles and to blend the fine additives into separate stockpiles.

The pre-mixed additive and river gravel were then blended and wet-mixed at a pugmill. Production and delivery of the wet-mixed material took place the evening before the material was required because of prior commitments of the plant. Despite the fact the materials were proportioned and mixed by front-end loader, the resulting wet-mixed material proved to be very uniform and complied, within very close tolerances, with the n = 0.45 grading aim.

Statistical density testing was applied to the pavement trial sections, sometimes being applied after initial rolling in addition to testing at the completion of back-up rolling. Densely compacted and stable pavements, with high characteristic values of relative compaction, were readily achievable with minimal rolling if the material was placed at moisture contents close to optimum. If placed drier than optimum, high densities were difficult to achieve. If wetter than optimum, stability decreased but was not a major problem.

Construction was undertaken during the drier summer/autumn period which aided stability, however it is considered that instability of river gravel in wetter periods could be minimized by specifying a relatively high level of crushed faces and by closely controlling the grading and moisture content of materials supplied to the roadbed.

Analysis of gradings before and after compaction showed a clear trend of the river gravel to break down some 2 per cent on most sieve sizes. Specifying a slightly coarser n = 0.475 grading would achieve the desired n = 0.45 grading after compaction.

Of the six different additives used in the trials, the three-component mixture was the most successful in terms of ease and degree of compaction, stability and cost. The two-component mixes were also successful to a lesser degree whilst the single additives were generally unsuitable for freeway construction, particularly for base layers. The various additives are subjectively rated in order of preference in Table 4.

Test Properties of Fine Additives

Material	Sieve Analysis (mm)					PI	* % Req'd	** Rating
	9.50	4.75	2.36	0.425	0.075			
1 Chiltern granitic sand	100	97	85	42	26	2-6	30	-
2 Milos gneissic sand	100	97	94	59	32	6-14	20	5
3 Howlong river loam			100	98	62	1-4	12	6
4 Mixture 1 & 2 (1:1)	100	97	90	51	29	5-9	24	3
5 Mixture 1 & 3 (1:1)	100	99	93	70	44	2-6	16	2
6 Mixture 2 & 3 (1:1)	100	99	97	79	47	6-10	15	4
7 Mixture 1, 2 & 3 (4:3:3)	100	98	92	64	39	3-8	16	1

*% by mass of additive required to achieve a n = 0.45 grading.
**Preference based on field performance, test properties and cost.

Monitoring frequency of testing of road works

In the 1979/80 Report the introduction of provisional standards for the minimum frequency of testing of road construction works was reported. Four standards of road construction were identified ranging from major roadworks estimated to cost in excess of $1 million per annum, and with full-time testing staff, to minor works estimated to cost up to $50,000.

Divisional and Project Engineers have since been made responsible for monitoring the frequency of testing being achieved on work under their control. To assist them in this task, a periodical summary of the numbers of tests carried out on each job was required.

Because all the results of field and laboratory tests carried out by the Board's Materials Division and regional divisions are already stored in a computer based file in a central data bank, a computer program was developed to produce the periodical summary. Using this summary and knowing the size and cost of each job, senior engineers can determine whether the provisional standard of minimum frequency of testing is being achieved and whether that standard is appropriate for the work.

Lot testing of crushed rock

Since 1979, specifications for earthworks and pavement construction have generally included requirements for the degree of compaction to be achieved in terms of a statistically-based lot testing scheme.

A similar scheme, but involving the quality of material, has been introduced to specifications for the supply of pavement materials. Recent contracts for the supply of relatively large quantities of crushed rock for use in freeway pavements at Drouin, Seymour, Pakenham and Berwick have included acceptance provisions based on testing of the material in lots and simple statistical analysis of the results of one of the specified tests.

In these contracts a 'lot' has been defined generally as a stockpile of about 1000-1500 tonnes of crushed rock produced in a single day. Five samples are taken essentialy at random from the lot with the aid of a mechanical loader. Each sample is tested for plasticity, sand equivalent, unsound rock content and grading. The lot is accepted if all the individual test results comply with the appropriate specified requirements, provided that the mean values of the grading results for particular sieve sizes fall within specified ranges which are narrower than the corresponding ranges specified for individual test results.

The purpose of the dual grading requirements is to allow realistically for random fluctuations in grading, which are inherent in acceptable crushing operations, and at the same time ensure that the material is produced with an average grading close to the specified target.

Once a lot has been accepted, the crushed rock is transferred to a main stockpile pending delivery to the job site.

The contract specifications provide for the engineer to accept, at a reduced rate of payment, those lots which meet all the individual test requirements but which fail by designated amounts to meet the requirements specified for the mean grading results.

Homogeneity of earthworks compaction

Testing procedures for statistically-based specifications for the assessment of compaction requirements have relied on the assumption that material in a test lot is reasonably homogeneous.

In the application of statistically-based requirements on the Hume Freeway, Seymour Project, much of the material under test, particularly the fill derived from the Palaeozoic siltstones, has been found not to be homogeneous in grading and/or plasticity. It is not uncommon, for instance, for the field density tests in a lot to be carried out on materials with maximum size ranging from less than 20mm to more than 75mm.

It has been assumed to date that by selecting a compaction mould size to suit the maximum particle size in the material, and performing compaction tests for the range of material present in the lot, the rules relating to homogeneity remain valid.

The occurrence of materials which are not homogeneous has led to the validity of the testing and assessment procedures being questioned.

An investigation was commenced to examine the factors involved in detail. The three stages of the investigation are to examine:

1 The Effect of Maximum Dry Density on Relative Compaction.
2 The Effect of Maximum Particle Size on the Relative Compaction.
3 The Effect of Mould Size on Maximum Dry Density.

In the Stage 1 investigation, an experiment was set up to check the range of maximum dry density (and optimum moisture content) results obtained with the mould sizes and rammers used to date.

The modified and standard methods of test to determine dry density, both CRB and Australian Standard 1289, are restricted to material having a maximum size of 19mm. Both methods permit the use of other moulds and rammers provided that the energy input is within specified limits. The methods warn, however, that where variation of moulds and rammers is considerable, very marked alterations in compaction test results may occur. No guidance is given as to the permitted degree of departure from the standard equipment.

Moulds of up to 150mm have been in regular use for many years, and it is known that they give results very close to those obtained in the standard 100mm diameter moulds. Moulds of 250mm and 300mm, using a 12.47kg rammer, have been in use for a number of years but no exhaustive study has been made of the maximum dry density and optimum moisture content values obtained with these moulds and rammers compared with those obtained with the standard equipment. The moulds and rammers used in the experiment are detailed in Table 5.

Table 5

Nominal Mould Size	Diameter (mm)	Height (mm)	Volume (cm^3)	Face Diameter (mm)	Hammer Mass (kg)	Drop (mm)	No of Blows per Layer	Energy Input (kJ/m^2)
100mm	105	115.5	1,000	50	2.7	300	25	596
150mm	152	116.6	2,127	50	2.7	300	53	594
200mm	213	192.2	6,849	90	12.47	306	36	590
250mm	255	227	11,593	90	12.47	306	62	600
300mm	308	299	22,300	90	12.47	306	118	594

The design of the experiment required:

- The material used to be homogeneous. Ripped siltstone was obtained and passed over a 19mm sieve to provide material of the required maximum size. The oversize was discarded and the pass 19mm material was placed in an agitator truck for mixing. The mixed material was then passed through a rotary splitter to provide the required number of portions.
- The replication of compaction curves. To reduce the risk of error due to random variations, each test was duplicated and the laboratory maximum dry density obtained from two consecutive separate determinations of the dry density curve.
- Operator variation to be minimized. Determinations in the 100mm and 150mm moulds were carried out by one operator and the same operator shared the compactions in the larger moulds with one other operator. Each layer of the compaction test was shared by the two operators. Variations in operator compaction techniques were not measured by the experiment but technique differences were minimized. Each set of duplicate compaction curves was drawn independently by two different experienced operators.

The compaction results obtained from the curves drawn by the two operators are shown in Table 6. Analysis of variance of these results indicates that there is no significant difference due to the variation in mould size nor to the operator drawing the density/moisture curve. These mould sizes are being incorporated into Board standard test procedures and Stages 2 and 3 of the investigation are proceeding.

Table 6

Repeat Curves	Nominal Mould Size	Operator 1		Operator 2	
		Maximum Dry Densities (t/m^3)	Optimum Moisture Contents (%)	Maximum Dry Densities (t/m^3)	Optimum Moisture Contents (%)
1	100	1.917	12.9	1.915	13.4
2		1.937	13.2	1.934	13.0
1	150	1.934	12.8	1.932	13.0
2		1.946	12.8	1.946	13.0
1	200	1.948	12.5	1.945	12.5
2		1.933	11.4	1.926	12.1
1	250	1.952	12.5	1.950	12.4
2		1.952	12.5	1.944	12.7
1	300	1.920	12.6	1.917	12.6
2		1.913	12.7	1.911	12.2

Assessment of asphalt compaction using lot testing

Research has shown that properties of asphalt such as fatigue life, impermeability and the rate of bitumen hardening are improved as the degree of asphalt compaction increases. With this improvement comes longer service life. For many years, the Board's standard specifications for asphalt construction were largely of the method type where requirements were set down relating to mix temperature, type of compaction plant and compaction procedure. The degree of compaction to be achieved was simply specified as "Each layer shall be compacted to a density not less than 96 per cent of the compacted density of the job mix". Very little field density measurement was undertaken to check compliance with this requirement.

When a programme of field density testing on randomly selected jobs showed that the general standard of compaction fell far short of the specified level, it was decided to introduce a statistically based specification with a provision to reduce payment to contractors if they failed to meet the specified minimum value of characteristic relative compaction. Similar statistically based specifications have been in use by the Board for earthwork and pavement construction compaction control for several years (see 1978/79 Report), however the concept of making a reduced payment if the specified minimum value of characteristic relative compaction is not met is not normally applied to earthworks or pavement construction using select fill or crushed rock because these materials can be reworked by contractors to achieve the specified requirements. Asphalt, however, can only be compacted while hot and can not be reworked when testing indicates that specified compaction levels have not been achieved.

Statistically based specifications acknowledge the inherent variability in materials and testing whereby a number of individual test results on a section of road will exhibit a spread of values approximating the statistical standard distribution.

In a given area of work, called a lot, the characteristic value of relative compaction is calculated as that value of relative compaction, R_C, where

$$R_C = \overline{X} - 0.92S \text{ for six core tests per lot}$$

or $$R_C = \overline{X} - 0.88S \text{ for ten nuclear gauge tests per lot}$$

where $\overline{X}$ and S are the mean of the individual site results and sample standard deviation of these results respectively and 0.92 and 0.88 are factors selected so that in an essentially normally distributed population of values of relative compaction, about 80 per cent of the values would be greater than the characteristic value.

The specified minimum values of characteristic relative compaction are 95 per cent for layers of thickness 50mm or more and 93 per cent for layers of thickness less than 50mm. These values were chosen after extensive testing on a number of projects. They represent compaction levels that were demonstrated to be readily achievable using good compaction techniques. The values may appear to be low in comparison to the specification replaced but they represent the minimum value of characteristic relative compaction for which a contractor receives full payment. To be confident of full payment, a contractor must aim for an average compaction quality significantly greater than the minimum characteristic value specified.

If the characteristic value of relative compaction of the lot is less than that specified above for acceptance but greater than or equal to 90 per cent the work represented by the lot may be accepted as far as compaction is concerned but payment is made according to the following formulae:

$P = 10\ R_C - 830$ for a layer of thickness 30mm to 50mm inclusive or

$= 6\ R_C - 470$ for a layer of thickness greater than 50mm

where P is the rate of payment expressed as a percentage of the relevant scheduled rate, the maximum value of P being 100 per cent.

The result of the new specification requirements has been an improvement in the quality of asphalt compaction. Before the new specification in the period January to July 1980, 25 per cent of 24 asphalt lots greater than 50mm thickness, failed to meet the 95 per cent minimum. In the 12 month period January to December 1981, only 10 per cent of the 76 lots greater than 50mm thickness failed to meet the 95 per cent minimum. Compaction of asphalt less than 50mm thickness shows greater variation as some contractors have had difficulty in meeting the 93 per cent minimum. For example, for the period January to December 1981, 25 per cent of 152 lots of thickness between 30mm and 50mm failed to meet the 93 per cent minimum. There is therefore still scope for improvement in compaction procedures in these thinner asphalt layers.

Extent of work

Table 7 shows that 4837 km of all types of bituminous surfacing work was completed in 1981/82 compared with 4718 km in 1980/81. The length of roadway treated increased by 119 km and the area treated has increased by approximately 1 484 000 m².
In 1981/82 the length of sealed road on the Board's declared system was increased by 49 km and the Board contributed to increasing the length on unclassified roads by 381 km as shown in Table 8. Reconstruction of previously sealed pavements and the restoration of the seal coat amount to 316 km of the declared system, or 1.5 per cent of the sealed length, compared with 1.1 per cent in 1980/81.
Retreatments on declared roads amount to 1736 km (8 per cent of the sealed road length), compared with 1702 km (7.8 per cent) in 1980/81.

Table 7 Bituminous surfacing work completed

Category of road and plant used	1980/81		1981/82	
	km		km	
Work on roads to which the Board contributed funds				
CRB declared roads				
Board's plant	2242		2187	
Municipal plant	39		113	
Contractor's plant	157		222	
	2438		2522	
Unclassified roads				
Board's plant	1581		1473	
Municipal plant	200		208	
Contractor's plant	158		288	
	1939		1969	
Sub-totals		4377		4491
Work done for other Authorities by the Board's plant (No Board contributions for these works)				
Municipalities	331		341	
State Instrumentalities	10		3	
Commonwealth works	-		2	
		341		346
Totals		4718		4837

Types of work

Sprayed work (initial treatments and retreatments) was again the principal type of work, amounting to 96.8 per cent of the total length of the work.
The plant mix work completed in 1981/82 was 143 km, i.e. 3.2 per cent of the total length and 5.7 per cent of the total area.
The 1981/82 expenditure on plant mix works was equivalent to 29 per cent of the total expenditure on bituminous surfacing. For the plant mix work a total of 284 900 tonnes was supplied and spread by contractors.

Cost of work

The average unit costs for sprayed work done by the Board's 17 bituminous surfacing units are shown in Table 9. The average overall cost of all types of sprayed work was 111 cents per square metre compared with 103 cents in 1980/81, an increase of 7.8 per cent.
The average cost per tonne for asphalt supplied and laid was approximately $45.41 in the Melbourne and Geelong areas, and approximately $51.34 in other areas of the State. The average cost per tonne was $45.85, compared with $39.88 in 1980/81.

Table 8 Bituminous surfacing work on various road categories
(on roads to which the Board contributed funds during 1981/82)

Type of Work	State highways	Freeways	Tourists' and Forest roads	Main roads	Total Board's Declared System	Unclassified roads	Totals
	km	km	km	km	km	km	km
Initial treatments							
Extensions to sealed system							
Sprayed work	15.55	7.01	6.78	12.26	41.60	377.04	418.64
Plant mix work	-	7.10	-	-	7.10	4.37	11.47
Reconstruction of lengths of previously sealed pavements							
Sprayed work	90.82	-	5.04	201.65	297.51	260.30	557.81
Plant mix work	4.24	0.54	-	13.61	18.39	25.86	44.25
Widening of existing sealed pavements							
Sprayed work	46.66	-	0.39	53.12	100.17	74.60	174.77
Plant mix work	2.54	-	-	4.21	6.75	4.40	11.15
Duplication of existing sealed pavements							
Sprayed work	13.88	-	-	1.92	15.80	2.48	18.28
Plant mix work	4.02	-	-	6.92	10.94	1.72	12.66
Final seal							
Sprayed work	107.95	16.87	12.49	119.62	256.93	248.26	505.19
Plant mix work	1.33	-	-	8.87	10.20	7.74	17.94
Retreatment							
Sprayed work	698.07	45.45	103.19	889.36	1736.07	937.86	2673.93
Plant mix work	6.61	2.30	-	11.81	20.72	24.76	45.48
Totals	991.67	79.27	127.89	1323.35	2522.18	1969.39	4491.57

Table 9 Average costs of sprayed bituminous surfacing done by CRB plant
(on roads to which the Board contributed funds during 1981/82) (Costs in cents per m^2)

	Nature of Work											
Item	ITP&S Size 14 & over	ITP&S Size 10	ITP&S Size 7	ITP&S 2 Appln Seal	IT Primerseal	ITSO&ITFS & Reseal Size 14 & over	ITSO&ITFS & Reseal Size 10	ITSO&ITFS & Reseal Size 7	ITSO&ITFS & Reseal Size 5	BSRS Reseal Size 14	BSRS Reseal Size 10	ITSO&ITFS & Reseal 2 Appln	Surface Enrichment
Square metres costed	690,844	835,982	9,239	48,248	2,178,972	3,522,891	8,680,625	6,479,229	912,864	410,776	297,706	53,222	332,836
Material													
Cents	106.0	104.2	84.7	197.2	67.0	80.2	66.7	55.0	55.8	113.5	89.7	164.9	20.6
%	58.0	63.9	53.6	66.9	62.5	60.5	62.4	62.3	62.1	61.0	59.6	71.0	70.5
Stores													
Cents	7.8	4.8	10.9	8.1	3.5	5.0	3.8	3.2	2.8	7.5	6.4	5.7	0.7
%	4.3	2.9	6.9	2.7	3.3	3.8	3.6	3.6	3.1	4.0	4.2	2.4	2.4
Plant													
Cents	31.2	23.4	33.2	38.2	16.2	19.0	15.0	12.4	13.4	24.6	20.8	26.2	3.2
%	17.1	14.3	21.0	13.0	15.1	14.4	14.0	14.0	14.9	13.2	13.8	11.3	11.0
Labour													
Cents	37.6	30.8	29.2	51.3	20.5	28.2	21.4	17.8	17.9	40.7	33.7	35.5	4.7
%	20.6	18.9	18.5	17.4	19.1	21.3	20.0	20.1	19.9	21.8	22.4	15.3	16.1
Totals													
Cents	182.6	163.2	158.0	294.8	107.2	132.4	106.9	88.4	89.9	186.3	150.6	232.3	29.2
%	100	100	100	100	100	100	100	100	100	100	100	100	100

ITP&S indicates "Initial Treatment Prime & Seal"
BSRS indicates "Bitumen Scrap Rubber Seal"
ITSO indicates "Initial Treatment Seal Only"
ITFS indicates "Initial Treatment Final Seal"

Materials

- **Aggregate**

The total quantity of covering aggregate used was approximately 253 000 cubic metres on sprayed work undertaken by the Board, and 46 400 cubic metres on sprayed work undertaken by municipalities and contractors. Table 10 details the average prices of aggregates over the last five years and illustrates that the average price in 1981/82 was $1.73 per cubic metre higher than the average price in 1980/81.

Table 10 Average price of aggregate (in roadside stacks) for bituminous surfacing

Material Prices/cubic metre	77/78	78/79	79/80	80/81	81/82
	$	$	$	$	$
Screenings	13-00	14-11	15-73	17-83	19-59
Gravel	11-97	12-09	14-72	16-92	17-29
Sand	6-40	7-07	8-95	8-86	9-37
Scoria	21-38	7-80	8-55	9-70	13-48
Average price all aggregate	12-92	13-69	15-43	17-54	19-27

- **Bitumen**

The Board purchased 34 800 tonnes of bitumen by contracts with four suppliers at a total cost of $9 313 800.

Experimental addition of hydrated lime to bitumen

Sprayed seals with the addition of up to 18 percent by mass of hydrated lime to the bitumen binder have been placed in several locations in the Shires of Swan Hill and Karkarooc.

The field trails follow laboratory studies by the Australian Road Research Board which demonstrated that the rate of hardening of bitumen is reduced by the addition of hydrated lime. The testing was undertaken using the procedures of Australian Standard AS2341.13—Determination of Durability of Bitumen. Increases of up to 50 per cent were obtained in the time taken for the treated bitumen to harden to the 'critical viscosity' of the bitumen durability test.

If the rate of bitumen hardening on the road follows the laboratory experience, large increases in seal life may be obtained, particularly in the hotter areas where the rate of bitumen hardening is normally greatest.

In the field trails, hydrated lime was manually handled into a transfer box placed in the bitumen suction line between the bitumen sprayer and the supply tanker. Blending was completed by circulating the contents of the sprayer for 20 minutes. With this field method, dust problems were experienced together with some difficulties in loading concentrations of 12 per cent or more, but once properly blended there was little sedimentation or change in the spraying characteristics of the binder.

The addition of 12 per cent by mass of hydrated lime to bitumen increases the binder materials cost by about 5 per cent.

The binder in the experimental seals will be tested from time to time for comparison with adjacent untreated binder control sections.

TRAFFIC MANAGEMENT

Traffic management studies

The Board has been involved in several traffic management studies which examine the road network and identify problems of safety, capacity, traffic operations and local amenity. Proposals were then formulated to relieve these problems with traffic management measures. Typical of these investigations is the Burke Road Corridor Traffic Management Study. This was conducted under the guidance of a steering committee consisting of representatives from the Board, municipal councils, the Road Safety and Traffic Authority and the Melbourne and Metropolitan Tramways Board.

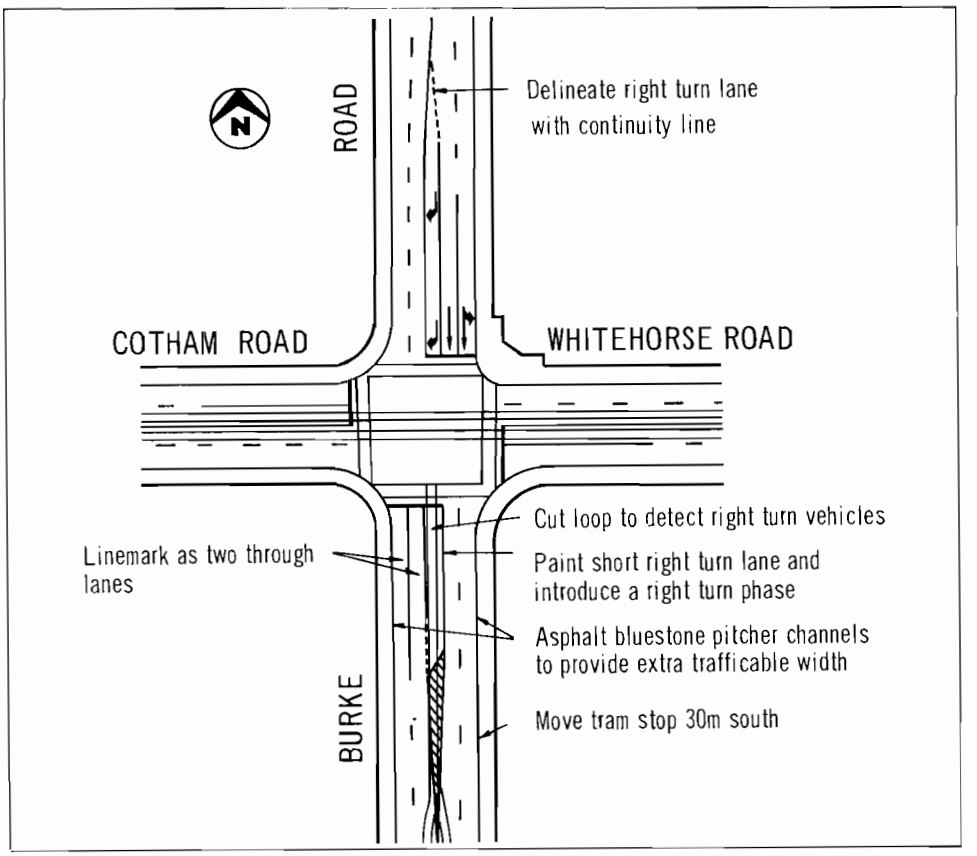
The study examined the Burke Road corridor from the Eastern Freeway to the Princes Highway East and revealed that there were many problems along the route. As there was little scope at most locations for major works (such as flaring of intersections) the proposed improvements were generally limited to minor works such as linemarking improvements, refinements to traffic signals and minor roadworks.

Despite these limitations, the study showed that significant improvements could be made to the capacity of critical intersections at reasonably low costs. This is illustrated in Table 11.

A typical example of a set of proposals for an intersection is that devised for the Cotham Road/Whitehorse Road/Burke Road intersection in the Cities of Kew and Camberwell.

- The intersection is currently congested in peak periods. The capacity can be significantly improved (AM Peak +11%, PM Peak Slight Improvement) by moving the tram stop on the southern approach 30m further south and repainting the linemarking on this approach to include a short right turn lane as shown in Figure 11.
  Priority A. Cost $3,000.

Figure 11: Cotham Road/Whitehorse Road/Burke Road intersection: low cost improvements which could significantly improve the capacity of the intersection



The poor safety record which exists, particularly on the southern approach, would be significantly improved by these measures.

In the proposed layout, it will be necessary for trams to store in the right turn slot when two or more trams are present at the tram stop. When the tram tracks are reconstructed in concrete, the length of single track should be extended to provide adequate tram storage clear of the right turn slot.

Table 11

Intersection	Capacity Improvement		Cost
	AM Peak	PM Peak	$
Doncaster Rd - High St - Burke Rd	16%	16%	2,200
Belmore Rd - Harp Rd - Burke Rd	10%	20%	38,200
Cotham Rd - Whitehorse Rd - Burke Rd	11%	2%	13,100
Barkers Rd - Mont Albert Rd - Burke Rd	18%	8%	25,500
Camberwell Junction	6%	6%	34,500
Toorak Rd - Burke Rd	0	15%	2,200
High St - Burke Rd	13%	30%	9,100
Wattletree Rd - Burke Rd	12%	30%	4,200
Waverley Rd - Burke Rd	22%	0	12,000
Princes Highway East - Burke Rd	13%	8%	32,500

- The existing 'temporary' signal controller can be replaced with a controller capable of handling all the existing groups and the right turn phase from the south. It would be necessary to cut a new detector loop in the right turn lane.
  Priority A. Cost $10,000.
- A continuity line can be painted to delineate the right turn lane on the northern approach and reduce the number of 'trapped' vehicles in the right lane and also reduce the likelihood of rear-end accidents.
  Priority A. Cost $100.

Eastern Freeway Arterial Road Extension lighting

The lighting along the Eastern Freeway Arterial Road Extension is a centrally mounted scheme consisting of three transition columns at the Bulleen Road end and 45 columns mounted on the concrete median barrier at 56m intervals. The transition columns are the 'see-saw' lowering type to allow servicing from the ground.
The lantern mounting height varies from 27m, 23m and 18m on the transition columns to 12m on the median barrier columns.
All columns and outreach brackets were supplied by Galvanizing Industries Pty Ltd. The lanterns used are Philips type SGS-201 with 400 watt high pressure sodium lamps on the transition columns and 250 watt lamps on the median barrier columns. There are 98 fittings installed along the median. The lanterns were chosen for their excellent light distribution and glare control which are important for the comfort of motorists and for minimum spillage of light into residential areas.
Prior to opening, tests were carried out to determine actual level of luminance from a selected pavement area. SAA Public Lighting Code AS1158 Pt 1 requires an average pavement luminance of at least 1.0 cd/m^2 and a uniformity ratio of minimum to average luminance greater than 0.33. The results of the test showed an average luminance of 2.2 cd/m^2 and a uniformity ratio of 0.41.

Below: The lighting arrangements at the western (city) end of the Eastern Freeway Arterial Road Extension, looking towards the Bulleen Road overpass and the Eastern Freeway. The high mast freeway lighting on the far side of the overpass changes to 12m column lighting via three transition columns immediately this side of the overpass

Accident analysis

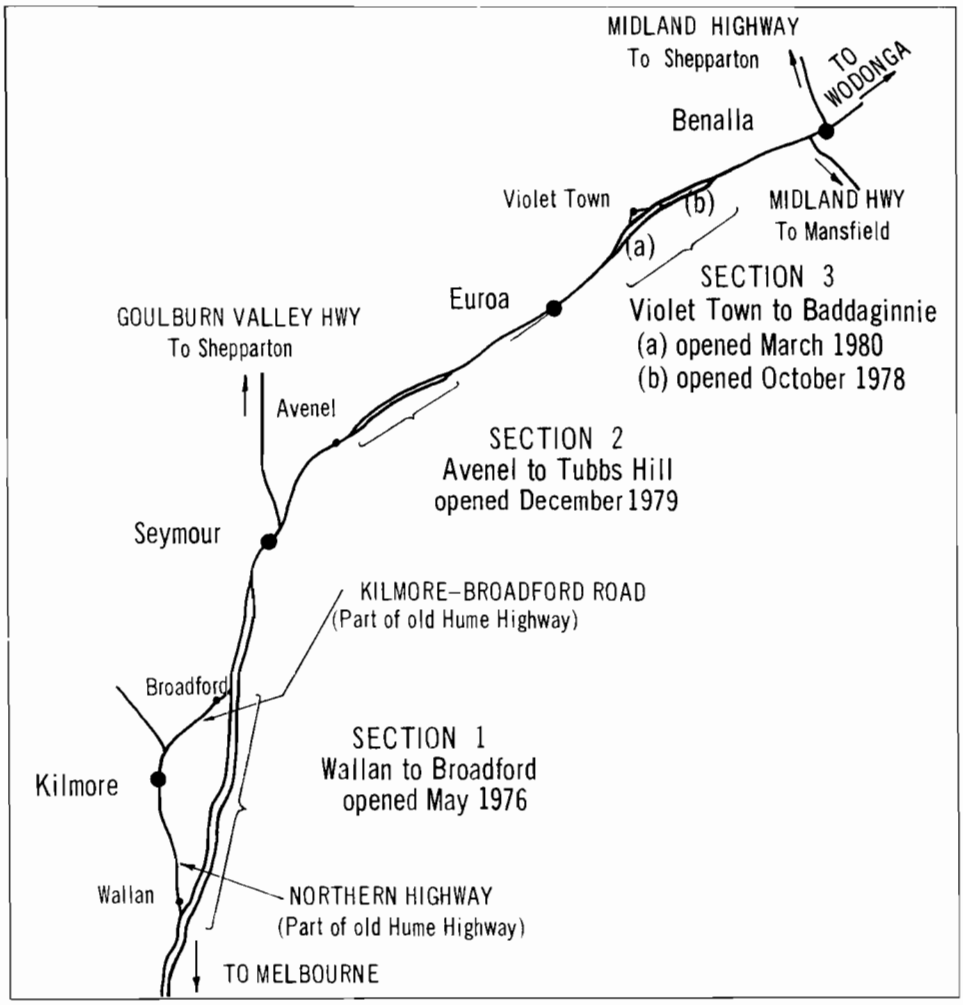
Hume Highway/Freeway, from Wallan to Benalla

The Board has carried out an analysis of casualty accidents on the Hume Highway/Freeway to compare the casualty accident rates on the undivided sections of the highway with those on the sections developed to freeway standards. The study was carried out in two parts by comparing casualty accident rates before and after conversion to freeway and then comparing sections developed to freeway standard with sections that remain undeveloped.

Three sections of freeway were included in the analysis:

- Wallan to Broadford — Opened May 1976
- Avenel to Tubbs Hill — Opened December 1979
- Violet Town to Baddaginnie — Opened in two stages—October 1978 and March 1980.

Figure 12: Sections of the Hume Highway/Freeway between Wallan and Benalla. The casualty accident rate on the freeway sections is 70 per cent less than the casualty accident rate for the undivided sections of the Hume Highway



The standard of the sections of two-lane two-way highway between these freeway sections is good.

The casualty accident rate, defined as the total number of casualty accidents per 100 million vehicle kilometres of travel for each section, was used to evaluate the levels of safety along each section of highway or freeway.

Initially, the casualty accident rates were calculated for the three sections of freeway after opening and compared with those calculated for the corresponding sections of undivided highway that they replaced. The old Hume Highway through Kilmore was replaced by the new Hume Freeway (Wallan-Broadford), the Northern Highway and the Kilmore-Broadford Road. The 'after' accident rate for this section included the rates for all these roads.

Table 12 Hume Highway/Freeway Casualty Accident Rates

Section	Casualty accidents per 100 million vehicle kilometres		
	Before freeway opening (generally undivided highway)	After freeway opening	Percentage reduction
1 Wallan to Broadford Corridor	45.1	10.8 Freeway only 19.5 Northern Highway 24.9 Kilmore - Broadford Road 14.4 Total corridor	(Old Hume Highway) 68
2 Avenel to Tubbs Hill	35.9	17.0	53
3 Violet Town to Baddaginnie	39.9	28.2	29

A summary of these 'before' and 'after' casualty accident rates is shown in the Table 12. Overall casualty accident rates were calculated for the three sections of the Hume Freeway and for the undivided sections of the Hume Highway. For the latter, all undivided sections of the Hume Highway between Seymour and Benalla were used. The overall rate for the three sections of Hume Freeway was 12.5 casualty accidents per 100 million vehicle kilometres, whereas the overall rate for the undivided sections of Hume Highway between Seymour and Benalla was 41.9 casualty accidents per 100 million vehicle kilometres.
The freeway casualty accident rate is 70 per cent less than the casualty accident rate for the undivided sections of the Hume Highway.

Impact absorbing lighting column

As part of a programme to evaluate the performance of a special type of impact absorbing lighting column manufactured by a firm in Perth, the Board participated in a joint project with the Traffic Accident Research Unit of the NSW Department of Motor Transport, and the NSW Department of Main Roads. The project involved the full scale crash testing of the special column together with similar testing of conventional steel plate-set columns for comparison.

Below: The result of the high speed impact (60 km/h) with the test column. The first 4 m of the column collapsed and is underneath the car. The baseplate with collapsed column still attached is just below the rear bumper of the car. The average deceleration on the frame of the vehicle over the first 80 msec after collision was just over 6g which is generally regarded as readily survivable for seat-belted occupants

The impact absorbing lighting column under test was an octagonal steel column 12.5m high with a 4.5m outreach bracket. For the first 4m above ground, each of the seams in the octagonal section were welded for only a portion of their length on a hit-and-miss system, so that the section would collapse on impact into eight separate strips. Both types of test column were impacted frontally at speeds of 15, 30 and 60km/h with a medium weight vehicle (1200kg Holden Torana) and at 30km/h side-impact with the same vehicle.

Preliminary results indicate substantial reductions in vehicle decelerations resulting from the special design. Within the limits of the test conditions, these decelerations can generally be judged as survivable for vehicle occupants, whereas deceleration on impacting conventional steel columns is somewhat above the normally acceptable limits.

The fact that control of the direction in which the column falls is uncertain at mid-range impact speeds is of some concern and will be taken into account when determining whether this type of column or the already proven 'slip-base' type now used on some freeways, is the better column for urban arterial road use.

Bitumen road tanker modernization

The Board's bitumen plant fleet includes nineteen 9000 litre articulated road tankers for delivering hot bitumen to sealing sites. Most units are over 15 years old, but are structurally good for considerable further service.

The tankers' heating and pumping system consists of a six cylinder petrol motor car engine, mounted on the tank trailer, which drives both the bitumen pump and the bitumen heater system. The bitumen heater burns diesel oil in a brick-lined mild steel tube passing through the main tank. Two auxiliary fuel systems are therefore needed. The firebricks in the heater system require regular renewal and spare parts for the oil burners require costly special manufacture. The petrol engine requires all the usual maintenance.

In recent years, LP gas has become widely available throughout the State at competitive prices which has lead to the development of a more efficient bitumen heating system using this fuel. Modern hydraulic equipment could also be utilized to enable the power to drive the bitumen pump and heater to be provided by the prime mover engine via the power take-off mounting on the gearbox, thus obviating the need for the additional petrol engine.

A programme of modernization utilizing these developments was begun in 1980. To date, 12 tankers have been modernized by the provision of the following:

- Hydraulic power units mounted on gearbox power take-off mountings to drive the bitumen pump on the trailer via hoses and a hydraulic valve and motor.
- LP gas burners and stainless steel fire tubes to replace the obsolete diesel burner and brick equipment in the bitumen heater units.
- Two 45 kg liquid-withdrawal cylinders mounted as the fuel supply in the space previously occupied by the petrol engine.

The cost of the modernization of each unit was approximately $6000.

The modernization of the bitumen heating and pumping systems has dramatically reduced the maintenance costs associated with the previous systems which was estimated at approximately $2000 per unit per year.

Above: One of the Board's 9000 litre bitumen road tankers after conversion to hydraulic pumping and LP gas heating systems

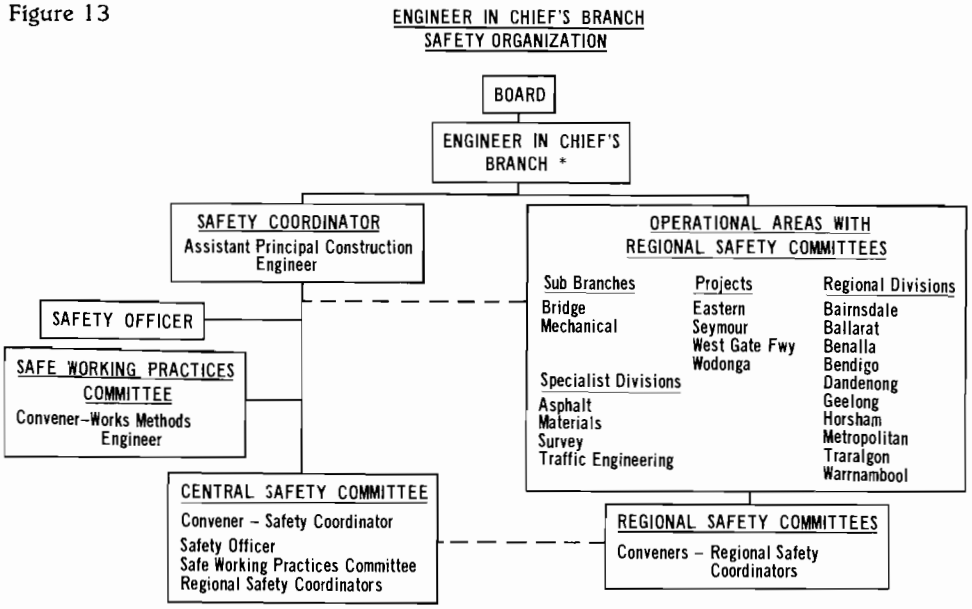
GENERAL

Safe Working Practices

Safety Organization

The Board's safe working practices organization was expanded in 1979 to provide for a Safety Co-ordinator responsible for co-ordinating safety policies within the Board.
The Safety Organization is shown in Figure 13 and provides for two levels of committee—the Safe Working Practices Committee and the Regional Safety Committees.

Figure 13



*Total employees, 4182 at June 1982

The Safe Working Practices Committee is responsible for developing guidelines, instructions or codes of practice relating to safe working practices to ensure the safety of employees and the general public, and the protection of private and community assets.
The Regional Safety Committees are at the operational level; they have representatives from the various work areas and are responsible for ensuring that personnel are aware of and adhere to established safe working practices, liaison with the Safety Officer, implementation of proposals from the Safe Working Practices Committee, surveillance of accident and injury experience, inspections of work areas and the study and appropriate circulation of information on safety issues. Regional Safety Co-ordinators are responsible to their respective Divisional/Project Engineers.
A Central Safety Conference is held twice yearly where the Safety Co-ordinator, Safety Officer, Safe Working Practices Committee, Regional Safety Co-ordinators and others meet to discuss current safety topics and proposals for the next half year. These conferences provide a valuable communication process.
The Safe Working Practices Committee and Central and Regional Safety Committees have identified a number of problem areas and have set about developing guidelines, instructions and codes of practices relating to these problems. During the year, circulars were issued on topics including work near electrical power lines and cables, portable ladders, transport of dangerous goods, and high visibility traffic jackets, caps and hats. Codes of Practice relating to trenching and protective clothing were issued and two specific work areas (West Gate Freeway Project and Materials Division) produced their own Safe Working Practices Code of Practice.

Accident Statistics

All accidents involving injury to Board personnel require the injured person to submit a Work Injury Report. From the information submitted it is ascertained whether the reported accident is statistically significant and requires further investigation. A statistical accident is a work injury in which the person is absent for at least one day after the day of the accident.
The accident statistics for the 1981/82 year are given in Tables 13, 14 and 15.

Table 13

	Cause of injury	Total number 1980/81	1981/82
1.	Arising out of or use of plant/vehicle/machinery	376	335
2.	Exposure to or contact with harmful substances, e.g. Epoxy	40	19
3.	Using powered or other hand tools/equipment, e.g. chain saws	390	401
4.	Falling, knocking, slipping, jumping, etc.	360	348
5.	While manual handling	323	327
6.	Arising out of a housekeeping problem	24	34
7.	Working environment/weather, e.g. allergies, sunburn	78	87
8.	Electrical discharge	2	4
9.	Other (including insects, misadventure)	156	102
10.	Journey or recess accidents	43	85
	Totals	1,792	1,742

Note: Four categories (1, 3, 4 and 5) account for over 80 per cent of the accidents.

Table 14

	Part of body	Total number 1980/81	1981/82
1.	Head or neck	152	150
2.	Limbs (includes wrists & ankles)	524	505
3.	Spine	352	341
4.	Eyes	191	163
5.	Hands or fingers	363	317
6.	Feet or toes	68	101
7.	Cardiovascular	2	7
8.	Skin/burns	20	29
9.	Hernia	7	14
10.	Loss of hearing	5	9
11.	Respiratory	20	4
12.	Chest, stomach or shoulders	-	142
13.	Other	229	106
14.	Fatalities	3	1
	Totals	1,936	1,889

Injuries to the limbs, spine and hands account for over 60 per cent of the accidents.

Table 15
Safety statistics

	Statistical Accidents	Non-Statistical Accidents	Total Statistical and Non-Statistical	Total Manhours Worked (million)	Disabling Injury Frequency Rate (DIFR)
1979/80	538	1,288	1,826	8.995	59.8
1980/81	491	1,301	1,792	8.833	55.6
1981/82	447	1,308	1,755	8.323	53.7

Trainee construction workers

In June 1981 the Board approved the establishment of a training scheme for construction workers who had the potential to become construction supervisors. The purpose of the scheme is to raise the standard of field supervision on road construction jobs by developing a group of better trained personnel from which many of the Board's future field supervisors could be chosen.

The scheme involves a continuous programme of field training under the guidance of experienced field supervisors and a job rotation programme over a maximum period of three years. The trainee's work is monitored to ensure the scope of training and experience is appropriate and this is supplemented at local and central level by relevant instruction.

Participants in the scheme are classified as Trainee Construction Workers.
All Divisions and Projects have nominated a Training Engineer who is responsible to the Divisional or Project Engineer for training their personnel. The Trainee Construction Workers spend the equivalent of a half day a month with the Training Engineer and other appropriate staff in discussions and inspections of various construction and quality control aspects. The Training Engineer maintains records of training carried out and submits quarterly summary reports.
Twenty employees have commenced the training scheme, from eight regional divisons and three projects. The first one-week central training course was held at Springvale in November 1981; seventeen trainees attended from ten Divisions and Projects. The course consisted of a balance of theoretical and practical work including instruction and discussion on supervisory skills, job records, job instruction techniques, organization of work, industrial relations, provision for traffic, assessment of sub-grade/pavement material types and roadworks signing. Those who attended the central course are now undertaking a job rotation programme within their own work area, including appropriate periods in the Divisional /Project laboratory and with a survey party.

Staff

At 30 June 1982, personnel in the Engineer in Chief's Branch numbered:

Engineers	508
Scientists	23
Surveyors	37
Other Professional Officers	28
Technical Staff	491
Administrative Staff	291
Printing and Other General Division Staff	18
Field Staff and Employees	2109
Depot Staff and Employees	677
	4182

There were also 16 staff on secondment to various other areas, 24 on extended leave and one student engineer.

Publications

The following papers by officers in the Engineer in Chief's Branch were presented or published in the 1981/82 year :

Proof Loading of Foundations: B Addis, Bridge Design Engineer.
Presented at the NAASRA Bridge Engineering Committee Seminar on Bridge Foundations, Melbourne, September 1981.

Handling Rubberised Bitumen in the Field: R G Allen, Asphalt Engineer.
Presented at the Nineteenth Australian Road Research Board Regional Symposium, Wagga Wagga, May 1982.

Methods of Establishing Compaction Standards—Laboratory-based Procedures for Soils, Aggregates and Asphalts: R H Barron, Scientific Officer, Materials Division.
Presented at the NAASRA/ARRB Workshop on Measurement and Use of Relative Compaction of Soils, Aggregates and Asphalt in Road Construction, Melbourne, April 1982.

Water Reducing and Workability Admixtures—Their Problems and Effects on Concrete Properties: S B Bromham, Scientific Officer, Materials Division.
Presented at the Concrete Institute of Australia Seminar on Admixtures, Melbourne, April 1982.

The Use and Limitations of Tertiary Gravels: T M Glazebrook, Divisional Engineer, Bendigo and P W Lowe, Materials Engineer.
Presented at the Seminar on Natural Construction Materials-A Diminishing Resource, Bendigo College of Advanced Education, Bendigo, March 1982.

A Penetrating Investigation with Quasi-Static Penetration Tests Using Electrical Friction Cone Penetrometers: J C Holden, Research Engineer, Materials Division.
Presented at the Australian Geomechanics Society (Qld Group)/Institution of Engineers Australia Mini Symposium on In-situ Testing, Brisbane, May 1982.

The Country Roads Board's Approach to the Calibration and Use of Nuclear Density/Moisture Meters: G W Jameson, Scientific Officer, Materials Division.
Presented at the NAASRA/ARRB Workshop on Measurement and Use of Relative Compaction of Soils, Aggregates and Asphalt in Road Construction, Melbourne, April 1982.

Fuel Usage Evaluation of Linked Signal Systems: B J Negus, Assistant Traffic Engineer (Signals) and K J Fehon, Chief Traffic Engineer, R J Nairn and Partners.
Presented at the Joint SAE-A/ARRB Second Conference on Traffic, Energy and Emissions, Melbourne, May 1982.

Design of Foundations to Suit Geological Conditions—West Gate Freeway, Melbourne: W L Pump, Engineer, Materials Division and R S Evans, Scientific Officer, Materials Division.
Presented at the Annual Conference of the Institution of Engineers Australia, Hobart, February 1982.

Community Values and Project Evaluation: R E Saunders, Leader, Environmental Studies Section.
Presented at the Annual Conference of the Institution of Engineers Australia, Hobart, February 1982.

The Changing Road Environment and the Driver: R T Underwood, Chief Engineer (Management Services).
Presented at the Driver Training Seminar—Steering a Course for the Future, Transport Regulation Board, Melbourne, March 1982.

The Victorian Transport Study: R T Underwood, Chief Engineer (Management Services).
Published in **Civil Engineering Transactions,** Vol CE 24 No 1, February 1982.

Urban Roads—Concerns of the 1980s: R T Underwood, Chief Engineer (Management Services)
Published in **Civil Engineering Transactions,** Vol CE 24 No 1, February 1982.

Predicting the Future—The Challenge for Engineers and Planners: B E Van Every, Engineer, Traralgon Division.
Presented at the Annual Conference of the Institution of Engineers, Australia, Hobart, February 1982.

Field Measurement of Density—Methods of Assessment Based on Judgment: M L Williams, Principal Construction Engineer.
Presented at the NAASRA/ARRB Workshop of Relative Compaction, Melbourne, April 1982.

Assessment of Asphalt Compaction Using Lot Testing: J J Rebbechi, Assistant Asphalt Engineer, and K I York, Scientific Officer, Materials Division.
Presented at the Australian Asphalt Pavement Association Australasian Conference, Surfers Paradise, July 1981.

Also published in 1981/82 was:
Research Memorandum No 26: **West Gate Freeway (South Melbourne), Pile Load Test in Mudstone—Pile 3385/1:** G Worotnicki, Engineer, Materials Division.