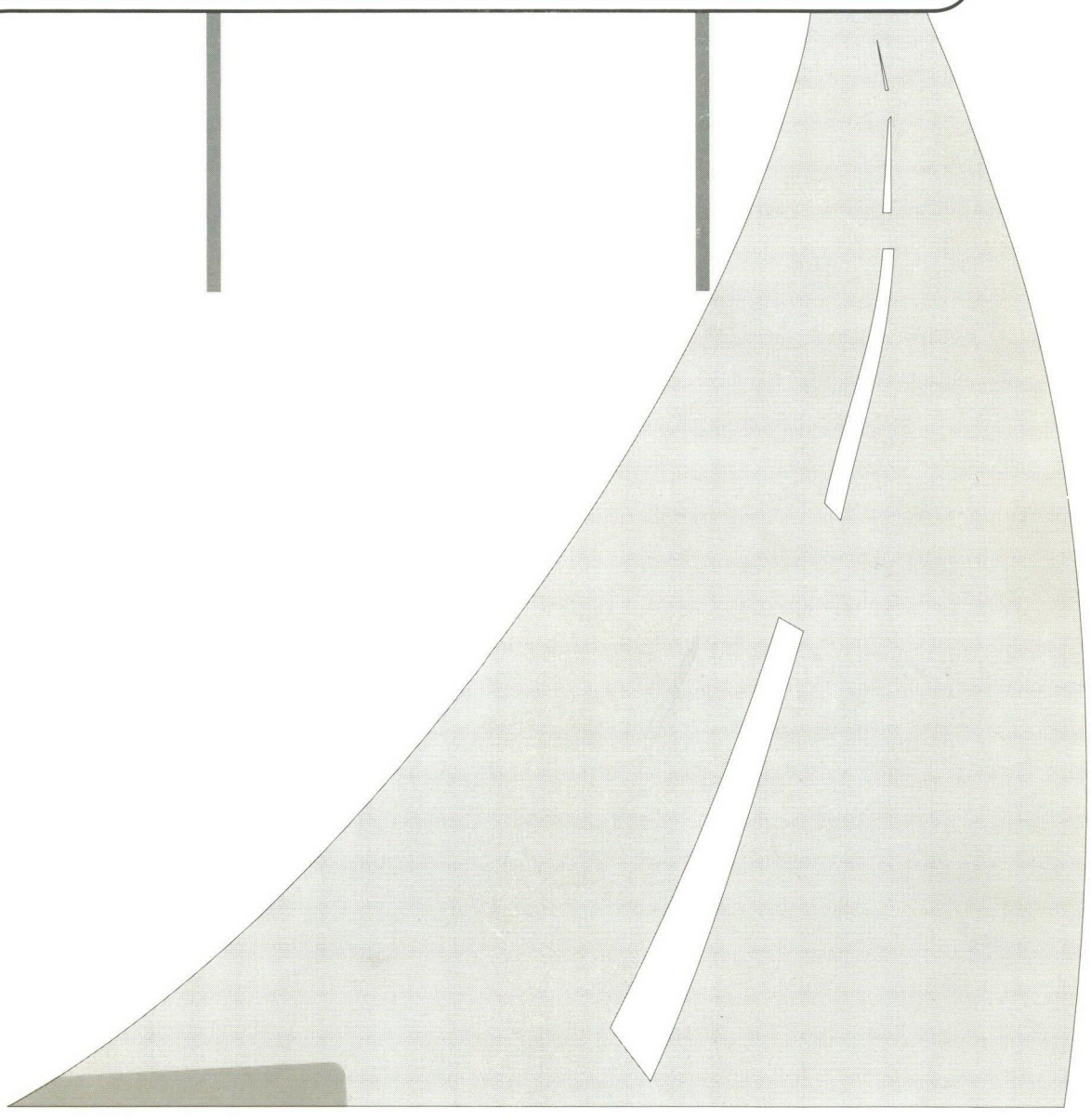
Roads and Traffic Authority
Southern Region

PROPOSED HUME HIGHWAY DUPLICATION INCLUDING BOOKHAM BYPASS ENVIRONMENTAL IMPACT STATEMENT



CHELL McCOTTER

PROPOSED HUME HIGHWAY DUPLICATION INCLUDING BOOKHAM BYPASS ENVIRONMENTAL IMPACT STATEMENT

For: Roads and Traffic Authority NSW
Southern Region

By: Mitchell McCotter & Associates Pty Ltd

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Mitchell McCotter & Associates Pty Ltd declares that it does not have a commercial interest in the outcome of this project. Although the firm may be asked to provide further advice related to this EIS and environmental approvals, it will not be taking part in any detailed engineering design or construction work which may be undertaken on the project.

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4. PROJECT DESCRIPTION

SUMMARY

Progressive upgrading of the Hume Highway has been underway for a number of years as part of the Commonwealth-funded National Highways strategy. Once committed works are complete, continuous dual carriageway will exist between Sydney and Coolac with the exception of a 19 kilometre section commencing 19 kilometres south of Yass. Completion of this section, centred on Bookham is the next planned major work to be undertaken as part of upgrading the Hume Highway and is the subject of this environmental impact statement.

Environmental assessment and determination of the proposal is conducted under Part V of the Environmental Planning and Assessment Act, 1979. The Roads and Traffic Authority is the determining authority with a duty to consider the environmental effects of the proposal.

Justification and Alternatives

The existing highway alignment is considered satisfactory as a result of major works undertaken to the east and west of Bookham during the past decade. Upgrading from the existing predominantly two lane road to a four lane configuration is required to achieve the required level of service. Annual average daily traffic on this section of highway is currently estimated to be 8,440 axle pairs, with a high percentage of heavy vehicles (some 33% of total traffic). Traffic is predicted to grow at a rate between 3.3 and 3.5 per cent per annum.

Upgrading the highway including a bypass of Bookham is projected to result in a 27 per cent reduction in accidents along that section of highway. Travel time savings will result increasing initially from two minutes at present traffic levels to almost four minutes in 2020. For 2020 this represents a travel time saving of up to 24 per cent. Provision of the Bookham bypass will improve residential amenity of the village with less noise, vehicle exhausts and reduced risks from passing traffic.

A number of alternatives for upgrading the highway were developed and compared. These included a major dual carriageway deviation, provision of a second carriageway either side of the existing highway and four alternative routes for bypassing Bookham. The do nothing option was also considered. Evaluation criteria were developed and applied to each alternative. These included ability to meet the project objectives; economics; land use impacts; visual impacts; ecological impacts and socio-economic consequences.

Comparison of alternatives led to the selection of a project involving:

- a new north-bound carriageway east of Bookham;

- a dual carriageway bypass of Bookham passing some 100 metres to the north of the existing highway in the village area; and

- a new south-bound carriageway west of Bookham.

Project Description

The project will involve duplicating the existing highway either side of Bookham and constructing a dual carriageway bypass of the village. Upgrading of the existing highway by resurfacing can then follow. At the completion of these works the entire section of highway would consist of dual carriageways with a 20 metre median between.

Design of the road will provide for traffic speeds of 110 kilometres per hour, with a concrete pavement designed to last 40 years. Provision will be made for at-grade intersections at local roads including Conroy Street and Binalong Road in Bookham to facilitate access to the highway including access to the village sporting facilities which are located immediately north of the proposed bypass, and Childowla Road. Culverts and bridges will be provided at creek crossings as required. Access to properties and underpasses for stock will be provided along the route including a public stock underpass at Binalong Road. Preliminary discussions have been held with Yass Council over a proposal to establish a rest area beside the highway in Bookham, at a location currently used by motorists to break their journey adjacent to the village store.

Although the Roads and Traffic Authority has previously purchased some of the land required for the project, further acquisition of land will be required for the bypass and adjacent to the existing highway east of Bookham. Standard acquisition procedures will be followed. Compensation would be assessed in accordance with the requirements of the Land Acquisition (Just Terms Compensation) Act, 1991.

It is anticipated that construction of the project will proceed in stages over a three to four year period with commencement date dependent on the availability of funds. Total construction costs are estimated to be $70 million (excluding a concrete overlay on the existing highway). This project has a benefit cost ratio of approximately 0.8.

A range of environmental safeguards have been incorporated into the design of the project to minimise potential impacts. These include sediment control measures; landscaping; noise attenuation using barriers and mounds; site restoration; judicious route selection and the provision of suitable access and crossings for both vehicles and stock.

Environmental Assessment

Land use within and surrounding the highway corridor is predominantly agricultural, mainly sheep and cattle grazing. Duplication of the highway will cause some loss of agricultural land although no major property severance will occur. The bypass of Bookham will not directly affect land use within the village. Loss of trade is expected to be experienced by the Bookham store, with the viability of the business at risk. Provision of a rest area near the store would minimise this impact. No significant effect on the development potential of Bookham is expected, however some parcels of land will be incorporated into the highway reserve. Although the bypass will impose a physical barrier between the village and its sporting facilities, provision of suitable access and landscaping measures will reduce this impact.

Although no new property severance will result, duplication of the highway and construction of the bypass will have some consequences for management of rural properties. The provision of access points, stock underpasses, restoration works or compensation for impacts on property management or productivity will be the subject of private negotiation between property owners and the Authority. Just terms will be agreed for acquisition and compensation.

No aboriginal sites of any cultural or archaeological significance will be affected by the proposal. Likewise the proposed upgrading and bypass will result in minimal impacts upon flora and fauna.

Duplication of the highway will not introduce a new element into the landscape, however the significant cutting at Conroys Gap, and bypass of Bookham will alter the visual landscape. The existing landscape consists of a mixture of rural, cultural (township) and natural (ridge and creeklines). These landscapes generally have a good ability to absorb the proposed roadworks. A landscape strategy for the route has been developed with specific guidelines for sensitive areas including: establishing native grasses; retaining existing vegetation, selected avenue plantings and establishing a rest area.

The proposal is not expected to significantly affect air quality. A comprehensive erosion and sediment control plan will be incorporated into the final design to minimise sediment mobilisation and maintain water quality in local creeks. No impacts on flooding are expected.

During the construction period noise levels may exceed Environment Protection Authority guidelines at some residences for short periods. There are no practicable means of avoiding this. Increased traffic speeds will result in a louder noise source. Noise modelling indicates that barriers and/or mounds will be required at some locations to ensure noise levels fall within criteria adopted by the Roads and Traffic Authority as described in this.

Conclusions

Benefits predicted to arise from the project include improved travel times and speeds, reductions in energy consumption, improvements in road safety and significant improvements to the amenity of Bookham. Environmental investigations have not revealed the presence of any areas of particular biophysical significance or sensitivity along the proposed route however some elements of the socio-economic environment, including the Bookham store and sporting facilities are sensitive to the potential impact of a bypass. Impacts on rural properties will be addressed through appropriate land acquisition and compensation procedures. Potential environmental effects are in many ways typical of those resulting from upgrading other similar sections of the Hume Highway. Nevertheless a range of environmental safeguards have been incorporated into the project.

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INTRODUCTION

Chapter 1

INTRODUCTION

This chapter introduces the proposal by outlining the background, giving an overview and explaining the decision-making process and consultation undertaken.

1.1 BACKGROUND

State Highway No 2 - the Hume Highway - is one of the most important highways in New South Wales and the State's major long distance freight route. The highway is one of a number of strategic road links throughout Australia that have been declared National Highways by the Commonwealth Government. As a consequence of this declaration a Commonwealth-funded initiative was commenced a number of years ago to upgrade the Hume Highway between Sydney and Melbourne to National Highway standards. The ultimate aim is to provide a dual-carriageway four-lane road along this entire route, bypassing all towns and limiting access.

Highway upgrading is progressing in stages. With completion of the Goulburn Bypass and Cullarin Range Deviation in 1992, dual carriageway standard currently exists continuously between Sydney and a location some 65 kilometres south of Goulburn. Additional sections of road are either completed, under construction or in the tender stage to extend the dual carriageway to approximately 19 kilometres south of Yass. A further section of dual carriageway commences 38 kilometres south of Yass and continues to 56.5 kilometres. When all of the committed works are complete, continuous dual carriageway will exist between Sydney and Coolac, with the exception of a short section between 19 and 38 kilometres south of Yass. This missing link includes the village of Bookham.

Completion of this 19 kilometre section centred on Bookham is the next planned major work to be undertaken as part of upgrading State Highway No. 2.

1.2 OVERVIEW

Upgrading the 19 kilometre section of the Hume Highway to National Highway standards will involve:

- constructing a new northbound carriageway adjacent to the existing road between Bookham and the northern end of works and resurfacing the existing carriageway in the same section;

- constructing a dual carriageway bypass of the village of Bookham;
- constructing a new south bound carriageway adjacent to the existing road between Bookham and the southern end of works and resurfacing the existing carriageway in the same section;
- providing modified (at-grade) intersections at crossings with major rural roads, other access as required, truck stops and rest areas;
- providing a range of environmental safeguards including sediment control measures, noise attenuation, landscaping, and provisions to minimise potential impact on property management practices.

The duration of construction would extend for approximately three years from commencement, with the date of commencement being dependent on funding considerations. At current values the capital cost is estimated to be $87 million.

Figure 1.1 shows the location of the proposed works.

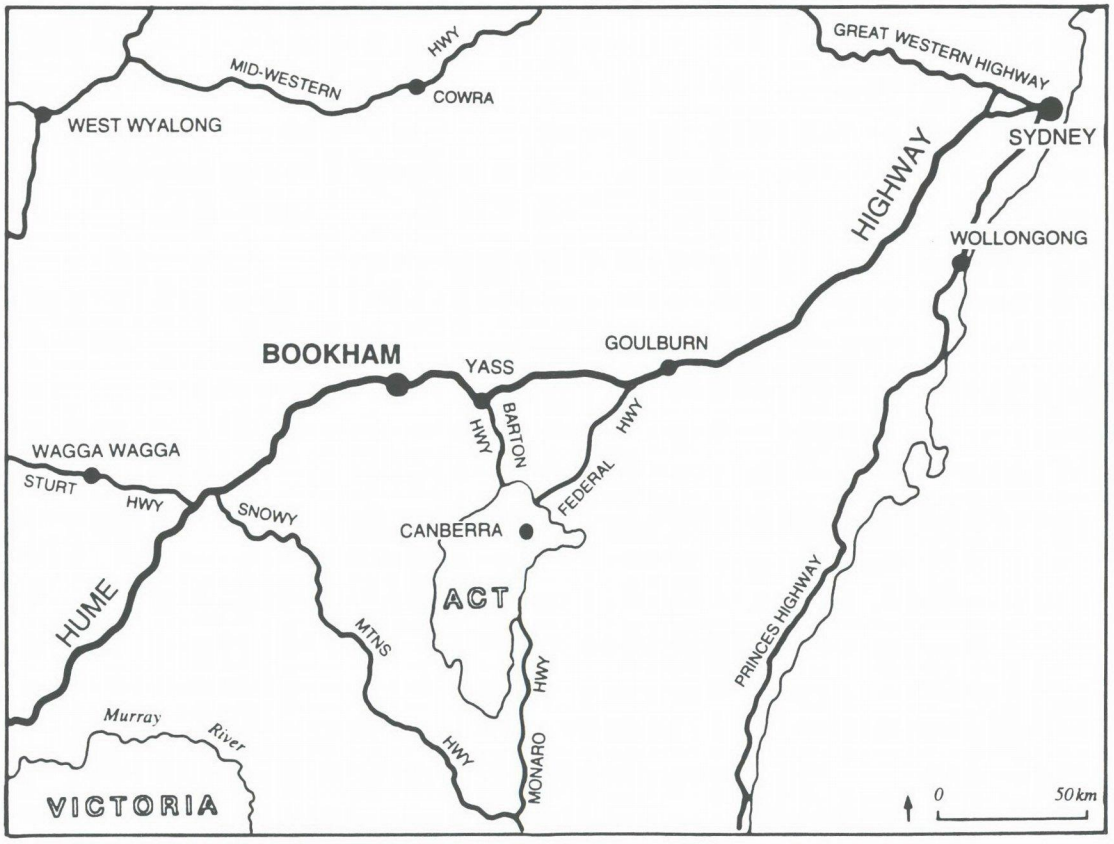


Figure 1.1 LOCATION

1.3 DECISION MAKING PROCESS

Environmental assessment and determination of the proposal is conducted under Part V of the Environmental Planning and Assessment Act, 1979. The Roads and Traffic Authority is the determining authority with a duty to consider the environmental effects of the proposal.

In April 1993 the Authority prepared an environmental overview report for the proposal. This report provided a brief description of the proposal, discussed statutory planning and traffic issues and assessed the effects on the physical, socio-economic and biological environment. The report concluded that while the proposal was likely to have a relatively low environmental impact overall, there was potential for significant effects in the vicinity of Bookham including visual impact, community severance and alteration to the setting of the village. As it was concluded that the proposal could result in a significant environmental impact, an Environmental Impact Statement was required to be prepared.

This environmental impact statement will be placed on public display by the Roads and Traffic Authority for a period of at least 30 days and submissions will be invited from the community. The proposal will be determined by the Authority after consideration of the EIS and any submissions received. A report of the Authority's examination and consideration of the EIS and representations will be prepared and made public as soon as possible after the examination and consideration has been completed.

Any necessary approvals or licences under other legislation will be obtained by the Roads and Traffic Authority at the appropriate time following determination of the proposal.

As the proposal will be funded by the Commonwealth Government, approval to proceed will be required from the Department of Transport and Communications.

Assessment of the proposal pursuant to the Endangered Fauna (Interim Protection) Act has been included in this EIS.

1.4 CONSULTATION

In the course of finalising the route, designing the highway and preparing this environmental impact statement, contact was made with a number of public authorities and interested parties.

These include:

- Department of Agriculture;
- Department of Mineral Resources;

- New South Wales Heritage Council;
- Environment Protection Authority;
- Natural Gas Company;
- Telecom Australia;
- Pacific Power;
- Southern Tablelands Electricity;
- Department of Conservation and Land Management;
- Yass Shire Council;
- Department of Planning;
- National Parks and Wildlife Service; and
- Department of Transport and Communications.

The requirements of the Director of Planning are excluded in Appendix A. A summary of responses from other authorities is included in Appendix B.

In addition to making contact with the above bodies, a community consultation program was undertaken for the project. As part of this program, a newsletter was distributed and a public display arranged in the Bookham Hall. The newsletter contained a brief outline of the need for the project, presented the various route options and explained the environmental investigation and assessment process. Opportunities for the community to have input into the decision making process were also outlined. Staff from the Roads and Traffic Authority and Mitchell McCotter attended the display to answer questions on the project and discuss specific issues with individuals who attended.

In addition, residents on all properties with a frontage to the existing section of highway were interviewed on their properties to explain the proposal, discuss any concerns and confirm they had received a newsletter and feedback form.

Input from the public was invited regarding factors to be considered in assessing route options and environmental impact, or other comments on the proposal. A copy of the newsletter and a summary of responses received is included in Appendix C.

1.5 ROLE OF THIS REPORT

The purpose of this environmental impact statement is to address the requirements of the Environmental Planning and Assessment Act, 1979, by consideration of the environmental effects of the proposal. The proposal includes:

- construction, operation and maintenance of the new carriageway and bypass;
- upgrading and maintenance of the existing highway; and
- alterations to existing roads and access arrangements.

The requirements of the Director of the Department of Planning regarding the form and content of the EIS have been obtained and are included as Appendix A. This document includes consideration of the Director's requirements and the matters listed for consideration in Clause 57 of the Environmental Planning and Assessment Regulation, 1980.

2

PROJECT JUSTIFICATION

2.2 TRAFFIC LEVELS

2.2.1 Existing traffic levels

Traffic levels are recorded by the RTA at a number of locations along the Hume Highway. Table 2.2 shows traffic levels from 1969 to 1992 at the four closest monitoring stations to Bookham.

Table 2.2 MAJOR COUNT STATIONS OF THE HUME HIGHWAY BETWEEN YASS AND GUNDAGAI

Station	Location	1969	1972	1976	1980	1984	1988	(1992)
94001 6 km west of Yass	1.5 km east of MR 56 Boorowa Road	4220	4980	6550	7800	9400	10338	(12501) (1)
94173 20 km west of Bookham	East of Reedy Creek Road	2430	3170	3380	3610	6260	7183	-
94050 Jugiong	East of MR 381 Murrumburrah Road	2880	3750	4370	5450	7610	8318	-
94467 Gundagai	4.7 km north of MR 243 Junee Road	-	-	-	5680	7050	8189	(9096) (2)

1. AADT for 21 weeks May - September 1992

2. AADT for 23 weeks January - July 1992

2.2.2 Traffic Projection

The most relevant traffic count station for the Bookham section of the Hume Highway is station No. 94173 located about 20 kilometres west of Bookham. The daily traffic volume AADT at this location was last recorded in 1988 where the total count was 7183 axle pairs.

The percentage of heavy vehicles on this section at the Hume Highway is relatively high. This is confirmed in Table 2.3 which summarises vehicle classification counts on nearby sections of the Hume Highway.

Table 2.3 HEAVY VEHICLE COUNTS

Year	Location	Heavy Vehicles[1]	Articulated Trucks[1]
1987	West of Yass (RTA station 94001)	32%	29%
1992	West of Yass (RTA station 94001)	32.5%	26%
1990	Coolac Culway Monitoring Site	36%	-
1991	Coolac Culway Monitoring Site	28%	-
1992	Gundagai (RTA station 94467)	37.2%	30.7%

Notes: 1. Percentage of total traffic volume.

The general percentage of heavy vehicles on the Bookham section of the Hume Highway is considered to be close to 33% of the total daily traffic flow. A very high proportion of these heavy vehicles are large articulated trucks (semi-trailers). The average number of axles per truck recorded at the Coolac Culway Site in 1990 and 1991 was 4.95.

Future traffic growth projections have been determined for the Bookham section of the Hume Highway from the historic trend in the daily traffic volumes at the two major traffic count stations (94001, 6 km west of Yass and 94467 at Gundagai). These two traffic count stations are permanent traffic count stations which record traffic on each day of the year and generally provide a more consistent trend in traffic growth over the years than the two other traffic count stations (94173, 20 km west of Bookham and 94050 at Jugiong).

Short term and long term traffic growth projections have been determined by linear regression of the data for the twelve year period 1980 to 1992 and the twenty-three year period 1969 to 1992. Both short term and long term growth rates are surprisingly similar, as shown in Table 2.4.

Table 2.4 TRAFFIC GROWTH RATES

	Short Term Linear Traffic Growth from Base Year 1988	Long Term Linear Traffic Growth from Base Year 1988
Station 94001, 6 km west of Yass	+ 3.5% per annum	+ 3.3% per annum
Station 94467 at Gundagai	+ 3.5% per annum	+ 3.5% per annum

Chapter 2

PROJECT JUSTIFICATION

This chapter outlines the need for the project based on road standards, traffic levels, traffic safety, travel speeds and times and impact on the village of Bookham.

2.1. ROAD STANDARDS

The existing highway is a 19.0 kilometre section of two and three-lane carriageway linking two upgraded dual-carriageway sections of the Hume Highway. The entire Hume Highway from north of Bookham to Sydney will be completed to dual carriageway standards in the foreseeable future as a result of the recent major roadworks undertaken for the Goulburn Bypass, Mittagong Bypass and Cullerin Range Deviation and other works under construction or firmly committed.

2.1.1 Alignment

The existing highway alignment is considered satisfactory as a result of major realignment works undertaken to the east and west of Bookham. These realignments have been undertaken during the past decade and have been constructed in accordance with the National Highway (Department of Transport, 1987) guidelines for horizontal and vertical alignment which require the following:

- minimum design speed of 110 kilometres per hour ;
- full control of access with service roads if necessary;
- horizontal alignment of a 1,000 metre radius curve as a general minimum (500 metre as an absolute minimum);
- vertical alignment with a 5% desirable maximum grade; and
- markings as required by Australian Standard AS 1742.

The only exception to compliance with the National Highway guidelines is the cutting at Conroys Gap where the vertical curvature of the road has a 90 kilometre per hour design standard. The use of a 100 kilometre per hour design standard at the crest of the road would have required major additional excavation in hard rock below the level of the existing highway which needs to be kept open to traffic during construction.

2.1.2 Gradient

Although the relevant section of existing highway has satisfactory alignment in terms of horizontal curvature, a major proportion of the length has gradients of between 2% and 5%. This requires the road to be classified as "undulating", which is recognised to indicate a reduced level of service, as explained below.

2.1.3 Level of Service

The relative levels of service provided by the existing highway alignment and the future four lane divided road are defined by the ranges in traffic volume (AADT).

Table 2.1 LEVEL OF SERVICE

	Average Annual Daily Traffic (AADT)			
Level of Service	Two Lane Road Flat	Two Lane Road Undulating	Four Lane Road Flat	Four Lane Road Undulating
A	0 - 2250	0 - 1080	0 - 25650	0 - 15990
B	2250 - 5380	1080 - 2790	25650 - 38470	15990 - 23980
C	5380 - 9410	2790 - 5180	38470 - 50580	23980 - 31530
D	9410 - 16860	5180 - 7770	50580 - 61990	31530 - 38640
E	16860 - 28320	7770 - 14750	61990 - 71250	38640 - 44410
F	over 28320	over 14750	over 71250	over 44410

Source: NAASRA (Guide to Traffic Engineering Practice 1988 Part 2)

The current AADT for the Bookham section of the Hume Highway is estimated as 8440 vehicles. For a two-lane road, this corresponds to Level of Service C in flat terrain but Level of Service E in undulating terrain. The four lane road is required at the current time to achieve Level of Service B or better, consistent with National Highway guidelines.

Table 2.6 SUMMARY OF MEAN TRAVEL SPEEDS (KM/HR)

Year	Vehicle Type	Existing Road Types			Future Road Types	
		2 Lane Flat*	2 Lane Undulating	3 Lane Undulating	4 Lane Flat	4 Lane Undulating
1993	Light vehicles	60	78.9	90.3	109.9	92.2
	Heavy vehicles	60	63.2	74.4	96.2	78.5
2000	Light vehicles	60	76.1	89.4	109.7	92.1
	Heavy vehicles	60	61.0	73.8	96.0	78.4
2010	Light vehicles	60	70.4	87.7	109.4	91.9
	Heavy vehicles	60	56.6	72.7	95.8	78.3
2020	Light vehicles	60	64.7	86.0	109.1	91.7
	Heavy vehicles	60	52.2	71.7	95.5	78.1

* *Speed Restriction Through Bookham*

Based on the above travel speeds, travel times for light vehicles over the 19 kilometres of road under both existing and proposed conditions have been estimated for current traffic levels and the years 2010 and 2020. Table 2.7 contains the results.

Table 2.7 TRAVEL TIME ESTIMATES

Year	Travel Times for 19 km Section (minutes)	
	Existing Highway	Proposed Highway
1993	14.2	12.2
2010	15.1	12.2
2020	16.0	12.2

Travel times for the existing highway will continue to increase as traffic levels grow and travel speeds reduce. Improving the alignment to National Highway standards is expected to result in travel time savings increasing from 2 minutes at present traffic levels to almost 4 minutes in 2020. For 2020 this represents a travel time saving of up to 24%.

2.5 IMPACT ON BOOKHAM

Bookham is a small-scale ribbon development along the existing highway. The highway is the main street of the village, with some seven houses and other establishments gaining access directly from the highway. As a result of this situation a number of impacts are experienced by the village including:

- significant levels of noise and vibration, which are particularly noticeable at night with the high percentage of heavy vehicles utilising the road.

- vehicle exhausts discharging into the immediate village area; and

- safety risk. Although travel speeds are restricted in the village area, the large volume of traffic presents a potential hazard for both pedestrians and local traffic. The existing intersection with Childowla Road in the village area is difficult to negotiate for local traffic because of poor visibility and high traffic levels on the highway. These problems are compounded by lack of observence of speed restrictions in the village.

Existing problems at Bookham would escalate as traffic levels increase in the future. Because of the consequences experienced by both road users and village residents when major highways pass through towns and villages, the National Highway guidelines require all such areas to be bypassed.

The maximum and minimum projected growth rates for traffic on the Bookham section of the Hume Highway are 3.5% and 3.3% per annum respectively, for linear traffic growth from the base year 1988.

A summary of future traffic growth projections for Bookham and nearby sections of the Hume Highway are given in Table 2.5.

Table 2.5 TRAFFIC GROWTH PROJECTIONS

Year	High Growth Projection (AADT)	Low Growth Projection (AADT)
1988	7183	7183
1993	8440	8368
1998	9697	9553
2003	10954	10739
2008	12211	11924
2013	13468	13109
2018	14725	14294
2023	15982	15479

An assessment of future highway heavy vehicle traffic growth has been made from the surveyed annual total truck traffic volumes at Marulan on the Hume Highway north of Goulburn. Although the total truck traffic at Marulan is generally higher than at locations on the Hume Highway further south, the relative growth from year to year is reasonably representative of truck traffic throughout the Hume Highway.

The total truck traffic volumes at Marulan for the years from 1964 through to 1986 reveal a relatively steady trend throughout the period, with a linear growth rate of 3.3% per annum from the base year 1988. This truck traffic growth rate is virtually identical to the general traffic growth projections, which indicates that separate traffic growth rates for cars and heavy vehicles are not necessary.

2.3 TRAFFIC SAFETY

A review of RTA statistical records for the period 1989 to 1991 indicates the following information relevant to the 19 kilometre length of undivided carriageway (Hume Highway) extending either side of Bookham.

Total Crashes	(89-91):	48
Annual Average Crashes	(89-91):	16
Total Fatalities	(89-91):	7
Total Injuries	(89-91):	43

Of the 48 crashes, seven were head on and would be potentially preventable on a divided carriageway. Only two crashes were located within one kilometre of Bookham.

On 28 February 1993 a head on collision involving five vehicles including semi-trailers resulted in one fatality. This crash occurred in the vicinity of Bogolong Creek bridge approximately one kilometre north of Bookham.

The total number of accidents recorded during the period corresponds to an average accident rate of 0.45 accidents per million vehicle kilometres of travel. This accident rate is not exceptional for a major rural highway in New South Wales, which has a combination of two lane and three lane carriageways.

The future provision of a four-lane divided road for this section of the Hume Highway is predicted to reduce the accident rate to approximately 0.33 accidents per million vehicle kilometres of travel which would be a 27% reduction in accidents. The actual reduction in the more severe types of accidents would be greater than this because of separation of opposing traffic flow by the dual carriageway.

2.4 TRAVEL SPEEDS AND TIMES

With the exception of the section of road through Bookham, travel speeds and consequently travel times are an outcome of the level of service provided by the road. Within the bounds of the village, travel speeds are restricted to 60 kilometres per hour. This restriction applies to approximately two kilometres of road.

Table 2.6 summarises mean travel speeds for different road conditions. Speeds for conditions relevant to both the existing and proposed highways for traffic levels to the year 2020 are provided.

The summary of mean travel speeds shows the contrast between low and declining average travel speeds with the present highway and high and sustained potential travel speeds with the future four lane road.

3

PROJECT ALTERNATIVES

Chapter 3

PROJECT ALTERNATIVES

This chapter defines the objectives which have been set for the highway upgrading, describes a range of feasible alternatives for the project, evaluates the alternatives and identifies the preferred project arrangement.

3.1 PROJECT OBJECTIVES

In response to the needs for the project outlined in the previous section, a number of objectives have been developed for the proposed highway upgrading. These objectives have been used in the identification and evaluation of alternatives and in the assessment of the preferred alternative.

The objectives are to:

- upgrade the section of Hume Highway and bypass Bookham to conform with National Highway guidelines;
- reduce travel times for vehicles on the highway;
- provide for more uniform operating speeds for vehicles using the highway;
- improve road safety for both highway and local traffic;
- minimise construction and maintenance costs associated with the project;
- minimise impacts on the biophysical, socio-economic and cultural environments; and
- minimise property severance and disruption to property management.

3.2 ALTERNATIVES

3.2.1 Development

A number of alternatives for upgrading the highway were developed and compared. Constraints to highway location were firstly determined. Within these constraints, alternatives for both the overall 19 kilometre section of highway, and for the bypassing of Bookham were identified. To facilitate analysis and comparison, the number of alternatives was kept to the minimum which encompassed the range of feasible solutions.

Constraints to route identification were:

- overall length and therefore cost;
- intersection with existing dual carriageways at either end of the proposed section of highway;
- houses and other development;
- areas of steep topography;
- creeks and watercourses; and
- ecologically sensitive areas.

Figure 3.1 shows the current highway, the extent of existing dual carriageway road and major features of the landscape. Throughout this section of road the highway is generally oriented east-west. Although the countryside is generally undulated and cleared for grazing there are a number of major ridges and vegetated ridge tops and creeklines. The existing highway crosses one of these ridges through a major cutting at Conroys Gap, some 22 kilometres from Yass. A second ridge four kilometres further on is skirted by deviating to the south. A number of creeks drain the area. The highway runs parallel to Conroys Creek and crosses Stony, Bogolong and Connors creeks.

The area is generally sparsely settled, with a small number of rural homesteads located in the vicinity of the highway either side of Bookham. With a population of less than 200 people the village has developed in a narrow strip along the highway. Although most development is to the south of the road, a small number of houses and the village oval and tennis court are north of the highway. Most village residents experience noise from highway traffic. Bookham has a limited economic base, with the general store depending heavily on passing trade.

3.2.2 Highway Alignment Alternatives

i. Major Deviation

Consideration of constraints imposed by the need to minimise route length and the major ridgeline which extends north of Stony Creek led to the identification of one major deviation shown in Figure 3.1. If this route were adopted, approximately 16.3 kilometres of new dual carriageway road would be constructed, commencing two kilometres west of Conroy's Gap. From this point, the route would consist of a generally straight section of road which would head south west, intersecting the existing highway again where the dual carriageway commences approximately four kilometres west of Bookham. The new road would cross the major ridge through a low point some two kilometres north of Stony Creek, follow the drainage divide between Stony and Garry Creeks, cross Bogolong Creek and pass approximately one kilometre to the north of Bookham.

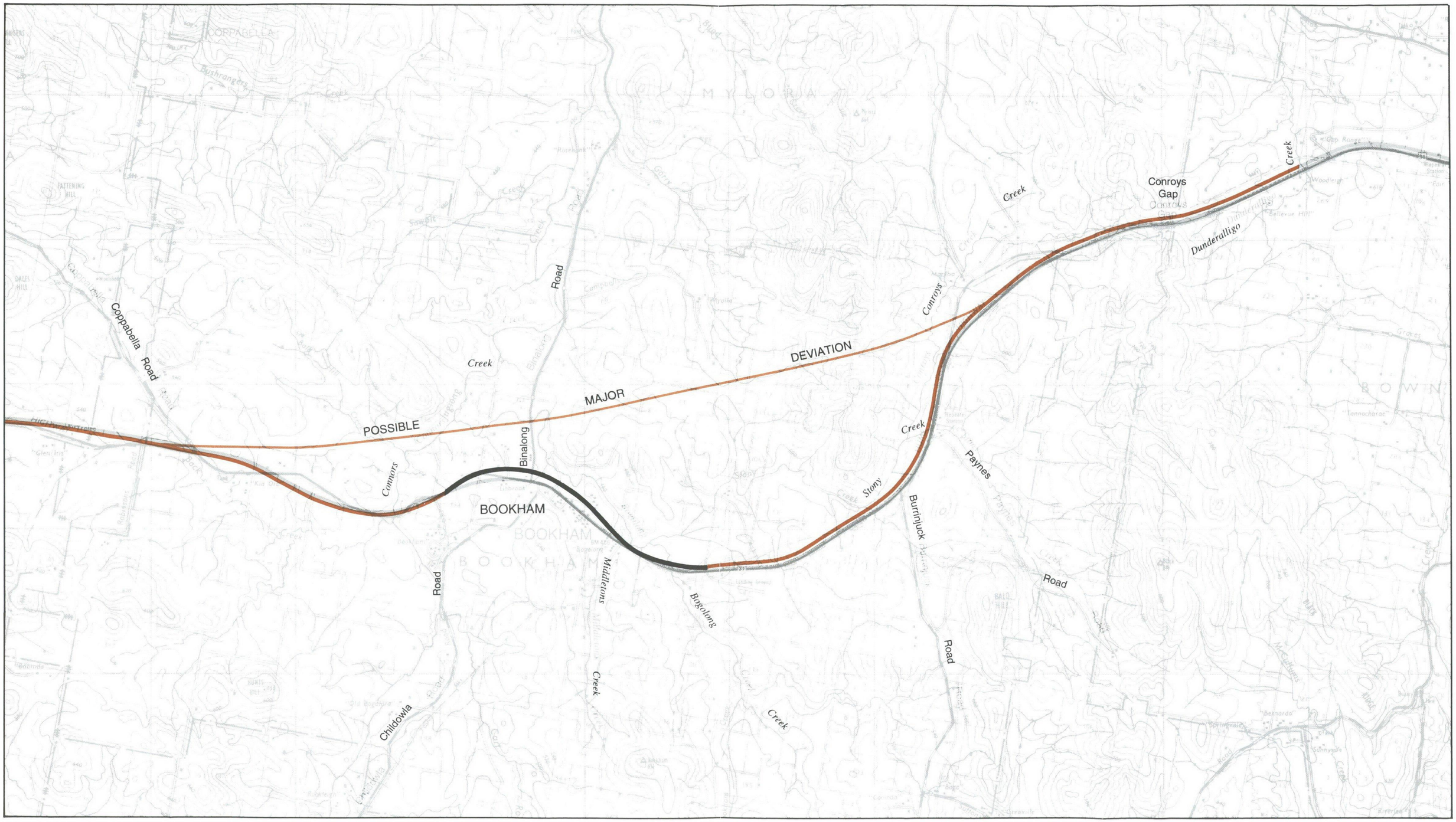


Figure 3.1 ROUTE ALTERNATIVES

ii. Existing Corridor

The existing alignment for the sections of highway either side of Bookham have been upgraded to conform with National Highway guidelines in the relatively recent past and are therefore suitable to serve as one of the carriageways in the dual carriageway road. Construction of another carriageway adjacent to and parrallel to the existing alignment, with a suitable median between, would complete the dual carriageway road and satisfy the objectives for the project. Resurfacing of the existing road would also be necessary.

The second carriageway could be constructed on either side of the existing road, however it is necessary to minimise crossings of the new and old carriageways as such crossovers result in expensive complications for construction sequencing and consequential disruption to traffic flows during this period.

Conceptual alternatives have been identified and are examined below. Although the Hume Highway generally runs north-south between Sydney and Melbourne, in the vicinity of Bookham the highway is oriented generally east-west. Consequently north-bound and south-bound carriageways referred to in this Environmental Impact Statement will be located north and south of each other.

East of Bookham

- new north-bound carriageway

A new carriageway could be constructed on the northern side of the existing highway from the end of the existing dual carriageway to Bookham. It would link directly with the existing road and could remain on the northern side of the existing road for the entire section.

- new south-bound carriageway

A new carriageway could be constructed generally on the southern side of the existing road. However it would be necessary to cross from the northern side of the existing dual carriageway to the southern side near Conroys Gap. Another crossing would be needed to the east of Stony Creek to avoid two buildings located adjacent to the highway near Paynes Road. The distances between crossovers would be only three kilometres. It would be preferable for ease of construction and safety for the new carriageway to remain on the northern side over this distance.

West of Bookham

- new north-bound or south-bound carriageways

West of Bookham the new carriageway could be theoretically constructed on either side of the existing road. Sufficient land for the provision of a new south-bound carriageway was acquired by the Roads and Traffic Authority in the 1970s and planning for this option is well advanced. Preliminary designs have been prepared in consultation with affected land owners. A new carriageway on the northern side would need to cross the existing road to join with the dual carriageway which has already been constructed.

3.2.3 Bypass Options

Four options for bypassing Bookham were identified and are shown on Figure 3.2. These have been labled A,B,C and D as follows:

- Route A

Route A bypasses the village to the north. It deviates from the existing highway approximately two kilometres east of the village centre, roughly parallels the existing highway some 800 metres to the north, rejoining it approximately one kilometre west of the villlage.

If this option were constructed new twin bridges would be required over both Stony and Bogolong Creeks. The route crosses the foothills of two large hills to the north of the village and major earthworks would be required to construct cuttings in this area, probably requiring drill and blast excavation techniques. This option has a total length of 5.5 kilometres and is estimated to cost $30.0 million

- Route B

Route B involves the construction of a new dual carriageway close to and parallel to the existing alignment on the northern side. The new road would deviate from the existing alignment in the vicinity of Bogolong Creek immediately east of Bookham, follow the existing road some 100 metres to the north and rejoin it two kilometres past the village.

New twin bridges would be required across Bogolong Creek for this option. As the existing ground is relatively flat in the area concerned, the new road could be constructed with minimal earthworks. The new carriageways would be lower or at approximately the same height as the existing highway. If this option were to be constructed, special provision would need to be made to maintain access to the village oval and tennis courts as the alignment would pass between these facilities and the remainder of the village.

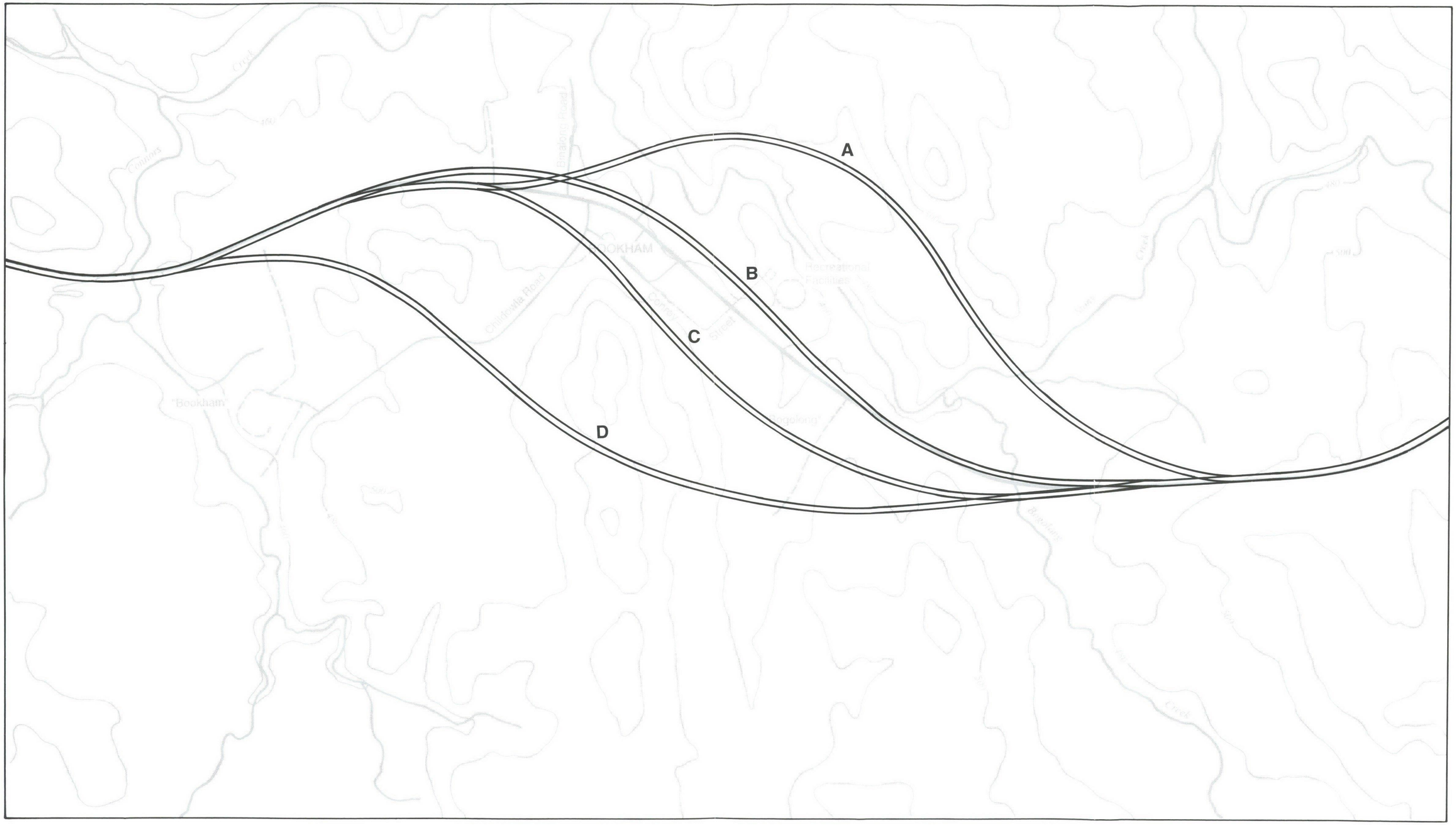


Figure 3.2 BYPASS OPTIONS

It is estimated that construction of this option would cost approximately $27.4 million.

- Route C

Route C passes immediately to the south of the village, approximately 250 metres from the existing road. It would pass behind the developed area of the village and close to the Uniting Church located off Childowla Road before rejoining the existing highway.

Construction of this option would require significant earthworks to achieve an acceptable alignment. In order to excavate in the granite which characterises the area it would be necessary to use explosives in close proximity to residences and the churches.

After this option was identified, further evaluation led to the conclusion that it was not feasible because of the significant damage which would result to nearby buildings during the construction period. For this reason, no estimate was prepared of the cost of this option and it was not considered further.

- Route D

Route D passes approximately 800 metres south of Bookham. The alignment deviates from the existing highway in the vicinity of Bogolong Creek just east of the village. It then crosses the creek and passes to the south of Bogolong Station homestead and through a saddle in the hills. The route crosses Childowla Road and rejoins the existing highway to the north of Bookham Station.

Construction of this option would require twin bridges over Bogolong Creek and extensive earthworks to create three major cuttings south of the village, probably requiring drill and blast excavation techniques.

This option has a total length of approximately 5.2 kilometres and is estimated to cost $33.2 milllion.

3.2.4 Do Nothing

The do nothing option would involve making no significant changes to the alignment, capacity or pavement condition of this section of the Hume Highway. This section would remain as a single carriageway and continue to pass through Bookham with a 60 kilometre per hour speed limit. On-going maintenance would continue to be carried out as at present. In time it would become the only single carriageway section of road between Sydney and Melbourne.

3.3 OPTION EVALUATION

3.3.1 Evaluation Criteria

The options were evaluated and compared using the following criteria:

- Ability to Meet Objectives - the ability to satisfy the objectives of the National Highway guidelines and specifically the objectives of the Commonwealth Government in upgrading the Hume Highway between Sydney and Melbourne;
- Economics - Construction cost and user benefits;
- Land Use - impact on both existing and planned land use, particularly with regard to property management and severance
- Visual Characteristics - changes to the landscape quality of Bookham and surrounding countryside;
- ecology - potential impacts on flora and fauna, water quality and sedimentation in watercourses; and
- socio-economic - potential changes to the character, lifestyle and viability of Bookham.

3.3.2 Evaluation

i. Major Alignment Deviation

Construction of the major deviation outlined in the previous section would result in a net shortening of the highway by approximately three kilometres over this 19 kilometre section. This would result in considerable user savings in travel times and costs compared to the existing alignment. These savings would be obtained, however, at the cost of abandoning up to 15 kilometres of existing road which has been constructed to National Highway guidelines.

In order to cross the steeply elevated land associated with the ridge north of Stony Creek, major excavations would need to be undertaken. The resulting road would have long lengths of approach grades of 7%, the absolute maximum grade under National Highway guidelines. It is estimated that cuttings to depths exceeding 50 metres would be required. While such engineering works are feasible, experience in the area has demonstrated that excavation in the granite of the Bookham district is very costly, with extensive use of explosives necessary.

ii. Existing Corridor

Duplication of the highway within the existing corridor either side of Bookham would enable the National Highway objectives to be met. Visual, socio-economic and ecological impacts would likewise be similar irrespective of which side of the existing road the new carriageway was constructed. There would, however, be differences between these options in terms of economics and potential land use impacts. These are discussed below:

- East of Bookham

Although new south-bound and north-bound carriageways would be of similar length, it would be necessary for the south-bound option to cross the existing highway at two locations. Such crossovers present significant cost increases for road construction as it is necessary for construction equipment and materials to cross the existing highway under controlled conditions while existing highway traffic continues. Accommodating crossovers involves segregating construction works into discreet sections and constructing temporary lengths of road to enable the highway to operate at all times. Despite these measures, delays and inconvenience to highway traffic inevitably result.

One of the crossings required would be close to Conroys Gap. Vehicle sight distances near this crest are limited and a cross over at this point would introduce a potential traffic hazard. The north-bound option would avoid the need for both cross-overs.

Construction of a new north-bound carriageway would necessitate considerable excavation at Conroys Gap whereas the south-bound carriageway could make use of an existing cutting, leading to lower excavation costs. However this is not considered a major drawback as the excavated material would be required for planned filling further along the route. If the south-bound option were adopted fill material would have to be imported.

Against these engineering advantages, property owners have advised that the north-bound carriageway would have the greater impact on property management. Reductions in paddock sizes and possible drainage implications would result. These consequences would be lower if the new carriageway was located on the southern, more elevated side of the existing highway where paddocks are larger and less constrained. Construction of the north-bound option would necessitate further liaison with property owners to ensure appropriate remediation works were undertaken and if necessary, compensation paid to address the effects on properties.

- West of Bookham

Although it is theoretically possible to locate the new carriageway either side of the existing highway, as noted in Section 3.2.2, planning for a new south-bound carriageway is well advanced. This planning has involved consultation with landowners, property purchase and preliminary road design including drainage works.

Construction of a north-bound carriageway would have no advantage over the south-bound option and would necessitate a cross-over of traffic at the western end. It would also require additional disruption to landowners and property acquisition.

iii. Bypass Alternatives

- Route A

Route A would be located generally in cleared countryside, with scattered trees occurring along the route. Some clearing of riparian vegetation would be necessary at the crossings of Bogolong and Stony Creeks. This option removes the highway completely from the village area, however this could maximise loss of trade to the village economy, as Bookham would no longer be visible from the highway.

Construction of this option would involve substantial earthworks in steep terrain north of the village. Blasting would be necessary for a high percentage of the 450,000 cubic metres of excavation. Despite this volume of excavation, grades exceeding 5% would still be required. Earthworks required for this option would involve removing a large portion of the hill, resulting in significant visual impact.

Two properties would be severed by this route. Although one of these properties is crossed by the existing highway, construction of the bypass would result in additional disruption to management practices through isolating sections of the property, fragmentating paddocks and disrupting stock movement. Some fragmented areas could become non-viable agricultural units.

Noise levels for most residences in and near the village would be reduced, although levels at at least two residences would be increased as they would be closer to the proposed road than the existing highway.

- Route B

While Route B would remove highway traffic from the centre of the village, traffic would still be audible and visible from much of the village. Noise levels would be increased for some residences. As the village would be visible from the highway, some passing trade would be maintained for the village store. The new road would pass between the village centre and the tennis court and oval. Although access would be provided across the highway, some inconvenience would result.

Route B is generally cleared although further clearing of vegetation adjacent to Bogolong Creek and part of the stand of trees north of the village would be necessary. This route follows generally flat countryside, would involve less than 220,000 cubic metres of earthworks and maximises utilisation of the existing road.

This option involves no clearing of ridges or hilltops and no major excavations and was assessed as having the lowest visual impact of all the bypass options.

Because of its close proximity to the existing highway, the impact on property management is reduced, however a number of small allotments in the village area would be affected.

- Route C

As noted in the previous section, Route C is not considered feasible and was not assessed further.

- Route D

Located to the south of the village, Route D would require two creek crossings and excavation of a major cutting. Up to 950,000 cubic metres of material would be excavated, with extensive blasting required extensively. Clearing of vegetation would be necessary at the creek crossings and on the ridge south of the village.

The resulting highway would have grades of up to 4% and would not utilise some 900 metres of existing road alignment which has been built according to National Highway guidelines. This is the most expensive bypass option.

As a consequence of the ridge clearing and cutting excavation, this option was assessed as having the greatest visual impact of all the options. It would also have a significant impact on property management, with severance of two properties resulting.

As with Route A, traffic would be well removed from the village with resultant advantages and disadvantages. Lower noise levels in the village would be accompanied by the loss of passing trade from a remote bypass.

- Economic Comparison

To enable an economic comparison between the bypass alternatives, capital costs have been estimated for each alternative. Table 3.1 gives the results.

Table 3.1 CAPITAL COST

	Alternative A	Alternative B	Alternative D
Capital Costs ($M)	25.5	21.7	29.3

Note: The above costs were derived in order to provide a comparison between the alternatives and include sections of both dual and single carriageway construction between two fixed points either side of Bookham. Costs for the bypass are therefore not directly comparable with those presented in Chapter 4 as those refer to dual carriageway construction only.

3.3.3 Preferred Option

Table 3.2 provides a summary of the options evaluation.

Table 3.2 OPTIONS EVALUATION SUMMARY

	National Highway Objectives	Economics	Visual Impact	Land Use	Ecology	Socio-Economic	Route Length (km)
Highway Alignment							
Major Deviation	4	5	3	4	3	2	16.5
East of Bookham							
New North-Bound	2	2	2	3	2	2	9.1
New South-Bound	3	3	2	2	2	2	9.1
West of Bookham							
New North-Bound	3	3	2	2	2	2	4.5
New South-Bound	2	2	2	1	2	1	4.5
Bookham Bypass							
Alternative A	4	4	4	3	2	3	5.5
Alternative B	2	2	2	2	3	2	5.4
Alternative D	3	3	4	4	3	3	5.2

Note: 1 Least Impact (Best)
5 Greatest Impact (Worst)

Evaluation of the alternatives, as summarised in Table 2.2 shows that while a major deviation has some advantages with respect to route length, it has significant economic and engineering disadvantages. It would be difficult to design and construct such a deviation with acceptable gradients. Severance of a number of properties would result. Comparison of the options of constructing new carriageways adjacent to the existing alignment shows that these options are preferable to a major deviation.

East of Bookham a new north-bound carriageway would avoid the need for cross-overs of the existing highway and associated costs and disruptions. Although a new south-bound carriageway would minimise the volume of excavation required at Conroys Gap, this could lead to a shortage of fill material. While both options will result in reductions in paddock sizes and other potential farm management consequences, these will be greater for a new north-bound carriageway. Careful attention would be needed to be paid to liaison to ensure impacts are minimised and appropriate compensation paid. On balance a new north-bound carriageway is preferable.

West of Bookham duplication of the existing highway through provision of a new south-bound carriageway would minimise the need for cross-overs with the existing road and avoid the need for property disruption or further property acquisition and is therefore proposed.

Comparison of the options for bypassing Bookham shows that Alternative B minimises visual impact, socio-economic impact and impact on property management and land use. It also has the lowest cost and avoids the need for steep grades and major excavations. However, Alternative B severs the village from its sporting facilities and does not remove noise impacts from all residences. On balance, Option B is considered the most preferable alternative.

4

PROJECT DESCRIPTION

Chapter 4

PROJECT DESCRIPTION

This chapter describes the proposal. The proposal is the preferred option defined in chapter 3, covering the entire section from 19.5 to 38.5 kilometres south of Yass. The description includes consideration of the location and design of the road, access and property details, bridges, culverts, construction, operation, maintenance and environmental safeguards.

4.1 INTRODUCTION

The following description is based on conceptual designs for the project undertaken by the Roads and Traffic Authority. These comprise the location of carriageway and road reserve boundaries; conceptual design of intersections and other access details; and preliminary road profiles and earthworks estimation.

Detailed design of the proposal will follow, should approval for the project be granted. It will be based on the concept plans and take into account the environmental constraints and mitigation measures identified in the EIS and matters raised by the community through the consultation process. Consequently, the centreline of the finished road may vary slightly from the concept route presented here, however this would only be as a result of the findings of the EIS and community consultation. Environmental investigations have been carried out on a corridor basis, with the view that the route may be altered to a small extent from the concept centreline shown here without affecting the conclusions of the environmental assessment.

4.2 DESIGN CRITERIA

As the proposed route will be part of the National Highway between Sydney and Melbourne, its design is subject to the design standards set down in *Standards and Guidelines for the Construction of National Highways* (Department of Transport 1987). The designs will be based on the following criteria:

- minimising of construction costs by balancing earthworks, minimising the length of road construction and the number and size of bridges;

- minimising of disturbance to property by locating the road near property boundaries and where practicable, avoiding creation of isolated parcels of land;

- maintenance of the local road system, stock routes and bus routes by way of intersections, underpasses and minor realignment of local roads;

- providing adequate separation distances between the route and buildings to reduce visual and noise impacts;

- minimising disturbance to existing services, particularly transmission lines;

- providing suitable access to Bookham;

- locating suitable bridge crossings for creeks;

- integrating the route with the existing highway, in order to maximise benefits of the present roadway configuration and current upgrading works;

- achieving National Highway standards and guidelines by adopting the following design parameters;

    - 110 km/h minimum design speed ;
    - full control of access with service roads if necessary;
    - fencing along road reservation boundaries;
    - at-grade road intersections;
    - horizontal alignment of a 1,000 metre radius curve as a general minimum (500 m as an absolute minimum;
    - vertical alignment with a 5% desirable maximum grade;
    - pavement design to withstand anticipated axle loads over the next 40 years;
    - markings as required by Australian Standard AS1742.

4.3 ROUTE DESCRIPTION

Figure 4.1 shows the entire length of upgrading works, while Figure 4.2 provides greater detail in the vicinity of Bookham. The route is described in three sections. Locations along the route are referred to by "chainage" or distance measured from Yass.

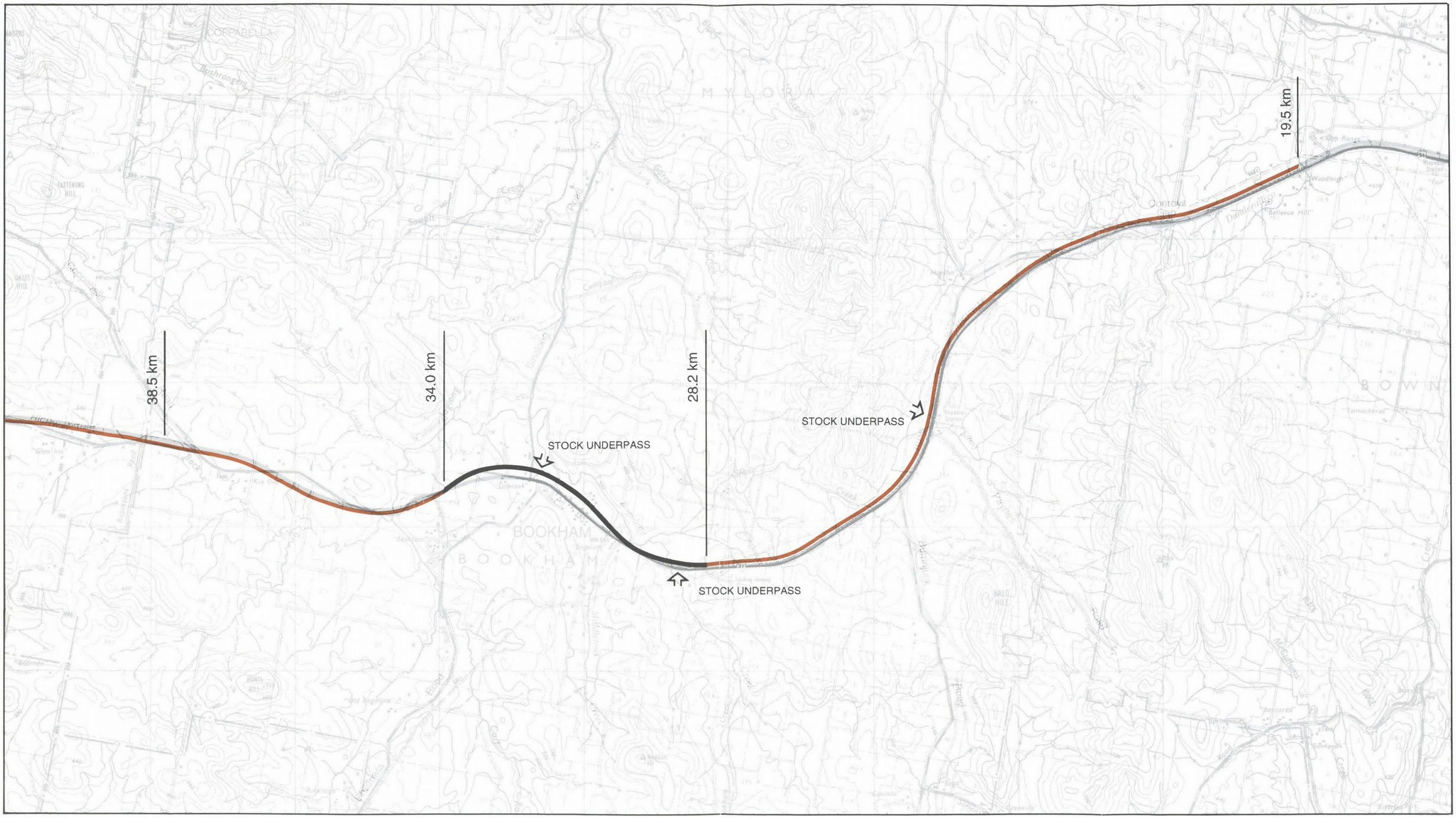
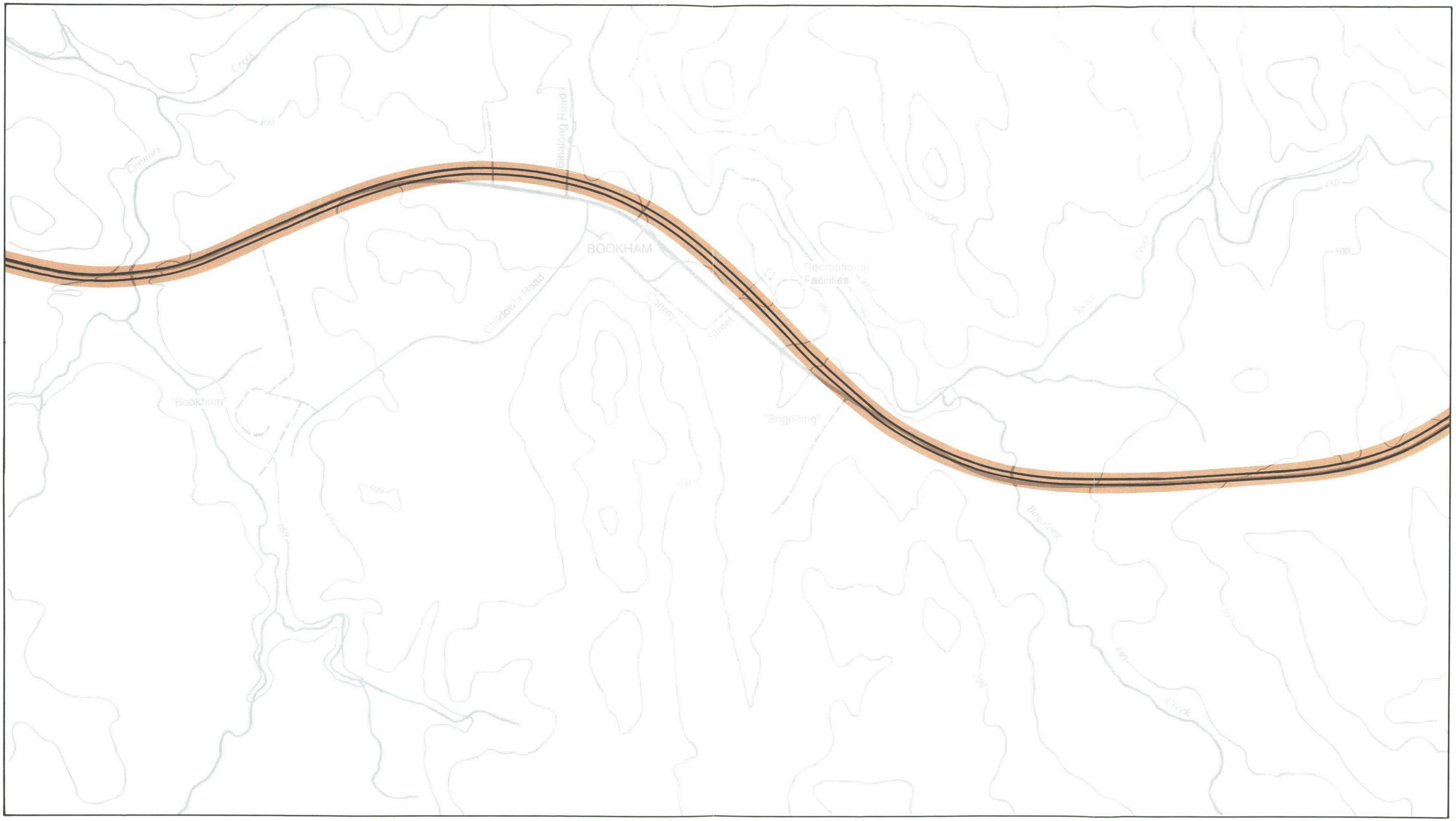


Figure 4.1 OVERALL ROUTE



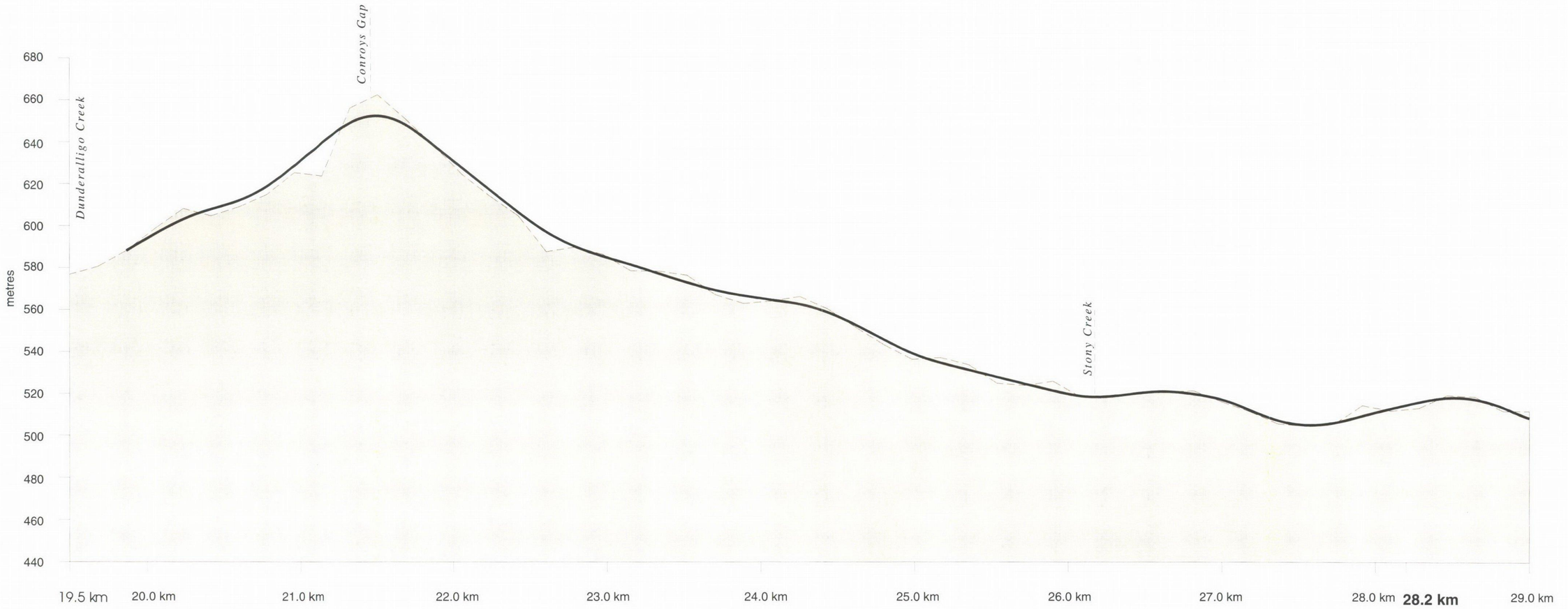
EXISTING HIGHWAY

PROPOSED DUAL CARRIAGEWAY

PROPOSED ROAD RESERVE

0 500m

Figure 4.2 BYPASS DETAIL



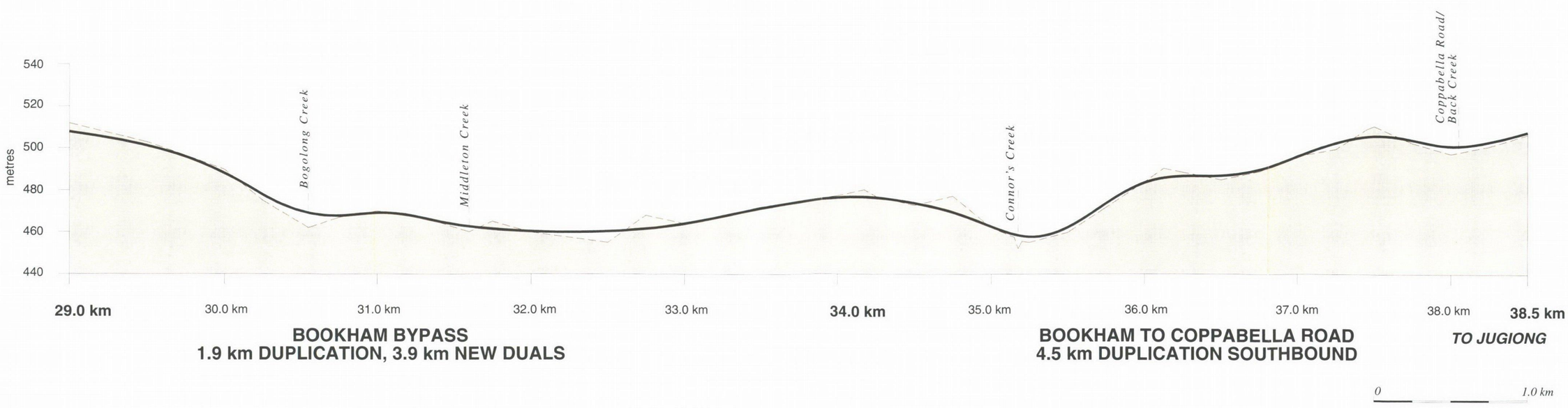


Figure 4.3 LONGITUDINAL SECTION

4.3.1 Conroys Gap to Bookham Bypass

From 19.5 kilometres (from Yass) to 28.6 kilometres the existing carriageway will be duplicated and resurfaced. The new northbound carriageway will be located parallel to and approximately 20 metres north of the existing road.

From 19.5 kilometres the route will climb two kilometres to Conroys Gap, pass through a widened cutting in the ridge and descend the other side, heading generally south-west. Following Conroys Creek, the route turns towards the south, crosses Stony Creek and intersects Paynes Road and Burrinjuck Road. The route then climbs a small ridge, turns to the south-west and descends towards Bogolong Creek.

4.3.2 Bookham Bypass

From 28.4 kilometres to 34.5 kilometres the alignment will deviate from the existing highway, bypassing Bookham. The route will cross Bogolong Creek, turn towards the north-west and roughly parallel the existing road some 80 metres to the north. The two new carriageways, separated by a 20 metre median, will be constructed in this section. Passing immediately south of the cricket field the route will cross Conroy Street and Binalong Road. Approximately one kilometre west of Binalong Road, the route turns towards the south-west and rejoins the alignment of the existing highway.

Figure 4.2 shows details of the bypass route.

4.3.3 Bookham Bypass to Coppabella Road

From 34.5 kilometres to 38.5 kilometres a new southbound carriageway will be constructed parallel to the existing highway, which will be resurfaced. The route will cross Connors Creek heading generally west, and climb towards the intersection with the existing dual carriageway road at chainage 38.5 kilometres.

4.4 DESIGN OVERVIEW

Figure 4.3 shows the long section for the route. It has been designed to achieve a balance between cut and fill. This removes any need to import fill or dispose of spoil. Preliminary calculations indicate that a total of approximately 910,000 cubic metres of material would be cut and filled on the route.

At the completion of the project the highway will consist of dual carriageways as shown in Figure 4.4. The design of the carriageways would comply with standard pavement widths for national highways. Each carriageway would contain two lanes, each 3.5 metres wide, with a two-metre shoulder on the left hand side and a one-metre shoulder on the right hand side. Carriageways would be separated by a depressed median, 20 metres wide.

The road surface would comprise a concrete pavement approximately 360 mm thick constructed on 300 mm of sub-grade. Each carriageway will have a cross-fall of 3.0% towards the left hand side to facilitate drainage on straight sections with a superelevation of 3.0% provided on curves.

Detailed earthworks design would be carried out following approval for the project. Embankment slopes in areas of fill could range from 2 in 1 to 5 in 1 depending on the height of the fill and other considerations such as visual impact and landuse factors. A guard rail would be installed at the edge of the left hand shoulder where fill depth exceeds two metres. The slope of the embankment in cuttings would depend on the depth of the cut and type of material, with a typical slope being 2 in 1. A catch drain would be provided at the top of cuttings and a gutter at the base to control runoff and prevent erosion. Environmental safeguards are discussed further in section 4.11.

The median would be grassed and planted with appropriate shrub and tree species in accordance with the landscape plan.

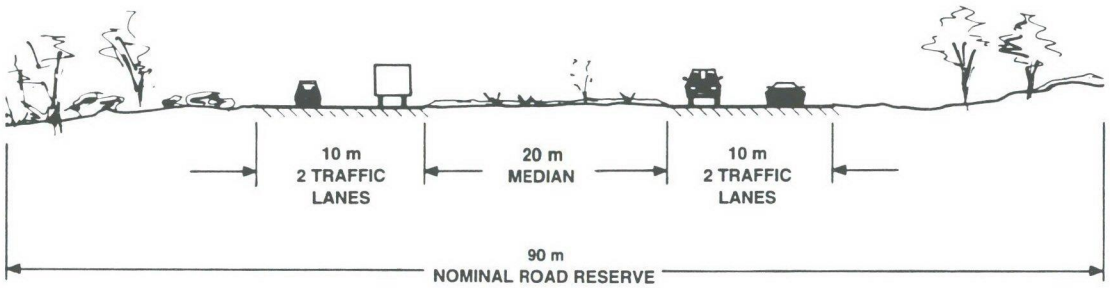


Figure 4.4 CROSS SECTION

4.5 ACCESS

One of the requirements of the National Highway guidelines is the provision of access control as part of the proposal. Accordingly, the road reserve will be generally fenced with specific provision made for access at selected locations. Provision will be made for access to and across the dual carriageway from existing local roads, properties and in Bookham as outlined in the following sections.

4.5.1 Local Roads

Five local roads intersect with the existing highway along the 19 kilometre length.

Paynes Road and Burrinjuck Road approach the highway from the south and terminate at Tee junctions located at approximate chainages 26.5 and 27.5 kilometres. As the new carriageway will be on the northern side of the existing road, these intersections will be unaffected by the proposed duplication. Minor regrading of the intersections may be necessary when the existing carriageway is resurfaced and standard at-grade "seagul" type intersections will be provided. Conroy Street crosses the existing highway and the route of the proposed bypass in Bookham providing access to the north for one residence and the village sporting facilities. The feasibility of providing a grade-separated crossing at this intersection for vehicles and pedestrians was investigated in some detail. This would have necessitated raising the bypass by in excess of four metres resulting in increased visibility and other impacts. An at-grade crossing will be constructed across both carriageways of the bypass to provide continued access between the village, sporting facilities and residence.

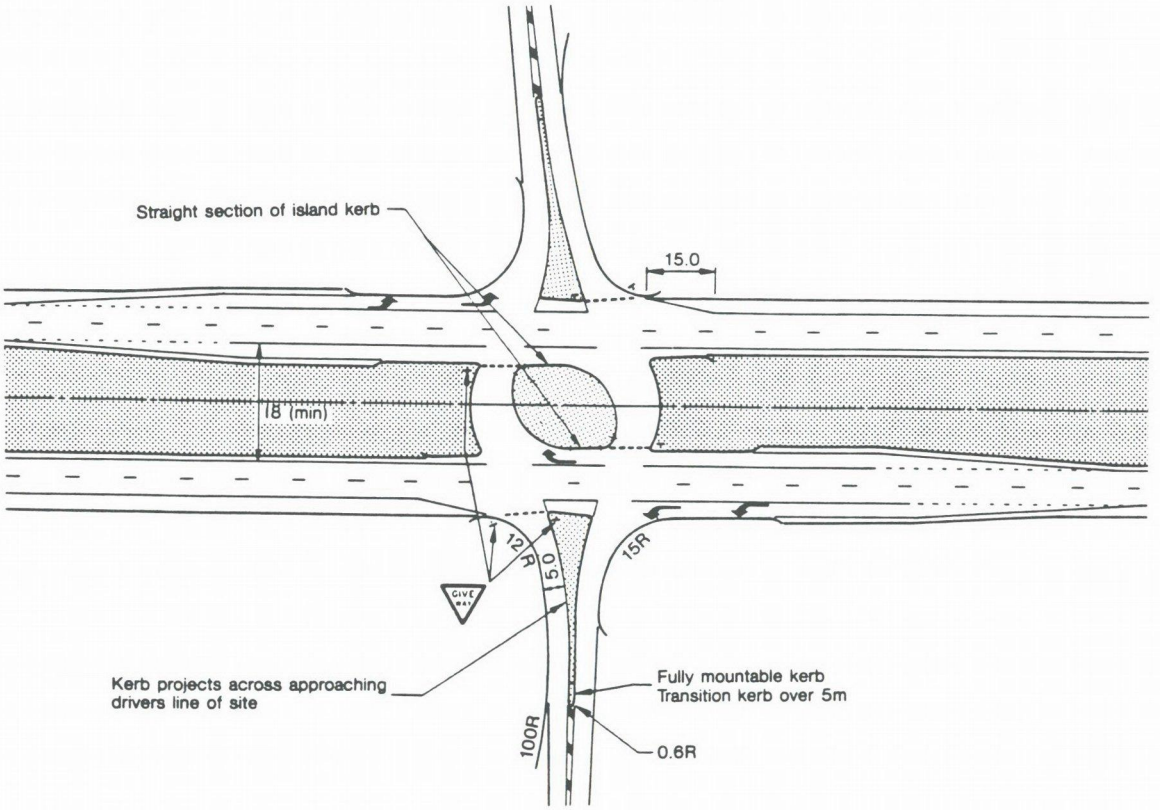
Childowla and Binalong roads approach the existing highway from opposite sides approximately 100 metres apart, immediately west of Bookham, within the area of the proposed bypass. A single at-grade crossing across both carriageways of the bypass will be constructed at Binalong Road. Both roads will access the bypass at the same intersection. Access from Childowla Road to the old highway will be maintained.

Figures 4.1 and 4.2 show the location of these intersections.

Both at-grade crossings (Binalong/Childowla and Conroy Streets) will be constructed according to the treatment for intersections of divided rural roads and two lane rural roads (NAASRA, 1988). This intersection type has been developed specifically to promote ease of access and road safety in these situations. Figure 4.5 shows a diagram of a typical intersection treatment.

4.5.2 Bookham

The bypassed section of existing highway will be closed at both ends of the village and cul-de-sacs constructed. Access to properties within the village will not be affected by the bypass. Primary access from the bypass to the village will be via the intersection with Conroy Street, although access will also be available via the Binalong Road intersection.



Source: Guide to Traffic Engineering Practice - NAASRA 1988

Figure 4.5 INTERSECTION DETAIL

4.5.3 Property Access

The bypass and upgraded highway would be a controlled access road, meaning that the provision of access to properties from the bypass would be subject to the consent of the RTA. Direct access to the highway would be permitted only to properties which have no feasible alternative. This policy would apply to any future subdivision of land in the area.

Access from the highway to properties where there is no feasible alternative will generally be provided as follows:

- **licensed access points** - one or more per property along the highway frontage with cross-median access to allow access to both carriageways. Where a property extends both sides of the highway consideration will be given to locating access points opposite each other to facilitate the movement of large items of machinery from one part of the property to another. The number of access points will be determined by the Roads and Traffic Authority in consultation with property owners in the light of property management practices and the length of frontage; and

- **stock underpasses** - where properties extend either side of the highway and stock or machinery are regularly moved across the alignment, consideration will be given to the installation of stock underpasses. Such underpasses would generally consist of concrete culverts measuring three metres square and would be suitable for stock and most farm machinery. Existing stock underpasses would be extended to provide safe passage under both carriageways of the new highway. A number of property owners have brought their need for underpasses to the attention of the Roads and Traffic Authority. Preliminary designs indicate that underpasses can be feasibly installed in response to each of these requests and the Authority will complete the design on that basis. Figure 4.1 shows the approximate location of proposed underpasses.

The RTA would request Yass Council to rezone land fronting the highway in such a way that future subdivision and the creation of traffic generating developments is discouraged unless alternative access is available.

4.5.4 Travelling Stock Route

The Pastures Protection Board has advised that one travelling stock route crosses the proposed highway alignment. Following Childowla Road, the route crosses the highway near Bookham and proceeds northwards along Binalong Road. This route will cross the upgraded highway in the Bookham bypass section.

An underpass for stock movement will be provided beside the at-grade highway crossing for Binalong Road. The underpass will be a three metre square culvert similar to those provided for individual properties and will provide for the safe movement of stock along the route. Stock will continue to move along Childowla Road onto Binalong Road as at present passing through the underpass to continue along Binalong Road. Underpasses provide the most satisfactory means of stock crossing highway routes.

The stock underpass and approaches will be public thoroughfares and will be suitable for use by pedestrians and cyclists, providing a safe means of crossing the highway near the village.

4.5.5 Wildlife Access

As the route is generally through cleared farming land, parallel to the barrier created by the existing highway, there will be no need to provide specific means of wildlife access across the highway as part of this project. Stock crossings, bridges and culverts will provide opportunities for wildlife to cross the highway at a number of locations along the route.

4.6 DESIGN DETAILS

4.6.1 Bridges and Culverts

To allow unimpeded passage of both normal and flood flows in local creeks and steams, a series of culverts and bridges will be constructed. Bridges and major culverts will be constructed at the following locations:

- Stony Creek - a new bridge will be constructed on the north-bound carriageway;
- Bogolong Creek - twin concrete bridges (one for each carriageway) will be constructed immediately north (downstream) of the existing bridge;
- Connors Creek - a new concrete bridge will be constructed for the south-bound carriageway immediately south (upstream) of the existing bridge; and
- Middleton Creek - a new box culvert will be constructed under both carriageways.

In addition to these significant structures, small pipe culverts will be constructed under the road at various points to convey minor watercourses and flows in drainage lines across the highway.

All bridges and major culverts will be designed in accordance with established Roads and Traffic Authority standards to accommodate floods resulting from a once in 100 year rainfall event.

4.6.2 Provision for School Bus

The school bus currently picks up and sets down children at various locations along the highway. Provision will be made for the bus to safely pull off the road at known pick-up points. This would involve widening the sealed shoulder from the normal width of two metres to allow the bus to pull off the road, stop and enter the highway again. The Roads and Traffic Authority will liaise with bus operators to ensure all pick up points are identified and adequately catered for.

4.6.3 Fencing and Guard Rails

The road reserve will be fenced along its entire length with the exception of intersections and licensed access points. The fencing will be stock proof, with construction details confirmed in consultation with individual property owners.

Corrugated steel guard fences would be installed along the shoulders where necessary, generally on fill sections where the height of fill exceeds two metres.

4.6.4 Truck Parking and Rest Areas

Heavy vehicles currently use two locations along the route as parking/rest areas. These are at Conroys Gap and near Coppabella Road at the western end of the proposed upgrading section. They are favoured as they provide adequate area for parking, are located on a crest to facilitate easy acceleration and are not located near curves in the road.

As part of the upgrading works the Roads and Traffic Authority will where possible retain adequate space for heavy vehicle parking at locations in close proximity to the two areas currently used.

An existing rest area is located just east of the Bogolong Creek bridge on the southern side of the highway. Whilst this area could be retained, the Authority has identified a site for the possible establishment of a new rest area at Bookham. This site is located between the existing highway and the proposed bypass, adjacent to Conroy Street on land previously used for the village school. Access to the site, which is owned by the Authority, would be available from the highway via the Conroy Street intersection.

The site is located in an attractive wooded area across the highway from the village store and is currently used for parking by passing motorists. It is seen as having the following advantages.

- some facilities associated with the now closed school could be incorporated into the rest area;
- it is located close to a planned intersection which would provide safe access to both carriageways of the bypass;
- it is located in a pleasant area currently used by passing motorists; and
- it is located within the village area, close to the store, which would be of benefit to both motorists and the village itself.

The Authority is aware of the advantages of this site and has discussed establishment and maintenance of the rest area with Yass Council.

4.6.5 Signposting

Signage would comprise standard directional signs indicating destinations, speed limits and intersections. A signposting plan will be prepared as part of the final design in accordance with the Authority's *Sign and Marking Manual* and AS 1742, which include guidelines on the manufacture, supply and erection of regulatory, warning, guide and directional signs. The speed limit on the dual carriageway road will be 110 kilometres per hour.

The highway will not be lit.

4.7 PROPERTY ISSUES

4.7.1 Property Acquisition

Property records indicate that some seventeen properties will be directly affected by the proposed upgrading and bypass. Where the road reserve or other works associated with the proposal are located on land not currently owned by the Roads and Traffic Authority the Authority will purchase the land concerned at market rates, as if the land were unaffected by the road. Compensation would be assessed in accordance with the requirements of the Land Acquisition (Just Terms Compensation) Act, 1991. For most of the route this will involve purchase of a strip of land parallel to the existing highway. Along the route of the Bookham bypass a number of small allotments are crossed. Some of these are owned by the Authority while others are privately held.

Properties may be purchased in whole or in part. If a property is likely to be significantly affected the Authority would consider whole purchase. Remnants of properties not required would be sold after completion of road construction.

The process of acquisition commences with a letter from the Authority informing owners of the need to acquire land. This would be accompanied by a map identifying the required area and information on the process and the costs that would be borne by the Authority. A valuation of the land would be carried out by Authority valuers. The Roads and Traffic Authority would then send a formal letter of offer, which would include a reasonable allowance for valuation and legal fees as required by the Land Acquisition (Just Terms Compensation) Act, 1991. If required, a negotiation conference may be arranged to settle on a price acceptable to both parties. Once agreement has been reached the Authority arranges contract preparation and the matter proceeds to settlement in the normal way.

4.7.2 Compulsory Acquisition

In the initial stages, the Authority attempts to reach agreement on price and conditions of purchase through direct negotiations with the landowner and/or the landowner's representatives.

Where these negotiations fail, the Authority has the statutory power to compulsorily acquire the land, under the provisions of the Land Acquisition (Just Terms Compensation) Act, 1991, for the purposes of the Roads Act, 1993.

The Authority will then issue a Proposed Acquisition Notice, ordinarily giving a further 90 days in which contracts must be exchanged. If not, compulsory acquisition is effected by notice published in the Government Gazette, following approval by the Governor.

Following Gazettal of the compulsory acquisition (which vests title to the land in the Authority), the owner's interest in the land is converted into a claim for compensation.

The owner's claim for compensation is referred to the Valuer General for determination. The Authority then issues a compensation notice to the former owner, incorporating the amount of compensation determined by the Valuer General.

Objections to the amount of compensation may be lodged with the Land and Environment Court.

4.7.3 Compensation

The Roads and Traffic Authority will compensate all directly affected property owners for the effect of acquisition on their properties.

The degree to which the project would affect individual properties and property management would depend on a range of factors that include the total size of the holding, productivity, current land use, location of dams and buildings, degree of severance, current property management practices and opportunities to provide access to the property. Compensation, depending on the circumstances, could take the form of reconstructing or moving dams, fences, gates, buildings or other farm infrastructure, or financial payment for costs and losses incurred. Details of impacts and appropriate compensation would be addressed during negotiations between the Authority and property owners as part of the land acquisition process.

4.8 CONSTRUCTION

4.8.1 Materials and Methods

The road surface will be constructed of concrete, with the pavement underlain by graded bedding material as described in Section 4.4. The use of an open-graded asphalt surface is sometimes adopted in urban areas in order to reduce noise production. However, this was found to be an unacceptable surface material for this project because:

- for noise attenuation open-graded asphalt can only be considered as an urban solution to high traffic volume continuous noise problems. It is not appropriate for application in isolated or short sections;

- open-graded asphalt has a maximum life expectancy of about eight years (30-40 mm layer). It would therefore need to be removed and replaced four times throughout the 40 year expected life of the concrete pavement. In addition to the costs, this would involve significant traffic disruption;

- noise levels from open graded asphalt surfaces tend to increase over time as the joints in the underlying concrete reflect through the surface; and

- the Authority has found that for rural settings appropriately placed noise attenuation barriers are the best solution to noise management for major highways.

Detailed construction methods and sources of materials would be decided by contractors carrying out the work. It would be the responsibility of the contractors to minimise disruption to property management and to implement appropriate environmental safeguards. These safeguards, which are outlined in Section 4.11, will be incorporated into the technical specification and contract for the project. The following description outlines the construction methods which are expected to be employed.

- **Initial Activities**

Initial activities include installing sediment control measures, clearing, stripping topsoil and laying culverts. Once these are completed the earthworks can proceed.

- **Major Earthworks**

After any necessary blasting, excavation of cut sections would be undertaken by bulldozers, scrapers, excavators and trucks, with material being carted directly to locations where fill is required, generally along the road reserve. This material would be compacted by roller and vibrating compactors then trimmed by graders. If necessary, a mobile crushing plant would be set up to process the excavated material to a suitable size. Mobile plant required during

earthworks and carriageway formation would include bulldozers, scrapers, graders, front-end loaders, rollers, dump trucks, cranes, fuel tankers, water tankers and service trucks.

- **Bridge and Pavement Construction**

Bridge and pavement construction would involve the use of large volumes of concrete. Temporary concrete batching plants would be located at strategic sites along the route as construction progressed, with concrete transported by mixing truck from the batching plant along the road reserve to the work site. Concrete trucks would not travel on the existing highway. Concrete pavement would be laid by a multi-lane paver. Once construction of the second carriageway was complete traffic would be switched to the new carriageway and sections of the existing highway would be re-surfaced with concrete pavement.

Although the final source of materials for concrete manufacture will be chosen by the contractor, local sources are well-established and supplying current construction operations associated with the Yass bypass. Quarries are currently operating at Bald Hill and Jugiong. Trucks carrying materials to the site from Jugiong or Bald Hill would travel to the construction site along the existing highway.

Ancillary works such as landscaping, grassing and removing temporary structures would be carried out towards the end of work on each section.

Bridges would be completed in advance of earthworks until earth can be backfilled and compacted up to the abutments.

4.8.2 Plant and Workforce Requirements

It is anticipated that for a project of this scale two groups of earthmoving equipment would be operating concurrently.

Each group would typically comprise three large scrapers, two large bulldozers, a small bulldozer, a grader, two rollers and a water-cart. Where rock blasting is necessary this would be supplemented with drilling rigs, a loader and two off-highway trucks. The earthworks phase would have the highest plant requirements. Other plant, such as an excavator, backhoe, additional rollers and graders and another water-cart would be on site for operations such as drainage and pavement construction.

Pavement construction operations would necessitate a batching plant, concrete trucks and pavement laying equipment.

Ancillary vehicles such as utilities, small trucks and four-wheel-drive vehicles would be necessary to transport stores, labour and supervisory staff around the job.

The maximum workforce on site at any time would probably not exceed 50 persons. Most would be contractor personnel and it is anticipated they would be accommodated in Yass for the duration of the construction period.

4.8.3 Construction Period, Staging and Work Hours

It is expected that construction would continue for a total period of approximately three to four years. Work would occur between 7.00 am and 6.00 pm, Mondays to Fridays and 7.00 am to 3.00 pm on Saturdays. Sunday work would only carried out when absolutely necessary under emergency conditions.

It is likely that the new carriageways will be constructed in three stages with estimated construction times as follows:

Stage 1	Conroys Gap to Bookham bypass	24 months
Stage 2	Bookham bypass	24 months
Stage 3	Bookham bypass to Coppabella Road	12 months

It is anticipated that Stages 1 and 2 would be undertaken concurrently, giving a total construction period of three years. Following completion of Stages 1 to 3 both carriageways could be opened to traffic along the entire route. It is likely, however, that all traffic would be diverted to the new carriageway and resufacing of the existing highway be undertaken. Resurfacing is estimated to take a further 12 months. The commencement of the staged construction will be largely dependent on the availability of funds. The project will be funded by the Commonwealth Government.

4.8.4 Construction Compounds

It is anticipated that a maximum of three construction compounds may be required for this project. Final locations will be decided after detailed design however it is likely that the first would be located at approximately 26 kilometres (Paynes Road). The second would be at approximately 31 kilometres between the by-pass route and the existing highway. The third would be towards the end of the proposed works.

The requirements for construction compounds are:

- an area of approximately 50 metres x 100 metres;
- a relatively level site; and
- able to be secured.

Each site would be fenced, covered with road base to stabilise the surface and erosion control

measures installed in accordance with the Authority's erosion control manual. If fuel storage is required, bunded areas would be constructed.

Compounds would be equipped with portable toilets and liquid wastes would be removed by tanker. Solid wastes would be removed by truck. There would not be any residential facilities at construction compounds.

Compounds would generally be located within or immediately adjacent to the road reserve at locations suitably removed from watercourses or environmentally sensitive areas. The exact siting of compounds will be determined by contractors and finalised in conjunction with property owners. Appropriate compensation would be paid for use of the land.

Upon completion of the work the road base would be removed and the compound areas topsoiled and revegetated.

4.8.5 Relocation of Services

Relocation of underground Telecom services would be required where the route crosses these services. All such services would be relocated in a manner acceptable to Telecom.

A number of transmission lines operated by the Southern Tablelands County Council will be crossed by the proposed works and some poles will need to be relocated. The County Council has advised that the 66,000 volt line between Bogalora and Yass will be crossed as will a number of feed lines to homesteads. It is also possible that the 11,000 volt distribution lines supplying Bookham and surrounding areas may be affected.

Some of these transmission lines may need to be deviated to accommodate the highway upgrading. The County Council does not expect any difficulty in carrying out this work at the appropriate time.

4.9 ECONOMICS

4.9.1 Construction Costs

Construction costs have been estimated in 1993 dollars to be:

Conroys Gap to Bookham bypass	$39 m
Bookham bypass	$15 m
Bookham bypass to Coppabella Road	$16 m
Total	**$70 m**

Subsequent upgrading of the existing highway by concrete overlay is estimated to cost an additional $17 million.

4.9.2 Benefit-Cost Analysis

To enable an economic appraisal to be made of the project, a benefit cost analysis has been performed for the project. The analysis was carried out by the Roads and Traffic Authority, using the current rural roads travel time and cost parameters in the Authority's economic analysis manual, updated 1993.

The analysis allocates values to a wide range of parameters with economic implications including:

- road length
- pavement type, width and condition;
- road alignment (both horizontal curves and vertical grades);
- traffic volume composition and growth rate;
- speed limits;
- the presence of slow vehicle or overtaking lanes;
- construction and maintenance costs; and
- the timing of the completion of works.

Costs and benefits which the economic model considers include vehicle operating costs, travel time savings (both private and commercial), accident reductions and road maintenance savings.

Benefits arising from the project would be substantially available on completion of the duplication of the highway either side of Bookham and provision of the bypass and the benefit-cost analysis has been carried out on that basis. Costs associated with resurfacing the existing highway with concrete are regarded as maintenance costs which would be incurred irrespective of upgrading the highway. These costs have not been included in the benefit cost analysis but have been included in the cost breakdown for the overall project to provide an estimate of total capital expenditure.

Table 4.1 shows the results of the benefit-cost analysis for the three main sections of the route and for the project as a whole.

The benefit cost analysis had been based on the current rural roads travel time and cost parameters in the RTA economic analysis manual, updated 1993. The benefit cost ratio for the project is relatively low because the route does not save any major travel distance by means of deviations from the current alignment.

An improved benefit-cost ratio could almost certainly be obtained by using alternative major deviations to the current alignment, however these are not currently favoured for reasons outlined in Chapter 3. In addition to practical and environmental difficulties, a major new deviation would require a large initial outlay of funds and must be totally completed before being opened to traffic. Upgrading along the existing alignment allows staged construction of sections which can be brought into service progressively.

The pavement on the existing highway has mostly been constructed recently (during the past decade) and is a roadbase pavement with a spray/chip seal surface. This type of pavement would require major rehabilitation in the future (by about 2003 to 2005) with a full depth asphalt overlay, at a cost of $60 per square metre at current prices.

Table 10.1 BENEFIT COST ANALYSIS

Economic Parameters for Projects	Discount Rate		
	4%	7%	10%
11 km Rural Section East of Bookham			
PVC ($m)	36.6	34.9	33.3
PVB ($m)	33.5	19.5	12.1
NPV ($m)	-3.1	-15.4	-21.2
BCR	0.9	0.6	0.4
3 km Bookham bypass			
PVC $m	14.1	13.6	13.0
PVB $m	29.2	17.9	11.7
NPV $m	15.1	4.3	-1.3
BCR	2.1	1.3	0.9
5 km Rural Section West of Bookham			
PVC $m	15.4	15.0	14.6
PVB $m	19.6	11.7	7.5
NPV $m	4.2	-3.3	-7.1
BCR	1.3	0.8	0.5
19.0 km Project Overall			
PVC $m	66.1	63.4	60.3
PVB $m	82.3	49.1	31.3
NPV $m	16.2	-14.3	-29.0
BCR	1.2	0.8	0.5

PVC = Present Value Costs discounted to current year 1993

PVB = Present Value Benefits discounted to current year 1993

NPV = Net Present Value (1993)

BCR = Benefit-Cost Ratio

4.10 OPERATION AND MAINTENANCE

Regular patrols by Authority maintenance crews would ensure that the carriageway and verges of the highway are maintained in a condition appropriate for safe high speed travel. From time to time, repairs might be necessary to the road surface, drainage or signposts. Any such repair work would be carried out in daylight hours with appropriate warning to traffic.

4.11 ENVIRONMENTAL SAFEGUARDS

A range of safeguards will be incorporated into the design and construction of the proposal to minimise potential environmental impacts. These are outlined briefly below. Where relevant further details are given in Chapter 5 - Environmental Assessment.

- **sediment control** - soil erosion and sediment control measures would be incorporated into the design for the project and implemented throughout the construction period. Measures employed will include an assessment of soil characteristics, minimising clearing and ground disturbance, providing buffer zones adjacent to natural drainage lines where possible and drainage and erosion control measures. Temporary and permanent sediment control structures will be installed and maintained at various locations along the route as outlined in Chapter 5.

- **landscaping** - development and implementation of a detailed landscape concept plant to minimise any visual impacts on the natural and cultural environment and views from residences and prominent locations;

- **noise attenuation** - erection of a combination of noise control mounds or barriers along the route as necessary to ensure traffic noise at all residences is within current guidelines adopted by the Roads and Traffic Authority.

- **site restoration** - at the completion of construction all rubbish and surplus materials will be removed from site. The surrounding ground surface will be restored as closely as possible to original conditions including construction compounds and other disturbed areas;

- **route selection** - the route of the proposed upgrading works has been selected to minimise overall impact on the physical, biological and socio-economic environments;

- **rest area** - the potential establishment of a rest area adjacent to Bookham will provide a pleasant location for travellers to rest and would serve to maintain the profile of Bookham and provide a continuing source of revenue for the store; and

- **access** - the provision of crossings at Binalong Road and Conroy Street and stock underpasses at various locations shown on Figure 4.1 will facilitate safe crossing of the highway by vehicles, pedestrians and stock.

4.12 ENERGY STATEMENT

4.12.1 Energy Consumption During Construction

The predominant of energy consumption during construction will be fuel used by construction vehicles. It is estimated that approximately 3.5 million litres of diesel and one million litres of petrol would be used throughout this period. Exact fuel consumption will depend on equipment selected, conditions encountered and operational and management practices employed by the contractor. Energy will also be consumed in quarrying materials and manufacture of cement for the concrete batching plant and pre-cast structures.

4.12.2 Operational Energy Consumption

Upgrading this section of the highway will not result in any net shortening of the road and hence will not lead to substantial energy savings for vehicles using the road. The fuel consumption of vehicles varies with vehicle speed and road conditions. Fuel consumption generally decreases with more constant travel speeds and avoiding the need to accelerate or decelerate, however it increases with increased travel speeds.

For the section of road under consideration, the upgrading works will promote higher travel speeds leading to increased fuel consumption but will eliminate congestion and the need to slow when travelling through Bookham resulting in fuel savings. An estimate of the fuel consumed by light vehicles over the 19 kilometre road length has been made for 1993 and 2020 traffic levels. The results indicate that for 1993 traffic levels there would be a small net reduction in fuel consumption (approximatley 1500 litres per year), primarily as a result of more uniform travel speeds. Savings in future years would grow progressively, with significant average savings over the life of the project because of increasing congestion on the existing highway.

Nominal quantities of fuel would be consumed during periodic inspections and road maintenance activities carried out by the Roads and Traffic Authority throughout the

economic life of the highway.

4.12.3 Sterilisation of Energy Resources

The Department of Mineral Resources has advised that there are no known mineable deposits in the area concerned and therefore there are no mining objections to the proposed works.

5

ENVIRONMENTAL ASSESSMENT

Chapter 5

ENVIRONMENTAL ASSESSMENT

This chapter describes the existing environment, outlines the potential interactions between the proposal and the environment, specifies measures to minimise impacts, and assesses the environmental impact.

5.1 LANDFORM, GEOLOGY AND SOILS

5.1.1 Landform

The Bookham district is characterised by an undulating landform consisting of broad valleys and low rounded ridges with gentle to moderate slopes. Topographic relief is provided by a number of steep hills and ridgelines with a north-south orientation, including Conroys Gap (660 m), Bald Hill (700 m) and a ridge to the north of Stony Creek (700 m). The majority of elevations range from 450 to 600 metres.

The lower rounded hills of the district are dissected by a number of small creeks which flow through broad gullies draining in a northerly direction into Connors Creek. Connors Creek flows to the Murrumbidgee River to the south-west of the district. Between the 440 metre and 460 metre contour the valleys are wide and drainage is via meandering channels.

The proposed highway upgrading largely follows the existing road alignment from 19.5 kilometres west of Yass where it climbs the ridgeline at Conroys Gap, before descending into a broad valley towards Bookham with a slope of approximately six percent. From Bookham the highway is relatively straight, traversing undulating topography and crossing Bogolong and Connors Creeks to the end of the upgrade section, 38.5 kilometres west of Yass. As shown on Figure 4.3, the landform will require significant cutting and filling in some areas, particularly near Conroys Gap, to construct the new carriageway, which will generally be at the same elevation as the existing road.

5.1.2 Geology

The geology of the area is characterised by a sequence of middle to late Silurian Volcanics and sediments known as the Douro Group and early Devonian Volcanics and sediments

termed the Mountain Creek Volcanics. The Douro Group consists of fine to coarse rhyolitic to dacitic crystal tuff, rhyolite, rhyodacite, andesite, and interbedded limestone and shale.

The Mountain Creek Volcanics form part of the Black Range Synclinorium which consists of a sequence of volcanic rocks and sediments including rhyolite, dacite, andesite and associated tuffs and agglomerate. These rocks have a high degree of folding and faulting.

Recent alluvial deposits occur on the broader creek areas to the north and east of Bookham. There are no known commercially extractible deposits or mineral resources in the area.

The eastern section of the proposed route including the ridge and steeper areas surrounding Conroys Gap is underlain by the Mountain Creek Volcanics, with the remainder of the route forming part of the Douro Group. A geotechnical investigation will be undertaken during the detailed design stage to determine suitable batter grades, examine the potential for groundwater contamination and assess the likelihood of settlement in fill zones.

5.1.3 Soils

An overview of soils in the area has been prepared as a basis for assessment of existing erosion and potential erosion from construction of the proposed Highway. The soils of the area were found to be strongly related to the underlying geology with variations principally related to local changes in topography and drainage conditions.

There are three principal soil associations in the study area. The first unit occupies the majority of the area and is located in the undulating to rolling hills associated with the Douro Group Volcanics and sediments. This unit is characterised by rock outcrops, stony skeletal soils on the ridges and hills, red podzolics on the upper slope areas and red and yellow earths on the mid-slope areas. Drainage lines and low lying areas with poor drainage contain yellow podzolic and yellow solodic soils.

The second unit occurs in association with Quaternary alluvium and is located in broad drainage basins. This unit consists of floodplain associations with alluvial soils occupying the present floodplains, prairie soils and red earths on the most recent terrace and remnants of red-brown earths and yellow podzolics on the old terrace sequences.

The third unit occupies the very steep and rugged hills and is associated with the Mountain Creek Volcanics and sediments. These soils consist of hard neutral red soils and include skeletal soils on the ridgelines, red podzolics in the upper slopes, red-brown earths in mid-slope positions and yellow podzolics in poorly drained areas.

No soils with acid sulphate potential have been detected or are likely to occur along the route.

The red podzolics and red-brown earths generally have a moderate soil erosion hazard in their natural state due to relatively high fertility levels and an ability to maintain a good vegetation cover. However, when these soils are disturbed the soil aggregates are easily detached and transported by runoff. The yellow podzolics, yellow solodic soils and alluvial soils generally have a high erosion hazard when disturbed, particularly around creeks and drainage lines where higher runoff rates can erode exposed soils.

The soils over most of the proposed route have moderate to high soil dispersion rates and erodibilities. The proposed alignment traverses soils which are generally suitable for grazing and occasional crop production. The highest quality soils are located on the banks of the major creek systems in association with Quaternary alluvium. A small section of these soils adjacent to Bogolong Creek will be effectively sterilized by the proposed route. Control measures designed to minimise both short-term and long-term impacts resulting from erosion and downstream sedimentation will be incorporated into the detailed design of the route. These measures would be installed and maintained in accordance with Roads and Traffic Authority guidelines and in consultation with the Department of Conservation and Land Management as discussed in Section 4.12.

5.2 ZONING AND LAND USE

5.2.1 Zoning

The proposed Hume Highway duplication and Bookham bypass is located within Yass local government area. The proposal traverses land zonings under the provisions of Yass Local Environmental Plan 1987 (LEP 1987). These zones are shown in Figure 5.1.

The works proposed fall within the definition of "road" under Yass LEP 1987. Under this instrument a road is defined as being:

> *"...a road, street, lane, highway, pathway or thoroughfare, including a bridge, culvert, causeway, road ferry, ford, crossing and the like on the line of a road through or over a watercourse."*

The existing Hume Highway is contained in an 800 metre wide corridor zoned *1(b) (rural highway)*. For the most part, the proposed highway duplication and bypass is contained within this zone. The objective of the *1(b) (rural highway)* zone is:

> *"...to maintain a corridor along major National and State highways so as to protect those roads from traffic generating developments which may affect the efficient and safe movement of the travelling public, and from those developments which would have an adverse impact on the amenity of the rural countryside."*

Under this zone, land uses such as agriculture (other than feed lots, piggeries, poultry farms or animal boarding, breeding or training establishments), dams and forestry are permissible without development consent. Prohibited uses include, inter alia, car repair stations, and transport terminals. All other uses are permissible but only with development consent. Therefore roads, as defined in clause 5(1) of the Yass LEP 1987, are permissible within the *1(b) (rural highway)* zone.

The proposed route also crosses part of a *2(v) (village)* zone on the north side of Bookham. The objective of this zone is to:

> *"...set aside land for rural villages to allow for future development of a residential, commercial or light industrial nature associated with residents of the villages, surrounding rural communities, tourists and travellers."*

Only dwelling houses are permissible without development consent. Prohibited uses include inter alia, generating works, roadside stalls and recreation establishments. Therefore the proposed works are permissible with development consent within this zone.

While there is currently no demand for any changes to existing zones in or around Bookham, Yass Council believes the proposed bypass "will have a major influence on any development in or around Bookham". Consequently, some potential exists for dwellings to be located on the sub-urban portions immediately surrounding the village. Council's Bookham Strategy Plan (1991) provides that dwelling houses could be approved on any land at the western end of the village subject to the land meeting the following criteria:

- suitable soils and land area for domestic effluent disposal;
- suitable all weather access via public or crown roads;
- adequate stockproof fencing;
- a suitable dwelling site can be identified on the land;
- the land is flood free;
- suitable dam site and adequate catchment area for each lot; and
- proposed building is of an unobtrusive scale and design.

The strategy does not encourage further subdivision of the existing sub-urban portions, however it makes provision for a dwelling on each existing lot provided it meets the above criteria.

The land affected by the Strategy is currently zoned *1(a) (Rural Agriculture)* and *1(b) (Rural Highway)*. A draft LEP rezoning the subject lands to *2(v) (Village)* is proposed to be placed on exhibition prior to December 1993. This draft LEP will prohibit further subdivision of the land and allow only one dwelling on each lot.

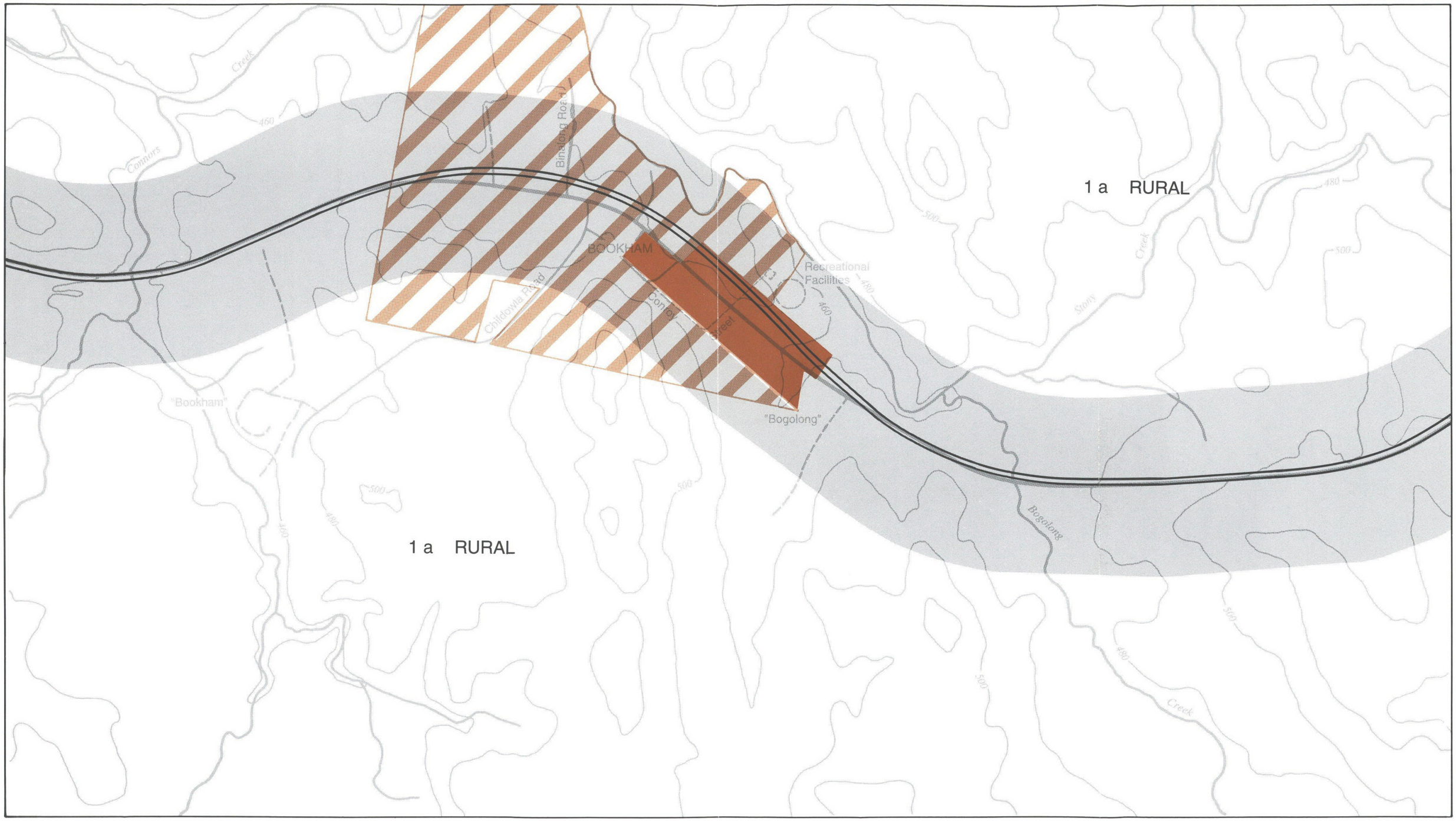


Figure 5.1 LANDUSE AND ZONING

The northern side of Bookham is also affected by a *1(a) (rural agriculture)* zone. The objective of this zone is to:

> *"...set aside certain land for agricultural purposes and purposes incidental thereto."*

Uses such as agriculture (other than feed lots, piggeries, poultry farms or animal boarding, breeding or training establishments), dams and forestry are permissible without development consent in this zone. Prohibited uses include inter alia, car repair stations, and transport terminals. All other uses are permissible but only with development consent. Therefore, roads are permissible with development consent under the provisions of the *1(a) (rural agriculture)* zone.

Yass LEP 1987 adopts clause 35 of the Environmental Planning and Assessment Model Provisions. The effect of this instrument is to override the need for the Roads and Traffic Authority to obtain development consent for the proposed highway upgrading in any of the above three zones

5.2.2. Land Use

This section provides an overview of land uses in the general area and potential impacts of the proposal on these activities. Section 5.3, Socio-economic Impacts, assesses in detail the impacts on Bookham, property management and other specific activities.

Land use within and surrounding the highway corridor is predominantly agricultural. Sheep and cattle grazing are dominant with horses evident on some properties. Cultivation of fodder crops including oats and lucerne occurs in occasional paddocks around the corridor. Lucerne is predominant on the more fertile soils bordering the creeks in the locality.

Some loss of agricultural land will occur with the duplication of the highway. As the corridor largely follows the existing highway alignment no major property severance will occur. Impacts will be limited to a strip paralleling the existing highway. It is estimated that less than 80 hectares of productive agricultural land will be affected along the 19 kilometre road length. The bypass of Bookham will not directly affect any of the village land uses.

Bookham contains approximately ten residential dwellings, of which three have frontage to the Hume Highway. The residential amenity of these dwellings and the village as a whole will improve once the bypass has been constructed.

Bookham also contains a small shop, community hall, two churches, a cricket field and tennis court which serve the needs of the surrounding rural community. Access will be maintained to these facilities via the existing highway. As shown on figure 4.2 the proposed bypass will not directly affect use of these buildings or facilities.

5.3 SOCIO-ECONOMIC IMPACTS

The proposed bypass will have a range of consequences for the Bookham community. Potential issues associated with the project include:

- the local economy;
- development potential of the village;
- community severance and local traffic movements; and
- access to properties and effective property management.

Consultation with the community and landholders along the various route options facilitated identification of issues and assessment of socio-economic impacts. All affected landowners, being the owners of any land traversed by the proposal or any land with a common boundary to the 19 kilometre section of the Hume Highway, were contacted. Issues such as road construction, access and severance were discussed.

A newsletter was distributed to the community to notify of the upgrading and invite attendance at an exhibition of the project. A display was set up at Bookham Community Hall on 19 July 1993 to allow interested persons to examine plans and discuss the proposed highway realignment with the Roads and Traffic Authority and consultant staff. Issues of concern to individuals were noted. Comments made by landowners are included as Appendix C.

5.3.1 Local Economy

Bookham currently supports two commercial operations. These are a general store/petrol station and an agricultural machinery service. Each business has a frontage to the existing highway. The village post office has recently closed.

The proposed bypass would affect the two remaining businesses to differing degrees. The general store/petrol station will lose passing trade. The effect on the agricultural store should be minimal as a specialised service is unlikely to rely on passing trade. Customers of a specialised business tend to actively seek out a service or product that they require (Mitchell McCotter, 1989).

The Bookham store is run by a husband and wife team and sells hot food, drinks and groceries. The store relies heavily on highway generated trade for a substantial part of its turnover and hence economic viability. Clientele comprises approximately two-thirds through traffic and one-third locals. The store benefits from optimum exposure to highway traffic especially during the school holidays as travellers stop for petrol and food snacks enroute to their destination. Average expenditure per vehicle stopping is estimated to be between five and ten dollars (pers comm, store owner).

During the short term the store is likely to benefit from the construction workforce buying hot lunches, snacks and drinks. Reduced traffic volumes associated with the bypass however will ultimately result in a reduction of highway related trade and a drop in petrol sales. It has been experienced that after construction of a bypass, there is a tendency for through traffic not to leave the highway and enter small towns to make purchases. If measures are not taken to encourage motorists to leave the highway the viability of this business will be significantly lessened.

As outlined in Chapter 4, the Roads and Traffic Authority is examining the feasibility of establishing a rest area or revival stop in Bookham opposite the store and has held preliminary discussions with Yass Council on this matter. Establishment of a rest area at this location will have the potential to retain some of the passing trade for the village store.

A number of community members expressed concern about the future of the store and agreed that Option B (the preferred route) would have the least impact on the business, as the village would still be visible to travellers on the highway compared to other options which bypass the town completely.

The agricultural machinery repair and supply store disposes of second-hand and reconditioned farm machinery and sells new farm machinery such as tractors, cultivators and cropping equipment. Clientele come from all parts of the State (Bookham School Centenary Committee, 1982) but the store mainly attracts farmers from the Yass and Canberra areas. As there is little relationship between the business and highway related trade, there will only be a nominal change associated with the construction of the bypass.

5.3.2 Bookham Village

Bookham is a small village which provides basic services for its residents and those in surrounding rural areas. The population of the village and surrounding areas has declined slightly over the last 40 years and is now less than 200 persons.

The village is contracting, as evidenced by the recent closure of the school and post office.

With the exception of possible impacts on the village shop, the role of Bookham is likely to change little should the bypass proceed. Residents stand to benefit from the removal of through-traffic, especially heavy vehicles, from the main street. The removal of through traffic will reduce traffic noise and air pollution in most of the village, improve safety for road users and pedestrians and improve residential amenity. Home owners may also gain some increase in the value of their real estate. More generally, the bypass will contribute towards lowering travel costs for residents by reducing travel times, vehicle operating costs and accident potential.

During construction there may be temporary inconvenience to local vehicle movements but it is expected that this will not create traffic congestion. Measures will be introduced to mitigate any noise disturbance, as outlined in Section 5.7.

The proposed bypass of the village will form a physical barrier to further residential development and expansion to the north. Yass Council has initiated a strategy plan to extend village zoning at Bookham to incorporate all of the existing village-sized portions, consisting of about 30 additional allotments which may be sold for housing development as shown on Figure 5.1.

The proposed highway realignment would have an impact on future development as the road passes through some of the land identified in the strategy plan. However, it is expected that there would be ample provision in the remainder of the village to accommodate future growth. Furthermore, there are existing lots in the village that have not been developed and some potential exists for dwellings to be located on the sub-urban portions immediately surrounding the village.

During the course of the community consultation program, some Canberra residents expressed interest in purchasing land in the Bookham area. The proposed bypass in conjunction with associated works such as the Yass bypass will cut travelling times between Bookham and Canberra by 15 to 20 minutes to about 55 minutes. Although there is potential for Bookham to be a dormitory satellite of Yass and Canberra the lack of services and infrastructure is likely to discourage settlement of the area by commuters.

The noise effects on homes or building blocks on the northern side of the village will be addressed in Section 5.7.

5.3.3 Community Severance and Local Traffic

The proposed deviation at Bookham would separate the bulk of the village from the sports oval, tennis courts and the residence located adjacent to these facilities. The impact of the bypass has been discussed with the owners of the residence who have confirmed the acceptability of the proposal. Although the bypass will constitute a physical barrier between the village and sporting facilities, the wide median island at the highway intersection, as

discussed in Chapter 4, will provide a safe means of driving and walking between the two sides of the village. With closure of the school, the sports facilities are no longer used regularly by large numbers of children. Primary usage is for weekend cricket matches during the summer season.

Despite these measures there will be a net impact on the facilities. To some extent they will no longer appear to be an integral part of the village and access will involve crossing two carriageways of traffic travelling at freeway speeds. These impacts are an unavoidable consequence of the proposed route.

Residents using Childowla Road to travel to the village will have easier access to Bookham. Access to the highway from Binalong Road and Conroy Street will be via at-grade intersections as outlined in Chapter 4.

Childowla and Binalong Roads are currently used as a travelling stock route. As outlined in Chapter 4, the Roads and Traffic Authority will provide provision for stock to pass under the highway on the travelling stock route.

5.3.4 Property Access and Management.

Duplication of the existing carriageway will not result in severance of any properties. As outlined in Chapter 4, a range of measures will be incorporated into the design and construction of the proposal to avoid or minimise any potential impacts on land use or properties.

Figure 5.2 shows property ownership along the route.

Landowners along the proposed highway deviation expressed concern that access would be maintained to homesteads and from the highway into paddocks to allow the movement of stock and farm machinery. This issue has been raised by owners of the following properties 'Bogolong Station', 'Kia Ora', 'Marilba', 'Sandy Beach' and 'Te Kooti'. Access is particularly vital to properties which occupy both sides of the current highway, 'Marilba', 'Bogolong Station' and 'Sandy Beach'.

General provisions for minimising impact on property management were outlined in Chapter 4. Although details of compensation or other measures will be finalised through private consultation, the primary concerns raised during the community consultation process are addressed on an individual property basis below. Specific potential impacts such as sedimentation or noise control are addressed in separate sections of this chapter.

Marilba currently has two access points to the highway by virtue of a previous deviation of the road alignment. Stock are moved across the highway, with the assistance of the police.

Most of the property improvements, including pasture improvement have been undertaken on the northern side of the highway.

Provision of a stock underpass will facilitate movement of stock and farm machinery across the highway in a manner which is more convenient and safer than existing arrangements. Drainage restoration, movement of stock watering points and compensation for reduction in productivity will be the subject of private negotiation. Details of future access points will likewise be finalised during detailed design of the project in consultation with the property owner.

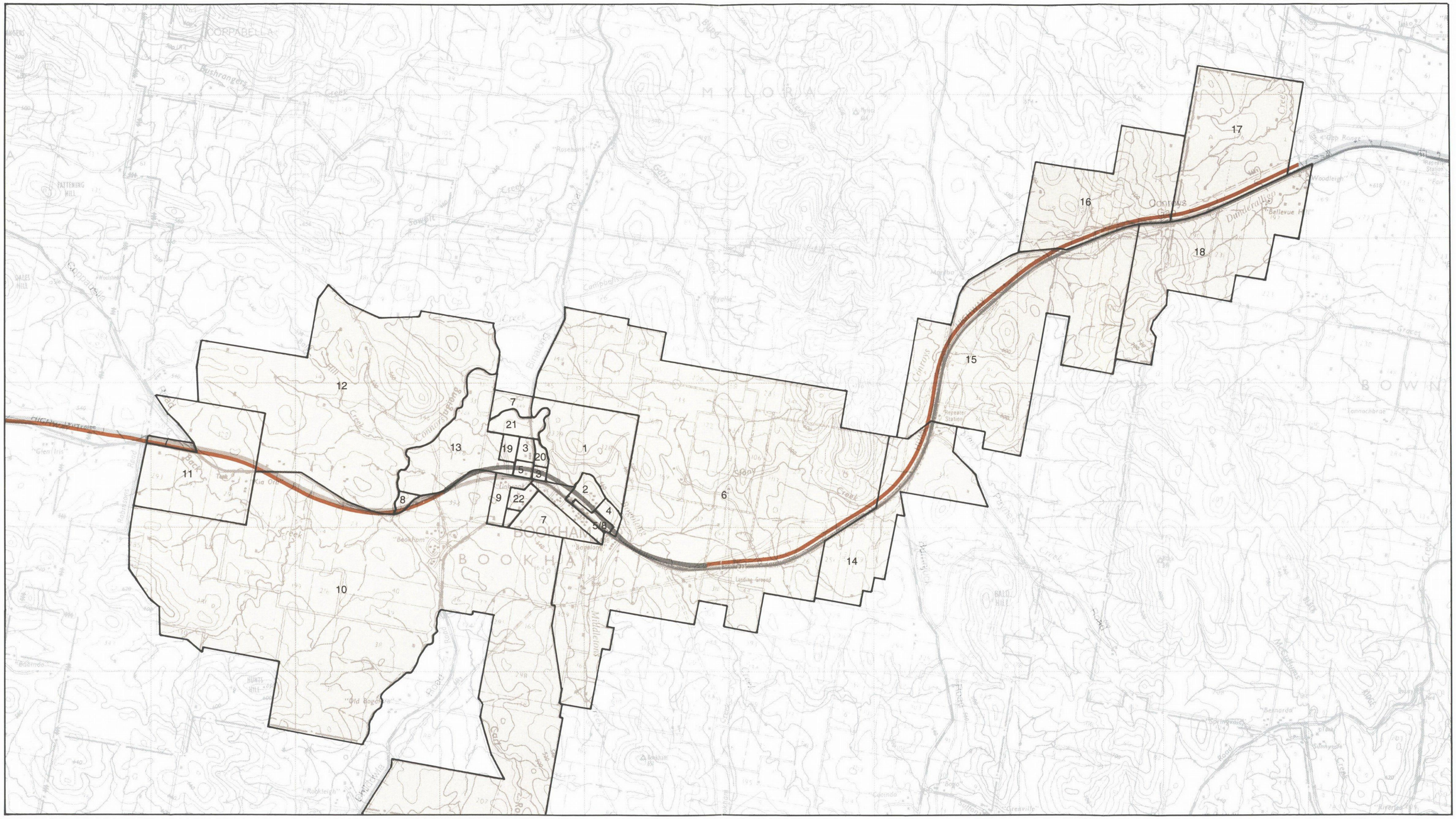
With establishment of the new north-bound carriageway there will be some loss of productive land and possibly a number of trees and improvements such as stock watering points will be affected.

Bogolong Station has expressed a number of concerns including impacts on the existing cattle yards which are located to the east of the homestead. Other improvements such as the shearing shed are located on the opposite side of the highway to the main large paddocks, necessitating significant stock movements across the road.

Provision of a stock underpass will facilitate movement of stock and machinery across the highway and should enhance the current levels of safety and convenience. Access across the highway will be provided for the movement of larger items of farm machinery. The relocation of infrastructure such as stockyards or access tracks and compensation for any loss of productivity will be negotiated in accordance with the normal procedure outlined in Chapter 4.

The owners of Bogolong Station also expressed concern about proximity of the upgraded road to the homestead and consequent safety risk and other impacts on the occupants. Once the bypass is constructed the distance between the house and the highway will increase by approximately 10 metres for one carriageway and 40 metres for the other. Although a number of alternatives were examined it was not feasible to locate the bypass further from the homestead due to the constraining influence of Bogolong Creek to the north. As the proposed new road alignment would be fenced, unrestricted access by children will not be available and existing safety levels will be unaffected. Vehicular access to the homestead will be via the cul-de-sac to be constructed on the truncated section of existing highway, facilitating easier, safer vehicular and pedestrian access to the property.

A number of property owners expressed concern as to whether bus stops for their children would be provided. As discussed in Chapter 4, the Roads and Traffic Authority has recognised that it will need to provide wider shoulders for the school bus to pull off the road at known pick-up points for school children.



1. RB & NP STEVENS
2. NW & BE BONNETTE
3. MJ & EE KELLY
4. RESERVE FOR PUBLIC RECREATION
5. RTA
6. BOGOLONG STATION PTY LTD
7. CROWN
8. YASS COUNCIL
9. DJ & EM SHANAHAN
10. BOZIGA PTY LTD
11. B. HAZELL
12. W. PAINTING
13. S. HALL
14. BOGO PTY LTD
15. MARILBA ROBERT SHANNON
16. MARILBA PROPERTIES PTY LTD
17. A & A WATERS
18. CALDON PTY LTD
19. J PECKHAM
20. JCM LENFERINK & EA LENFERINK
21. A.M. DONOHUE
22. P LIVERS & J & A KOUTSIS

0 500m

Figure 5.2 PROPERTY OWNERSHIP

Sandy Beach is located generally north of the highway however the property extends close to the existing highway near the western end of the village area. The property owners need to move stock across the highway and gain access to the existing silo and Reserve 2577, which is currently leased for sheep grazing. A small area of the property will be purchased by the Roads and Traffic Authority for incorporation into the road reserve.

Details of access requirements to the property's silo and Reserve 2557 will be determined as the project design is finalised. Access points will be required where necessary and any necessary track realignment or upgrading carried out by the RTA. Stock access across the highway will be available nearby through the stock route underpass to be constructed at the Binalong Road intersection.

Kia Ora extends either side of the highway at the western end of the proposed upgrading. The property's existing stock underpass will be extended to ensure farm management practices are not affected by upgrading works.

Rockdale extends north of the existing highway in the vicinity of Bookham and abuts the village sporting facilities. Approximately 15 to 20 per cent of the property will be incorporated into the road reserve associated with the bypass. The owners of this property also own a house in the village between the highway and Bogolong Street. The bypass road reserve will abut the rear of this block. There is unlikely to be any need for transfer of land associated with the house.

In addition to the above-mentioned properties, the bypass road reserve will incorporate a number of smaller undeveloped allotments on the northern side of the village. Fair and just compensation will be paid to the owners of these properties as outlined in Chapter 4.

5.4 HERITAGE AND ARCHAEOLOGY

5.4.1 European Heritage

A review of relevant historical literature and consultation with the Australian Heritage Commission, National Trust of Australia (NSW), NSW Heritage Council and Yass Council was undertaken to identify items of heritage significance in the Bookham area.

There are no current heritage listings or gazettals held by any of the above bodies for items along the highway route or in Bookham. However, a number of potential historic sites, including early homesteads and churches have been recognised as being of local significance and are worthy of preservation. These include 'Bogolara', 'Bogolong Station', 'Bookham Station' and 'Marilba'; the residences which were the former Bogolong and Bookham Inns, Bookham Presbyterian Church, St Columba's Catholic Church; and the old school building.

Historical descriptions of these sites were obtained from recordings of the Bookham School Centenary Committee (1982).

Samuel Barber's holding 'Bogolara' was one of the first in the area and extended from Bookham towards Jugiong where it fronted the Murrumbidgee River. In 1853 Richard Julian bought the leasehold rights to the 'Bogolong Station' property situated on the Port Phillip Road for £2550. The property consisted of a four roomed cottage, out-buildings, woolshed and land with a carrying capacity of 6,000 sheep. The property is still owned by the Julian family. The New South Wales Gazette in 1866 described Bookham as a bush police station lying in the neighbourhood of 'Bogolong Station' for the protection of the district. Both 'Bookham Station' and 'Marilba' were two other properties established by early settlers to the area. In 1880 the Love family bought 'Bookham Station' from the Drummond family. The property comprised of 12,000 acres before the Love family made half of it available after the Second World War for soldier settlement. Mr A.J Shannon purchased the 'Marilba' property comprising of 6,000 acres in 1905 from Archibald McLeod.

Banjo Patterson attended a race meeting in Bookham as a boy in 1873 and later described Bookham in the Sydney Morning Herald, February 4, 1939, as *'a town with a pub at each end and nothing in between'*. The Bogolong Inn was at the Yass end of the village and the Bookham Inn at the Jugiong end. Both inns were established around the 1860s and were frequently visited by surrounding pastoralists and settlers using the Great Southern Road. The Inns operated until the 1930s, when the depression forced many people to move elsewhere for employment and have since been converted into residences.

Also of importance to the community were the two churches built around the turn of the century. The land for the Presbyterian Church, on a rise above the junction of the Hume Highway with Childowla Road, was dedicated on July 19, 1881. By 1885 there was a small corrugated iron church on the site. In 1922 it was decided to build a new church called 'The Pioneer's Memorial Church'. The foundation stone for the church was laid on October 13, 1926 and the church opened on April 18, 1927. The church is an imposing structure built of bluestone quarried in the Bookham district. The site of the old church is marked by four shrubs. On August 14, 1910 the foundation stone for St Columbia's Catholic Church in Goborro Road was laid. The new church was finished in 1911.

Another important structure to the village is the former school building. A provisional school in Bookham opened on December 4, 1882. This original building, a rough slab structure, was burnt down in March 1935. Plans for a new building, a weatherboard structure with an 18 by 14 foot room and surrounding verandahs, were drawn up by May 1935 and the building was erected in January 1936. The school building was transported to a safer level site in 1952 and extended by an additional eight feet. With the recent closure of the school the structure was moved to the sports oval and is now used as a clubhouse.

The proposed highway upgrading and bypass will not directly affect any of these significant structures. The highway will continue to be largely visible and audible from most of the structures and have some effect on the aesthetic qualities that are part of the significance of the sites. Measures to mitigate the noise and visual impacts of the proposed bypass are described in Section 5.6 and 5.7.

5.4.2 Archaeology

An archaeological assessment for the project was undertaken by Navin Officer Archaeological Resource Management. The full report of the assessment is included in Working Paper No. 2 "Archaeological Survey for Aboriginal Sites". A summary of the assessment, its findings and conclusions, is given below:

i. Methodology

Existing documentation including information contained in the NSW National Parks and Wildlife Service Register of Sites and associated reports were examined to provide an understanding of the archaeological setting and known information. In addition a field survey was carried out during April 1993 by two archaeologists and a representative of the Onerwal Aboriginal Land Council. In areas where archaeological visibility was minimal, spot checks were made of nearby erosion gullies, tracks and areas of ground disturbance. The remainder of the route was selectively surveyed, concentrating on areas offering good ground visibility such as eroded creek banks, graded access tracks and roadside erosion. Mature native trees along the road verge were also inspected for scarring.

ii. Findings and Conclusions

Visibility (the ability of the archaeologists to see the soil surface) was generally low along the route.

All the archaeological materials located during the survey were situated in areas of higher than normal visibility and several of the sites revealed artefacts buried beneath the present topsoil. This tends to suggest that further materials may lie buried in areas of poor visibility. However the overall low artefact numbers and densities of sites and the number of isolated finds, despite the extension of survey to areas of good visibility off the route, suggests that any buried materials are likely to be of a similarly dispersed nature.

A total of three artefact scatters and one isolated find were recorded along the proposed bypass route during the survey. No sites were located along the routes of proposed

carriageway duplication. These included:

Bookham 1	-	Artefact Scatter -	an open scatter of two stone artefacts. The degree of disturbance of nearby land and part depositional damage to the artefact renders this site of negligible research value and low archaeological significance.
Bookham 2	-	Isolated Finds -	a single stone artefact of negligible research potential and low significance.
Bookham 3		-	a low density open scatter of four stone artefacts in an erosion gully. Due to its low artefact density and the degree of disturbance caused by erosion, this site is considered to be of low archaeological significance.
Bookham 4		-	an open scatter of five artefacts in a track. This scatter was assessed as being of little research value and low significance.

These sites have now been included in the register held by the National Parks and Wildlife Service.

Other sites identified in the survey will not be affected by the proposal.

Archaeological significance refers to the significance attached to a place for its ability or potential to reveal information which through archaeological research will add to existing knowledge of human society, technology, economy and landuse. Such sites may date to historic or prehistoric time periods.

Aboriginal significance is the significance attributed to Aboriginal sites by contemporary Aboriginal people. Prehistoric sites in Australia physically document an occupation history spanning some 40,000 years. Historic sites that demonstrate the effect of European colonisation upon Aboriginal groups and the Aboriginal response to colonisation constitute evidence of a later stage in Australian history and are also significant to contemporary communities. Aboriginal significance also attaches to sites featuring in traditions and beliefs, and to sites which are sacred to Aboriginal people. Aboriginal communities and hence the determination of Aboriginal significance requires consultation with an appropriate Aboriginal organisation.

All the artefact scatters and open finds recorded during the survey are assessed as being of low archaeological and Aboriginal significance. It is also considered unlikely that further significant archaeological materials lie buried along the routes. No further archaeological survey or investigation is considered necessary in the bypass areas.

Areas affected by the proposed duplication of carriageway are already severely disturbed. No sites were located and it is considered unlikely that any survive. No further archaeological survey or investigation is considered necessary in the carriageway duplication areas.

In summary, construction of the highway duplication including the bypass will result in disturbance to four registered aboriginal sites.

In the case of planned destruction of known archaeological sites, the developer is required to seek a 'Consent to Destroy archaeological materials' from the Director, National Parks and Wildlife Service, NSW. The Roads and Traffic Authority will follow the procedure prior to carrying out any works likely to effect the identified aboriginal relics.

5.5 FLORA AND FAUNA

Ecological studies carried out for this project included describing and mapping flora and fauna and assessing their conservation value. An assessment of potential impacts of the proposal was undertaken and measures to mitigate the impacts of the proposal outlined. The investigation methodologies are summarised in section 4.3.1.

Areas of former native vegetation in and around Bookham have been cleared for grazing as part of development of the district. Remaining vegetation occurs as roadside strips of both native and exotic species and small areas of severely disturbed forest, as identified by the National Parks and Wildlife Service (1993). Figure 5.3 shows the extent of clearing and remaining vegetation.

5.5.1 Methodology

i. Flora

Preliminary investigations involved interpretation of 1:8000 colour aerial photography and 1:50,000 topographic maps and review of relevant literature including the Proposed Bookham Bypass Environmental Overview (RTA, 1993c). A reconnaissance survey was undertaken by foot traverse to detail the composition of vegetation communities. Vegetation

was defined in terms of dominant canopy species. Community structure was assessed according to Specht (1981).

Factors considered to influence vegetation distribution and condition were recorded. The level of disturbance and modification from a pristine state was noted. The conservation status of communities was assessed by field observations, discussions with the National Parks and Wildlife Service and Royal Botanical Gardens and reference to available literature.

ii. Fauna

Vegetation communities were classified on the basis of the habitat they provide for native fauna. Each habitat was investigated by foot traverse, its condition and significance for native wildlife was assessed. Fauna species, habitat elements and indirect evidence of fauna use were noted during field investigations.

Assessment Criteria involved:

Mammals:	the amount of ground cover, extent of shrub layer or tree canopy, occurrence of old trees with hollows, type of substrate (for burrowing etc). Signs of the presence of various species such as droppings, diggings, footprints, scratches on trees, nests, burrow paths and runways were sought.
Birds:	structural features such as the extent and nature of understorey and ground stratum, extent of the canopy, and flowering characteristics of vegetation species. Bird species present were noted.
Reptiles and Amphibians:	availability of cover, shelter, suitable substrate, basking sites, breeding sites (free water). Reptiles and frogs were sought in their likely sheltering places.

The survey was undertaken during the winter months, conditions less than optimal. Many fauna are inactive during this time, especially reptiles and amphibians. It was not the intention of the study to conduct a fauna survey but to assess the potential of various habitats to support native wildlife populations.

5.5.2 Flora

The following vegetation descriptions are provided according to Specht (1981). Vegetation present has been subdivided into communities and is shown on Figure 5.3.

EXISTING CARRIAGEWAY

PROPOSED DUPLICATION

PROPOSED BYPASS

CLOSED GRASSLAND

WOODLAND

CREEKLINE WOODLAND

SEDIMENT BASIN

0 500m

Figure 5.3 VEGETATION AND EROSION CONTROL

i. Community 1 - Woodland

The community consists of trees ranging from six to twenty metres in height, canopy cover ranges from 10 to 50 per cent, understorey generally absent, with a sporadic distribution of small and tall shrubs and a dense ground cover of grasses. It is widespread in the area, occurring on slopes, ridges and valley floors. The canopy is dominated by Yellow Box (*Eucalyptus melliodora*) on valley floor sites and Blakelys Red Gum (*E. blakelyi*) elsewhere in the study area. Other tree species include Candlebark (*E. rubida*), Red Stringybark (*E. macrorhyncha*), White Box (*E. albens*), Bundy (*E. goniocalyx*), Apple Box (*E. bridgesiana*) and Tumbledown Gums (*E. dealbata*) on rocky hillslopes.

The tall shrub layer is sporadic. Individual examples of Silver Wattles (*Acacia dealbata*) and Hickory Wattle (*Acacia implexa*) are sparsely distributed throughout the study area. A single example of Native Cherry (*Exocarpos cupessiformis*) was observed. Grey Tea Tree (*Leptospermum myrtifolium*) and Blackthorn (*Bursaria spinosa*) also occur as tall shrubs in the study area.

A small shrub layer was only observed in one stand of vegetation on the southern side of Childowla Road. The acacias and tea tree mentioned previously were observed as tall and small shrubs.

The ground cover consists of a range of introduced pasture grasses and pasture weeds, as well as moss in moist areas.

ii. Community 2 - Creekline Woodland

In this community trees range from 10 to 25 metres in height. The shrub layer is sporadically distributed and ground cover is a mixture of grasses and reeds. The canopy is dominated by Blakelys Red Gum (*E. blakelyi*) and Yellow Box (*E. melliodora*), other tree species include Candlebark (*E. rubida*) and Red Stringybark (*E. macrorhyncha*). The shrublayer includes the species mentioned previously and introduced species including Willows (*Salix babylonica*), Populars (*Populus alba*), Privet (*Ligustrum sinense*) and Blackberry (*Rubus sp.*).

The shrublayer also includes wetland species such as *Melaleuca* spp: *Typha* sp, *Potamoyeton* sp, *Juncus usitatus* and *Cyperus* sp. The Giant Reed, *Arundo donax* forms extensive stands on the banks of Connors Creek, adjacent to the existing Hume Highway.

iii. Vegetation Community 3 - Closed Grassland

This is a closed grassland reaching 0.5 metres in height, with varying sized stands of native shade trees. It is widespread and covers the majority of the study area. The grassland is made up of a mixture of introduced pasture grasses and herbs and some native grasses. The shade trees are a mixture of the eucalypts mentioned previously.

5.5.3 Fauna Habitats

The vegetation communities previously described reflect differences in plant species composition. The majority of native animal species do not detect these floristic differences, but choose habitat based on its structural characteristics, that is, the number of layers, the vegetation density and height. For many specialised groups, their ability to survive may depend upon the availability of water, a certain species of tree, or microhabitat conditions. Any activity that would alter the structure or the cover of the vegetation would also alter the habitat characteristics and may lead to changes in the fauna. Fauna habitats generally coincide with the vegetation communities outlined in the previous section. Both the woodland and closed grasslands habitats are extensively fenced and actively grazed by sheep.

Appendix E contains a list of fauna species recorded or likely to occur in the study area.

5.5.4 Significance

Vegetation Communities

The woodland vegetation communities have a moderate conservation significance. This is largely a result of the community not being well represented in the region. The remaining woodland communities are fragmented, they do not contain rare or restricted flora species, or special natural features. The woodlands have been modified by grazing and no longer exhibit a native shrub layer or ground cover. The majority of remaining woodland areas are within fenced paddocks and are actively grazed.

The creekline woodland communities exhibit a higher conservation significance. The communities surrounding Bogolong, Stony Creek and Connors Creek exhibit less disturbed vegetation communities and contain some significant mature eucalypts. These communities are considered important as they are not well preserved on a local or regional level.

The closed grassland is not considered to be of particular conservation significance. The communities have been severely modified by grazing. They do not contain any rare or restricted plant species or special natural features and cover extensive areas of land throughout the local area and the region.

The vegetation communities located in the area proposed for the Hume Highway upgrade have been identified and mapped by the National Parks and Wildlife Service as severely disturbed forest. Overall the conservation significance of the vegetation communities in the Bookham area is moderate. The communities are disturbed and do not contain any rare or restricted flora species or special natural features.

No species of rare or endangered flora were identified within the area examined. The shrub layer and ground cover of vegetation communities have been cleared and replaced with pasture grasses and is actively grazed by sheep and cattle. These factors have decreased the species diversity of vegetation communities and greatly reduced the likelihood of rare or endangered flora species being present in the area.

Briggs and Leigh (1988) have identified two plant species in the Yass area as rare or threatened on a national scale. They are *Grevillea iaspicula* and the Daisy (*Ammobium craspedioides*).

Grevillea iaspicula is confined to areas underlain by limestone. The nearest record of this species held by the Botanical Gardens at Canberra is on the southern shore of Lake Burrunjuck, opposite Burrunjuck. The species is highly unlikely to occur in the Bookham area (Mark Richards, Botanical Gardens, Canberra, pers comm).

The Daisy (*Ammobium craspedioides*) is more widespread. There are two known populations of the daisy in the area. One on the Burrunjuck Road, south of the Hume Highway and another on Black Range Road south east of Bookham. All sightings of the species recorded by the Canberra Botanical Gardens are south of the Hume Highway. The daisy is now considered more widespread than first thought, although it is not preserved in reserves. It is considered unlikely that this species occurs in the Bookham area.

Fauna

The Southern Tablelands Region of NSW contains a variety of environments which support a large number of native animal species. A number of species reach their geographical limit of distribution in this region while for others it represents part of a migratory path. Increasing pressure from grazing has resulted in the fragmentation of many habitats thereby reducing their conservation significance.

It is unlikely that any rare or endangered fauna species, listed on Schedule 12 of the National Parks and Wildlife Act occur in the Bookham area. Faunal diversity in the area is low due to the disturbed nature of fauna habitats and the intensive land use.

A number of Gang Gang Cockatoos were observed in the district. This species is known by local naturalists to utilise the small stand of relatively mature woodland opposite the general store in Bookham. This area contains a number of mature trees with hollows and provides habitat suitable for breeding for this species. The species was also observed in woodland along Childowla road and adjacent to the town hall.

The Superb Parrot listed on Schedule 12 of the National Parks and Wildlife Act has been recorded in the region. Bookham lies within the known breeding range of the Superb Parrot. It is possible that the Superb Parrot utilises habitats in the Bookham area for breeding and or foraging.

The following factors are listed under Sections 77, 90 and 112 for consideration to decide whether there is likely to be a significant effect on the environment of endangered fauna:

"(a) the extent of modification or removal of habitat, in relation to the same habitat type in the locality;

(b) the sensitivity of the species of fauna to removal or modification of its habitat;

(c) the time required to regenerate critical habitat, namely, the whole or any part of the habitat which is essential for the survival of that species of fauna;

(d) the effect on the ability of the fauna population to recover, including interactions between the subject land and adjacent habitat that may influence the population beyond the area proposed for development or activities;

(e) any proposal to ameliorate the impact;

(f) whether the land is currently being assessed for wilderness by the Director of National Parks and Wildlife under the Wilderness Act 1987;

(g) any adverse effect on the survival of that species of protected fauna or of populations of that fauna."

These factors were considered in view of the likely impacts of the proposal. The proposed upgrading of the Hume Highway including the Bookham bypass are unlikely to result in a significant effect on the habitat of endangered species, known or likely to occur in the area.

The conservation reserves in the area, including Burrinjuck State Recreation Area increase the chances of survival of representative faunal communities that occur in the region. The disturbed nature of fauna habitats, the prevalence of feral cats, foxes and rabbits and the intensive land use in the region, reduce the likelihood of rare or endangered fauna in the Bookham area.

5.5.5 Impacts of the Proposal

The location and construction of the proposed upgrading of the Hume Highway and the bypass at Bookham will result in minimal impacts upon the ecology of the area. The route between Conroys Gap and Bogolong Creek parallels the existing Hume Highway. The impact on vegetation will be confined to the removal of roadside vegetation on the northern side of the existing roadway. This vegetation consists largely of eucalypts common in the region and pine trees.

The impact on fauna will be minimal as the existing highway already forms a barrier to movement of terrestrial fauna. Studies have demonstrated that several mammal species may avoid using areas near roads (Mitchell McCotter, 1992). Fauna utilising habitats in the area will already have adapted their behaviour due to the existing highway. The location of the proposed route between Conroys Gap and Bookham is unlikely to result in increased road kills and will destroy a minimal amount of fauna habitat.

The Bookham bypass will result in removal of a small area of vegetation on the banks of Connors Creek, a section of a small stand of woodland on the northern side of the existing Hume Highway within Bookham, a number of trees on the eastern side of Binalong road and a small stand of trees just east of Binalong Road. None of the vegetation to be removed has particular conservation significance. Stands of the same type of woodland occur in and around Bookham.

The vegetation communities along Bogolong and Stony Creeks provide linear habitats which fauna can move along. The bridgeworks will result in clearing some vegetation from the creek banks, however fauna will be able to move beneath the highway along the creek banks. This will enable fauna to continue existing patterns of habitation along the creekline and in woodland habitats.

The proposed route of the highway from just west of Binalong Road is parallel to the existing highway on the southern side. The proposal will have a minimal impact on vegetation in this area. Some individual trees located within the proposed roadway will be cleared. A small area of vegetation beneath the proposed bridge at Connors Creek will also be cleared. Small areas of vegetation may be cleared for access, however this will only occur if necessary. The species affected are represented elsewhere along the highway and in Bookham. The proposal will have a minimal impact on fauna in the locality as no large areas of fauna habitat will be removed. As stated previously fauna are likely to have adapted to the existing highway location and the proposal is unlikely to result in an increase in roadkills. The provision of fauna underpasses at Connors Creek due to bridgeworks will enable fauna to continue to utilise creekline woodland habitats.

On the whole the proposed upgrading of the Hume Highway and the Bookham bypass will result in minimal impacts upon terrestrial flora and fauna.

5.5.8 Measure to Reduce Impacts

There are several measures which will be taken to minimise the ecological impacts of the proposal and these are set out below:

- The areas disturbed by construction, the roadside reserves and medians will be rehabilitated with local native species. The seeds for these species will be collected from the local area (with approval of Yass Council) to maintain local genetic homogenety and to increase the chances of survival as local species are already adapted to the conditions. The areas of dry forest and woodland in the local area would provide a diverse seed resource for this purpose;

- This process will retain existing links and corridors between existing vegetation that may be affected by the proposal and between stands of vegetation previously separated by clearing;

- Areas of weed invasion within the road reserve such as at Connors Creek will be identified and regenerated using appropriate bush regeneration methods, such as those outlined by Buchanan (1989). This will reduce the chance of weed invasion in rehabilitation areas. The Roads and Traffic Authority will inspect all rehabilitation at least twice annually for five years following construction. Weed control will be carried out as necessary;

- The fauna underpasses created by bridgeworks will be revegetated at the entrance and exit points including the placing of dead branches and logs. This will ensure fauna utilising the underpasses are not exposed to extreme risk of predation;

  Mature old growth trees remaining along the route will be retained where possible. Two such trees occur on the southern side of the existing highway just east of Connors Creek. Old growth trees like these provide an important seed resource and may provide essential breeding habitat for bird or arboreal mammal species in the region. Trees to be removed will be checked for hollows and the presence of animals prior to felling, and before the chipping of vegetation.

- The amount of vegetation removed for access and construction of the proposed upgrading and bypass will be minimised. Vegetation will only be removed where necessary. Stands of woodland adjacent to access areas or at risk of accidental damage will be fenced off for protection;

- An area of relatively mature woodland occurs opposite the Bookham general store. It is currently owned by the Roads and Traffic Authority and utilised as a depot. The

woodland community is visited by the Gang Gang Cockatoo and provides suitable breeding habitat for this species. This area also exhibits suitable breeding and foraging habitat for the Superb Parrot listed on Schedule 12 of the National Parks and Wildlife Act.

Disturbance of this area will be minimised and on completion of the proposal converted into a rest area with controlled access for vehicles, if this proves feasible. This would enable preservation of a small area of habitat of a locally significant species and provide an attractive resting place for travellers with easy access which may stimulate local trade as it is located opposite the Bookham store.

5.6 VISUAL ASSESSMENT

A comprehensive landscape and visual impact assessment was undertaken for the project by M.A.Schell & Associates. The following section comprises a summary of the findings. Working Paper No. 1 "Landscape and Visual Assessment" contains the full assessment report.

5.6.1 Existing Landscape

The landscape in the vicinity of Bookham is distinguished by a series of mostly cleared hill-topped ridgelines which run in a roughly north south direction. This landscape is not unusual in the district or even the region as cleared undulating landscape is quite common.

Three landscape elements were identified. Each element has been described and its ability to absorb a highway development identified. Ability to absorb is a measure of the degree of change which the development would cause to the dominant visual features or characteristics of the landscape.

i. Rural Landscape

The majority of the study area can be described as having a rural character as a result of being mostly cleared of native stands of vegetation, and covered with grasses for grazing cattle and sheep. Properties in this type of landscape are large with a small number of farm buildings and dwellings contained on each. Roadways except for main roads are mostly unsealed and there is little industrial or commercial development.

This type of landscape has value within a local context, is not prominent and contains a relatively low population and therefore has a relatively high ability to absorb the proposed

development. The Rural landscape has been considered as two categories: valleys and slopes; and ridgelines.

The study area contains two particularly large properties, Bogolong and Bookham. In addition there are a number of other dwellings contained within the rural category. Although rural in character, they have a low ability to absorb the proposed development within their views due to the contrast created between the style and character of a farm homestead and that of a dual carriageway highway.

ii. Cultural Landscape (Township)

Bookham is an example of a very small rural village which contains commercial, cultural and social facilities to serve the local district. The buildings within the township, (with the exception of the churches which are features in the landscape) are mostly typical of the scale of the town. They are single storey, small scale, using different building materials and in have few architectural features to distinguish them from the farm buildings within the district. One dominant element in this landscape is the old farm machinery yard which tends to give the village a slightly derelict character but also adds interest and commerce. Unifying features within the village are the two churches which are similar in artchitectural style and building materials.

This landscape type has value within a local and district context. Located within a small valley surrounding Bogolong Creek, Bookham is not very prominent within the landscape, however it is the centre for the district and supports the largest concentration of people within the study area. It therefore has a relatively low ability to absorb the proposed development.

The two churches which serve Bookham would have value within the district and potentially the region, if they were used as an identifying feature of the area, and have a low ability to absorb the proposed development within their vicinity.

The small area north of the village which contains the cricket ground and tennis courts has value within a local and district context not because of its appearance or location but because of its use within the social life of the village. The proposed development would not reduce its intrinsic value but it may have an effect on its prominance within the area. The sporting grounds therefore have a mid level of ability to absorb the development.

iii. Natural Landscape

These areas have been defined as having a predominantly native vegetation cover. They occur where the land has been left uncleared for some reason or where there is significant regrowth of tree species.

Vegetated ridgelines occur on higher more inaccessible areas which have not been cleared although they are probably grazed. They are relatively rare in the landscape and their elevation makes them relatively prominent. They have a low ability to absorb the development. The proposed highway project will not effect any vegetated ridgeline areas.

Pockets of mature eucalypts are located along Bogolong Creek and its tributaries. They are not prominent in the landscape due to their low elevation however they have a value within a local and district context. They have a relatively low ability to absorb the development which involves clearing and a reduction in the total area of mature trees.

Table 5.1 summarises the features of the landscape and their ability to absorb the proposed development.

Table 5.1 ABILITY TO VISUALLY ABSORB THE ROAD

LANDSCAPE TYPE	INTRINSIC VALUE	PROMINENCE	DEGREE OF CLEARING/ CONTRAST	ABILITY TO * ABSORB ROAD
RURAL				
Valleys and slopes	Local	Low	Low/Low	(5)
Ridgelines (cleared)	Local	Mid-high	Mid/Low	(7.5)
Homesteads	Local	Low-Mid	Low/High	(7.5)
Rocky Hilltops	Local	Mid-High	High/Mid	(10.0)
CULTURAL				
Rural Town	District	Low-Mid	Low/Mid	(7.5)
Sporting Grounds	District	Low-Mid	Low/Low	(6.5)
Churches	District	Mid	Low/High	(8)
NATURAL				
Ridgelines	District	High	High/High	(14)
Creeklines	District	Low	High/Mid	(9)

* *The lowest score indicates greatest ability to absorb.*

5.6.2 Effects of the Proposal

i. Rural Landscape

The proposed development would have a relatively minor impact on the rural landscape as the dominant elements in this landscape, pastureland, rolling hills, and occasional remnant

vegetation, are easily incorporated into the road development. Where deep cuttings into ridgelines occur, such as at Conroys Gap, visual impacts will be significant.

In the vicinity of Binalong road, the carriageways will be elevated to allow for a stock underpass. The existing landform is sloping in this area with carriageway levels below the profile of the existing highway. Residences on the northern side of the bypass however, will view the raised roadway in the foreground.

ii. Cultural Landscape

One of the characteristics of the district is the rows of ornamental trees which were historically planted along the highway route. Many of the views into these historic plantings were lost when the existing highway alignment replaced the original Hume Highway. As a result there are very few areas where ornamental plantings will be affected by this proposal. There will be some effect adjacent to "Bogolong Station", however the impressive stand of conifers which currently screens the homestead from the existing highway will remain unaffected. The landscape surrounding other historic properties of "Bookham Station" and "Marilba" will remain unaffected by this proposal.

The landscape surrounding the Uniting Church and machinery yard will not be affected by the proposal although the bypass will be visible from that area.

The landscape surrounding the Cricket Ground will be altered by this proposal as earthworks will abut the south western corner of the ground, and the development will remove many of the mature trees on that side of the ground.

iii. Natural Landscape

Some native vegetation located between Stony Creek and Burrinjuck Road will be cleared as required for road duplication in this area. Similarly the native trees along the bypass route in the Bookham will be cleared. Other significant stands of native vegetation within the landscape will remain unaffected by this proposal.

iv. Effect on Views and Vistas

Existing views and vistas most affected by this proposal will be those from the cricket ground and nearby residences, the entry to Bogolong Station, the view from the Church and hall and the views from the residences in the vicinity of Binalong Road. Views from the southern side of the existing highway will be generally less affected than views from the

northern side as the landform slopes down from south to north. Most of the proposed earthworks will be concealed in views from the south.

The views from the north in the vicinity of the stock crossing at Binalong Road will be the affected as the dual carriageway in this area will be elevated to allow for the stock crossing.

Table 5.2 summarises the degree of alteration to views from residences. The degree of alteration to view has been determined by assessing the position of the road in relation to the house or other important facility. For example a view from the front of a residence which contains the proposed road in the foreground and which does not have an existing screen of vegetation would have a high degree of alteration. Foreground has been assessed in this study to be less than 100 metres, middleground is less than 250 metres and background is greater than 250 metres.

Table 5.2 ALTERATION OF VIEWS

HOUSE NUMBER [1]	POSITION OF OBSERVER	POSITION OF ROAD IN VIEW	EXISTING SCREEN	DEGREE OF ALTERATION
1	Front of house	Middleground	Yes	Mid
2	Rear and sides	Middleground	Partial	Mid
3	Sides of house	Background	Partial	Low
4	Front and sides	Middleground	Partial	Mid
5	Front and sides	Foreground	Yes	Mid-High
6	Front and sides	Foreground	Partial	High
7	Rear and sides	Foreground	Partial	High
8	Front and side	Middleground	Partial	Mid
9	Front and side	Middleground	Partial	Mid
10	Front and sides	Middleground	Partial	Mid
11	Front	Middleground	Partial	Mid
12	Front, rear and side	Middleground	No	Mid-High [2]
13	Front and side	Foreground	Partial	Mid-High [2]
14	Front and side	Middleground	Partial	Mid
CULTURAL ITEMS				
Uniting Church	Front	Foreground	Partial	High
Oval	All sides	Foreground	Partial	High

Note: *1. House numbers correspond to theose shown on Figure 5.13.*

2. The degree of impact is relatively lower in these cases as the existing road is in front of the new road.

5.6.3 Landscape Strategy

A detailed landscape strategy and concept plan has been developed for the proposal to:

- maintain the predominantly rural character of the landscape by replacing pastureland and minimising noise intrusion on residences;
- enhance the cultural landscape by restoring some of the historic character to the highway which was lost with its relocation;
- reinforce natural landscape by replanting native vegetation surrounding the creeklines and Bookham;
- minimise erosion within the highway corridor and to ensure that existing erosion is not accelerated by the highway upgrading by providing additional planting and stabilisation works along watercourses; and
- minimise impacts on views and vistas by screening views of the highway from nearby residences.

Specific landscape guideline treatments to minimise impacts have been developed for each of these objectives. Key aspects of the treatments which will be applied at various locations along the route include:

- re-seeding with native grasses such as Wallaby grass, planting with Eucalypts along verges and native shrubs along the median;
- plantings of deciduous trees at specific locations to supplement historical avenue plantings along the highway; and
- retain existing trees in the median where possible and where they will not present a potential hazard to vehicles.

The following specific measures are incorporated in the landscape concept:

- avenue plantings in the vicinity of "Marilba" and Kia Ora";
- planting the proposed rest area in Bookham with a combination of evergreen natives, native grasses and ground covers;
- planting creeklines and watercourses with a range of native species including Acacia, Leptospermum, Casuarina and Melaleuca;

- stabilising, topsoiling and planting of batters with native grass and native tree species; and

- locating noise barriers and mounds to minimise visual impact by

  - setting barriers back from the road in vegetated areas;
  - grassing and planting mounds with native vegetation; and
  - using a combination of barriers and mounds to minimise disturbance to existing roadside vegetation.

The Landscape and Visual Impact Assessment (Working Paper No. 1) contains details of the landscape concept and measures to be applied in specific situations, including details of construction, species types and maintenance applicable to each situation.

5.6.4 Visual Impact Assessment

The visual impacts of the proposed development has been determined by assessing the degree of alteration to the character, views and vistas that will occur as a result to the road and the relative significance of the affected character and views. For example a high degree of alteration to a view of regional significance would be considered a relatively high visual impact. In this study the views and vistas are mostly of district or local significance and therefore there are no high visual impacts.

Many of the guidelines proposed as a part of the development will mean that the prominance of the new road will be reduced as planting becomes established. As a consequence, impacts will decline in the longer term. Table 5.3 summarises visual impacts on residences and cultural facilities that can be expected in both the short and long term.

Table 5.3 VISUAL IMPACT ON RESIDENCES AND CULTURAL FACILITIES

VIEW FROM HOUSE NO.	CHANGE TO VIEW	SIGNIFICANCE	SHORT TERM IMPACT	IMPACT REDUCTION TREATMENT	LONG TERM IMPACT
1	Low	Local	Low	Screen planting, noise barrier	Low
2	Mid	Local	Mid	Screen planting, noise barrier	Low
3	Low	Local	Low	Screen planting, noise barrier	Nil
4	Mid	Local	Mid	Screen planting, noise barrier, selective clearing	Low
5	Mid-High	Local	Mid-High	Screen planting, noise barrier, selective clearing	Low-Mid
6	High	Local	High	Screen planting, noise barrier, selective clearing	Mid
7	High	Local	High	Screen planting	Mid-High
8	Mid	Local	Mid	Screen planting, noise barrier	Low-Mid
9	Mid	Local	Low-Mid	Screen planting	Low
10	Mid	Local	Low-Mid	Screen planting, noise barrier	Low
11	Mid	Local	Low-Mid	Screen planting, noise barrier	Low
12	Mid	Local	Low-Mid	Screen planting, noise barrier	Low
13	Mid	Local	Low-Mid	Screen planting, noise barrier	Low
14	Mid	Local	Low-Mid	Screen planting, noise barrier	Low
Church	High	District	High	Screen planting	Mid
Oval	High	District	High	Screen planting, noise barrier	Low-Mid

The proposal will have the most impact on the view from residence 7. This residence currently fronts the highway, and will be the only residence located between the existing highway and the bypass. The visual impact will be high in the short term due to the fact that the rear of the residence is only 53 metres from the bypass. As the house is slightly elevated above the road it will be possible to view down onto the road. Until the vegetation becomes established, both carriageways will be visible.

Other views from residences which will be altered to a mid to high degree in the short term are those shown in Figures 5.5, a photomontage of the view from Residence No 5, Bogolong Station, Figure 5.6, a photomontage of the view from Residence No 6, and Figure 5.7, a photomontage of the view from Residence No 8 in Binalong Road. These views have been chosen for illustration in photomontages to show how a mid - high relative visual impact will actually appear in the longer term.

Figures 5.4 to 5.7 show photomontages of the route at four selected locations and Figures 5.8 to 5.12 are artists impressions of the completed project from a further five locations.

5.7 NOISE

5.7.1 Existing Noise Levels

Existing noise levels were monitored at four residences located near the proposed by-pass. These are shown in Figure 5.13 as residences 3, 4, 6 and 14. Monitoring was conducted over seven days, from 14 to 20 July, 1993, at each of these locations. In all cases, existing noise levels were dominated by noise from the Hume Highway, with a small contribution from local sources such as wind in vegetation.

Because environmental noise levels vary with time, statistical descriptors are required to adequately characterise the noise environment. The L_{10} level is the noise level which is exceeded for 10% of the time, and is approximately the average of maximum noise levels . The L_{90} level is the level which is exceeded for 90% of the time, and is approximately the average of minimum noise levels. The L_{90} level is often referred to as the "background" noise level. The L_{eq} level represents the average noise energy during a measurement period.

Equipment used consisted of unmanned noise loggers, set to record statistical noise levels over 15-minute periods. Appendix D shows recorded L_1, L_{10}, L_{90} and L_{eq} noise levels for each measurement location throughout the logging period.

The RTA uses the noise level descriptors $L_{eq,24\ hr}$ and $L_{eq,8\ hr}$ to determine its road traffic noise criteria (see Appendix D, Table 1). These represent the total noise energy at a receiving location, measured over a 24-hour period and over the 8-hour period from 10 pm to 6 am, respectively.

Table 5.4 shows measured values of $L_{eq,24hr}$ and $L_{eq,8hr}$ for each measurement location.

Table 5.4 MEASURED NOISE LEVELS

MONITORING LOCATION	MEASURED NOISE LEVEL, dB(A)	
	$L_{eq,24hr}$	$L_{eq,8hr}$
Residence 2	54.0	54.5
Residence 4	58.3	59.5
Residence 6	52.9	53.9
Residence 14	54.1	56.0

From Table 5.4, in each case the $L_{eq,8hr}$ noise level, representing the night-time noise level, is higher than the $L_{eq,24hr}$ level. This result is due to the large number of heavy vehicles using the Hume Highway at night. This situation is expected to continue in the future.

5.7.2 Noise Criteria

Criteria for assessment of traffic noise at potentially-affected residences and other noise-sensitive locations are set in the Roads and Traffic Authority's recently-released Interim Traffic Noise Policy (RTA September 1992). These criteria are applicable both for the introduction of a new road into an area and for upgrading of an existing road. The criteria set out in that Policy will be adopted in the present report for assessment of noise from the proposed by-pass.

For residences, the RTA criteria are defined in terms of the descriptors $L_{eq,24hr}$ and $L_{eq,8hr}$. For traffic noise to be considered acceptable, relevant criteria in terms of $L_{eq,24hr}$ and $L_{eq,8hr}$ should both be met.

The recommended residential traffic noise criteria depend on the existing ambient noise level at the assessment location. The criteria are shown in Table 5.5 below. These criteria are to be met at a point 1.0 metre from a residential facade. The policy states that they should be met 10 years after opening of any proposed road project, in this case the year 2003.

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Figure 5.4 FROM RESIDENCE 7

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Figure 5.5 FROM RESIDENCE 5 - "BOGOLONG"

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Figure 5.6 FROM RESIDENCE 6

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Figure 5.7 FROM RESIDENCE 8

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Figure 5.8 STONY CREEK CROSSING

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Figure 5.9 CONNORS CREEK CROSSING

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Figure 5.10 BINALONG ROAD INTERSECTION

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Figure 5.11 VIEW FROM CHURCH

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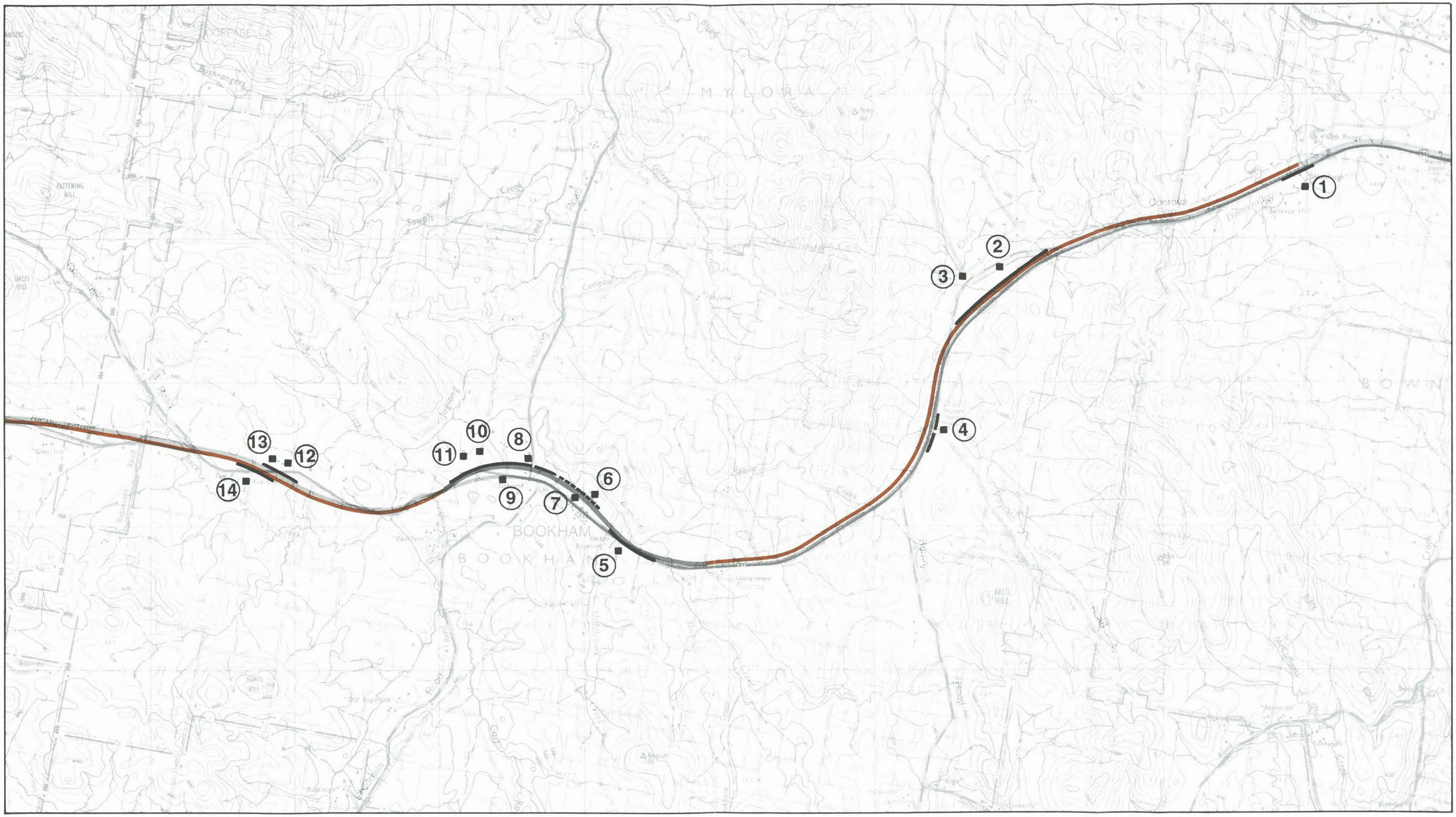
Figure 5.12 VIEW AT YASS END OF NEW ROAD



EXISTING CARRIAGEWAY

PROPOSED DUPLICATION

PROPOSED BYPASS

BARRIERS (FENCE)

RESIDENCES

MOUND

0 500m

Figure 5.13 NOISE CONTROL

Table 5.5 RECOMMENDED TRAFFIC NOISE CRITERIA FOR RESIDENCES

NOISE DESCRIPTOR	EXISTING AMBIENT NOISE LEVEL, dB(A)	RECOMMENDED MAXIMUM LEVEL, dB(A)
$L_{eq,24hr}$	< 48	Ambient + 12
	48 - 57	60
	> 57	Ambient + 3
$L_{eq,8hr}$	< 43	Ambient + 12
	43 - 52	55
	> 52	Ambient + 3

Source: RTA Interim Traffic Noise Policy (refer Appendix D)

Actual criteria for all residences along the route are shown in Section 5.7.4.

For noise during construction, criteria are laid down in the Environment Protection Authority's Environmental Noise Control Manual (EPA 1985). These are expressed in terms of the L_{10} level of noise from the construction site - that is, the noise level which is exceeded for 10% of the time. The criteria depend on the existing background noise level at the assessment location, which is measured as the L_{90} level, i.e. the noise level which is exceeded for 90% of the time.

The EPA criteria for noise from construction sites are:

- For construction periods of four weeks and under, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 20 dB.

- For construction periods of between four and 26 weeks, the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 10 dB.

- For construction periods greater than 26 weeks, the criteria for a continuously-operating source would apply, which would generally mean that the L_{10} noise level due to the construction site should not exceed the existing L_{90} background noise level by more than 5 dB.

In addition, where noise is audible at residential premises, construction should be limited to the following times:

- Monday to Friday, 7am to 7pm
- Saturday, 8 am to 1 pm
- No construction work to take place on Sundays or public holidays.

In the present case, construction of the proposed bypass is expected to take place near an individual residence for between four and 26 weeks, and hence L_{10} noise levels should not exceed the existing L_{90} background levels by more than 10 dB.

To determine the existing L_{90} background noise levels, average measured L_{90} values were calculated for each hour of the day at each measurement location. The minimum of these hourly values between 7 am and 7 pm was taken as the background level for assessment. These values are shown in Table 5.6.

Minimum daytime L_{90} background noise levels at the noise measurement locations are summarised in Table 5.6. The levels are approximately 41 dB(A) for most residences, and 37 dB(A) for one residence which is shielded and further from the road (280 m).

It is therefore recommended that the L_{10} construction noise levels should not exceed 51 dB(A) for most residences, and 47 dB(A) if a residence is significantly shielded from the road or more than approximately 300 metres from it (residence 14).

Table 5.6 MINIMUM DAYTIME BACKGROUND NOISE LEVELS AT MONITORING LOCATIONS, dB(A).

MEASUREMENT LOCATION	MINIMUM DAYTIME L_{90} BACKGROUND NOISE LEVEL, dB(A)
Residence 2	41
Residence 4	41
Residence 6	41
Residence 14	37

5.7.3 Noise Prediction Methodology

Residences which will be affected by increase in noise levels from the proposed bypass are shown on Figure 5.13. Both existing and future noise levels at these residences were calculated using the Highway Traffic Noise Prediction Model developed by the United States Federal Highways Administration, Washington (FHWA). Results of the model have been extensively validated. In this case, the alternative CORTN traffic noise prediction model was considered unsuitable due to the unusual daily distribution of heavy vehicle numbers.

The FHWA model predicts L_{eq} noise levels for a given traffic volume and mix. L_{eq} levels were predicted for each hour, and values of $L_{eq,24hr}$ and $L_{eq,8hr}$ were calculated from these hourly levels.

The latest annual average daily traffic (AADT) volumes on the existing Hume Highway at station number 94173, located about 20 kilometres West of Bookham, were recorded by the Roads and Traffic Authority in 1988. This is the most relevant traffic count station for the Bookham section of the Hume Highway. Short-term and long-term AADT projections, using linear regression, for the years 1993 and 2003 were based on 1988 data and are shown in Table 5.7.

Table 5.7 ANNUAL AVERAGE DAILY TRAFFIC VOLUME PROJECTIONS.

YEAR	AADT	
	HIGH GROWTH PROJECTION	LOW GROWTH PROJECTION
1988	7183	7183
1993	8440	8368
2003	10954	10739

Other factors used in calculations are:

- mean speeds for heavy and light vehicles, as shown in Table 5.8;

Table 5.8 ASSUMED MEAN TRAFFIC SPEEDS

ROAD TYPE	ASSUMED AVERAGE VEHICLE SPEED	
	LIGHT VEHICLES (km/h)	HEAVY VEHICLES (km/h)
2-lane undulating road	79	63
4-lane undulating road	92	79
2-lane flat road	92	79
4-lane flat road	110	96
Existing section of the Hume Highway inside Bookham	60	60

- the distribution of traffic volumes and percentage heavy vehicles by hour based on data recorded by the RTA at Gundagai for the period 10-17 Dec 1992;
- 20% of heavy vehicles are "medium trucks" under the FHWA definition, and 80% are "heavy trucks";
- the existing road surface is chip seal;
- the road surface for future development will be concrete, as proposed by the RTA.

Where the road consists of two carriageways, noise levels were calculated separately for each carriageway and then added.

Calculated traffic noise levels at the measurement locations were compared with the measured levels, to provide a validation of the calculation procedure. The results are shown in Table 5.9. Note that in some cases the measurement location was not exactly at the residence, and hence predicted noise levels at the logger location and the residence will be slightly different. Where the logger location is very close to the residence, the measured noise levels will be used rather than calculated levels to assess the existing noise levels.

Table 5.9 COMPARISON OF PREDICTED AND MEASURED NOISE LEVELS

MEASUREMENT	MEASURED NOISE LEVEL, dB(A)		PREDICTED NOISE LEVEL, dB(A)	
LOCATION	$L_{eq,24hr}$	$L_{eq,8hr}$	$L_{eq,24hr}$	$L_{eq,8hr}$
Residence 2	54.0	54.5	55.4	56.6
Residence 4	58.3	59.5	59.6	60.8
Residence 6	52.9	53.9	54.7	56.0
Residence 14	54.1	56.0	56.6	57.8

From Table 5.9, there is reasonable agreement between predicted and measured noise levels, but predicted levels are consistently higher, by an average of 1.8 dB. In subsequent calculations, this value was subtracted from the calculated values to provide a more accurate prediction.

5.7.4 Predicted Traffic Noise Levels

Predicted noise levels, for 1993 at each of the residences marked in Figure 5.13 are shown in Table 5.10.

Table 5.10 PREDICTED NOISE LEVELS FOR 1993, dB(A).

RESIDENCE	DISTANCE FROM EXISTING ROAD, m	CALCULATED NOISE LEVEL, dB(A)	
		$L_{eq,24hr}$	$L_{eq,8hr}$
1	176	55.4	56.6
2	232	53.2	55.1
3	512	48.5	49.6
4	96	59.4	60.5
5	40	63.1	64.4
6	192	52.9	54.5
7	24	66.4	67.7
8	272	50.6	51.9
9	32	64.5	65.8
10	288	52.2	53.4
11	224	53.8	55.0
12	136	57.1	58.3
13	80	60.5	61.7
14	280	52.4	53.6

From Table 5.10, noise level criteria can be determined for each residence in accordance with the RTA Interim Traffic Noise Policy. Table 5.11 shows these criteria, as well as calculated noise levels for each residence for the year 2003.

Table 5.11 PREDICTED NOISE LEVELS FOR 2003, dB(A).

RESIDENCE	DISTANCES FROM CARRIAGEWAYS OF PROPOSED BY-PASS, m	CALCULATED NOISE LEVEL, dB(A)		NOISE LEVEL CRITERION, dB(A)	
		$L_{eq,24hr}$	$L_{eq,8hr}$	$L_{eq,24hr}$	$L_{eq,8hr}$
1	176, 200	59.1	60.2	60.0	59.6
2	216, 232	57.9	59.1	60.0	58.1
3	504, 512	52.6	53.8	60.0	55.0
4	96, 112	62.9	64.1	62.4	63.5
5	50, 82	66.4	67.5	66.1	67.4
6	120, 152	61.3	62.4	60.0	57.5
7	58, 89	65.5	66.7	69.4	70.7
8	185, 217	58.7	59.8	60.0	55.0
9	74, 106	64.1	65.3	67.5	68.8
10	265, 297	56.5	57.6	60.0	56.4
11	192, 224	58.4	59.6	60.0	58.0
12	136, 152	60.8	62.0	60.1	61.3
13	80, 96	64.1	65.3	63.5	64.7
14	264, 280	56.7	57.8	60.0	56.6

From Table 5.11, predicted noise levels in 2003 exceed RTA criteria at all residences except residences 3, 7 and 9. In many cases the exceedances are less than 1 dB, but for residences 2, 10, 11 and 14 they are between 1 and 2 dB and for residences 6 and 8 the exceedances are approximately 5 dB.

It is clear that in order to reduce noise levels to within RTA criteria, noise control measures would be required along a proportion of the proposed route.

5.7.5 Recommended Noise Control Measures

The simplest and most effective measure which could be adopted to reduce traffic noise at nearby residences would be the use of an open graded asphalt road surface for the by-pass in place of the concrete surface assumed in the above calculations. However, for reasons

outlined in Chapter 4, this alternative is not considered feasible for National Highway projects.

Noise control measures which will be adopted are a range of mounds and barriers. At residence 6, the exceedance of the RTA criterion of 5.3 dB could be eliminated by the use of a mound adjacent to the road. The mound should be at least four metres high, with its highest point approximately ten metres from the road edge. The location is shown in Figure 5.13. The calculated noise level at residence 8 would be 4.8 dB over the criterion. In this case, a barrier approximately two metres high would be required, since the road is on fill at this point.

Mounds or fences would also be required near other residences, as shown in Figure 5.13. In each case, these should be sufficiently high to break the line of sight from the residence to a point two metres above the roadway.

The location and extent of mounds or barriers is shown on Fig 5.13.

Mounds, barriers or a combination of the two may be used at each location nominated, the choice being dependent on topography, vegetation and land owner preference.

5.7.6 Noise During Construction

Construction will be carried out in several phases, namely earthworks, forming the road base and laying of the road surface. Of these, the highest noise levels will be generated during earthworks.

Equipment to be used during this phase would typically consist of one bulldozer, equivalent to a Caterpillar D10, one scraper and one front-end loader loading haul trucks. In these cases, maximum noise levels would be due to road construction equipment, assumed to consist of a grader and a vibratory roller.

Table 5.12 shows the accepted sound power levels for this equipment (see Appendix D, Table 2) and Table 5.13 shows calculated maximum noise levels at each of the residences identified above. Calculations included the effect of geometrical spreading and the ground effect.

Rock breakers will be used only intermittently and not generally in conjunction with other equipment. Hence, noise from this source has not been included when calculating total noise levels.

Table 5.12 ASSUMED SOUND POWER LEVELS OF CONSTRUCTION EQUIPMENT

EQUIPMENT	SOUND POWER LEVEL, dB(A)
Bulldozer (D10)	118
Scraper	110
Front-End Loader	115
Haul Truck (idling)	108
Grader	110
Vibratory Roller	114
Rock Breaker	122

Table 5.13 CALCULATED MAXIMUM NOISE LEVELS DUE TO CONSTRUCTION EQUIPMENT

RESIDENCE	MAXIMUM NOISE LEVEL, dB(A)	CRITERION, dB(A)
1	69	51
2	67	51
3	60	51
4	74	51
5	80	51
6	72	51
7	78	51
8	68	51
9	76	51
10	65	51
11	68	51
12	71	51
13	76	51
14	65	47

From Table 5.13, calculated levels of construction noise are considerably in excess of the recommended criteria at all residences - up to 30 dB in the case of residence 5. To reduce the noise impact it is recommended that residential class mufflers be used on all construction equipment. This would reduce noise levels by approximately 3 - 4 dB, but these would still be well above criterion levels.

Some blasting may also be necessary when excavating through hard granite. The route has been selected to minimise excavation in this material, particularly near residences or other sensitive structures. Blasting is likely to be required near Conroys Gap with a minor requirement at other isolated locations.

There are few options available to further control of noise from this form of construction. The use of moveable barriers would not appear to be justified for work of such relatively short duration, and in some cases would be of limited use due to the nature of the local topography. Residents will be informed in advance that construction is to take place and is likely to generate relatively high noise levels. Construction will be completed in as short a time frame as possible, with residents being kept informed of progress at regular intervals.

In addition to earthmoving machinery, a mobile batching plant and possibly aggregate processing plant will be located within the road reserve at various locations along the route. To minimise any noise effects on residences from operation of these facilities, they will not be located within 150 metres of any residences.

5.7.7 Summary of Noise Control Measures

The following measures will be implemented to control noise from the construction and operation of the proposed by-pass.

- Barriers or mounds will be installed at the locations shown in Figure 5.13. The mound near residence 6 should be four metres high, and the fence near residence 8 should be two metres high. Mounds or fences near other residences should be sufficiently high to break the line of sight from the residence to a point two metres above the roadway.

- During construction, all mobile plant and equipment will be fitted with residential class mufflers and will comply with standard Environmental Protection Authority noise guidelines for road construction equipment.

- Residents will be informed in advance that construction is to take place and is likely to generate relatively high noise levels, and construction will be completed in as short a time frame as possible, with residents being kept informed of progress at regular intervals.

5.8 CLIMATE AND AIR QUALITY

5.8.1 Existing Conditions

Climatic information was obtained from the nearest meteorological station, located at Yass. Average seasonal temperatures in the Bookham area range from a minimum of 1 ^{o}C to a maximum of 16.2 ^{o}C in winter and from a minimum of 11.1 ^{o}C to a maximum of 29.3 ^{o}C in summer. Winter temperatures commonly fall below zero degrees Centigrade resulting in frost conditions on an average of 72 days per year, mainly between April and October.

The area receives an annual median rainfall of 646 millimetres per year which is generally highest in the winter months. Fog is experienced on an average of 34 days per year, and is more common in the winter months.

During summer, winds are predominantly from the south-east in the morning with a shift towards the south-west in the afternoon. In winter, winds are predominantly from the north-west with speeds ranging from 6 to 10 kilometres per hour, which is relatively light.

The existing highway passes through an essentially rural area and the highway itself is the main influence on air quality. Although the highway area is generally well ventilated and emissions from vehicles would disperse freely under most conditions, there would be some changes to air quality at locations in close proximity to the road.

5.8.2 Potential Impacts

The upgraded highway will closely follow the alignment of the existing road along its entire length. Operation of the upgraded road will therefore not introduce vehicle emissions into areas not currently subject to emissions. Bypassing the Bookham will increase the distance between most residences and the highway alignment.

i. Vehicle Emissions

Primary constituents of motor vehicle emissions are hydrocarbons, carbon monoxide and nitrogen oxides, with particulate matter including lead also emitted. The emission rates and concentration of pollutants adjacent to the road depend on traffic volume and speed, meteorological factors and distance to residences or other sensitive receptors.

Emission rates of carbon monoxide, oxides of nitrogen and hydrocarbons vary with speed and individual vehicle emission controls. Both carbon monoxide and hydrocarbon emissions generally decrease as speed increases while those of oxides of nitrogen gradually increase.

Levels of hydrocarbons and carbon monoxide in the vicinity of the highway will therefore be reduced as a consequence of increased travel speeds, although overall emission rates will gradually rise towards existing levels as traffic increases over the years.

Established road reserve boundaries and careful route selection have minimised the numbers of residences in close proximity to the highway. Most residences will be further from the proposed highway than the existing highway. Preliminary design indicates that no residence will be closer than 50 metres from the traffic source. Most residences near the road are located in Bookham and are expected to experience reduced emission levels as a consequence of the bypass.

The Environment Protection Authority has adopted criteria for the levels of air pollutants at residences in the vicinity of roads. These are generally applied to urban areas with high traffic volumes and large numbers of residences and other development in close proximity to the road.

Having regard to the volume of traffic involved and the exhaust emission controls which are imposed on modern motor vehicles, the concentration level of pollutants such as carbon monoxide (CO) and lead, would be much lower than the generally accepted air quality criteria for health (ie, 35 parts per million, one hour maximum exposure for CO, and 1.5 micrograms/cubic metre, 90 day average, for lead). A study undertaken for the proposed F2 Freeway in Sydney, with predicted traffic volumes in excess of 50,000 vehicles per day, has predicted concentration levels of less than three parts per million for CO and 0.01 micrograms/cubic metre for lead (Hyde in Mitchell McCotter, 1989). This was for conditions of very low wind speed (0.5 metres per second or approximately two kilometres per hour). A more recent assessment for the M5 Motorway in Sydney with peak traffic flows exceeding 8000 vehicles over the two-hour am peak period predicted that nitrogen dioxide particulate levels would be below EPA criteria at residences immediately adjacent to the road reserve.

Having regard to the much lower traffic experienced in the vicinity of Bookham (less than 16 000 vehicles per day by the year 2020), it is concluded that levels of all emissions will be well below EPA criteria at all residences along the route. Improvements in vehicle engine efficiency and emission characteristics and greater use of lead-free fuel over time will continue to reduce emissions and pollutant levels experiences near alignments.

ii. Dust

Dust levels will be controlled throughout the construction period by minimising cleared areas, rehabilitating disturbed areas as soon as practicable and the use of water carts to suppress dust generation when necessary.

5.9 HYDROLOGY AND FLOODING

The proposed road alignment follows the existing Hume Highway which is located in the Stony, Bogolong and Connors creek catchments. Hydrology and flooding are characterised by catchment features and the performance of main drainage lines. Hydrological characteristics of the major catchments, existing flooding and impacts of the proposed road are discussed below.

5.9.1 Catchment Description

i. Stony Creek

Stony Creek headwaters originate near Bald Hill. The creek initially flows in a north westerly direction towards the Hume Highway, where it passes under a three-span concrete bridge. Downstream of the bridge it is joined by Conroys Creek and then flows in a westerly direction to its confluence with Bogolong Creek.

Total catchment area of Stony Creek to its confluence with Bogolong Creek is approximately 37 square kilometres. The majority of the catchment is cleared agricultural land, with isolated areas of scattered timber on steeper slopes and along drainage lines.

ii. Bogolong Creek

Bogolong Creek headwaters originate on the northern slopes of Carrolls Ridge in the southern part of the catchment. It flows in a northerly direction and is joined by Bookham Creek, which drains a small western portion of the catchment, and an unnamed creek draining an eastern portion. The creek passes under the Hume Highway via a five-span concrete bridge.

Bogolong Creek is joined by Stony Creek approximately 800 metres downstream of the highway crossing and Middleton Creek a further 900 metres downstream. It then flows in a north westerly direction past Bookham, and joins Connors Creek downstream of Binalong Road.

Total catchment area of Bogolong Creek to its confluence with Connors Creek is approximately 70 square kilometres, including the Stony Creek catchment. The catchment is largely cleared agricultural land with scattered timber on steeper slopes.

iii. Connors Creek

Connors Creek headwaters rise near Burrinjuck State Forest. The creek flows in a northerly direction through Talmo to the Hume Highway. It is joined by Cart Road Creek approximately 1.5 kilometres upstream of the highway. Cart Road Creek, along with Black

Range Creek, drain an eastern portion of the catchment. Connors Creek is joined by Bogolong creek approximately two kilometres downstream of the highway.

Connors Creek has a catchment of 86 square kilometres at its confluence with Bogolong Creek. The majority of the catchment is pasture with isolated scattered timber on steeper slopes.

iv. Middleton Creek

Middleton Creek drains a 4.6 square kilometre catchment south of Bookham and passes under the highway via a twin cell box culvert. The catchment is generally cleared grazing land with some stands of medium to heavy timber on steeper slopes and along drainage lines.

Middleton Creek joins Bogolong Creek downstream of the Hume Highway.

v. Minor Drainage

There are numerous minor drainage lines intercepted by the current highway alignment. The largest of these in the vicinity of Bookham is an unnamed drainage line which drains an area of 42 hectares south of Bookham and passes under the highway via a large box culvert near Binalong Road. Other minor watercourses are generally conveyed under the road via small pipe culverts.

5.9.2 Design Flows

Design flood flows were estimated using a rainfall-runoff model called RAFTS-XP. This model is recognised in the 1987 edition of Australian Rainfall and Runoff (Institution of Engineers Australia, 1987) and is able to analyse a wide range of catchment conditions. The model was used to obtain flows at various points in catchment.

Model calibration to observed floods was not possible as no previous flood data is available. Therefore model parameters were adjusted within reasonable limits to match discharges obtained using the probabilistic rational formula as outlined in Australian Rainfall and Runoff.

Design flows for the 100 year average recurrence interval (ARI) storm under existing conditions are presented in Table 5.14

Table 5.14 ONCE IN 100 YEAR FLOOD DESIGN FLOWS

Creek Name and Location	Catchment Area km^2	Design Flow m^3/s
Conroys Creek - Stony Creek Junction	10.5	15.6
Stony Creek - Hume Highway	15.2	24.4
Stony Creek - Bogolong Creek Junction	37.4	50.2
Bogolong Creek - Hume Highway	34.6	49.5
Bogolong Creek - Bookham	76.6	97.3
Bogolong Creek - Binalong Road	79.6	106.8
Middleton Creek - Hume Highway	4.6	8.4
Connors Creek - Hume Highway	79.4	73.0

The proposed road alignment crosses Stony Creek approximately one kilometre north of Burrinjuck Road, Bogolong Creek at the existing Hume Highway bridge and Connors Creek approximately 2.5 kilometres west of Bookham, adjacent to the existing bridge. The once in 100 year design discharge and estimated velocity in the natural creek channel at each proposed bridge crossing are shown in Table 5.15

Table 5.15 ESTIMATED ONCE IN 100 YEAR FLOOD VELOCITIES

Bridge	Design Flow m^3/s	Design Velocity m/s
Stony Creek	24.4	1.5
Bogolong Creek	49.5	1.5
Connors Creek	73.0	2.5

5.9.3 Existing Flooding

Two areas of local flooding were highlighted through community consultation. These are:

- an overland flow path between the existing Hume Highway and tennis courts at Bookham; and

- a section of Conroys Creek adjacent to the Hume Highway - approximately 500 metres upstream of Stony Creek confluence.

The first area receives runoff from the hill south of Bookham. Flow passes under the highway and flows along a wide drainage depression towards Bogolong Creek. Estimated once in 100 year flow is one cubic metre per second. This corresponds to an approximate flow depth of 0.25 metres and velocity of 0.6 metres per second.

Conroys Creek upstream of Stony Creek comes to within 150 metres of the Hume Highway. The area is flat and floodwaters tend to spread out. Estimated once in 100 year flow at this point is approximately 15 cubic metres per second. This corresponds to an approximate flow width of 30 to 40 metres.

5.9.4 Flooding Impacts

Flooding impacts result from restrictions created by structures, alterations to channels or floodways and increased runoff due to an increase in paved or impervious areas.

Bridges across Stony, Bogolong and Connors creeks will be designed to accommodate a once in 100 year flood. Approval for construction will be sought from the Department of Water Resources. Drainage culverts will be provided at locations where the proposed road intercepts watercourses, depressions or natural drainage lines.

Sections of the proposed road alignment will be constructed on embankments. An assessment was made on the impact of embankments in areas where they were likely to affect flooding.

A hydraulic model was used to assess impacts on Bogolong Creek downstream of the existing bridge. Impacts were assessed by modifying relevant sections to reflect a road embankment. Results showed increases of less than 0.05 metres immediately downstream of the bridge for a once in 100 year flood. Flooding patterns further downstream are unaltered as flood flows are mostly contained within deep creek sections or overbank areas not affected by proposed embankments.

The drainage line between the tennis courts and existing highway is slightly affected by embankment construction. Assessment of once in 100 flooding showed an increase of less than 0.1 metres could be expected. The batter toe will be protected to prevent erosion of the embankment.

A quantitative assessment of impacts on Conroys Creek was not made. However impacts are expected to be minimal, given the magnitude of once in 100 year flood flow, and the extent of floodplain to redistribute floodwaters.

Increased runoff from the proposed road would be a small proportion of existing flows. Runoff from the road will be directed to appropriate discharge points and natural drainage channels and would not result in localised flooding.

5.10 WATER QUALITY

5.10.1 Existing Water Quality

As outlined in Section 5.9, the route crosses a number of creeks, notably Stony, Bogolong, Connors and Middleton Creeks, and a number of smaller watercourses. These creeks predominantly drain closed agricultural areas used mainly for grazing. Existing influences on water quality would be sediment mobilised through soil erosion and accompanying nutrients from grazing land. Significant erosion is evident at various locations along the route, particularly adjacent to streams and creeks.

5.10.2 Potential Impacts

Construction of major roadworks has the potential to result in erosion of exposed areas and sedimentation of creeks and streams further downstream. Excessive sediment leads can introduce high levels of nutrients to streams, deteriorate aquatic habitats and affect hydraulic capacity and the occurrence of flooding. General litter and debris and runoff from road surface (which can contain hydrocarbons and rubber compounds) can also affect water quality.

The Roads and Traffic Authority takes active steps in the design, construction and maintenance of highways to minimise affects on water quality. Comprehensive guidelines have been prepared for the control of erosion and sedimentation. (Roads and Traffic Authority, 1993a). Their guidelines will be adopted for the proposed upgrading of the Hume Highway. Details of sediment control measures will be determined in conjunction with finalisation of the road design. General principles which will be followed are outlined below.

5.10.3 Erosion Control Measures

Soil erosion and sedimentation control measures would be applied during all construction activities including clearing; drainage works; removal, storage and replacement of topsoil; earthworks; and revegetation. Soil conservation has in previous upgrades of the Hume Highway (including the Yass, Goulburn and Mittagong bypasses) been given a high priority by the Roads and Traffic Authority and has included close consultation with the Department of Conservation and Land Management.

The techniques and criteria which would be applied during construction operations will include:

- **Clearing:** Vegetation is the most effective method of minimising erosion and sedimentation. Therefore initial clearing would be limited to areas required for the construction of drainage works, culverts and sedimentation control structures. This would only include the areas actively being used for construction of the carriageway and additional areas required for the storage of materials and site machinery. Cleared vegetation will be chipped and used for mulch throughout the project.

- **Buffer Zones:** Adequate buffer zones between the area of disturbance and the natural drainage lines would be included as part of the detailed design where possible. These buffer zones would place a high priority on the protection of natural drainage lines from impacts resulting from construction activities;

- **Revegetation:** Temporary revegetation of disturbed areas (short-term stabilisation) during the construction phase is critical for soil erosion control. Progressive permanent revegetation will be necessary to stabilise completed works and minimise potential impacts. Revegetation will need to be implemented to coincide with the final stages of construction (fill batters would require permanent revegetation in stages as each batter is constructed);

- **Drainage and Flooding:** Drainage from undisturbed areas will be diverted away from disturbed areas wherever possible. This would be achieved by installing catch drains with suitable channels and cross-drainage culverts in the natural water courses, with inlet and outlet scour protection and energy dissipaters where required. Increases in the total volume of runoff water and peak discharge rates resulting from road construction in the major drainage lines will necessitate permanent sediment control ponds. These will incorporate controls for flood mitigation and the control of accidental pollution;

- **Erosion Controls:** Design and construction of temporary erosion and sediment control structures such as diversion banks, drains, sediment traps and sediment fences would be integrated into the stable drainage system.

- **Stockpiles:** Stripping and storage of topsoil, including light vegetation and surface mulch from areas in which both the topsoil and the environment can be protected from erosion and sediment damage. This material would then be respread during revegetation of the disturbed areas;

- **Maintenance**: Regular maintenance and evaluation of all erosion, sediment and pollution control devices will be carried out to ensure effective operation is maintained.

Sedimentation controls would be designed to contain runoff from a once in five year, three hour duration storm. All completed sections of the route would drain to ponds fitted with outflow baffles, to prevent the discharge of oil and grease products. Although sediment control measures will be designed in conjunction with the road design, it is anticipated that sediment basins will have volumes of approximately 350-400 cubic metre for each hectare of disturbed land. Figure 5.5 shows approximate location of basins. Wherever possible basins will be located within the road reserve. Exact locations will be determined in consultation with landowners. In some locations it may be feasible for sediment basins to serve as farm dams once construction is complete.

As detailed in Section 5.9, the upgrading works will not result in any significant change to runoff rates or flooding. With the implementation of the mitigation measure outlined above, soil erosion should be effectively controlled and water quality maintained both in the short and long term.

Sediment basins along the route would serve as temporary control measures in the event of spillage from a tanker using the road. The basins would hold the spillage until cleanup could occur, minimising an impact on local water courses.

5.11 HAZARD AND RISK

5.11.1 Sources of Hazard and Risk

The transportation of dangerous goods on highways has the potential to lead to hazardous incidents. Such incidents are generally linked to accidents involving heavy vehicles and usually to collisions between two or more heavy vehicles, often at night or in adverse weather conditions. Risks associated with hazardous incidents include release or spillage of dangerous goods and fire which have potential consequences for the public, property and the surrounding environment. Of concern is the potential for spills to enter watercourses and affect water quality, particularly within water catchment areas.

The risk of a major incident occurring is dependent on the:

- percentage and frequency of vehicles transporting dangerous goods;
- accident rate on the road concerned;
- proximity of residences or other sensitive developments or land uses; and
- extent of awareness and preparedness for handling incidents.

Upgrading the Hume Highway in the vicinity of Bookham including bypassing the village will improve road safety and produce greater separation to residences. Overall traffic levels are projected gradually to increase from current levels. High growth projections indicate a potential increase in traffic levels (AADT) from 8440 (1993) to 15982 (2023).

Upgrading the highway is not expected to directly affect the percentage of heavy vehicles or vehicles carrying dangerous goods. Traffic projections indicate that the proportion of heavy vehicles will remain relatively constant in the future.

Major incidents involving dangerous goods are rare. Most hazardous goods incidents to do not result in the release of hazardous materials or injury. Table 5.16 provides a breakdown of dangerous goods transport in New South Wales. Comparison of the table with traffic figures for the section of highway concerned indicates that less than 0.4% of vehicles using the highway would carry dangerous goods.

Table 5.16 DANGEROUS GOODS VEHICLE TYPE AS A PERCENTAGE OF ALL HEAVY VEHICLES IN NSW

Vehicle Type	% of Total Heavy Vehicles
Petrol	0.75
LPG	0.1
Chlorine	0.1
Poisons	0.1
Other Dangerous Goods	0.1

Source: Workcover Authority in RTA 1993(b)

5.11.2 Emergency Procedures

The Environment Protection Authority details procedures for a co-ordinated response to hazardous incidents. The Chemical Incidents Procedures Manual, 1989 identifies the role of various authorities, in conjunction with industry and the community (the manual would be affected by the State Emergency and Rescue Management Bill 1990). According to the manual, the following applies:

- The Fire Brigade is responsible as on site co-ordinator where a fire or any risk of fire exists, or where incidents involving chemicals have occurred. The Brigade's main functions include containing any fire, containing and treating any chemical spill and cleaning up the incident.

- The Police Force is responsible for control of traffic and crowds, and the supervision of evacuation if necessary. In the absence of the Fire Brigade the Police assume control. Police would contact the owners of dangerous goods, vehicles and premises involved in an incident.

- Casualties involve the Ambulance Service. Responsibilities include first aid, transport of casualties to hospitals, protecting people from further injury and assistance in evacuations.

- The Roads and Traffic Authority and local councils are often involved in the containment and clean up of spills and restoration of the road.

Transporters of dangerous goods are required to comply with the Australian code for the transport of dangerous goods by road and rail (1987). The code requires that hazardous goods be labelled to indicate the degrees of hazard involved.

The Standards Association of Australia publishes an Emergency Procedures Guide-Transport (AS 1678). This provides for transport incidents, including spills, leakages, fire and personal contact. Further advice is provided by the Environment Protection Authority, Fire Brigade Control and Datachem. (Datachem is a computerised information data bank on hazardous chemicals set up by the Australian Chemical Industries Council).

5.11.3 Impact of Proposal

As stated in Section 2.1.3, provision of a four lane divided road is estimated to result in a 27% reduction in accident rates. However, the actual reduction in the more severe accidents would be greater than this because of separation of opposing traffic flow by the wide median. The reduction in the risk of accident with potentially hazardous consequences is expected to be in excess of 30%.

In addition to the reduction in accident rates, provision of the Bookham bypass will greatly increase the distance between most village residences and the road alignment. Over the entire project length, the number of houses within approximately 200 metres of the alignment will decrease from eight to four. Currently there are three residences within 50 metres of the highway. On completion of the project the closest residence will be at least 50 metres from the nearest carriageway.

Although the route of the highway crosses a number of creeks, none of these crossings are within water supply catchments. No major streams are crossed. The potential for any spills to cause widespread environmental damage or contaminate water supplies is therefore limited. Upgrading the highway will not result in any additional creek crossings and provisions of twin bridges or culverts at each crossing in conjunction with other upgrading works will serve to reduce the probability of accidents at these locations. A major collision including heavy vehicles occurred in February 1993 near the Bogolong Creek bridge. This structure will be replaced by new twin bridges if the upgrading proceeds.

It is concluded that the proposed upgrading works would result in a significant decrease in the risk of an incident involving hazardous goods as consequences of improved road safety and alignment. Although small, the probability of a hazardous incident is directly linked to traffic levels and would therefore continue to increase over the years in proportion to traffic increases.

5.12 CURRENT ECOLOGICAL ISSUES

In recent years a number of serious environmental issues have prompted governments to become involved in environmental management, on both national and international levels. In February 1992, the Australian Inter-Governmental Agreement on the Environment was released with the aim of unifying the policies of government departments, providing a united and sustained effort to minimise further environmental degradation. The Roads and Traffic Authority is now working to ensure that its environmental goals and policies are consistent with those outlined in the inter-governmental agreement.

Two main areas of this agreement applicable to the Bookham bypass project are:

- greenhouse effect; and
- ecologically sustainable development, including energy conservation.

i. The Greenhouse Effect

The greenhouse effect is the name given to the process whereby gases, including water vapour, carbon dioxide, and other pollutants released into the atmosphere, trap heat and radiation. It is thought the effect of these gases will be to increase temperatures on the earth's surface in much the same way as the sun warms the air inside a greenhouse. The greenhouse effect is a key issue for the Roads and Traffic Authority as 26 per cent of Australia's total carbon dioxide (CO_2) emissions come from the transport sector. Of this, cars produce 58 per cent and trucks and buses 19 per cent. Therefore, the Roads and Traffic Authority is committed to decreasing the amount of greenhouse gases emitted. Part of this commitment includes the development and maintenance of an efficient road system.

The Bookham bypass is part of the overall upgrading of the Hume Highway, between Sydney and Melbourne. This development is expected to decrease the amount of greenhouse gases produced along the route. Firstly, overall travel times will be reduced, next, a better road surface will encourage more efficient fuel consumption and a corresponding decrease in carbon dioxide emissions, and finally bypasses of smaller towns, such as Bookham, will allow the traffic to maintain a constant speed and eliminate slowing in residential areas or interference from local traffic or pedestrians.

It may be argued that provision of an improved road link could encourage greater use of road transport, hence negating some of the benefits referred to above. The national objective of establishing a four-lane divided carriageway between Sydney and Melbourne may promote increased commerce, interaction and hence movement of freight and passengers between these centres. Australia's ability to respond to the greenhouse effect depends upon developing a more efficient economy, which improved transport links will help to achieve. Hume Highway upgrading is only one of the communication links being improved throughout Australia, including road, rail, sea and air components.

ii. Ecologically Sustainable Development

Ecologically sustainable development is an important way of preserving the earth's non-renewable resources, including energy-producing resources. The Bookham bypass project adheres to this policy by maintaining the use of the existing Hume Highway as one of the dual carriageways, for most of the route. Resurfacing the existing road and constructing one new carriageway uses less materials and less energy in construction than building two new carriageways on a different alignment.

Upgrading the Hume Highway should minimise transport times and fuel use between Sydney and Melbourne, giving substantial energy savings to the community. Furthermore, a safer and more efficient road system may encourage better patronage of mass transport systems, such as buses, which would contribute further to energy savings and help decrease pollution levels.

5.13 CUMULATIVE IMPACT

Enquiries with Council and other government bodies have not revealed any planned developments along this stretch of the Hume Highway or in nearby areas such as Lake Burrinjuck which are accessed via the highway. There will therefore be no direct cumulative impact with other proposed activities.

Upgrading this section of the highway and construction of the Bookham bypass is part of the overall upgrading of National Highway No. 1. The cumulative effect of this major initiative will be significant improvements in road safety and decreased travel times between Sydney, Canberra and Melbourne with associated economic benefits.

Yass Council has advised that slight population growth is expected in the Bookham area. With decreased travel times to Canberra, some Canberra residents may consider moving to Bookham and commuting to work. However, the lack of services and infrastructure around the village is likely to limit any population growth to low numbers.

6

CONCLUSIONS

Chapter 6

CONCLUSIONS

If upgrading this section of Hume Highway between 19 and 38 kilometres south of Yass, including constructing a bypass of Bookham proceeds, there will be both benefits and potential environmental effects.

Benefits predicted to arise from the project include improved travel times and speeds, some reductions in energy consumption, improvements in road safety and significant improvements to the amenity of Bookham and a number of residences along the route. Many of these benefits will be experienced immediately on the completion of works, however the magnitude of all potential benefits will increase over time in line with projected traffic levels and establishment of landscaping. This project will comprise an important missing link in the dual carriageway highway which would then extend from Sydney to Coolac.

Environmental investigations have not revealed the presence of any areas of particular biophysical significance or sensitivity along the proposed route, however some elements of the socio-economic environment, including the Bookham store and sporting facilities are sensitive to the potential impacts of a bypass. Potential environmental effects are in many ways typical of those resulting from upgrading other similar sections of the Hume Highway. During the construction period noise levels may exceed Enviornment Protection Authority guidelines at some residences for short periods. There are no practicable means of avoiding this. A range of environmental safeguards have been incorporated into the project including the adoption of a visual strategy and landscape planting; judicious route selection; erosion protection and sediment control; acoustic mounds and barriers; and the provision of suitable access points, stock crossings and a rest area. The implementation and adoption of these measures into the design construction and maintenance of the project will reduce potential impacts to an extent which is reasonable by contemporary standards.

Resulting impacts are predicted to be as outlined in this document.

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REFERENCES

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APPENDICES

A

REQUIREMENTS OF DIRECTOR OF PLANNING

Department of Planning

[redacted]

Mr J Brockhoff
Environmental Planner
Roads and Traffic Authority
PO Box 28
GPO SYDNEY NSW 2001

[redacted] 2085

S Findlay

Dear Mr Brockhoff,

BOOKHAM BYPASS AND HIGHWAY DUPLICATION
HUME HIGHWAY, SHIRE OF YASS

Thank you for your letter of 14 April, 1993 indicating that you are consulting with the Director with regard to the preparation of an environmental impact statement (EIS) for the above development.

2. An EIS is required to be prepared where the proposal is an activity referred to in Section 112(1) of the Environmental Planning and Assessment Act, 1979. The EIS shall bear a certificate required by clause 59 of the Regulation (see Attachment No 1).

3. In addition, pursuant to clause 58 of the Regulation, the Director requires that the following matters be specifically addressed in the EIS:

. full description of the proposal to indicate sections of duplications and of dual carriageway, new road widths, carriageway arrangements, bridges and crossings and new routes chosen, to be indicated with maps, diagrams and photomontages;

. justification for the new route;

. construction impacts to include construction process, any staging of works, timing, depots, construction vehicle routes, traffic arrangements during construction, noise and dust;

. details of cut and fill required;

. identification of proposed property acquisition if any, and a description of the acquisition process;

. measures to preserve water quality of Stony Creek, Bogolong Creek, Connors Creek and any adjoining ephemeral waterways, to include sediment and run-off controls both during construction and normal operation;

. impacts on flora and fauna;

. impact of the proposal on Bookham, to include,

- local traffic management,
- measures to increase safety of both traffic and pedestrians,
- community severance,
- noise impacts,
- impact on public recreation areas in terms of access and parking,
- impact on residential and commercial areas,

. visual impacts;

. consultation with:

- National Parks and Wildlife Service,
- Department of Conservation and Land Management (Soil Conservation Service),
- Yass Shire Council.

4. Attachment No 2 is a guide to the type of information most likely to be relevant to the development you propose; not all of the matters raised therein may be appropriate for consideration in the EIS for your proposal; equally, the guide is not exhaustive.

5. When an adequate EIS has been prepared for the subject proposal, as determining authority, you should then proceed with the matter in accordance with Sections 112 and 113 of the Act, and place the document on public exhibition. The procedures for public display that are to be followed by the proponent and/or determining authority are as in clauses 60 to 64 of the Environmental Planning and Assessment Regulation, 1980.

6. When the EIS is completed, four (4) copies should be forwarded to the Secretary, Attention: Manager, Assessment Branch pursuant to Section 112(2) of the Act, as well as details of the exhibition period and public display locations.

7. The determining authority should also note that section 113 of the Environmental Planning and Assessments Act, 1979, and clause 61 of the associated Regulation, requires that the EIS be made available for inspection at the same time in the offices of the determining authority and the Department as well as any other agencies nominated by them. To ensure that simultaneous exhibition occurs, the Roads and Traffic Authority should forward the necessary documents to the Department prior to the commencement of the public display period. This will enable concurrent exhibition in the Department's head office and the relevant regional office where appropriate.

8. Should any submissions be made during the period of public exhibition, it is advised that such submissions should be forwarded to the Secretary in accordance with Section 113(3) of the Act.

9. If the determining authority has not received a reply within 21 days of sending submissions to the Secretary, it should proceed to determine the matter. The Department will only contact the determining authority after the receipt of submissions if an issue of major significance is involved.

10. If there is no objection to the proposed development as a result of the exhibition, the determining authority may determine the matter at any time after the last day upon which submissions are accepted.

11. It would be appreciated if a copy of the determination could be forwarded to the Department for our information.

12. Should you require any further information regarding this matter please do not hesitate to contact us again.

Yours faithfully

B. Adams 24/5/93

B. Adams
Manager
Assessments and Major Hazards Branch
As Delegate for the Director

STATUTORY REQUIREMENTS FOR ENVIRONMENTAL IMPACT STATEMENTS.

In accordance with Part V of the Environmental Planning and Assessment Act, 1979, the form and content of an environmental impact statement (EIS) must meet the following requirements pursuant to clause 57 of the Environmental Planning and Assessment Regulation, 1980, as amended:

(1) An environmental impact statement referred to in section 112 (1) of the Act shall be prepared in written form and shall be signed by the person who has prepared it.

(2) The contents on an environmental impact statement referred to in subclause (1) shall include the following matters:-

(a) a full description of the proposed activity;

(b) statement of the objectives of the proposed activity;

(c) a full description of the existing environment likely to be affected by the proposed activity, if carried out;

(d) identification and analysis of the likely environmental interactions between the proposed activity and the environment;

(e) analysis of the likely environmental impacts or consequences of carrying out the proposed activity (including implications for use and conservation of energy);

(f) justification of the proposed activity in terms of environmental, economic and social considerations;

(g) measures to be taken in conjunction with the proposed activity to protect the environment and an assessment of the likely effectiveness of those measures;

(g1) details of energy requirements of the proposed development and measures to be taken to conserve energy;

(h) any feasible alternatives to the carrying out of the proposed activity and the reasons for choosing the latter;

(i) consequences of not carrying out the proposed activity.

The EIS must also take into account any matters required by the Director of Planning pursuant to clause 58 of the Regulation, which may be included in the attached letter.

The EIS must bear a certificate as required by clause 59 of the Regulation.

DEPARTMENT OF PLANNING
ATTACHMENT NO 2

ADVICE ON THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR A MAJOR ROAD DEVELOPMENT IN A RURAL/SUBURBAN ENVIRONMENT

Pursuant to S112 of the Environmental Planning and Assessment Act, 1979, where a proposal is a prescribed activity or where a proposal is likely to significantly affect the environment, a determining authority must, before deciding whether to proceed with the proposal, consider an EIS prepared in respect of the proposal.

It is the responsibility of the determining authority to decide whether an EIS is required (unless the proposal is a prescribed activity). While the site characteristics largely determine the need for an EIS to be prepared, in general major road developments in rural/suburban environments have the potential to create problems for local residents and landholders due to land resumption, loss of access, severence effects on agricultural activities, sterilisation of minerals, noise generation, erosion and siltation; and impacts on flora and fauna, visual amenity, local and regional traffic flows, and local commercial interests.

The purpose of this paper is to outline various issues relevant to the preparation and consideration of an EIS for such major road developments. It is intended to assist the preparation of the EIS. It is the applicant's responsibility to identify and address, as fully as possible, the matters relevant to the specific development proposal in complying with the statutory requirements for EIS preparation (see Attachment No 1).

The matters nominated in this paper are not intended as a comprehensive identification of all issues which may arise in respect of such a major road development. Some of the issues nominated may not be relevant to a specific proposal. On the other hand, there may be other issues, not included, that are appropriate for consideration in the EIS.

Information provided should be clear, succinct and objective and, where appropriate, be supported by maps, plans, diagrams or other descriptive detail. The purpose of the EIS is to enable members of the public, the determining authority and the Department of Planning to properly understand the environmental consequences of the proposed development.

1. Description of the proposal.

The description of the proposal should provide general background information on the location of the proposed road works, particularly in relation to, and compatibility with, the arterial and local road network and any traffic management schemes in force or proposed and including the criteria used for route selection. It should provide an indication of adjacent developments, and land use activities, as well as details of the site, land tenure, zonings and relevant forward planning proposals, and any other land use constraints including natural environmental features sensitive to the impact of the proposal.

It may also be appropriate for the EIS to describe statutory procedures for implementing the proposal.

This section should provide specific information on the nature, intent and form of the development. Particular details that may generally be relevant include:

- The form and physical dimensions of the proposed roadworks, including locations and dimensions of bridge structures and associated facilities.
- Earthworks involved including details of cut and fill and balancing of volumes proposed.
- Presence of median strips, barriers to pedestrians, and grade separation proposals at intersecting roads.
- Provision of facilities for faunal corridors.
- Flood prevention measures.
- Alterations to access to adjoining properties.
- Resumptions required of existing development to accommodate the proposed road.
- Construction problems envisaged including staging of works, source and transport and assembly of plant and materials, employment details, construction camps, access arrangements, alternative routes and traffic management proposals for local and through traffic, and hours of operation for demolition/construction works etc.
- rehabilitation proposals on completion.

2. Description of the Environment.

This section should provide details of the environment in the vicinity of the development area and also of aspects of the environment likely to be affected by any facet of the proposal. In this regard, physical, natural, social and economic aspects of the environment should be described to the extent necessary for assessment of the environmental impact of the proposed development. In particular:

- Geography, topography, geology and geotechnical data, meteorology, hydrology etc.
- Noise and air quality where appropriate for impact consideration.
- Aesthetics.
- Flora and fauna with particular regard for sensitive environments such as wetlands.
- Agricultural and mining activities that may be affected by the proposed works.
- Utilities and communications.
- Buildings or items having architectural/heritage significance.
- Existing traffic levels and traffic flow patterns.
- Socio economic aspects including local commercial activities.

3. Assessment of Alternative Routes.

The EIS should include a proper assessment of the alternative routes considered in the feasibility study for the proposal including the key physical and engineering constraints as well as the environmental and economic factors pertinent to same including clear reasons for rejecting such alternatives in favour of the recommended proposal.

4. Analysis of Environmental impacts.

Environmental impacts usually associated with a major road development in a rural/suburban environment and related activities are listed below. Where relevant to the specific proposal, these should be addressed in the EIS, taking into account the adequacy of safeguards proposed to minimise them both during construction and when in use after completion:

- Likely noise disturbance caused by the construction of the road, and by traffic operating on the completed roadway, on any nearby residential and commercial buildings. A map depicting anticipated noise contour levels in relation to residences and inhabitants involved may be necessary. Consideration should be given to both existing and proposed residential developments for such an analysis.
- Emission of air pollutants from vehicular traffic affected by the proposal, and their impact on the local and regional environment.
- Stormwater runoff and erosion and siltation potential.
- Impact on natural vegetation and faunal movement, flood plains, drainage patterns, (particularly sedimentation from construction activity).
- Mineral sterilization and subsidence potential.
- Visual impact, particularly on residential developments by both day and night taking into account the following effects of the proposed road:
  - Scale in relation to the natural landscape and adjacent residential and commercial development.
  - Appearance from nearby and afar.
  - Lighting effects on existing and proposed residential/ commercial buildings.
- Changes in traffic patterns.
- Impacts of traffic at entry/exist points.
- Impact on historic buildings, heritage items and matters of archaeological interest.
- Effect on commercial and agricultural operations and changes in community characteristics caused by severence.

In addition, any potential for hazard or risks to public safety and any proposal to monitor and reduce environmental impacts should be included.

5. Contact with relevant Government Authorities.

In preparing the EIS, it is suggested that authorities, such as those listed below, should be consulted and their comments taken into account in the EIS.

- The Environment Protection Authority in regard to air, water and noise impacts and relevant pollution control legislation requirements.
- The Traffic Authority with regard to traffic and road development aspects.
- Any servicing authorities which may be required to supply water, power, etc.
- The Department of Conservation and Land Management with regard to erosion control.
- The Department of Agriculture with regard to impact on agricultural activities.
- The Department of Mineral Resources with regard to mineral sterilisation and subsidence.
- The Heritage Council of NSW if the proposal is likely to affect any place or building having heritage significance for the State.
- The National Parks and Wildlife Service with regard to impact on known archaeological sites.
- Local Councils through whose areas the road passes.

It is the responsibility of the person preparing the EIS to determine those Departments relevant to the proposed development.

6. Supporting information.

The EIS should refer by suitable appendices to all relevant studies/investigations that have been carried out in support of the proposals. This supporting documentation should be made available during the period of public display of the EIS.

B

RESPONSES FROM PUBLIC AUTHORITIES

APPENDIX B: RESPONSES FROM PUBLIC AUTHORITIES

During the preparation of this environmental impact statement a number of government bodies and statutory authorities were consulted and invited to comment upon the project. A summary of the responses received is presented in this appendix.

Department of Conservation and Land Management 11/5/1993
(Reply Received)

- any crown land affected should be discussed with the Goulburn Office of CaLM;
- Soil Conservation - the RTA is asked to consult with CaLM when more detailed construction designs are available. It is considered likely that a Soil Conservationist would be permanently stationed on-site as was the case during the Goulburn and Yass Bypass projects; and
- the proposed route crosses some protected lands along Bogolong Creek. The RTA will require permission to remove trees from these lands. Protected lands applications need to consider impacts upon soil, vegetation and endangered fauna; and
- the impact of the proposal with respect to the Endangered Fauna (Interim Protection) Act, 1991 should be considered.

Yass Council 5/7/1993

- Council has no objections to the proposal and considers it may improve the amenity of Bookham;
- access must be maintained to the tennis courts and cricket grounds on the opposite side of the highway; and
- need to provide an alternative access route through Bookham.

National Parks and Wildlife Service 5/7/1993

- archaeological survey of proposed by-pass and carriageway should be undertaken and presented as part of the EIS; and

- route should be located in cleared areas to avoid felling trees in areas of remnant bushland which are considered a limited resource on the Southwest Slopes.

Natural Gas Company 13/7/1993

- does not have any assets in the project area nor any issues it wishes to be addressed in the EIS.

Southern Tablelands County Council 15/7/1993

- from preliminary designs it appears some transmission lines may need to be deviated or reconstructed. This will become evident following further design of the selected route; and

- a capital contribution will be required towards the work, but work involved is considered to be of a routine nature.

Heritage Council of NSW 23/7/1993

- provided a printout listing the four heritage items registered in the Yass local government area; and

- recommend contact with the local council, local aboriginal land council, the National Trust of NSW and the Australian Heritage Commission.

Department of Mineral Resources 11/8/1993

- route does not impinge on any applications or titles administered by the Department;

- does not affect any proposed or identified mineral resources; and

- EIS should describe the sources of road aggregate and other construction materials, including intended quarry locations.

Pacific Power 20/8/1993

- noted two transmissions lines crossed by the proposal. As these had been recently sold to Southern Tablelands Electricity contact with this authority was recommended.

Environment Protection Authority 2/9/1993

- ensure care at both design and construction phases to minimise risk of polluting numerous local watercourses;
- sediment ponding, catch drains and geotextile fabrics may be required to treat "dirty" water prior to release to local waterways. Need to identify both permanent and temporary sediment control structures;
- concrete bridge crossings designed to minimise stream bed and bank erosion;
- use of water carts to control dust emissions;
- EIS to address noise controls during construction and ensure they comply with the EPA's "Environmental Noise Control Guidelines". Also address noise effects on local residents;
- storage areas for road construction materials and associated plants identified in EIS so site selection is based on environmental principles. This includes quarry locations etc.; and
- pollution control approvals will be required at later stages of the project.

Department of Agriculture

- No response received from the Department.

Telecom Australia

- No response received.

C

RESPONSES FROM THE COMMUNITY

Hume Highway Duplication Including Bookham Bypass

19.5 km to 38.5 km south of Yass

Investigations have commenced into the potential environmental effects of duplicating a 19 kilometre section of the Hume Highway south of Yass, including a bypass of Bookham. Mitchell McCotter and Associates is examining options for the Roads and Traffic Authority and will prepare an environmental impact statement (EIS) for public exhibition.

The project would upgrade the existing roadway to complete a missing link in the dual carriageway National Highway between Sydney and Melbourne.

This newsletter is intended to inform residents and other interested parties that the study has commenced. It also seeks comments which will be considered in the environmental assessment.

What is Planned?

For most of the route, the proposal is to construct a new carriageway beside the existing Hume Highway. The present highway would be resurfaced and retained as one of the dual carriageways, except at Bookham. At Bookham it is proposed to deviate both carriageways away from the existing highway to bypass the village. For this deviation, initial consideration is being given to the options shown as A, B, C and D on the map. Variations and combinations of these corridors may also be considered.

Although no decision has been made, preliminary investigations indicate that option B may be the best solution.

On the Yass side of Bookham, it is expected to construct a new northbound carriageway beside the existing highway. On the Gundagai side of Bookham the new carriageway is expected to be on the opposite side of the highway to carry southbound traffic.

What Happens Next?

Initial studies and submissions received from the community will assist to confirm a preferred scheme. Consideration will be given to alternative routes for bypassing Bookham and alternative locations for the new carriageway north and south of the village. When the alignment has been confirmed, notification will be sent to all people who have made a submission. In addition, owners or occupants of all affected properties will be contacted in person.

Detailed studies will then focus on the preferred scheme, investigating the effects on the physical and social environment. Measures will be proposed to overcome or lessen impacts which are identified. Particular attention will be given to the effects on properties, both in Bookham and along the highway. Other important considerations include the appearance of the upgraded highway, the effect on flood waters, loss of vegetation and soil erosion.

Over the next two months members of the study team will be carrying out investigations along the highway. Team members will always seek the consent of owners before entering private lands. When the Environmental Impact Statement is completed it will be placed on exhibition by the Roads and Traffic Authority.

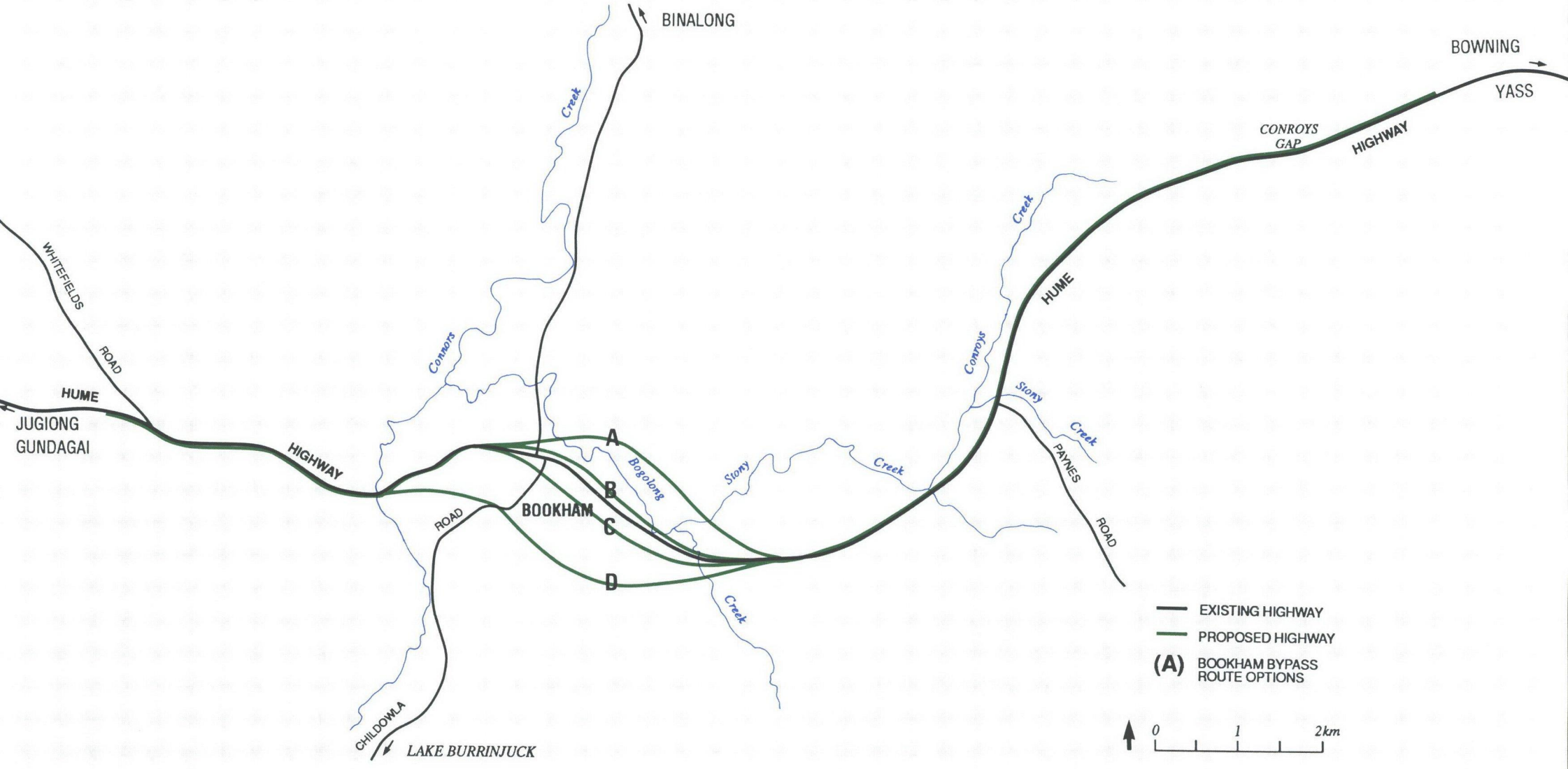
Have Your Say

A display has been arranged to explain the proposal and provide an opportunity to discuss the alternatives. The display will be held in Bookham Hall on 19 th July. Please drop in between 4 pm and 8 pm and discuss the proposal with staff from Mitchell McCotter and the Roads and Traffic Authority.

Now is the time to have your say on the alternatives, before a preferred scheme is nominated. If you would like to have an input to the selection process please fill in the accompanying questionnaire and send it to:

Stephen Hafer
Mitchell McCotter
PO Box 943 Crows Nest NSW 2065
Tel: (02) 906 1666 Fax: (02) 906 5375

We would like to receive any inquiries or comments by 26 July 1993.


BINALONG
BOWNING
YASS
CONROYS GAP
HIGHWAY
HUME
WHITEFIELDS ROAD
HUME
JUGIONG
GUNDAGAI
HIGHWAY
Creek
Conroys
Creek
Conroys
Stony
Creek
Stony
Creek
Bogolong
A
B
C
D
BOOKHAM
ROAD
PAYNES
ROAD
Creek
CHILDOWLA
LAKE BURRINJUCK
EXISTING HIGHWAY
PROPOSED HIGHWAY
(A) BOOKHAM BYPASS ROUTE OPTIONS
0
1
2km

Mr Gary Armour
'Te Kooti'
BOOKHAM

The writer is in favour of the Highway duplication following Option B provided that an underpass is provided to enable stock and cars to cross from Childowla Road to Binalong Road. This request is based on reasons of safety resulting from the high speeds associated with a dual carriageway.

Pat Barton
9 Dry Street
BOOROWA 2586

The writer preferred Option B because it utilises some existing RTA land, reducing the amount of land to be acquired. The writer also requests that good access to and from the Bookham Store is maintained.

Nanette Betts
'Cowridge' RMB 715 Black Range Road
YASS 2582

The writer expressed a preference for Option B in order to keep Bookham alive, and minimise the disturbance to local Eucalypt stands which are important to Black Cockatoos. The writer would also like to see a revive stop in Bookham and the replacement of any cleared vegetation.

N.W. Bonnette
'Rockdale'
BOOKHAM 2528

Option B is considered to be the most appropriate option by the writer. However, with regards to the centreline marking of the new road the writer would like to see a less noisy alternative used. Having worked close to the Coppabella Road to Reedy Creek section the writer found that large trucks continually running over the centrelines created a lot of unnecessary noise. The owners would also like to see that the alignment does not cut into blocks in the town (one of which they own) and should therefore border Bogolong Street. If the alignment were to cut through the back portion of their property there they are concerned that there would not be enough room for a septic system to service the house they are currently restoring.

Mr Gregory Davies
9 Balala Place
ISABELLA PLAINS ACT 2905

The writer is in favour of the Highway duplication if Option C was selected. This results from the writers intent to purchase land in Bookham Village. This land would be greatly affected if Option A were to be selected. Additional areas of concern included:

- Effects on waterways;
- An intersection and stock crossing on Childowla Road.

Jennifer and Greg Davies
Unit 7 Commercial Centre Heffernan Street
MITCHELL ACT 2911

The writer is in favour of the Highway duplication as long as it does not follow alignments A and B which will severely affect an intended property purchase in Bookham village. The writer also expressed concern about the effects that the duplication may have on the adjacent Bogolong Creek and trees used by local bird species.

B. Hazell
'Kia Ora'
BOOKHAM 2528

The owner was concerned about splitting the village of Bookham in two and especially the division which may be created between the sporting fields and the town hall. The owners would also like to have their current access preserved and a duplication of the existing stock crossing on their property.

Richard Julian
'Bogolong'
BOOKHAM 2582

The owner objected to the proposed reconstruction of the Hume Carriageway at Bookham based on a number of factors. These include:

- the lack of time that was given to prepare a submission in response to the proposal;

- the preferred Option B and its effect on the privacy of the owners home. The residence currently affronts a 60 km/h zone of the existing highway with the owners principle concern being the closeness of the new dual carriageway and the increased speed limit of 110 km/h. The owners house would also be subject to headlights from the new road;

- noise levels associated with the new alignment and speed limit;

- safety of children during the construction period and daily traffic of the dual carriageway;

- a reduction in the air quality associated with the construction and new carriageway especially increases in lead levels and its effect on health;

- the historical value and real estate value of the Bogolong homestead which may be affected by the proposal;

- the operation of the property which occupies both sides of the current highway. The owner requests that current access to the new carriageway and the land on the other side of the carriageway be maintained. The movement of machinery and stock from one side of the property to the other will require a significant stock crossing.

- loss of the owners cattle yards and property.

T.A. Noyes
'Avalon'
BOOKHAM 2528

The writer considers Option B to be the best in terms of preserving the local store in Bookham. The writer feels that this is necessary because it is 30 km to Yass and provides the only public telephone between Yass and Jugiong. The writer would also like to see good access provided to the shop and some signs indicating that a rest stop and telephone are available. It is felt that if trade in the town diminishes the shop may close and create further unemployment in the town.

R.A. Shannon
'Marilba'
BOWNING 2582

The writer is opposed to the duplication being planned for the northern side of the existing highway between Yass and Bookham and raises a number of points against this option. These include:

- an excavation which has largely been completed on the southern side of Conroys Gap which would reduce the need for blasting of the hard granite and additional earthworks;
- the location of the owner's residence on a small hill adjacent to the additional carriageway which may be affected by blasting and earthworks, lights and traffic noise;
- the removal of the properties' warm sheltered northern paddocks and alteration of the natural drainage of the area leaving swampy, poorly drained soils;
- the clearance of a number of important stands of trees used by cattle for shelter and local birds for breeding;
- a number of construction difficulties which may increase the cost of the development such as the extensive fill required on the northern side, relocation of a number of powerpoles, loss of stock watering points, and access to the property;
- a significant amount of land has already been resumed on the southern side of the Highway.

The owner was also concerned about the preservation of existing access to the property, including a point were stock and machinery can cross, drainage problems including erosion and sedimentation from construction, rubbish carried along the watercourses, and provision of an area for the school bus to stop and children cross in safety.

R.B. and N.P. Stevens
'Sandy Beach'
BOOKHAM

The writer would not like to see the duplication follow alignment A because it would divide the property in two. The resident also expressed the need for access across the Highway in order to move sheep and cattle. Access is required to the owner's cattle yards and sheds on the northern side of Bogolong Creek. Access to the property owner's silo may also be cut by the new alignment which may involve moving the silo. Access to Reserve 2557 will also be affected which is currently leased by the owners to graze sheep. If the area remains viable alternative access will be required.

Alan and Judy Ticehurst
'Rockleigh'
BOOKHAM 2528

Option D is the preferred alignment because it does not divide the village of Bookham. Also the writer suggests that this alignment would require fewer bridges, cost less and not resume the best farming land in the area. The writer also suggests that this is the most direct route.

D

NOISE MEASUREMENT RESULTS

Table 1: Traffic Noise Level Objectives [1] for new road and bridge projects (for uses conforming to zoning)

Column 1	Column 2	Column 3	Column 4	Column 5
Assessment site category [2]	Descriptor	Base Objective	Lower noise areas	Higher noise areas
Buildings of a residential nature including residences, hospitals, motels, and caravan parks	"Daytime" (24 hour) Leq (24 hour)	60	Ambient [3] +12 dBA	Ambient+3 dBA
	Night-time (10 pm-6 am) Leq (8 hour)	55	Ambient+12 dBA	Ambient+3 dBA
Classrooms in educational institutions	8.30 am-3.30 pm Leq (1hour) internal	45 [4]	45	Ambient+3 dBA
Community facilities, eg places of worship passive urban parks and noise sensitive facilities (eg libraries)	Consideration will be given to ambient noise conditions, extent and type of use to determine whether noise reduction strategies are needed.			

How to use Table 1

To select an appropriate Noise Level Objective for any site:

- Select the appropriate site category in Column 1.
- Refer to the Base Objective in Column 3.
- Refer to Column 4 for the appropriate Noise Level Objective in lower noise areas, that is, where the ambient noise level is 12 dBA or more below the Base Objective.
- Refer to Column 5 for the appropriate Noise Level Objective in higher noise areas, that is, where the ambient noise level is greater than the Base Objective (in Column 3) less 3 dBA.

Notes

(1) The Noise Level Objective is the noise level which the RTA aims to achieve. It generally reflects the noise from the ultimate predicted traffic flow.

(2) An assessment site is a location being investigated to determine possible noise impacts. The noise level at the site is determined at the 'Assessment Point'. For all assessment sites other than classrooms in educational institutions, the assessment point is outside a building at 1.2 metres above ground or floor level (whichever is appropriate), and one metre from the ground floor window or door which is most exposed to traffic noise.

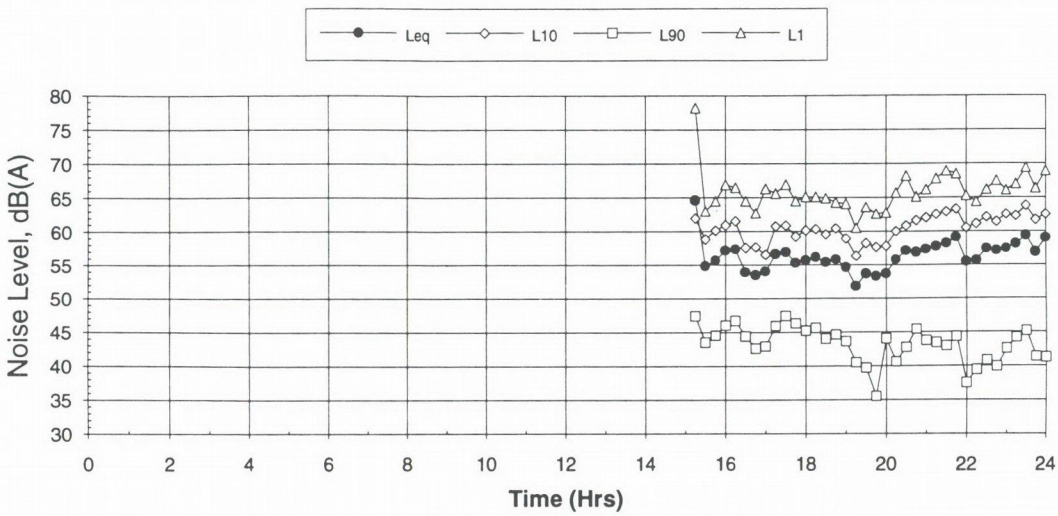
(3) The ambient noise level is the total noise at the assessment site excluding extraneous noises, such as cicadas, before the road project commences.

(4) This is the Noise Level Objective used by the Public Works Department for inside classrooms. The RTA will endeavour to meet this objective in those cases where a classroom has been located, designed and constructed to meet 45 dBA.

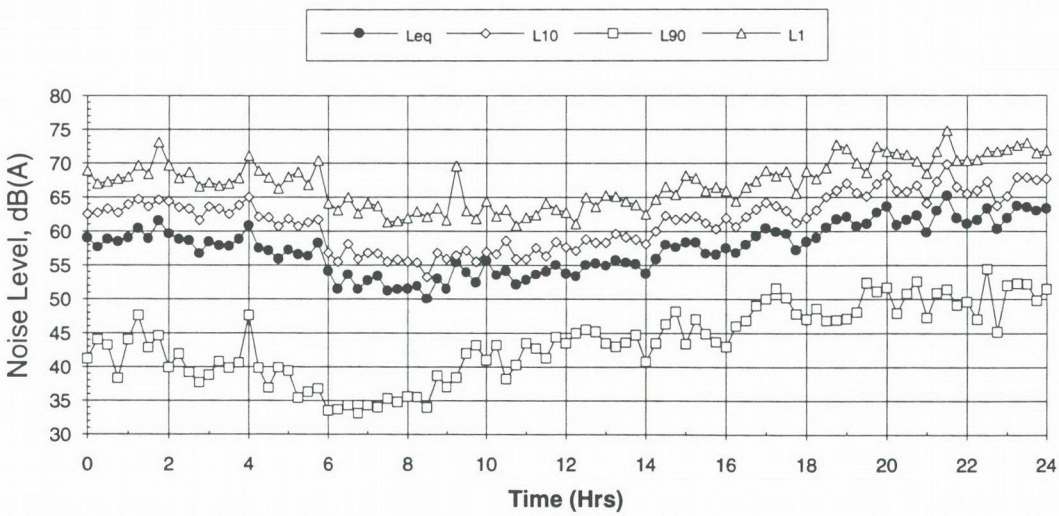
Table 2 ACCEPTED MAXIMUM NOISE LEVELS FROM ROAD CONSTRUCTION PLANT

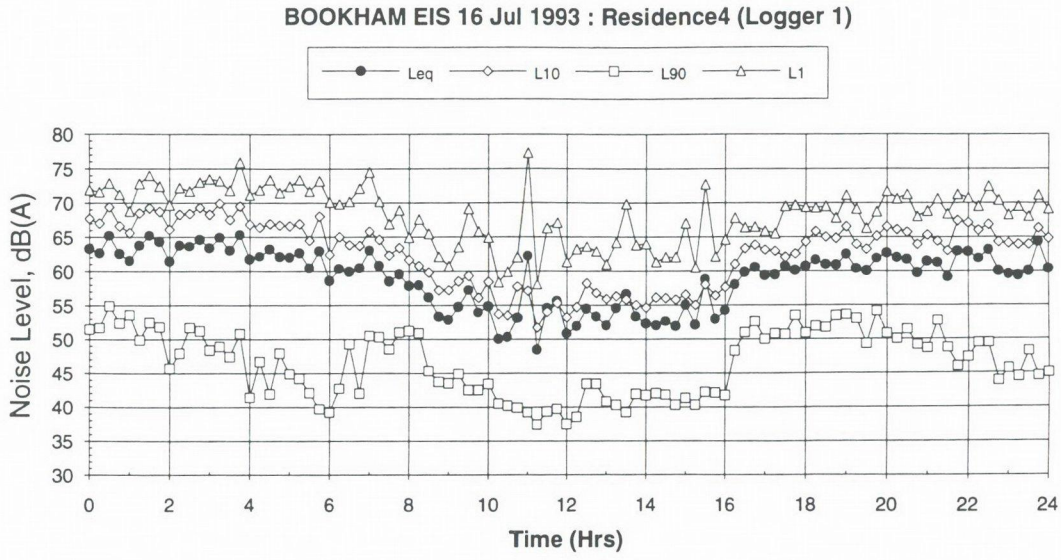
ITEM	TYPICAL PLANT TYPE OR ACOUSTICAL TREATMENT	MAXIMUM NOISE LEVEL L_{Amax} AT 7M
Bulldozer	Caterpillar D7, D9	88
Bulldozer	Caterpillar D10	93
Front End Loader	Wheeled	90
Jackhammers	With silencing bags	85
Air Track Drill	800 cfm compressor	96
Scraper	Caterpillar 651	85
Grader	Caterpillar 16	85
Compactor	Caterpillar 825	85
Vibratory Roller	10-12 tonne	89
Water Cart		88
Dump Trucks	30-35 tonne	96
Excavator	Kato 750	86
Rock breaker	Hydraulic on Kato 750	97
Truck		80
Crane	Truck mounted	85
Compressor	600 cfm	75
Compressor	1500 cfm	80
Backhoe		88
Compactor	Caterpillar B15	89
Compactor	Vibrating plate	92
Spreader	Asphalt, concrete	70
Asphalt truck		92
Asphalt paver		89
Tip truck		83
Generator	Diesel	79
Spraying machine		75
Mechanical brook		83
Piling hammer	For piles and casing	93
Concrete truck		83
Concrete pump		84
Concrete vibrators		80
Drill	Air	85
Drill	Pneumatic	85
Concrete saw		93
Welders		85
Concrete leveller	90	
Cherry picker on truck		80

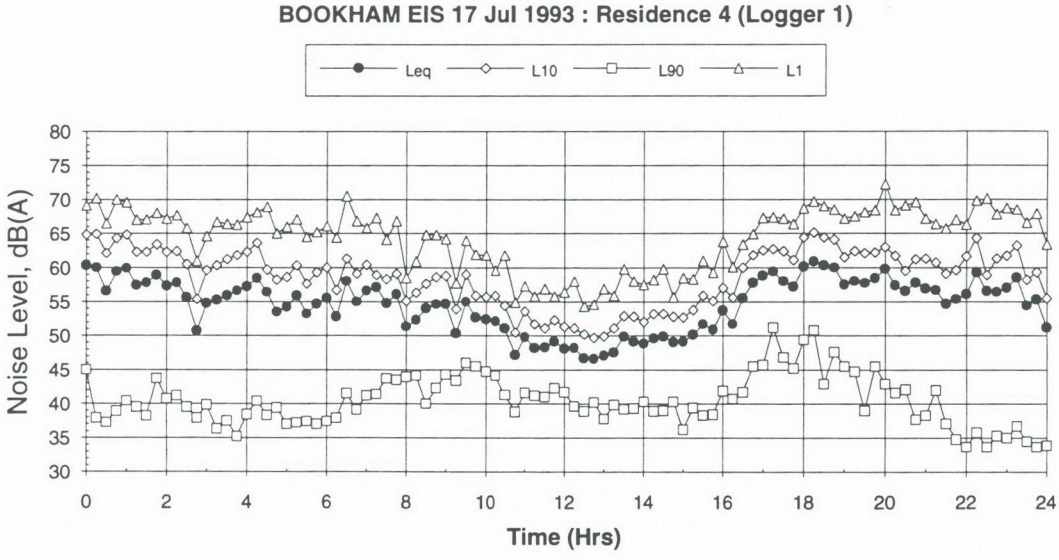
BOOKHAM EIS 14 Jul 1993 : Residence 4 (Logger 1)



BOOKHAM EIS 15 Jul 1993 : Residence 4 (Logger 1)




BOOKHAM EIS 16 Jul 1993 : Residence4 (Logger 1)
Leq
L10
L90
L1
Noise Level, dB(A)
80
75
70
65
60
55
50
45
40
35
30
0
2
4
6
8
10
12
14
16
18
20
22
24
Time (Hrs)


BOOKHAM EIS 17 Jul 1993 : Residence 4 (Logger 1)
Leq
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L90
L1
Noise Level, dB(A)
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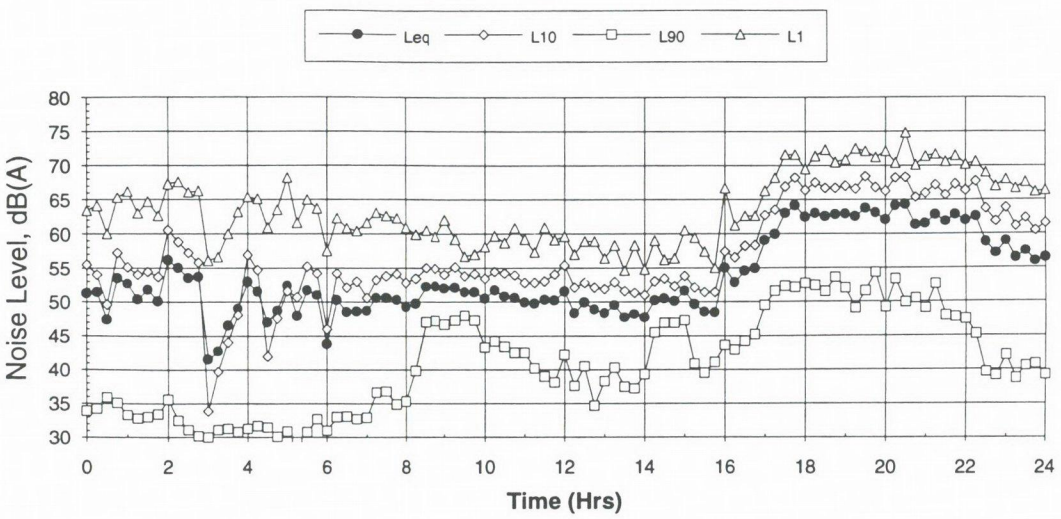
Time (Hrs)

BOOKHAM EIS 18 Jul 1993 : Residence 4 (Logger 1)



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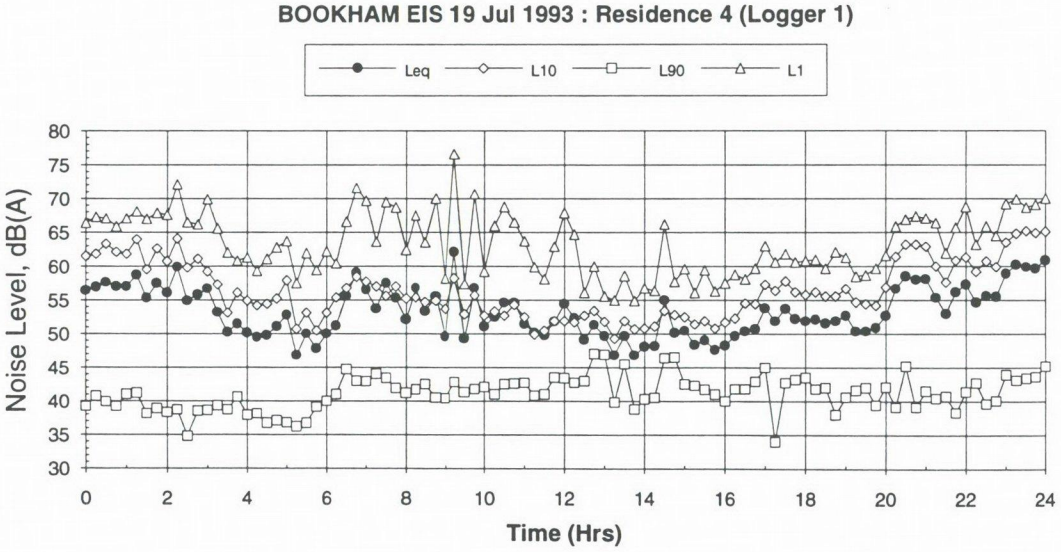

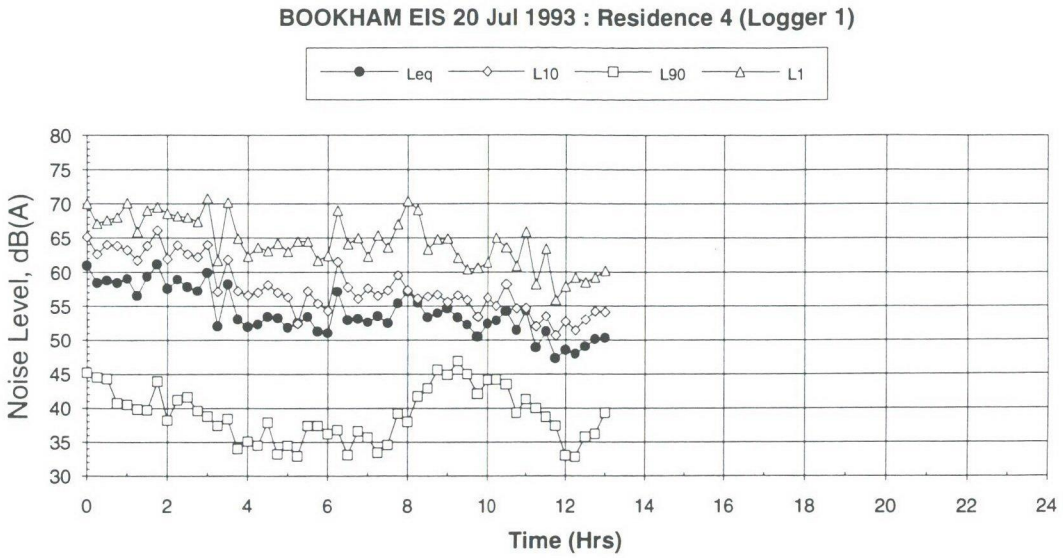
BOOKHAM EIS 20 Jul 1993 : Residence 4 (Logger 1)
Leq
L10
L90
L1
Noise Level, dB(A)
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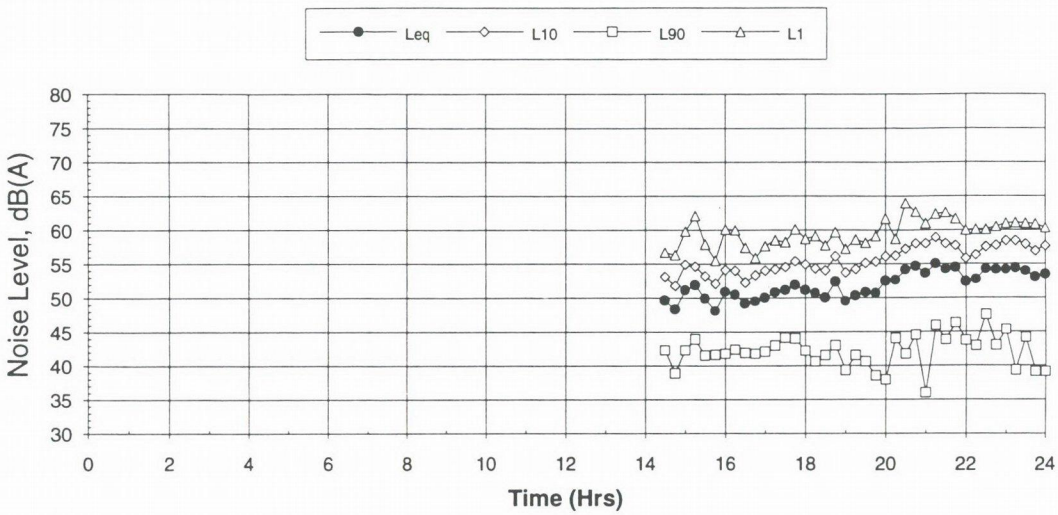
Time (Hrs)

BOOKHAM EIS 14 Jul 1993 : Residence 6 (Logger 2)



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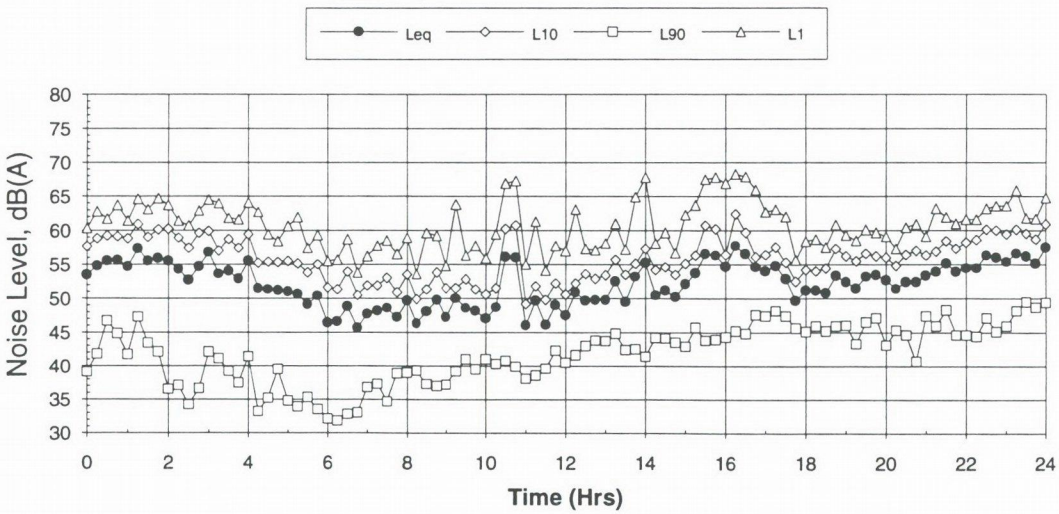

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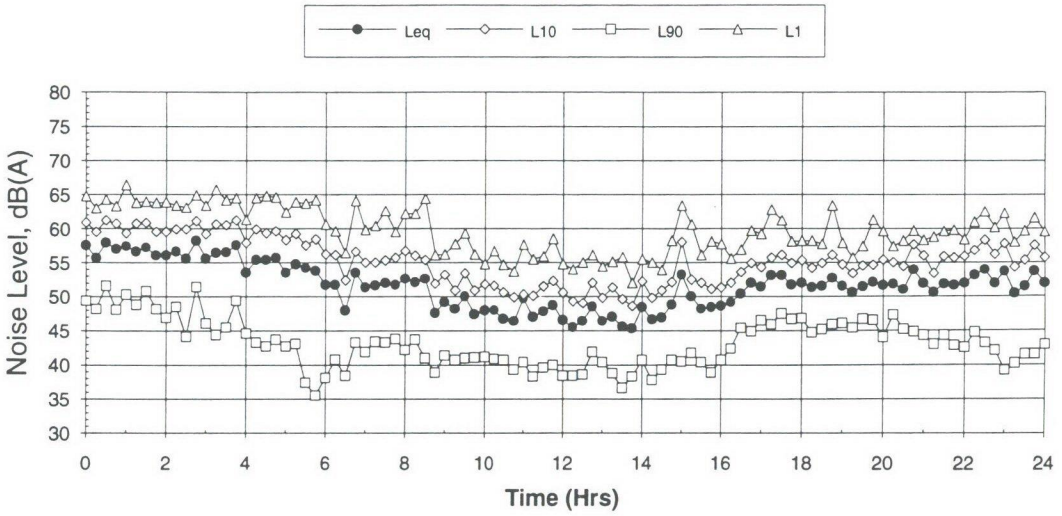

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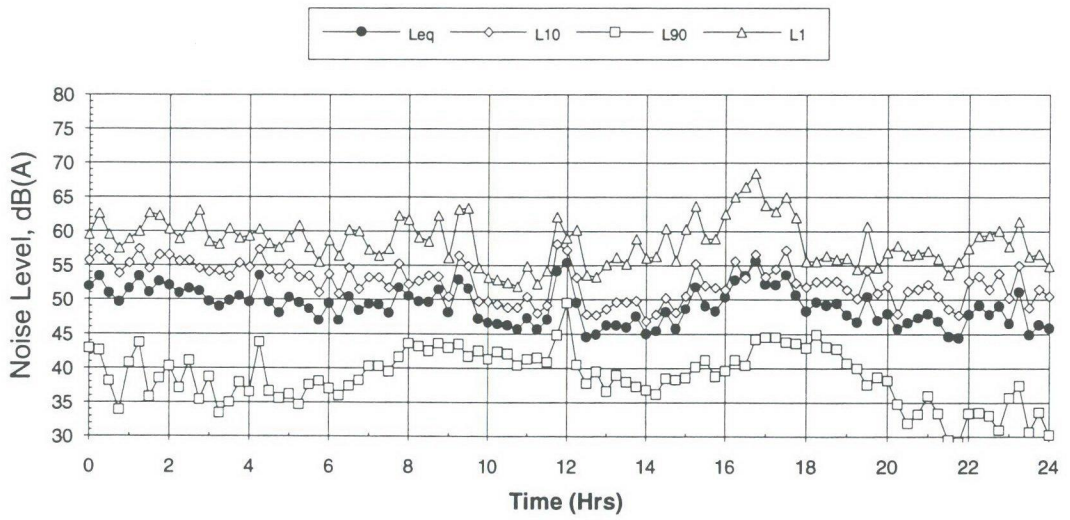

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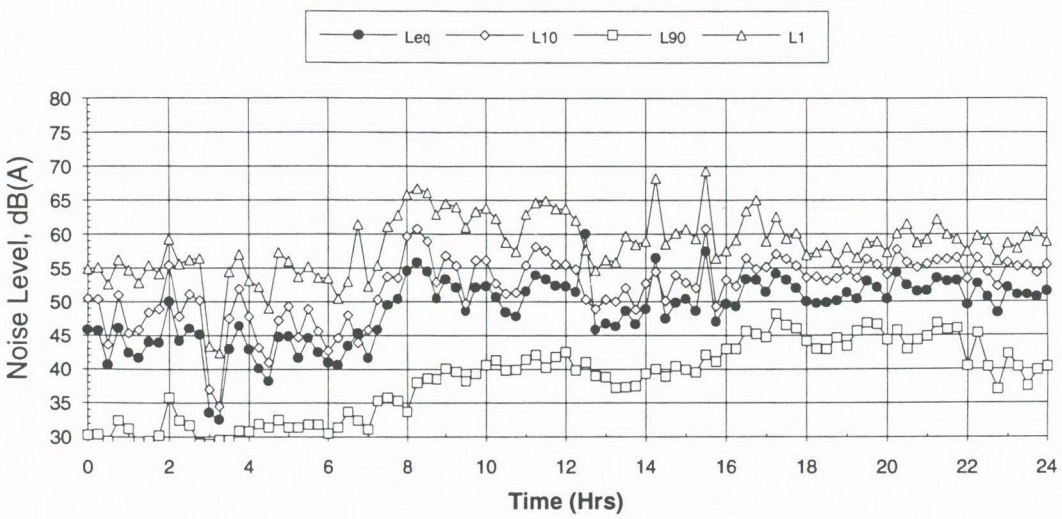

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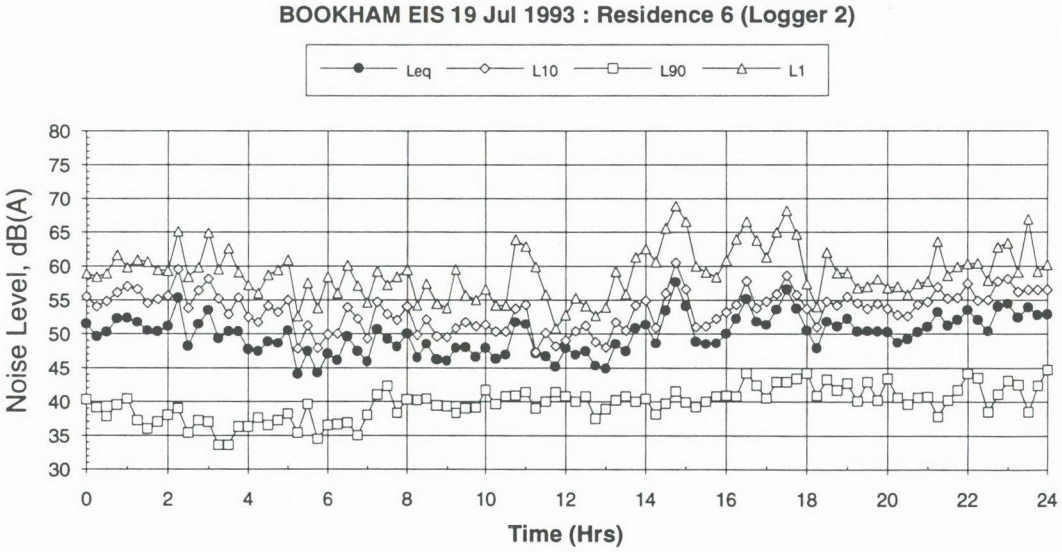

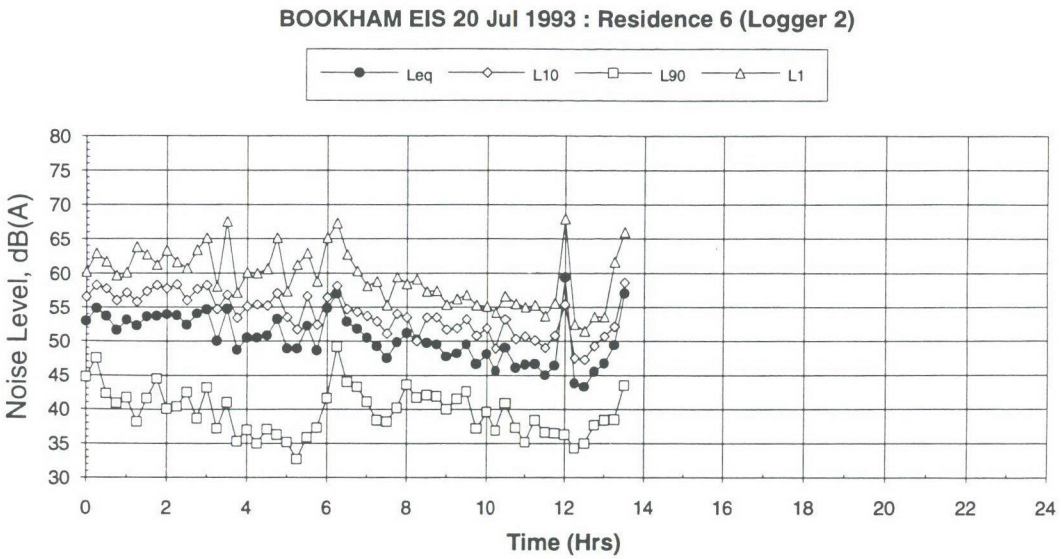
BOOKHAM EIS 20 Jul 1993 : Residence 6 (Logger 2)
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Noise Level, dB(A)
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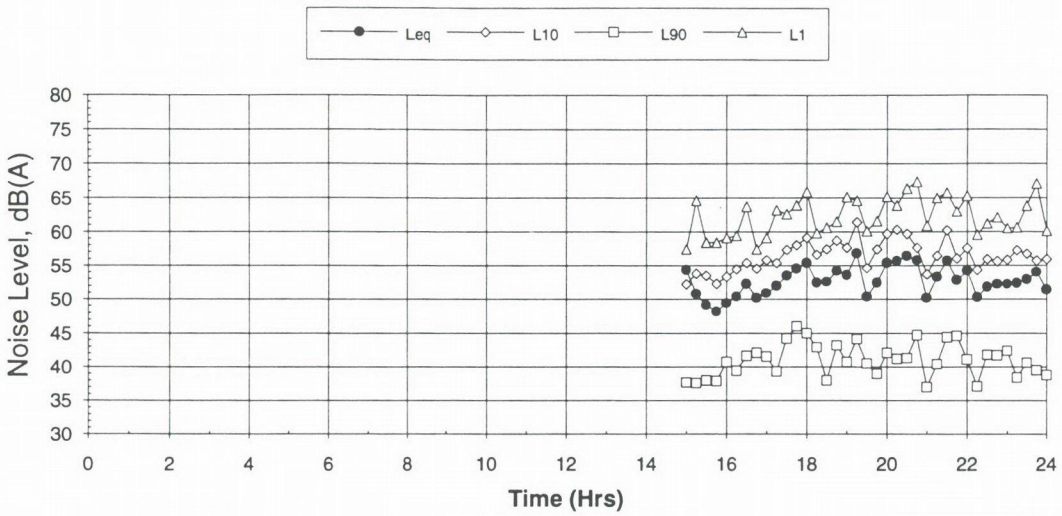
Time (Hrs)

BOOKHAM EIS 14 Jul 1993 : Residence 14 (Logger 3)



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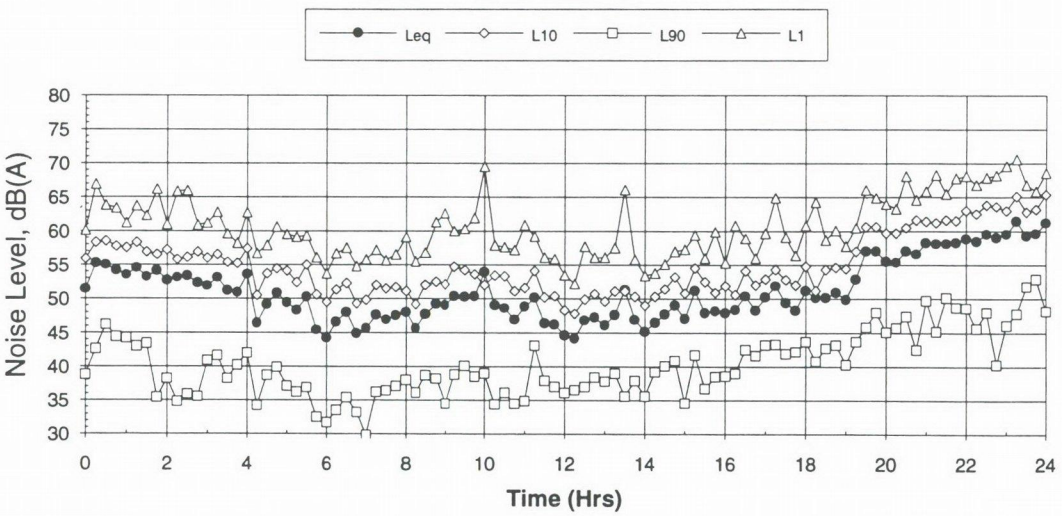

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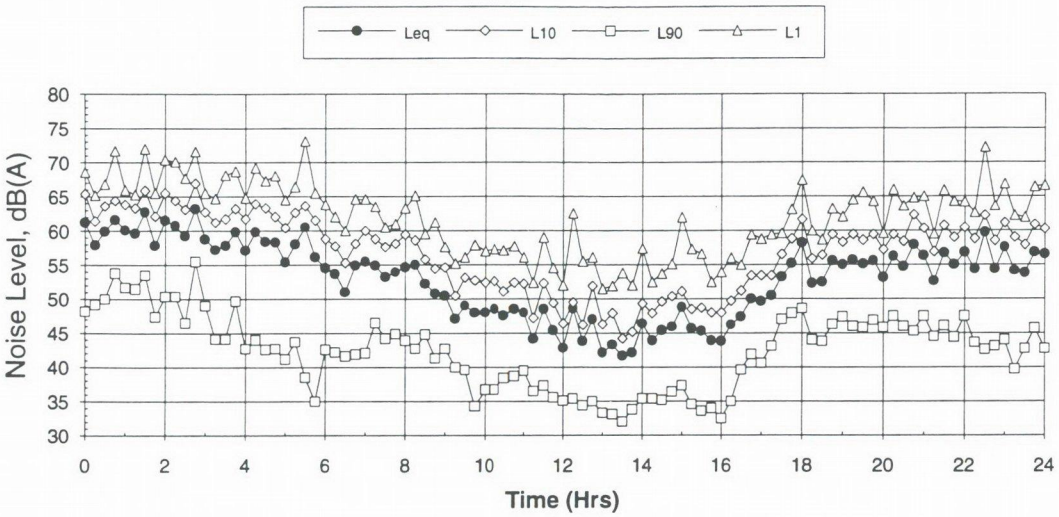

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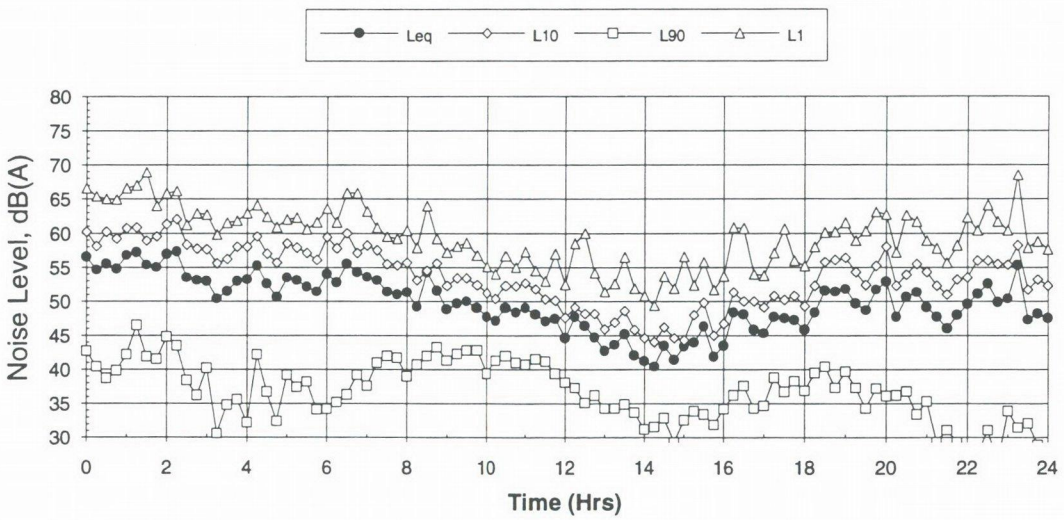

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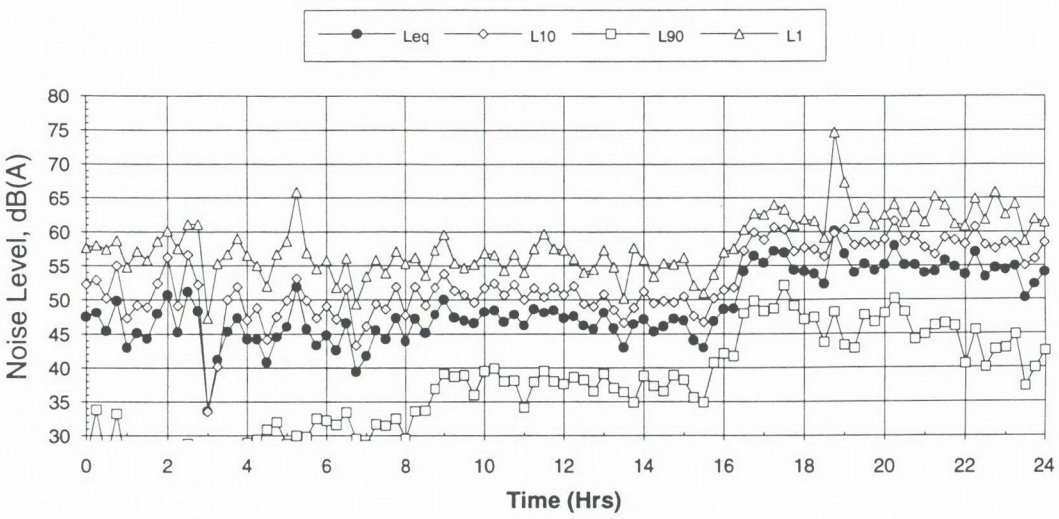

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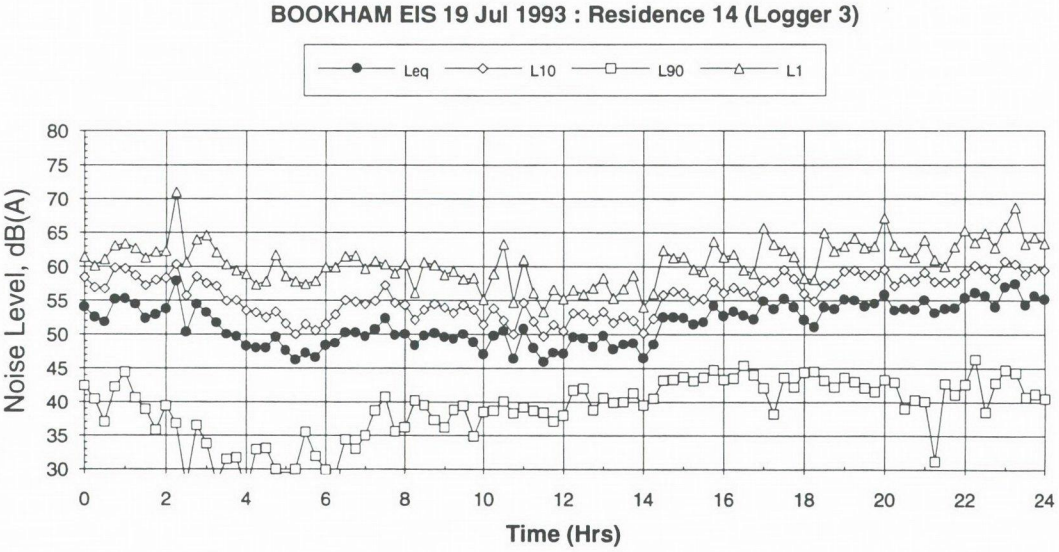

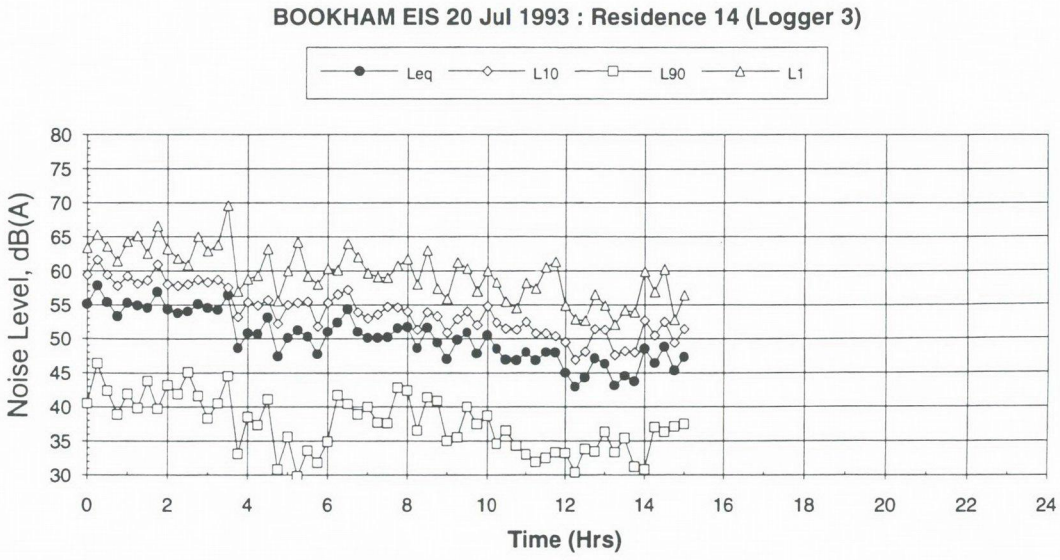
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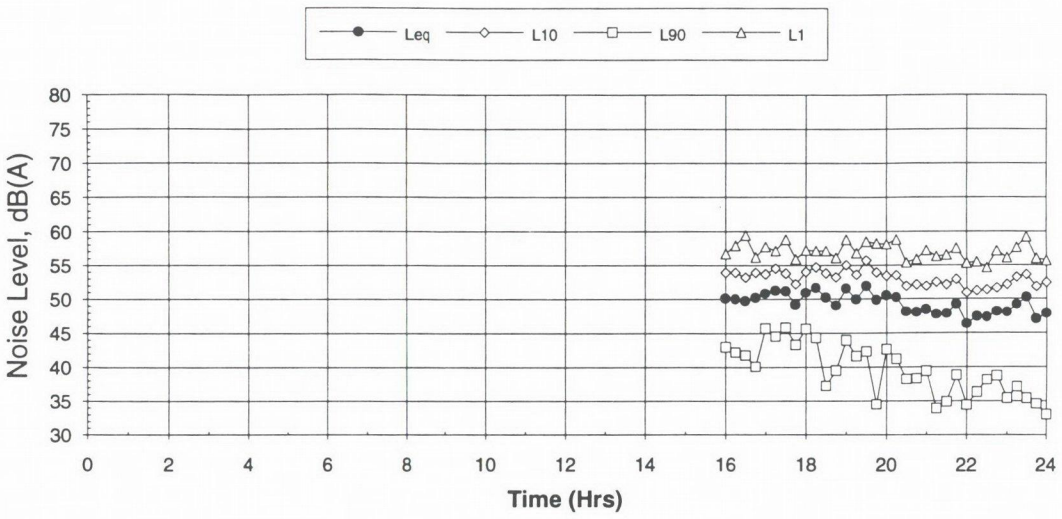
Time (Hrs)

BOOKHAM EIS 14 Jul 1993 : Residence 2 (Logger 4)



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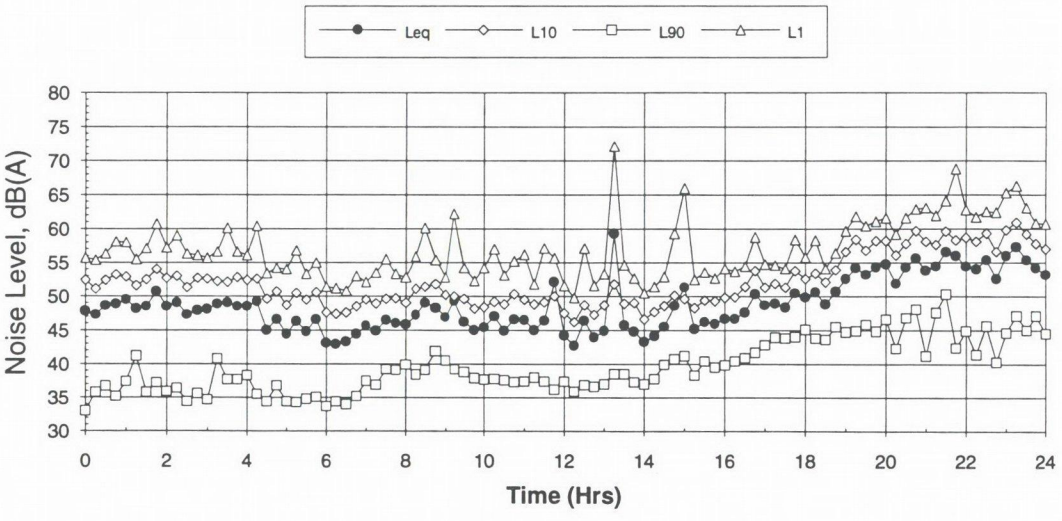

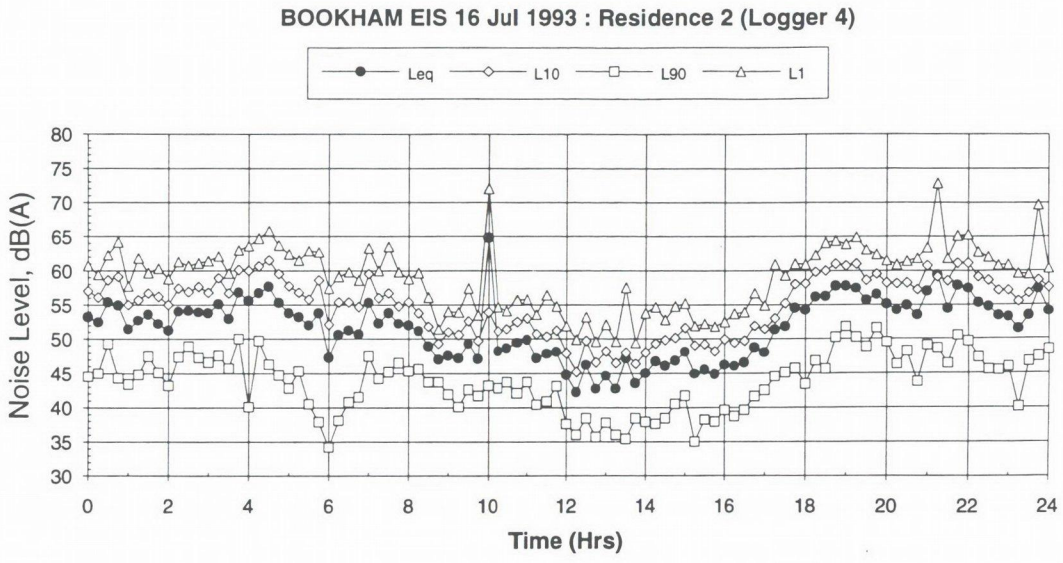
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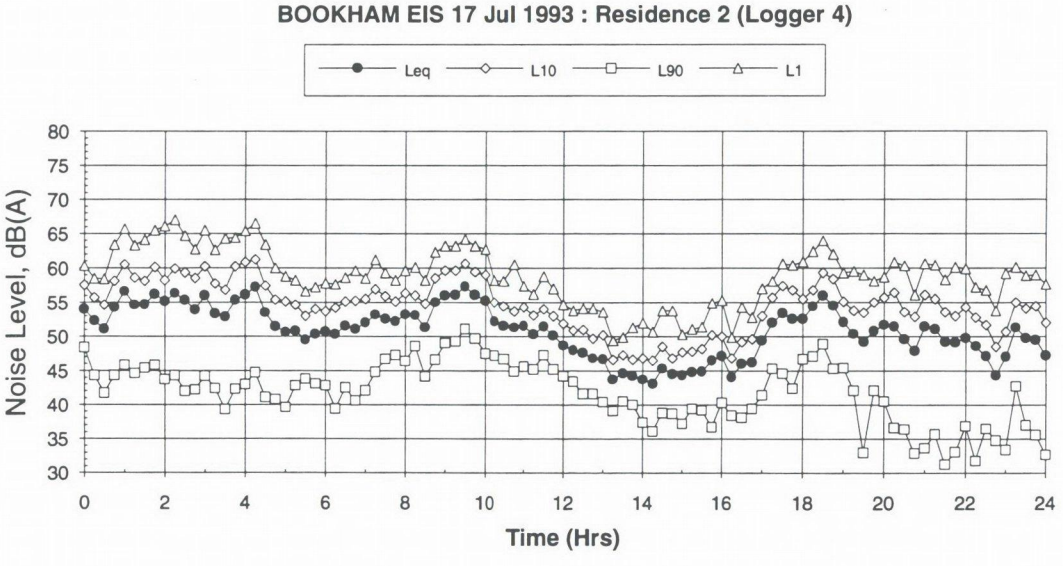
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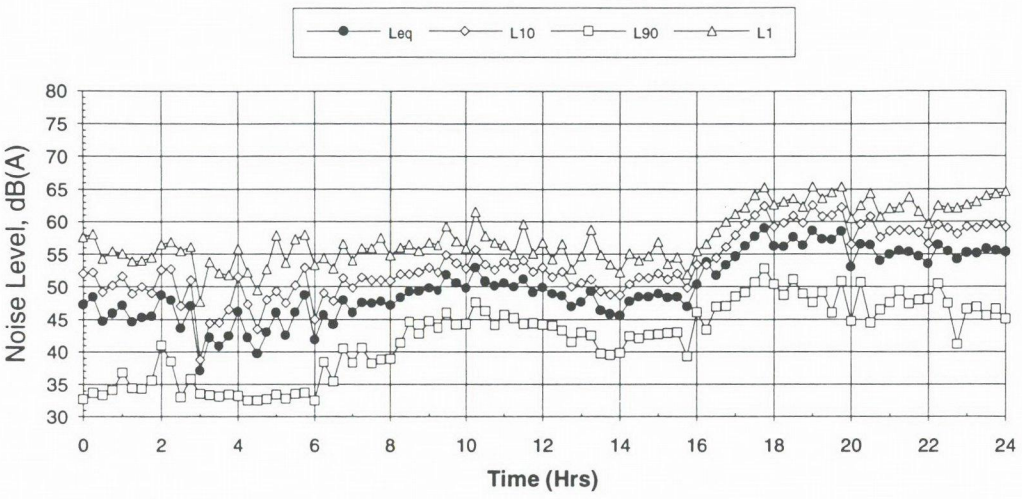

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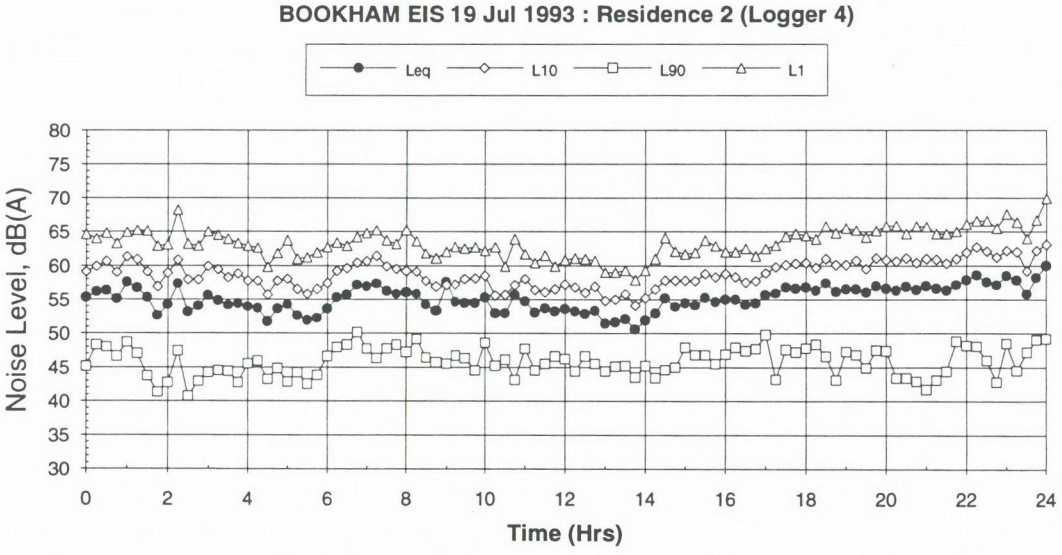

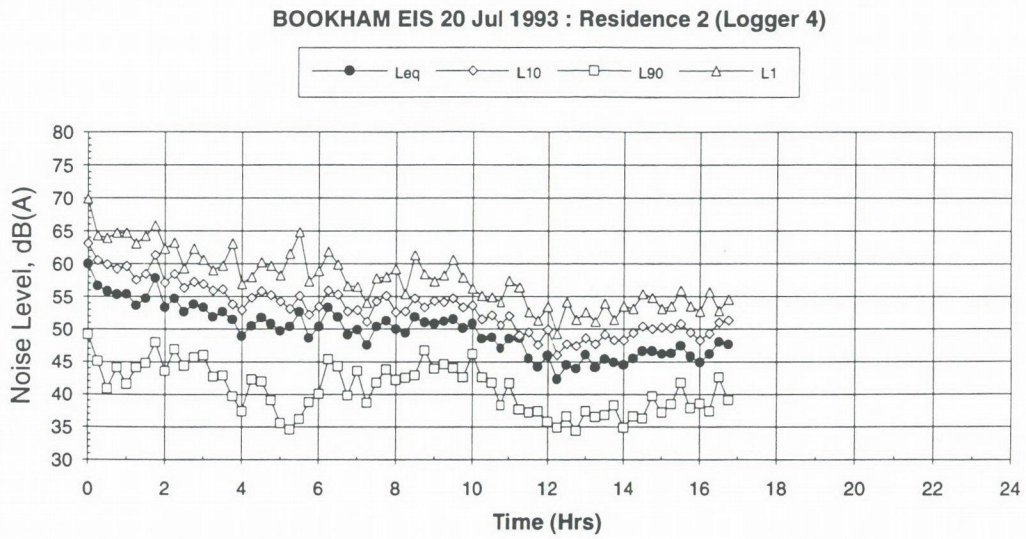
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Time (Hrs)

E

FAUNA SPECIES

E. FAUNA SPECIES RECORDED OR LIKELY TO OCCUR IN THE STUDY AREA

Species observed:

- BIRDS

Australian Raven	*Corvus coronoides*
Laughing Kookaburra	*Dacelo novaeguinea*
Gang Gang Cockatoo	*Callocephalon fimbriatum*
Willie Wagtail	*Rhipidura levcophrys*
Yellow Wagtail	*Motacilla flava*
Mistletoe bird	*Dicaeum hirundinaceum*
Galah	*Cacatua roseicapilla*
Wood Duck	*Chenonetta jubatta*

- MAMMALS

Swamp Wallaby	*Wallabia bicolour*
Eastern Grey Kangaroo	*Macropus giganteus*

- INTRODUCED MAMMALS

Rabbit	*oryctolagus cuniculatus*
Feral cat	*Felis catus*

- AMPHIBIANS

Common Eastern Froglet	*Crinia signifera*

Species known or likely to occur:

- BIRDS

Eastern Rosella	*Platycercus eximus*
Black-faced Cuckoo Shrike	*Coracina novaehollandiae*
Noisy Friarbird	*Philemon corniculoatus*
Richards Pipit	*Anthus novaeseelandiae*

❑ MAMMALS

Long-nosed Bandicoot	*Perameles nasuta*
Brush-tail Possum	*Trichosurus vulpecula*
Echidna	*Tachyglossus aculeatus*
Common Wombat	*Vombatus ursinus*
Bat species	

❑ REPTILES

Red Bellied Black Snake	*Pseudechis porphyriacus*
Eastern Brown Snake	*Pseudonaja textilis*

❑ INTRODUCED MAMMALS

Fox	*Vulpes vulpes*
Horse	*Equus caballus*
Cattle	

F

CLAUSE 59 CERTIFICATION

Roads and Traffic Authority

Proposed Hume Highway

Duplication including Bookham Bypass

ENVIRONMENTAL IMPACT STATEMENT

Clause 59 Certification

This is to certify that the Environmental Impact Statement set out herein has been prepared in accordance with Clauses 57 and 58 of the Environmental Planning and Assessment Regulation, 1980.

T.W. Perram
Principal
Mitchell McCotter and Associates
November 1993

G

STUDY TEAM

APPENDIX G STUDY TEAM

This Environmental Impact Statement was prepared for the Roads and Traffic Authority by Mitchell McCotter and Associates Pty Ltd and a number of specialist sub-consultants. The following personnel participated in the study:

Mitchell McCotter & Associates Pty Ltd

T. Perram, BSc, MEngSc., DipEnvStud.	Project Principal
G. Begg, BE, BSc	Project Manager
R. Bullen, BSc, PhD	Acoustical Engineer
T. Brooker, BE, PhD	Traffic Engineer
S. Hafer, BSc	Environmental Scientist
C. Howard, BSc	Environmental Scientist
S. Fikkers, BSc	Environmental Scientist
T. Pilkington, BTP	Town Planner
K. Milne, BSc	Social Scientist
P. Walker	Graphics
J. McDonald	Word processing
J. Mansson	Word Processing

M.A. Schell & Associates

M. Schell, B.L.Arch, DipEnvStud	Landscape Architect

Navin Officer Archaeological Resource Management

K. Navin, BA	Archaeologist
J. Kauer, BA	Archaeologist