

NECS

NATIONAL
ENVIRONMENTAL
CONSULTING
SERVICES

REVIEW OF ENVIRONMENTAL FACTORS

**REPLACEMENT OF THORNES BRIDGE OVER THE
MULWAREE RIVER
AT GOULBURN**

**Prepared by National Environmental Consulting Services
for
The Roads and Traffic Authority**

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LIST OF ABBREVIATIONS

AADT	Annual Average Daily Traffic
ANZECC	Australian and New Zealand Environment and Conservation Council
BCR	Benefit Cost Ratio
dB	Decibel
DCP	Development Control Plan
DG AC	Dense Grade Asphalt
DLWC	Department of Land and Water Conservation
DUAP	Department of Urban Affairs and Planning
EPA	Environment Protection Authority
EP&A Act	Environmental Planning and Assessment Act 1979
ESD	Ecologically Sustainable Development
F/S	Flushed Seal
FYRR	First Year Rate of Return
GST	Goods and Services Tax
ha	Hectare
hr	Hour
km	Kilometre
km ²	Square Kilometre
kph	Kilometres per hour
LALC	Local Aboriginal Land Council
LEP	Local Environment Plan
m	Metre
m/sec	Metres per second
MBK	McMillan, Britton & Kelly Pty Ltd
mm	Millimetre

MR 79	Main Road 79
NECS	National Environmental Consulting Services
NPV	Net Present Value
NPWS	National Parks and Wildlife Service
NSW	New South Wales
OG AC	Open Grade Asphalt
REF	Review of Environmental Factors
RTA	Roads and Traffic Authority
SEPP	State Environmental Planning Policy
Stn	Station
TSC Act	Threatened Species Conservation Act 1995

REVIEW OF ENVIRONMENTAL FACTORS REPLACEMENT OF THORNES BRIDGE OVER MULWAREE RIVER AT GOULBURN

SECTION A - PRELIMINARIES

1.0 INTRODUCTION

1.1 Brief Description of the Proposal

The Roads and Traffic Authority (RTA) is proposing to replace an existing timber bridge (Thornes Bridge) over the Mulwaree River with a new concrete bridge. There is currently funding available for the replacement of timber bridges on classified state roads and Thornes Bridge, which is located on Braidwood Road, has been identified as one of the timber bridges to be replaced.

The existing 9 span, 100 metres (m) long timber truss and beam bridge would be replaced with a 5 span, 125 m long concrete bridge. The new bridge would consist of a reinforced concrete deck and kerbs on precast prestressed concrete girders supported by reinforced concrete piers and abutments. It would be located on a straight, with a minimum horizontal clearance of 0.5 m from Thornes Bridge at the northern abutment. The new bridge would be located to the west of Thornes Bridge.

The northern and southern approaches to the proposed bridge would require realignment. The area covered by the proposed bridge and approaches is mainly situated within the existing road reserve. About 0.5 hectares (ha) would need to be acquired from The Towers property.

The existing bridge may have regional heritage significance and the design of the new bridge allows for the existing bridge to be retained.

Figure 1.1 shows the location of Thornes Bridge and Braidwood Road and the location of the proposed bridge to the west of Thornes Bridge.

National Environmental Consulting Services (NECS) was commissioned by the RTA to prepare this Review of Environmental Factors (REF).

1.2 Need for the Proposal

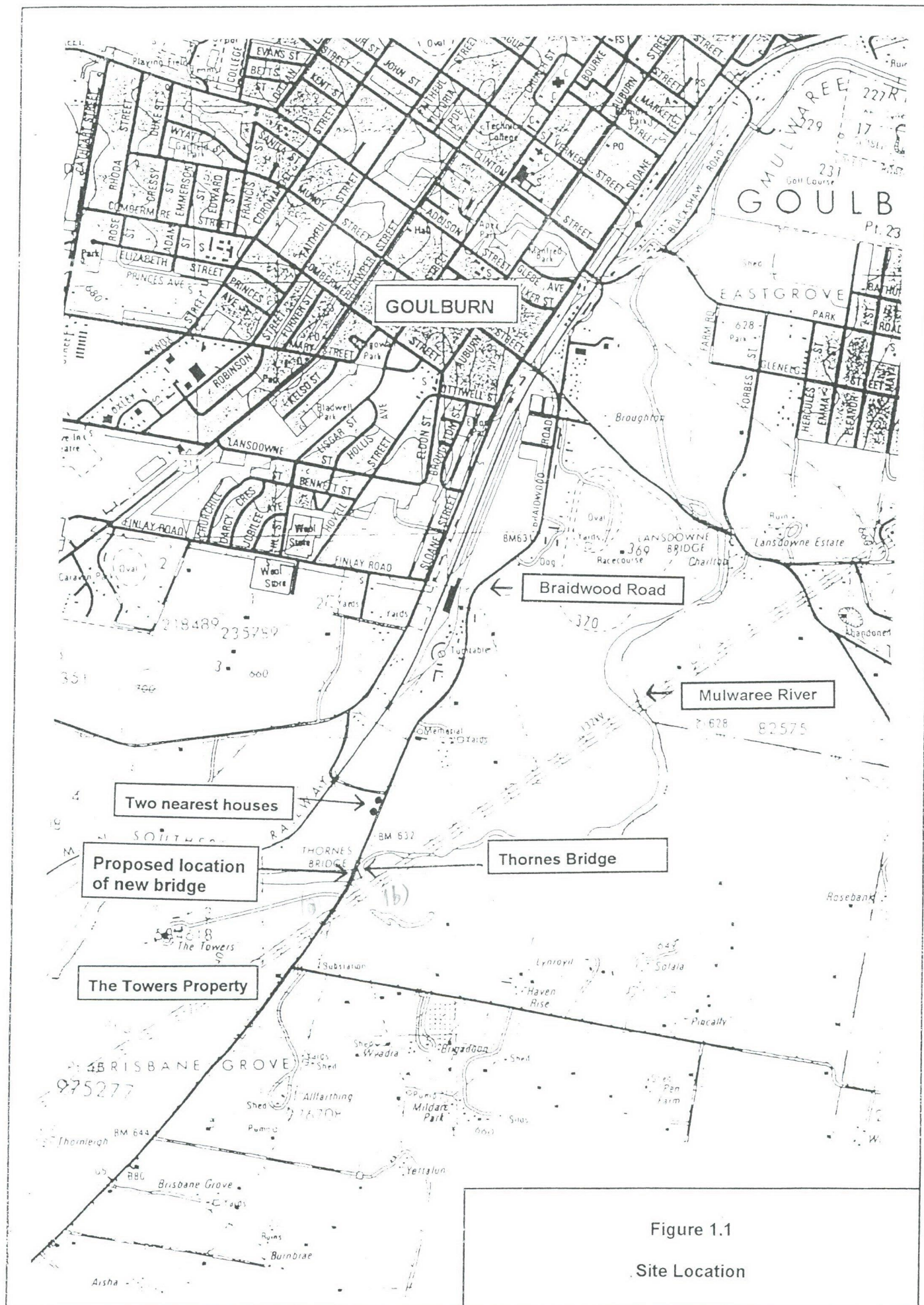
The proposal to replace Thornes Bridge is part of a programme to gradually replace timber bridges on state classified roads. This proposal was put forward for the following reasons:

- To reduce bridge maintenance costs by providing a structure in concrete or concrete and steel;
- To ensure that state roads will carry the projected increase in weights of heavy vehicles; and
- To increase the width of the new bridge to that of the approaches to improve safety, particularly for heavy vehicles.

1.3 Legislative Framework

State Environmental Planning Policy (SEPP) No 4 – Development Without Consent, stipulates that work related to classified or main roads which would normally require consent, may be carried out without the consent of Council. Given that Braidwood Road is classified as a main road (MR 79), consent is not required for the upgrading works. Consequently, Part V of the *Environmental*





Planning and Assessment Act 1979 (EP&A Act) applies to this proposal and the RTA is the determining authority.

Under the terms of the Act, the determining authority must consider the likely environmental impact of the upgrade.

The proposed works are an activity for the purposes of Part V of the EP&A Act. This REF provides information as specified in Clause 82 of the Environmental Planning and Assessment Regulation to enable the RTA to assess whether the proposal has a significant effect on the environment. If the assessment concludes that there is not likely to be a significant effect on the environment, the proposal can proceed, subject to safeguards outlined in the REF.

The proposal has been considered in terms of the principles of Ecologically Sustainable Development (ESD) and the environmental management during both the construction and operational phases involves provisions to meet these principles.

The RTA requires waste material to be recycled where possible. The implications of *the Waste Minimisation and Management Act 1995* have been incorporated into the REF.

The REF has been prepared in accordance with the RTA Proforma 2 – REF Guidelines.

1.4 Contact for Project

Name: Ian Archer

Address: Project Management Section
Roads and Traffic Authority
Wollongong Zone Office
71-77 Kembla Street, Wollongong
PO Box 477, Wollongong East NSW 2520

Phone: (02) 4221 2426

Fax: (02) 4227 3705

2.0 PROPOSAL IDENTIFICATION

2.1 Name of Proposal

MR 79 – Replacement of timber bridge over Mulwaree River, Thornes Bridge, Bridge Number 6463.

2.2 Region/Zone

Thornes Bridge is located within the Southern Region.

2.3 Local Government Area

The southern end of Thornes Bridge marks the border between Goulburn City and Mulwaree Shire.

Thornes Bridge and the area immediately to the north are located within Goulburn City and the area to the south of the bridge is located within Mulwaree Shire.

2.4 Construction Programme

The programme for the development and implementation of the project indicates that the project development activities can be completed by the end of this financial year to allow physical construction to commence this financial year and be completed next financial year.

Construction is scheduled to take place between June 2000 and March 2001 (refer Section 3.4).

2.5 Plan Registration No. / File No.

- Plan Registration No. 0079.297.BA.2701.
- File No. 172.1108 Design.
- State Project No. 67804 & 68429/6.
- Sketch KD 330 CPI.

2.6 Road Location

The section of Braidwood Road (MR 79), which would be affected by the construction of the new bridge and the realigned northern and southern approaches, is located within Goulburn City and Mulwaree Shire, approximately 4 kilometres (km) south of the township of Goulburn. The proposed bridge and northern approach are within Goulburn City and the southern approach is within Mulwaree Shire. The road passes over the Mulwaree River and continues in a southerly direction towards Tarago and Braidwood. Figure 1.1 shows the location of Braidwood Road as well as the location of Thornes Bridge.

The road is located on the Goulburn 8828-III-N 1:25000 Topographic Map. Roadloc: 0050.A2.9.537.

3.0 PROPOSAL DESCRIPTION

3.1 Location

Thornes Bridge is located within the City of Goulburn, to the south of the Hume Highway. The bridge is located on Braidwood Road, which passes over the Mulwaree River and continues into the Mulwaree Shire.

There are two houses approximately 200 m to the north of the bridge and The Towers property lies to the south west of the bridge (refer Figure 1.1). The area immediately surrounding the bridge consists of mainly exotic trees and grasses.

3.2 General Features

3.2.1 Overview

Figure 1.1 shows the location of Thornes Bridge in relation to surrounding properties and land uses, including the Mulwaree River.

3.2.2 Property Acquisition

The RTA would need to acquire approximately 0.5 ha of land from The Towers, for a distance of approximately 500 m on the western side of the road.

3.2.3 General Design Parameters

The existing 9 span, 100 m long, timber truss and beam bridge would be replaced by a 5 span, 125 m long concrete bridge with a width between kerbs of 11 m. The proposed bridge width provides for 3.5 m lanes, 2 m shoulders and 1 m verge (embankment) and would allow for the bridge to be used safely by cyclists. The proposed bridge would consist of a reinforced concrete deck and kerbs on precast prestressed concrete Super-T girders supported by two reinforced concrete frame piers and three column frame abutments.

The realignment of the road has been developed to a 100 kilometres per hour (kph) standard.

The proposed vertical alignment and bridge configuration provides sufficient waterway area not to increase the level of the 1% probability flood, which has been reported as not having flooded the two adjacent houses on the Goulburn approach to the bridge. The bridge configuration also allows for the retention of the existing bridge, without increasing afflux, should the existing bridge be retained. The approaches of the new bridge would be raised to provide an improved level of service. The northern and southern approaches would have horizontal curves of radii 1500 m and 1000 m respectively, making it possible to tie-in to the existing road at Stn 30 (start of work) and Stn 720 (end of work) (refer to Figure 3.1). The length of the northern and southern approaches to the bridge would be approximately 150 m each (refer Figure 3.1).

The access road to The Towers would be relocated for 100 m and would involve minor works within the property. The proposed boundary and entrance gates would be located 13 m from the travel lane, suitable for a single truck to stand. The same gates would serve both access tracks running through the property, similar to the existing arrangement.

Due to previous flooding incidents at the entrance of The Towers property, which is served by a 600 millimetres (mm) diameter concrete pipe, a 1200 mm x 450 mm precast box culvert would be provided and the existing 600 mm diameter concrete pipe would be relocated under the access road to The Towers further north in order to relieve the catchment flow. This would cater for a 20 year flood frequency. The open drain has been designed on a 0.5% grade from the access junction to the river and would be 1 m deep and capable of carrying the 20 year flood at a height of 0.6 m with a velocity of 1 m/sec. A three cell 450 mm diameter concrete pipe at Stn 180 would be extended by 4.88 m.

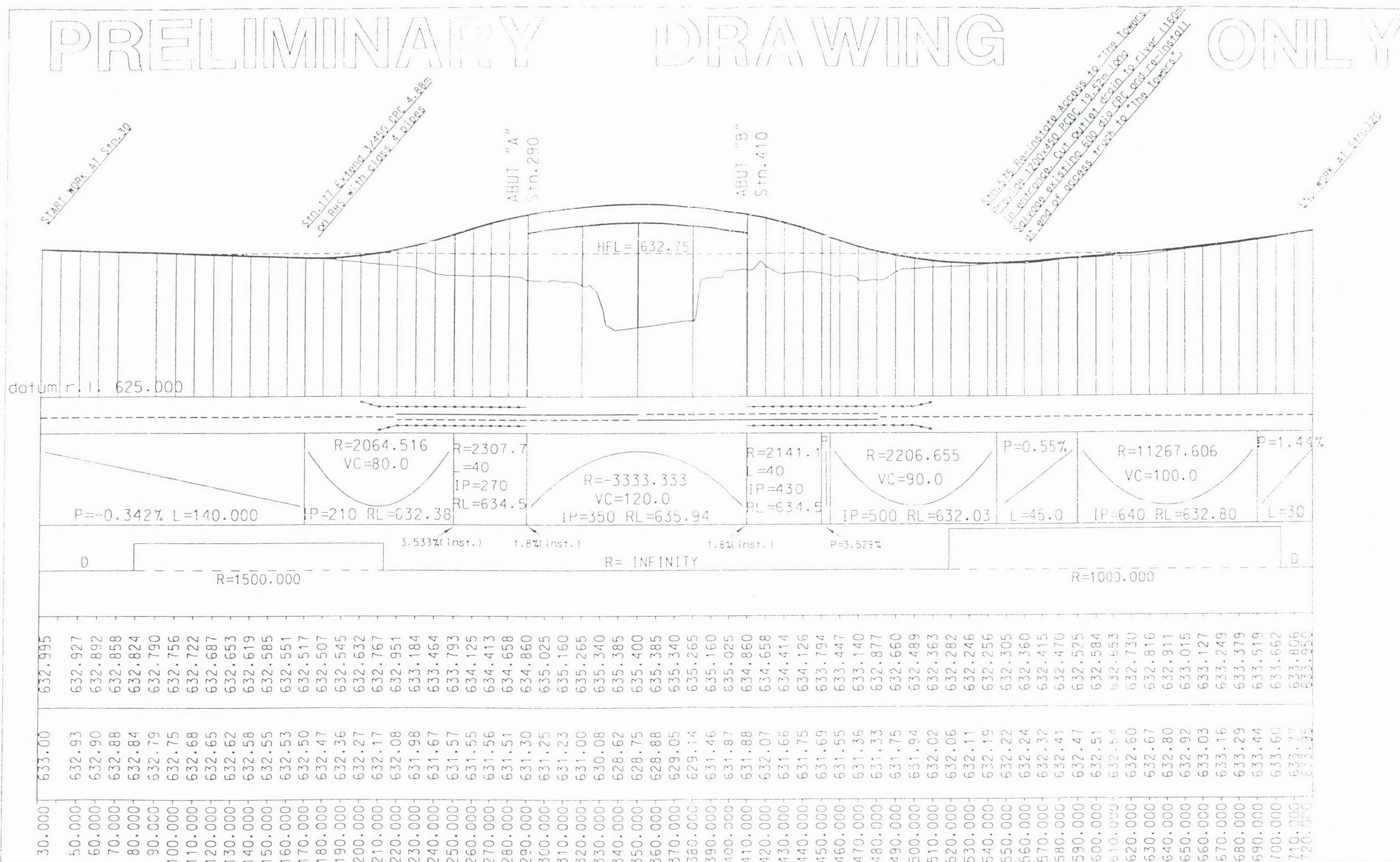
An 8 m long sediment containment wall (1 m x 1 m) with the inner wall faced with geotextile, located at the end of the open drain would act as a permeable siltation basin.

A Telstra cable would need to be relocated on the western side of the work. An allowance for this has been made in the estimate of cost for the work.

The design constraints relate to two houses on the upstream side of the northern approach.

Figures 3.1 to 3.3 show the design plans for the proposed bridge.

PRELIMINARY DRAWING ONLY



long section along control line M002

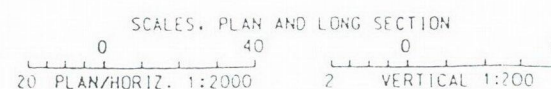


Figure 3.1

Design Plans - Longitudinal Section

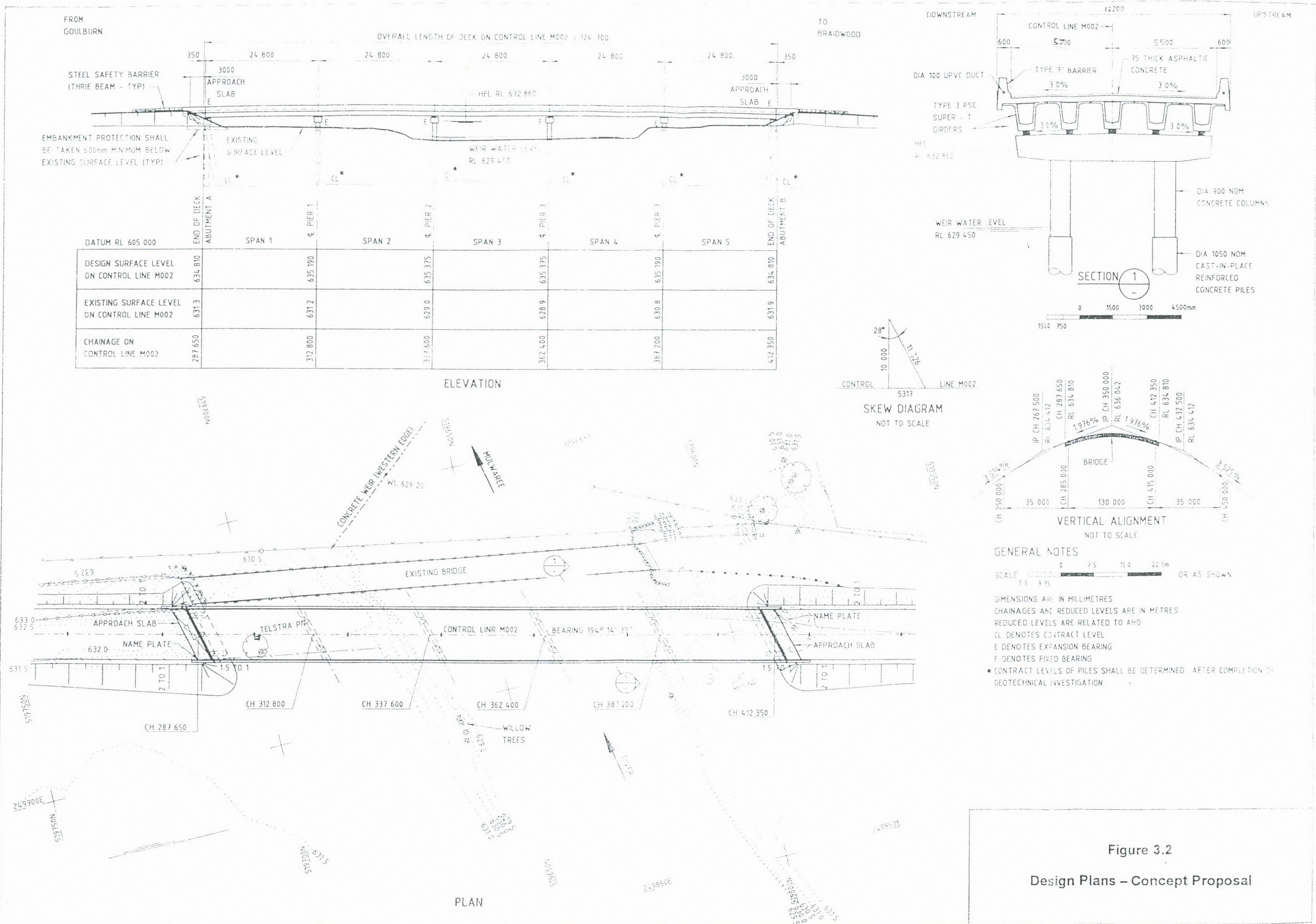


Figure 3.2
Design Plans – Concept Proposal

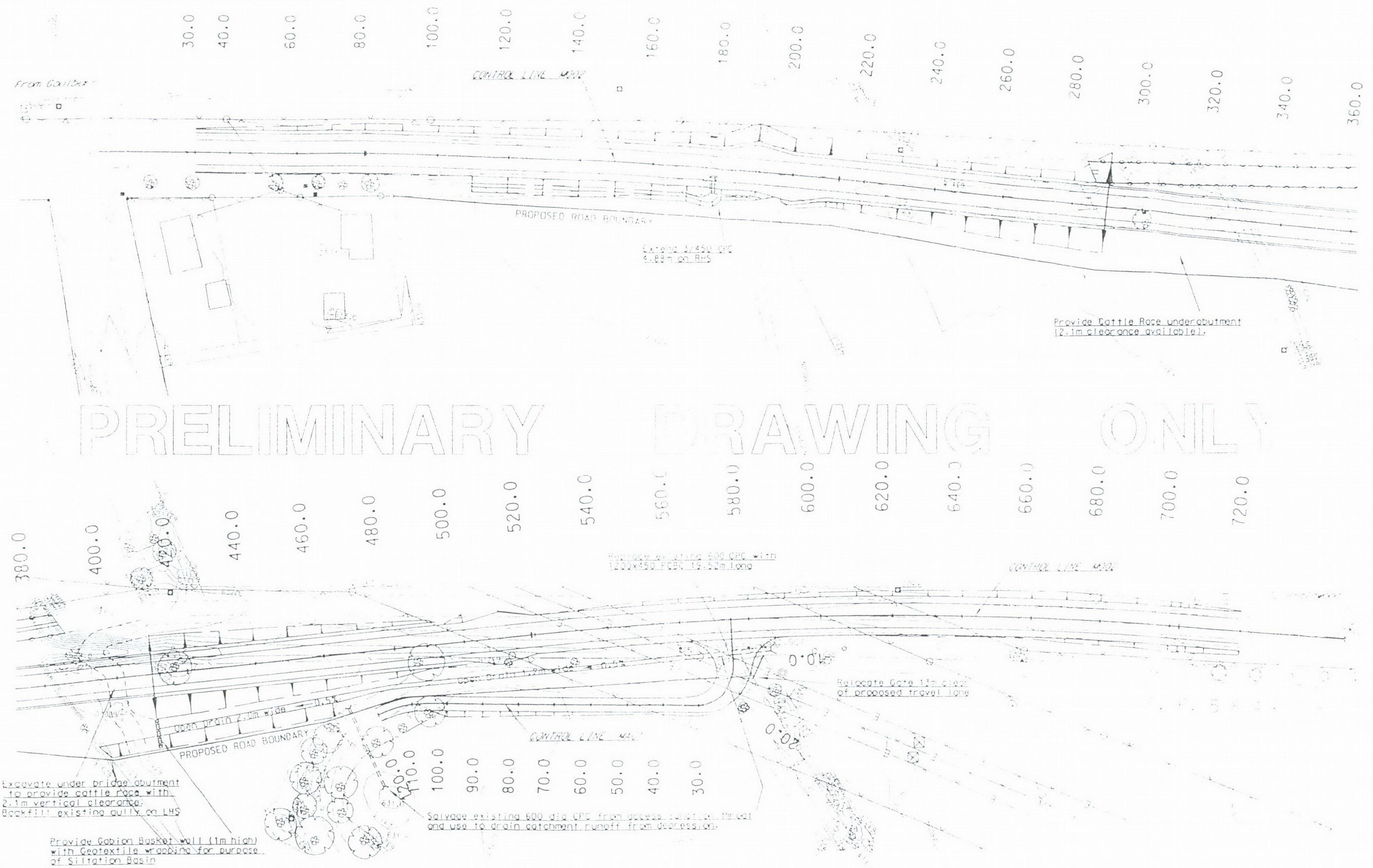


Figure 3.3

Design Plans – Concept Detail Plan

3.2.4 Demolition of Existing Bridge

As described in Section 3.2.3, the proposed bridge configuration allows for retention of the existing bridge. Based on the McMillan, Britton and Kell (MBK) (1998) study of the Heritage Significance of Timber Bridges, the existing bridge is not considered to be of state significance. As such the RTA would not propose to retain and maintain the existing bridge once the proposed new bridge has been constructed.

In the event that Goulburn City Council and/or Mulwaree Shire Council resolve that the bridge should be retained for local or regional historic values, the RTA would transfer the ownership of the bridge to the Local Government Authority. A financial contribution for ongoing bridge maintenance would be made equal to the cost of demolition of the bridge less the value of reusable salvageable timber. Apart from this contribution, ongoing maintenance of the bridge would be the responsibility of the Council(s).

3.3 Costs

An estimate for the proposal based on the concept plans, preliminary quantities and proposed cash flow is \$3,145,000 including an allowance for contingencies on items of higher risk (and demolition of the existing bridge) of \$372,500 (~12% of the project total). The cash flow scenarios for the proposed project (based on a project cost of \$3,145,000) are presented in Table 3.1.

Table 3.1
Cash Flow

Project Number	Funding Scenario	Expenditure to 1998/99	1999/2000 (\$,000)	2000/01 (\$,000)	2001/02 (\$,000)	TOTAL (\$,000)
68429/6	Allocated	57	100	75	75	307
67804		0	110	1,200	1,050	2,710
68429/6	Proposed	57	100	188	0	345
67804		0	110	2,690	0	2,800

An additional amount of \$300,000 has been allowed due to uncertainty of the effect of GST on future tenders from contractors. This additional contingency would bring the total project cost to \$3,450,000.

The RTA have undertaken a Simplified Cost Benefit Analysis for the bridge replacement. The Analysis indicates a Nett Present Value (NPV) of \$3000, a Benefit Cost Ratio (BCR) of 1.0 and a First Year Rate of Return (FYRR) of 5.8%.

3.4 Timing

The programme for the development and implementation of the project indicates that the project development activities can be completed by the end of this financial year to allow physical construction to commence this financial year and be completed next financial year. Construction is scheduled to take place between June 2000 and March 2001.

The timing of the proposed bridge replacement is presented in Table 3.2.

Table 3.2
Project Milestones

Activity	Start	Finish
Detail Design	May 2000	July 2000
Acquisitions	September 1999	May 2000
Construction	September 2000	June 2001
Open to Traffic	N/A	June 2001

4.0 SPECIALIST STUDIES AND COMMUNITY INVOLVEMENT

4.1 Specialist Studies

Indigenous Heritage

Specialist studies for the project included an Indigenous heritage assessment, involving a site visit by Rob Paton Archaeological Services Pty Ltd, a search of the NSW Aboriginal Site Register, consultation with the NSW National Parks and Wildlife Service (NPWS) to ascertain any particular requirements and consultation with the local Aboriginal Land Council.

European Heritage

A Statement of Heritage Impact was prepared by John Armes & Associates Pty Ltd. This included a review of reports on the heritage significance of the bridge.

4.2 Community Involvement

There is one property which would be affected by the proposed replacement of Thornes Bridge. This is The Towers property.

Consultation with Mr Tim Titheradge (Owner of The Towers Property)

Mr Tim Titheradge, owner of The Towers property was contacted by the RTA in relation to the proposal early in 1999. Following is a summary of the issues raised by Mr Titheradge:

- He expressed concerns regarding the paddock on the northern side of the river, which is his best agricultural land and any encroachment would disturb the function of his irrigation system;
- He requested that the willow trees on the northern bank of the river be retained within his property boundary;
- The owner explained that the area near his main entrance has been covered by runoff. The catchment area on the south-western side of the road is approximately 32 ha;
- He requested that:
 - Cattle races be provided under both of the bridge abutments. It was agreed that this would be a sound traffic safety initiative and could be implemented without much difficulty;
 - A culvert be located under his access road (near the second gate) to drain the paddock and disperse the residue of the runoff from the catchment area. The existing 600

diameter concrete pipe (CPC) under the existing junction could be salvaged for this purpose;

- ▶ The new boundary fence be equivalent to the existing rabbit proof fence which is dug well into the ground; and
- ▶ Landscaping to be carried out between the relocated access track and the proposed road boundary.

There are two houses located approximately 200 m north of the bridge. Prior to the preparation of the northern approaches to the proposed bridge, these residents would be advised of the work to be undertaken so any concerns they may have can be addressed.

4.3 Government Agency Consultation

The following government agencies and organisations have been informed of the proposed bridge replacement by a letter or by meeting with them in person:

- AGL;
- Department of Agriculture;
- Department of Land and Water Conservation (DLWC);
- Department of Urban Affairs and Planning (DUAP);
- Goulburn City Council;
- Environment Protection Authority (EPA);
- Mulwaree Shire Council;
- NSW National Parks and Wildlife Service (NPWS);
- NSW Fisheries;
- Optus Communications;
- Sydney Catchment Authority;
- State Rail Authority;
- Telstra; and
- TransGrid.

Copies of the correspondence and the replies are presented in Appendix A.

Table 4.1 summarises the issues raised in the correspondence.

Table 4.1
Summary of Issues

Authority	Issues
AGL	There are no gas mains at the location of the proposed works.
Dept of Agriculture	No significant concerns over this replacement, however, consider: - Loss of any agricultural land when road alignment is changed; - Control of siltation to maintain water quality. This river is part of the Sydney Catchment; and Consideration of retention of the old bridge as a historical piece is to be commended.
Dept of Land and Water Conservation	DLWC provided general guidelines which recommended consideration of the following in relation to the proposal: - <i>Rivers and Foreshores Improvement Act</i>; - Hawkesbury Nepean Catchment; - NSW State Rivers and Estuaries Policy; - Crown Land Matters; - <i>Soil Conservation Act 1938</i>; - Erosion and Sediment Control Plan; and The latest edition <i>Managing Urban Stormwater, Soils and Construction</i>, NSW Dept of Housing, 3rd Edition (1998) should be used.
Dept of Urban Affairs and Planning	REF needs to address: - Requirements of local planning controls, such as Goulburn Local Environmental Plan (LEP) and Mulwaree LEP, and any relevant Development Control Plans (DCPs); - Compliance with provisions of Habitat Protection Plan No. 3 – Hawkesbury-Nepean River System. Consultation with NSW Fisheries may be required; - Consultation with Local Aboriginal Land Council; - An appropriate level of environmental impact assessment including: • Impact on hydrological processes and water quality of Mulwaree River, particularly during construction; • Impact on aquatic flora and fauna, especially fish and benthic life; • Impact on vegetation, particularly on the banks and in other areas to be used for vehicle access; • Impact on threatened species under the Threatened Species Conservation Act 1995 (TSC Act); • The need for mitigation works to address these impacts, including soil and water management during and after construction; and • Site rehabilitation after completion of bridge works;

Authority	Issues
	- Flooding data such as frequency, degree of inundation, flood behaviour and identification of flood hazard zones and its relevance in determining bridge design and location; - Heritage significance of existing bridge structure although not identified as a heritage item in Goulburn LEP; consult with John Armes.
Goulburn City Council	Council expressed concern over the heritage significance of Thornes Bridge.
Environment Protection Authority	No specific requirements. Under Section 120 of the <i>Protection of the Environment Operations Act</i>, adequate erosion/sedimentation control measures should be implemented to protect the Mulwaree River.
Mulwaree Shire Council	Supports the replacement of Thornes Bridge.
NSW National Parks and Wildlife Service	No response received.
NSW Fisheries	Compliance with <i>Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures 1999</i> (attached in Appendix A).
Optus Communications	There are existing Optus assets within the vicinity of the proposed works (see Appendix A).
Pejar Local Aboriginal Land Council	The Land Council attended a site survey. They recommend: - Test pitting be done on various sections of the area; - Soil samples be taken from an area where there is a ring of mushrooms. This is in order to see whether there is any salt present in the soil; and - The Land Council wishes to have 1 or 2 representatives present during soil testing and test pitting.
Sydney Catchment Authority	The area is located within the Warragamba Outer Catchment Area. Activities within the catchment should have a neutral or beneficial effect on water quality in the Mulwaree River. REF should include: - Soil and water management plan approved by DLWC prior to construction activity. Appropriate location and safeguards for fuel storage, location of areas to be cut and filled and traffic diversion details.
State Rail Authority	No response received.
Telstra	Maps of existing Telstra cables provided. Refer to Telstra response in Appendix A.
TransGrid	Replacement of Thornes Bridge may have an impact on Great Southern Energy's 971 Yass-Goulburn 132kV transmission line. The line is operated and maintained on Great Southern Energy's behalf by TransGrid. RTA to inform TransGrid about any ground line changes or developments on the 45 m easement.

SECTION B – ENVIRONMENTAL IMPACT ASSESSMENT

5.0 STRATEGIC STAGE

5.1 General

To enable an adequate assessment of the likely environmental impact of a proposal, including its cumulative impact, it is necessary to examine its relationship to broader national, state, regional and local planning and environmental issues. This strategic stage of environmental assessment is achieved in this REF by reporting strategic planning and environmental information from existing sources, rather than undertaking additional studies.

5.2 Planning and Environmental Background

The weights of heavy vehicles are expected to increase in the future and the City of Goulburn would be required to improve its roads, including bridges, in order to provide suitable roads and supporting infrastructure for these vehicles. One step in meeting this goal is to replace old timber bridges within the City with more stable ones, which have lower maintenance costs.

5.3 Strategic Justification and Needs Definition

The RTA has received funding from the State funded Infrastructure Maintenance Programme, State Funded Works, 1998-1999 and Forward Years Maintenance Programme. This programme has been established to eliminate timber bridges on classified state roads. Thornes Bridge has been identified as one of the timber bridges to be replaced.

The new bridge would enable the road to carry the projected increase in weights of heavy vehicles and would improve safety, particularly for heavy vehicles. The new bridge would also result in the reduction of noise levels created as vehicles cross the bridge.

As the cost of keeping timber bridges in good condition is rising and all structures on state roads should be capable of carrying proposed heavier truck loads, it has been decided to replace all timber bridges on state roads, including Thornes Bridge.

6.0 CONCEPT STAGE

6.1 Objectives

The objectives of the project are:

- To reduce bridge maintenance costs by providing a structure in concrete, or concrete and steel;
- To ensure that state roads will carry the projected increase in weights of heavy vehicles; and
- To increase the width of the new bridge to that of the approaches to improve safety, particularly for heavy vehicles.

6.2 Options

Four options were considered for a new bridge and approaches, based on hydraulic calculations which estimated the resulting flood levels for each of the options. The options were:

- Option 1 80 kph grading with existing bridge retained;
- Option 2 80 kph grading with existing bridge removed;
- Option 3 90 kph grading with existing bridge retained; and
- Option 4 90 kph grading with existing bridge removed.

The hydraulic calculations are presented in Appendix B. Table 6.1 compares the flood levels for the existing condition to the above four conditions.

Table 6.1
Calculated Flood Levels for the Four Options

	(1) 80 kph Existing Bridge Retained	(2) 80 kph Existing Bridge Removed	(3) 90 kph Existing Bridge Retained	(4) 90 kph Existing Bridge Removed
1% Flood Level - Proposed	632.84	632.82	632.86	632.83
1% Flood Level - Existing	632.85	632.85	632.85	632.85
Proposed - Existing	-10 mm	-30 mm	+10 mm	-20 mm

The calculations indicate that the difference in flood levels between Options 1 and 3 (retaining the bridge) is only 20 mm. This is due to the availability of waterway areas on both approaches. By removing the existing bridge and reinstating the abutments to the natural condition, the difference in flood levels between Option 2 and 4 is only 10 mm. The waterway area of the proposed bridge is fully utilised.

6.3 Proposal Selection

Based on the estimated flood levels shown in Table 6.1, Option 3 was not recommended as the flood level upstream of the bridge increases by 10 mm. All the other options were considered satisfactory. Options 1 and 2 were chosen for the basis for this proposal, providing the options to either keep the existing bridge or to remove it, without increasing the flood level upstream of the bridge.

The waterway investigation used a four 30 m span option for analysis. As the bridge would not be high above the ground and the headroom in the end spans would be minimal, a five 25 m span structure is proposed. This would allow a more slender superstructure with significantly lighter concrete girders. The design would require two piers in the river rather than one but these would be close to the riverbank.

The reduced depth of the superstructure would provide greater freeboard above high flood level and further reduce the potential impact on flood levels.

6.4 Statutory Planning

6.4.1 Zoning

Bridge and North of Bridge

Thornes Bridge and the area immediately to the north is zoned 1(d) Rural (Flood Hazard) under the Goulburn City Local Environment Plan (LEP) (Goulburn City Council, 1990).

1. Objectives of zone

(1) The objectives of this zone are:

- (a) To identify land liable to periodic inundation and generally within the high hazard storage or floodway areas of the Wollondilly River and Mulwaree Ponds which should be kept free of development liable to be damaged by floodwaters or likely adversely to affect the flow of floodwaters or to endanger human life;
- (b) To ensure the proper management of land within this zone which is of environmental significance or vulnerability by excluding or controlling development likely to have an adverse effect on the environmental value of that land; and
- (c) To identify urban floodways as localities requiring special planning considerations and development control policies.

(2) The particular objectives of this zone are:

- (a) To reduce risk of life and damage to property and the environment in localities subject to hazard flooding;
- (b) To permit development for certain purposes (including public utility undertakings and environmental facilities) only where it can be demonstrated;
 - (i) That the development would not adversely affect or be adversely affected by flood processes; and
 - (ii) That such development will not destroy, damage or compromise ecological processes and hydraulic function, or otherwise degrade the scenic amenity, landscape quality, recreation opportunities or heritage significance of the land forming the riverine environment along those reaches of the Mulwaree Ponds and Wollondilly River within the City of Goulburn;
- (c) To encourage recreational use of the riverine environments, including wetland systems along the Mulwaree Ponds;
- (d) To control land clearing and surface modification; and
- (e) To enhance visual diversity in the urban environment by defining substantial riverine environments which transect and define urban development and provide opportunity for internal landscape focus;

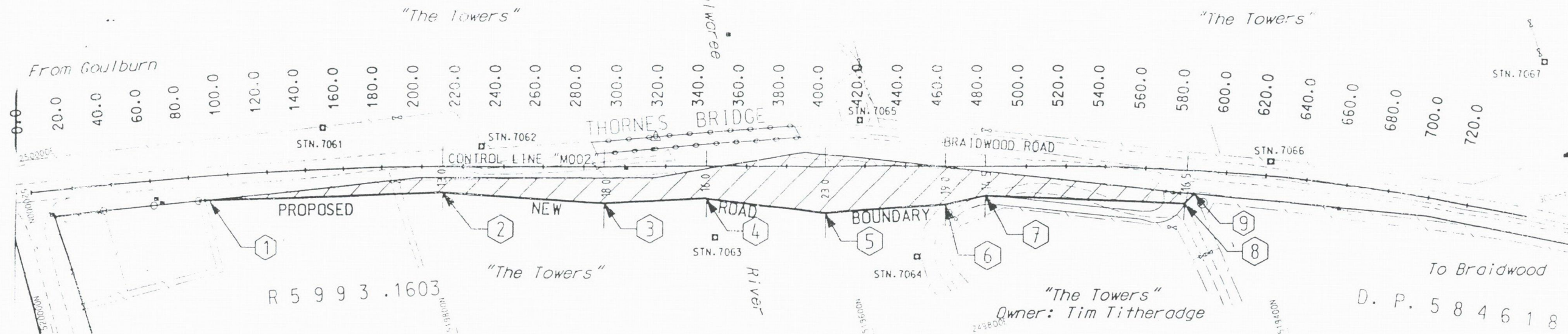
2. Without development consent

Nil.

3. Only with development consent

Any other purpose other than a purpose specified in item 2.

The area covered by the proposed bridge and approaches is mainly situated within the existing road reserve. About 0.5 ha would need to be acquired from The Towers property, to the north and south of the Mulwaree River (refer Figure 6.1).

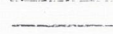


SURVEY CONTROL CO-ORDINATES

STATION	EASTING	NORTHING	HEIGHT
7059	249860.529	520002.434	634.948
7060	250000.000	520000.000	633.259
7061	249980.718	519841.919	632.315
7062	249951.873	519766.143	632.057
7063	249879.540	519665.520	631.345
7064	249845.347	519569.606	632.405
7065	249917.850	519580.699	632.983
7066	249847.470	519387.428	632.676
7067	249862.480	519244.395	634.181
7068	249797.085	519215.380	635.116
7069	249724.672	519117.635	636.640
STN1	249573.399	518780.338	640.124

NEW ROAD BOUNDARY CO-ORDINATES

POINT	EASTING	NORTHING
1	249960.20	519908.75
2	249934.35	519790.40
3	249900.80	519714.10
4	249899.45	519665.15
5	249877.90	519608.70
6	249867.00	519549.55
7	249866.45	519529.05
8	249838.43	519434.18
9	249841.90	519428.60

Land To Be Acquired 
 Existing Road Boundary 
 Proposed Road Boundary 
 Total Acquisition = 0.59 ha

SCALE 1:2000
 0 40 80
 20

Figure 6.1

Concept Boundary Plan – Approaches to
 Thornes Bridge

South of Bridge

The area immediately south of the bridge is zoned 1(a) General Rural under the Mulwaree Shire LEP (Mulwaree Shire Council, 1995).

1. The objectives of this zone are to promote the proper management and utilisation of resources by:

- (a) Promoting, enhancing and conserving:

- (i) Agricultural land, particularly prime crop and pasture land, in a manner which sustains its efficient and effective agricultural production potential;
 - (ii) Soil stability by controlling and locating development in accordance with soil capability, as identified by the Department of Conservation and Land Management;
 - (iii) Forests of existing and potential commercial value for timber production;
 - (iv) Valuable deposits of minerals, coal, petroleum and extractive materials by controlling the location of development for other purposes in order to ensure the efficient extraction of these deposits;
 - (v) Trees and other vegetation in sensitive areas and in any place where the conservation of the vegetation is significant to the protection of scenic amenity or natural wildlife habitat or is likely to control or contribute to the control of land degradation;
 - (vi) Water resources and water catchment areas for use in the public interest;
 - (vii) Localities of significance for nature conservation, including localities with rare plants, wetlands, permanent watercourses and significant wildlife habitat; and
 - (viii) Places and buildings of archaeological or heritage significance, including aboriginal relics and places;

- (b) Minimising the costs to the community of:

- (i) Fragmented and isolated development of rural land; and
 - (ii) Providing, extending and maintaining public amenities and services; and
 - (iii) Providing land for future urban development, for rural residential development and for development for other non-agricultural purposes, in accordance with the need for that development, and subject to the capability of the land and its importance in terms of the other objectives of this zone.

2. Without development consent

Agriculture; periodic public entertainments; tree planting (including planting for the purpose of growing farm woodlots of up to 10 ha each, but not including planting for the purpose of forestry).

3. Only with development consent

Any purpose other than a purpose included in item 2 or 4.

4. Prohibited

Boarding houses; child care centres; clubs; commercial premises; dog breeding or boarding; hospitals; hotels; institutions; motor showrooms; offensive or hazardous industries; residential flat buildings; roadside stalls; shops; professional consulting rooms; refreshment rooms; taverns; units for aged persons.

6.4.2 State Environmental Planning Policies

SEPP 4 – Development without Consent

This Policy stipulates that work related to classified or main roads which would normally require consent, may be carried out without the consent of Council. Given that Braidwood Road (MR 79) is classified as a main road, consent would not be required for the proposed bridge replacement on this road.

6.4.3 Regional Environmental Plans

Goulburn City does not have a Regional Environmental Plan (REP) in place. However, an REP is in preparation to protect Sydney's drinking water supplies which includes this area.

6.5 Relevant Approvals, Permits and Licences

The RTA is responsible for obtaining all necessary permits and approvals relating to NSW legislation. As mentioned in Section 6.4.2, consent would not be required from either Goulburn City Council or Mulwaree Shire Council for work related to classified main roads which would normally require consent.

For the purposes of motor traffic safety, the RTA can remove or destroy any tree under 3 m high or top or lop any tree over 3 m high within 15 m of the longitudinal centre line of a declared public road.

A Part 3A Permit would be required from DLWC under the *Rivers and Foreshores Improvement Act* "to excavate or remove material from the bank, shore or bed of any stream, estuary or lake, or land that is not more than 40 m from the top of the bank or shore of protected waters". Protected waters means a river, lake into or from which a river flows, coastal lake or lagoon.

A licence from DLWC would be required if water for construction activities would be extracted from the Mulwaree River.

7.0 DETAILED ASSESSMENT STAGE

7.1 Design Considerations

7.1.1 Existing Road

Braidwood Road runs within Goulburn City and Mulwaree Shire. It runs in a north-south direction, connecting Goulburn to other towns such as Tarago and Braidwood in the south. The existing road is two-lanes, one lane for travelling north and one for travelling south.

Currently, there are restrictions on heavy vehicles crossing the bridge. Only one heavy vehicle can cross the bridge at any one time. Overtaking on the bridge is not permitted. The speed limit over the bridge is 60 kph.

Vegetation on either side of the road, both north and south of Thornes Bridge, comprises predominantly exotic species. There are no pavements or footpaths along this section of Braidwood Road.

7.1.2 Existing and Forecast Traffic

The 1994 Traffic Volume Data shows annual average daily traffic (AADT) of 1835 on MR 79 (Braidwood Road), 2 km south of the bridge site. Future traffic growth rates are expected to be about 2% per annum (Ian Archer, pers. comm, February 2000).

The existing speed limit across the bridge is 60 kph. The new bridge would provide a speed limit of 100 kph.

7.1.3 Design Parameters

The speed limit would increase to 100 kph with the new bridge and approaches in use.

All design work has been carried out in accordance with the RTA's Road Design Guide.

The proposed bridge is located on a straight with a minimum horizontal clearance of 0.5 m from the old bridge at the northern abutment.

Constraints to widening the road reserve are the two houses on the north western side of Thornes Bridge (on the western side) and The Towers property on the south western side.

A Telstra cable would need to be relocated in order to construct the bridge and approaches. The access road to The Towers property would be realigned for 100 m. The proposed boundary and entrance gates would be located 13 m from the travel lane, suitable for a single unit truck to stand clear of the edge line. The same gates can serve both access tracks running through the property, similar to the existing arrangement.

7.1.4 Construction Activities

The construction of the bridge would take place between September 2000 and June 2001. Construction activities would take place between the hours of 7 am to 6 pm and 7 am to 1 pm on Saturdays. No construction activities would take place on Sundays. These timings are in accordance with the EPA's *Environmental Noise Control Manual*.

Thornes Bridge would continue to be used while construction of the new bridge and approaches is undertaken. On-site personnel would place appropriate signage near the construction site and would direct traffic along this section of Braidwood Road.

Replacement fencing would be carried out in consultation with the owner of The Towers property.

7.1.5 Waste Disposal

Waste material would be recycled where possible or otherwise disposed of in a responsible manner.

Waste material generated from the bridge replacement and preparation of the approaches would generally comprise three types which are:

- General refuse generated by personnel and remains of any fence removal from The Towers property;

- Excess soil material from changes in landscape surfaces and gravel from the realignment of the existing gravel road for the northern and southern approaches;
- Vegetative matter resulting from clearing of vegetation from roadside verges and along the river banks.

In general, waste would either be recycled or disposed of in an environmentally responsible manner. Trees that are removed would be mulched and the mulch used in landscaping. Cleared vegetation and other materials would not be burned.

General refuse would be stored in rubbish bins with heavy, lockable lids at the site. This would ensure that no rubbish is blown out of the bins or food scraps are scavenged by animals. Bins would be regularly emptied. All rubbish loads would be covered when transported away from the site.

Temporary toilets at the site would be serviced on a regular basis.

Although there is likely to be very little chemical material generated as waste from the replacement of the bridge, the proper disposal of chemicals according to appropriate Environment Protection Authority (EPA) Guidelines would occur. Recycling or disposal of waste oils would occur at licenced sites. EPA licences and approvals would be obtained for the disposal of any contaminated waste and the operators of the waste disposal site would be notified in advance. Any storage of materials in the vicinity of the site would be bunded and placed away from the river. The Soil Erosion and Sediment Control Plan also deals with waste control (refer Appendix C).

The above strategies would ensure that environmental impact from waste disposal is negligible at the site.

7.1.6 Demand on Resources

Resources used in the construction of the new bridge and the associated approaches would include materials such as fill material, base and sub-base gravels, fuels and oils and land. About 0.5 ha of land would need to be acquired from The Towers property.

Pre-cast concrete sections would be used in bridge construction.

The project would require water for spraying during construction and concrete curing. Spraying assists in grading the road and reduces the dust e.g. spraying roadwork. Water would be obtained from the Mulwaree River for these purposes.

Demand on resources also occurs during the operational life of the bridge. These resources include personnel to maintain the road pavement and fuel resources for vehicles. The replacement of the bridge would result in increased safety and increased savings in travel time, for all vehicles, but particularly for heavy vehicles.

7.2 Description of Site and Surroundings

Thornes Bridge is located south of the City of Goulburn approximately 4 km from the centre of the town on the Braidwood Road. The bridge crosses the Mulwaree River which flows in a north easterly direction to join the Wollondilly River. The bridge is about 600 m south of the Hume Highway bypass. Surrounding land uses consist of grazing, and lucerne growing for hay. The property The Towers is located upstream of the bridge and its owner also leases the Garroorigang property through which the Mulwaree River runs downstream of the bridge.

A waterway assessment was carried out by Woodlots and Wetlands (1998). It described the reach of the Mulwaree River from the Highway bypass as 8 m wide, 0.8 m deep, incised in portions with bank slumping and undercutting. It described the area as needing revegetation, subject to heavy grazing pressure and willows choking the stream below Thornes Bridge. This situation around Thornes Bridge was confirmed by field inspection. Flow in the river on the eastern side of the bridge is also affected by a low weir, which was thought to have been constructed for a water supply for the railway (pers. comm. Sonia Spotswood, Goulburn City Council, 1999). The historic significance of the weir is also referred to in Section 7.3.11. Thornes Bridge passes over the Mulwaree River at a point where the river is approximately 30 m wide. To the north east of the bridge the river is narrower and to the west, it continues at roughly the same width for approximately one kilometre. The area on the western side of the bridge was more heavily grazed than the eastern side. Both sides of the river to the west were planted with lucerne which is irrigated and had been recently cut for hay. There was erosion of the riverbank on the southern side caused by lack of vegetative cover.

The closest residences are two houses about 200 m north of the bridge on the Braidwood Road. Both these houses are close to the road. The residence on The Towers property is on the southern side of the river, about 700 m to the west from the bridge and well screened by trees. The residence on the Wyadra property is also approximately 700 m to the south east off Brisbane Grove Road. Figure 1.1 shows the location of these properties.

7.3 Environmental Impacts

7.3.1 Regional Landform

Thornes Bridge is located on the Mulwaree River which is surrounded by the broad alluvial plain formed by the river flooding over time. The general elevation is 630 m. The land to the north has been modified by the construction of the Hume Highway bypass which was constructed above the floodplain. Marian Hill, 700 m to the north west has an elevation of 675 m and is the other closest prominent landform on the floodplain.

The catchment area on the south west side of the main road is approximately 32 ha and the main entrance and surrounds to The Towers property is often covered by water, at a shallow depth. This has occurred on a few occasions over the past five years, even though the river was not breaking its banks. The outlet drain from the existing partly submerged pipe does not provide a gradient to the river. This would require the construction of an open drain within the new road reserve between the property boundary and the river.

Figure 7.1 from the Goulburn LEP shows that the area immediately south of the two nearest houses falls within an area with a 1:100 year flood frequency. The area immediately south of this, including Thornes Bridge, has a 1:20 year flood frequency.

Environmental Impacts

Replacement of the bridge would have no effect on the regional landform apart from minor changes in the vicinity of the bridge itself associated with changes to the drainage system on the southern side of the bridge and fill batters on the northern and southern approaches. The open drain would be 1 m deep and has been designed with a 0.5% grade from The Towers access entrance to the river.

A box culvert would be placed at the entrance to The Towers and the existing pipe would be salvaged and relocated further north, under the access road to the property. This would cater for a 20 year flood frequency and provide relief for the remainder of the catchment flow. It also meets the requirements of the landholder.

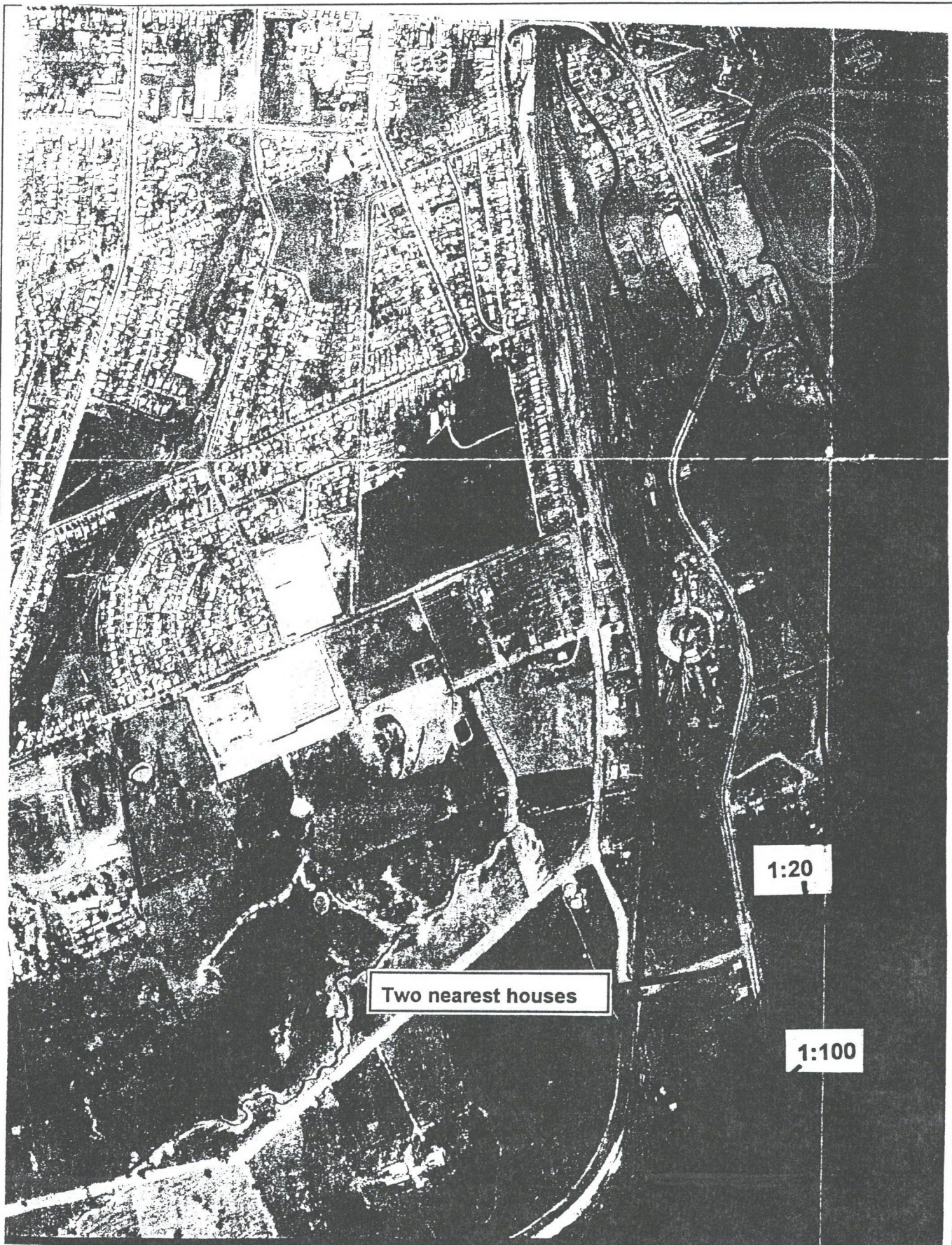


Figure 7.1

Flood Map

Cattle races would be provided under both of the bridge abutments and some excavation would be required under the southern abutment to obtain the 2.1 m clearance required.

Based on the flood calculations for a new bridge with an 80 kph grading, it is envisaged that the flood levels upstream of the bridge would not increase, but would in fact decrease. If the existing bridge is retained then the flood levels are expected to decrease by 10 mm and if the existing bridge is removed, then the flood levels are expected to decrease by 30 mm.

As described in Section 6.3, the adoption of a five-span structure would allow a more slender superstructure and provide greater freeboard above high flood level.

7.3.2 Geology and Soils

The area occurs within the Southern and Central Highlands Fold Belt and is the most complex geological province in NSW. Deposits of Quaternary alluvium are confined to fairly narrow floodplain development adjacent to the major river systems.

The soils of the Collector Creek Soil Landscape have formed on colluvial and alluvial deposits of Quaternary and Cainozoic clay, silt and sand. The alluvial deposits also consist of clays, silt and sands.

Soil Landscapes of the Goulburn 1:250,000 sheet (1991) provided information on the two main soil landscapes in the vicinity of Thornes Bridge. These are:

- Alluvial Soils (Goulburn Soil Landscape)

This general category includes a large number of individual landscapes which have formed as a result of deposition of alluvium around creeks and small river systems, notably the Lachlan, Wollondilly and Yass Rivers. Most occurrences are little more than 2 to 3 km² in any one location. Relief is generally to 20 m and slopes to 3%. The soils occur on frequently flooded areas.

Adjacent to the river, alluvial soils have formed. These soils show little evidence of soil forming processes apart from the accumulation of organic matter at the soil surface. Distinct bands of alluvial soil can be seen throughout the profile. Soil textures vary from gravels to coarse sands to silts and light clays. Yellow earths, minimal prairie soils and red podzolic soils are found on terraces.

- Collector Creek Soil Landscape

This soil landscape occupies the narrow floodplains of Saltpetre Creek, the Mulwaree River, Wollogorang and Collector Creeks. The soils are moderately deep, grey and yellow mottled duplex soils with bleached A2 horizons and neutral to alkaline reaction trends. These soils are similar to gleyed and yellow solodic soils.

Environmental Impacts

Construction works in the vicinity of the river would increase the possibility of sediment migrating from the site into the water. Bank erosion is already occurring in the vicinity of the river, in particular on the southern bank. Suitable erosion and sediment control measures would be implemented to ensure that the environmental impact of the construction works is minimised.

As part of the bridge works, an 8 m long sediment containment wall with an inner wall faced with geotextile, would be built at the end of the open drain to act as a permeable siltation basin. This structure would minimise sediment from runoff during rainfall events from reaching the river. It would also reduce the area of land that needs to be acquired from The Towers property.

A Soil Erosion and Sediment Control Plan is at Appendix C.

7.3.3 Climate

Goulburn is 648 m above sea level and experiences a cool, temperate climate. Rainfall is seasonal with the highest falls occurring in the warm to hot summer period. Goulburn's annual average rainfall for the last 10 years is 651.5 mm (Bureau of Meteorology, January 2000). Winters are generally cold with morning frosts occurring regularly and occasionally snow. Frosts occur on average 70 days per annum.

Fogs have been experienced in each month of the year. The average number of foggy days is 23 per annum. They occur more regularly from April to August at a frequency of approximately four days per month. Predominant winds are westerlies.

Average minimum and maximum temperatures recorded for the past 10 years range from 12°C to 26.1°C in December and from 1.7°C to 11.7°C in winter (Bureau of Meteorology, January 2000).

Average summer humidity is 57% in the mornings and 37% in the afternoons, and in winter, 86% in the mornings and 37% in the afternoons (Goulburn City Council web-site).

7.3.4 Landform Stability and Erosion Hazard

Streambank erosion occurs in both soil landscape types as well as gullying of drainage lines. Some areas of the Collector Creek Soil Landscape are affected by salting and this appeared to be the case in a paddock to the south east of the bridge. Streambank erosion is occurring close to the bridge on the south west, mainly because of heavy grazing and the lack of vegetative cover.

Willows below Thornes Bridge are creating significant disruption to flows (Woodlots and Wetlands, 1998). Willows in this and other areas are choking off low flows, causing sedimentation, and encouraging bank scouring. They have also discouraged native vegetation and significantly altered the light and nutrient supply in portions of the streams.

Environmental Impacts

The proximity of works to the Mulwaree River means that care would need to be taken during construction. Potential impacts include soil disturbance and sedimentation, however, in order to minimise these impacts, the following mitigation measures would be implemented:

- Soil disturbance would be minimised as far as possible in order to reduce erosion;
- Channels leading to and from culverts and drainage lines would be lined to prevent scouring from high flow velocities;
- Installation of culverts and drainage pipes would ensure that flow is not concentrated and lead to erosion. Channels would be lined to prevent scouring from high flow velocities;
- Landscaping is proposed between the relocated access track on The Towers property and the proposed road boundary. This and other cleared areas would be revegetated with native species that are local to the area. A list of possible species is included in Section 7.3.8; and
- Revegetated areas would be protected from disturbance using barriers during and after bridge works. These areas would be inspected to ensure revegetation has been successful.

More detail is provided in the Soil Erosion and Sediment Control Plan (Appendix C).

7.3.5 Air Quality

A lack of concentrated heavy industry within Goulburn helps ensure that pollutant loadings are relatively low and are usually dispersed (Environment ACT, 1998). However, higher concentrations of pollutants may occur briefly in small areas, for example, close to busy roads during peak traffic periods. There are also inversions on some clear winter nights, which can trap pollutants, such as wood smoke from domestic fireplaces and stoves, close to ground levels.

Thornes Bridge is situated in a rural area, surrounded by predominantly cleared, agricultural land. The most common air contaminant here would be dust from the road, agricultural activities and vehicle exhaust fumes and vehicle movements particularly along any unsealed roads and property entrances. This section of Braidwood Road is sealed and the closest unsealed road is The Towers property entrance. Other air pollutants in this area would include pollen, seeds and smoke.

Environmental Impacts

Construction activities associated with the new bridge and approaches would involve the use of a range of equipment such as a bulldozer, a grader, a roller, a pile driver, a compressor, a generator, a crane and water tankers. Air pollution arising during the construction phase would include exhaust emissions from construction vehicles and equipment, dust and other particulate matter generated from the movement of trucks on site and from materials and waste transported to and from the site. Dust may also be generated from cleared areas and topsoil stockpiles, particularly during dry periods.

The two nearest houses on Braidwood Road are likely to be the main residential properties affected by dust resulting from the proposed activities, however these impacts would be temporary. The construction site and approaches would be watered regularly in order to minimise dust and any soil stockpiles on the site would be watered or stabilised with vegetation.

7.3.6 Water Quality

Thornes Bridge provides access across the Mulwaree River, which flows in a northerly direction and eventually flows into the Wollondilly River.

Goulburn City Council has undertaken a detailed study of urban water quality since 1993 (Woodlots and Wetlands Pty Ltd, 1998). The water quality monitoring sites included four sites along Mulwaree Ponds, including one site at Thornes Bridge (refer Figure 7.2). A complete set of water quality data for Thornes Bridge is provided in Appendix D.

Data since 1996 was used to develop an overall site ranking for water quality, depending on whether an individual water sample complied with each Australian and New Zealand Environment and Conservation Council (ANZECC) criteria. The percentage of time the samples were within guideline values were then determined and the sites graded. The results for the Thornes Bridge site are presented in Table 7.1. The results of all the sites are presented in Appendix D.

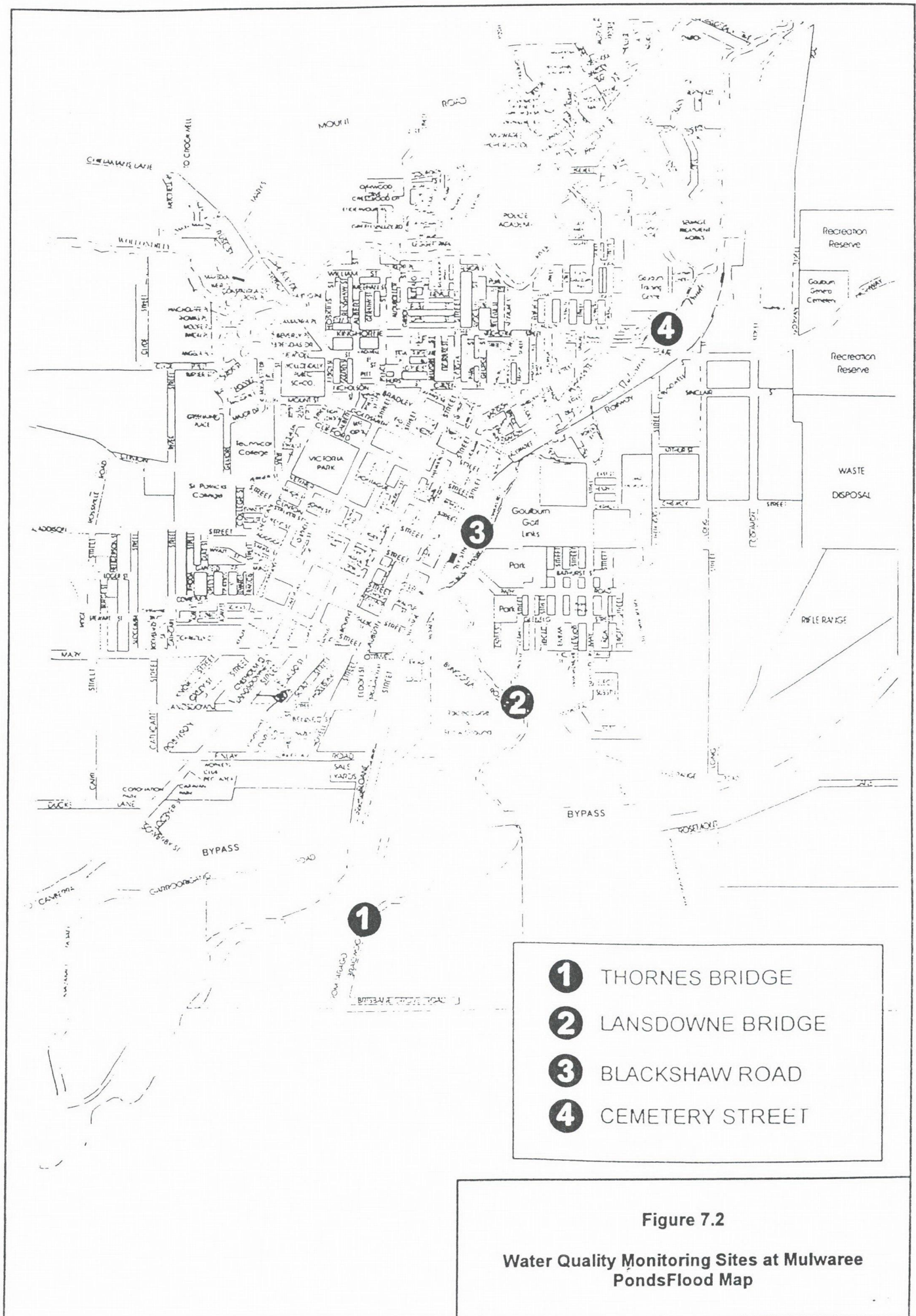


Table 7.1
Water Quality Grading System for Ecosystem Health and Recreational Use: Thornes Bridge

	Aquatic Ecosystem Health – Physical Indicators	Aquatic Ecosystem Health – Chemical Indicators	Primary Contact Recreation	Secondary Contact Recreation
Thornes Bridge	Fair	Fair	Very poor	Good

(Source: Woodlots and Wetlands, 1998)

Notes: Water quality grade and range of time the criteria were met:

Good (75-100%) Fair (50-75%) Poor (25-49%) Very Poor (0-24%)

The physical indicators measured were dissolved oxygen, conductivity, pH and turbidity. The physical health of the water was fair upstream of the city. It was lower through the city, but improved by the time it reached Murray Flats.

In general, there was a depression in biological quality indicators such as oxygen concentration and faecal coliform population as the water flowed downstream through the city, but the river had recovered by Murray Flats. Turbidity showed a similar trend.

A study by O'Rourke (1997) examined the nitrogen, phosphorus and suspended solids and biological oxygen demand concentrations in water in 25 existing sub-catchments in the Goulburn urban area in three rain events. Three catchments which drain into the Mulwaree Ponds south of Thornes Bridge were found to have the highest contaminant concentrations in all three rain events, indicating that urban stormwater was a major contributor to the pollutant load and the presence of saleyards and high grazing intensity in the Mulwaree Ponds catchment could also contribute to the contaminant load. Woodlots and Wetlands (1998) state that these results are consistent with the generally low water quality that frequently occurs in the Mulwaree Ponds, downstream of Thornes Bridge.

Environmental Impacts

Construction activities close to the river have the potential to affect water quality if sediment or spillages reach the river. The installation of a sediment containment wall with an inner lining faced with geo-textile at the end of the open drain on the southern side of the bridge would act as a permeable siltation basin and minimise sediment pollution in the river from surrounding land uses. The early installation of this measure during construction would help reduce any effects of sediment on water quality in the river.

Containment ponds would be constructed to collect any spillages during construction of chemical and/or toxic liquids to prevent contaminants entering the river. The location and size of the ponds would be dependent on the land available. However, a capacity of about 30,000 litres would be provided.

Contaminated liquids would be pumped from the containment ponds if spills occur and disposed of in a manner approved by the EPA.

Possible pollutant materials would also be stored well away from the river in suitably bunded areas. Spillages would also be cleared up as soon as possible after occurrence.

Implementation of the Soil Erosion and Sediment Control Plan (Appendix C) would minimise these effects, however constant checking, particularly of the integrity of the silt fences, would be required.

7.3.7 Aquatic Biology

Woodlots and Wetlands (1998) carried out a study of the aquatic biology of the waterways in the Goulburn City area as part of the study. A site below Thornes Bridge was sampled four times from September 1997 to February 1998. These results are included in Appendix E and discussed below.

Macro-invertebrates

Species richness and species composition provide an assessment of ecosystem health. The general assumption (ANZECC, 1992) is that "high levels of diversity are desirable and equate with high levels of biological integrity". Appendix E shows that the number of macroinvertebrate taxa varied from 17 to 30 over the four sampling periods. The Woodlots and Wetlands study suggests that land uses upstream of the city in the Mulwaree Ponds are having a negative impact on ecosystem health.

Fish

The native fish Australian Smelt *Retropinna semoni*, which is widespread and abundant in south eastern Australia, was present at Thornes Bridge.

Algae

Phytoplankton

The results of the survey are in Appendix E. Large populations of organisms were recorded in February 1998, consistent with an algal bloom which may have been the consequence of pollution from upstream industry.

Periphyton

The results of periphyton sampling are also shown in Appendix E. The number of taxa varied from six to 13 over the four sampling events. A summary of the periphyton and benthic algae results for Thornes Bridge are shown in Table 7.2

Table 7.2
Summary of Periphyton and Benthic Algae at Thornes Bridge

	September 1997	October 1997	December 1997	February 1998
Dominant Genera	<i>Navicula</i> <i>Fragilaria</i>	<i>Melosira</i> <i>Navicula</i> <i>fragilaria</i>	<i>Fragilaria</i> <i>Spirogyra</i>	<i>Spirogyra</i>
Abundance of Dominant Genera (% coverage)	(25 – 50)	(75 – 100)	(50 – 75)	(50 – 75)

Season, temperature, flow and surrounding land use all influenced stream ecology. The site at Thornes Bridge showed mild to moderate levels of pollution.

Environmental Impacts

Construction activities associated with the new bridge and approaches have the potential to increase the sediment load in the river which may in turn affect aquatic species diversity. Higher sediment levels smother plants and animals living on the bottom of the river and destroy spawning sites for fish. Increased sedimentation affects the depth to which light penetrates the water, reducing plant growth and changing the type of algae present.

Implementation of the Soil Erosion and Sediment Control Plan (Appendix C) including revegetation of the riverbanks would minimise the impact on aquatic biology which is already affected to some degree by upstream industry and adjacent land uses.

7.3.8 Vegetation

The low-lying areas around Goulburn have been extensively cleared for agriculture and very few native trees or shrubs have survived, especially along the two main waterways, the Mulwaree Ponds and the Wollondilly River (Woodlots and Wetlands, 1998). This is certainly the case in the vicinity of Thornes Bridge. The riverbanks are dominated by Willows *Salix* spp., Hawthorn *Crataegus monogyne*, English Elm *Ulmus procera* and Large-leaved Privet *Ligustrum lucidum*.

The upper riverbanks and adjoining paddocks contain a range of pasture grasses and weeds as well as the legume Lucerne *Medicago sativa* which is irrigated and cut for hay in the paddocks on the western side of the bridge and approaches. A list of species found in the study area is presented in Appendix F. It shows that exotic species predominate, with only two native grasses Windmill Grass *Chloris truncata* and *Poa* spp. occurring on the south eastern side of the bridge. *Phalaris aquatica* was the most prevalent species. It is a persistent perennial, pasture species. Noxious weeds included Blackberry *Rubus fruticosus*, St John's Wort *Hypericum perforatum*, African Boxthorn *Lycium ferocissimum* and Patterson's Curse *Echium plantagineum*. The main thistles were Scotch Thistle *Onopordum acanthium*, Black Thistle *Cirsium vulgare* and Groundsel *Senecio vulgaris*.

The main aquatic plants included Common Rush *Juncus usistatus*, Umbrella Sedge *Cyperus eragrostis* and Water Ribbons *Triglochin procerum*.

Threatened Species

Two vulnerable orchids listed under the TSC Act have been recorded within a 5 km radius of Thornes Bridge (NSW Wildlife Database). These include Buttercup Doubletail *Diuris aequalis* and *Diuris tricolor*. Neither species were located and were not expected as the former favours montane eucalypt forest with a grassy-heathy understorey and the latter prefers grassy *Callitris* woodland.

Environmental Impacts

The majority of the vegetation types in the vicinity of the bridge are exotic species. The construction of the new bridge would result in the removal of mature English Elms and Large-leaved Privet to the west of the existing bridge as well as a range of weeds and pasture species. Some Willows on the northern bank may be affected by construction, however the property owner of the Towers has specifically requested that the trees on the northern bank of the river within the property boundary be retained.

Landscaping is proposed to be carried out between the relocated access track to The Towers and the proposed road boundary south of the bridge. It would be advantageous if a range of riparian species could be planted in the vicinity of the bridge. Such species would include the following:

- Ribbon Gum - *Eucalyptus viminalis*;
- River Bottlebrush - *Callistemon sieberi*;
- Early Black Wattle – *Acacia decurrens*;
- Late Black Wattle – *Acacia mearnsii*;
- Blackwood – *Acacia melanoxylon*;
- Green Wattle – *Acacia parramattensis*;
- Black Sallee – *Eucalyptus stellulata*; and
- Spiny Matrush – *Lomandra longifolia*.

Other species which could be included as scattered specimens include:

- Apple Box – *Eucalyptus bridgesiana*;
- Yellow Box – *Eucalyptus melliodora*; and
- Candlebark – *Eucalyptus rubida*.

7.3.9 Wildlife and Habitat

Appendix F lists the animal species recorded during a site visit in December 1999. Fourteen species were identified, all of which were birds, except one which was the Rabbit *Oryctolagus cuniculus*. There were a number of warrens in the side of the river bank and on the bridge approaches. No other signs of fauna such as scats, scratches, diggings or bones were observed although sheep droppings were numerous on the south eastern side of the bridge. No frogs were heard calling.

Threatened Species

The vulnerable Striped Legless Lizard *Delma impar* has been recorded as occurring within a 5 km radius of the bridge (Atlas of NSW Wildlife Database). It is found primarily in lowland native grasslands. This habitat type occurs on flat or gently undulating plains, and is dominated by perennial, tussock-forming grasses such as Kangaroo Grass *Themeda triandra*, Speargrass *Stipa* spp. and Wallaby Grass *Danthonia* spp. The species is also found in some areas dominated by exotic grasses. However, a tussock structure in grassland appears to be an important habitat characteristic as well as soils that generally have a moderate to high clay content which often produce cracks in summer (Environment ACT, 1998).

Most areas where the species persists are thought to have had low to moderate levels of agricultural disturbance in the past. It is highly unlikely that the species occurs in the area around the bridge as it has been highly disturbed by agricultural activities such as heavy grazing, hay making and pasture improvement, as well as weed invasion. Additionally, neither the tussock species nor soil type favoured by the lizard occurs at the study site.

The vulnerable Comb-crested Jacana *Iredippara gallinacea* was recorded within a 5 km radius of the bridge. This bird occurs in coastal and sub-coastal areas in northern and eastern Australia and south east to the Hawkesbury River. It would appear that the sighting was a vagrant as it is so far from the southern end of its known distribution (Schodde and Tidemann, 1986). It occurs on deeper, permanent, still freshwater swamps, ponds and billabongs. None of these habitats occur within the vicinity of the proposed bridge.

Environmental Impacts

The construction of a new bridge would have little impact on wildlife habitat. An Eight Part Test was not undertaken for the two threatened species discussed above, as there is no suitable habitat available for either species in the vicinity of the bridge.

The majority of the vegetation provides little in the way of habitat apart from water plants which provide some shelter and foraging for water birds. The exotic species already present have a

significant impact on habitat opportunities and no threatened species are recorded or expected to occur in the vicinity. The revegetation of the bridge surrounds with native riparian species would increase the opportunity for native species to inhabit the area in the future.

7.3.10 Socio-economic Considerations

Goulburn is located approximately 200 km from Sydney and 95 km from Canberra. The town was established in 1833 and proclaimed a city in 1859, which makes Goulburn, Australia's oldest inland city.

The City Council covers an area of 43 km² and supports a population of 22,500 people (1996 figure). In addition, approximately 15,000 people live in the districts surrounding the City (Goulburn City Council Website). Since 1991, the population has grown approximately 0.8%. The 1996 census figures indicate that the median age is 32 years. The population is relatively static and consists of an essentially Anglo-Irish background with approximately 92% of the population born in Australia and 95% of the population having Australian citizenship (Environment ACT, 1998).

Goulburn City has strong rural industries, led by the wool industry. These rural industries combine with other secondary and tertiary industries to strengthen the City's economic foundations. A wide range of commercial and professional sectors service the needs of the community (Goulburn City Council web-site).

Goulburn's secondary industry is based on a mix of private and Government enterprise. In the private sector, firms engaged in wool scouring, cotton products, footwear, abattoirs, heavy and light engineering, building related undertakings, retail distribution, concrete products and air-conditioning can be found. State and Federal Government workshops exist for Public Works, RTA, the Railways, Electricity and Telecommunications (Goulburn City Council web-site).

The top five industries, in terms of employment size/number of people, are retail trade, health and community services, personal and other services, manufacturing, and transport and storage. The number of businesses in 1996 was 1,037 (Goulburn City Council web-site).

Thornes Bridge is located on the main road (Braidwood Road) south to Tarago and Braidwood. Braidwood is 92 km from the site and Tarago is 44 km. Braidwood Road provides access into the Goulburn township from these southern townships.

Environmental Impacts

Replacement of Thornes Bridge with a new bridge with wider approaches would result in a more efficient road for vehicles entering Goulburn. This would be particularly important for heavy vehicles, as currently only one heavy vehicle can be on the bridge at any given time. The new bridge would provide faster travel times for heavy vehicles entering or leaving Goulburn. Safety, in particular for heavy vehicles, would increase with the provision of a more stable and secure structure.

The new bridge would affect a small area of agricultural land on the western side. The land is currently irrigated and used for lucerne hay making. The area affected totals approximately 0.5 ha.

7.3.11 European Heritage

Goulburn was established in 1833. In 1869, the railway from Sydney reached Goulburn, resulting in rapid growth and wealth which lasted through to the mid-1890's. Goulburn was an important Government service centre as well as having educational and ecclesiastical facilities and being a pastoral service centre (Environment ACT, 1998).

To the north of Thornes Bridge is the Garroorigang Homestead, which was built in the mid-1850's as the Mulwaree Inn and was subsequently used as a school (Lester Firth Associates, 1983) and then as the home of the Belcher/Hume family. The building itself is Georgian in character and the Victorian drawing room has remained unaltered since 1868 and the schoolroom can still be seen. Regular tours of the homestead are conducted. Adjacent to the homestead is a stone memorial to the explorers Hume and Hovell.

John Armes & Associates conducted a review of material from the McMillan, Britton and Kell (MBK) (1998) study of the Heritage Significance of Timber Bridges. This review is attached to the Statement of Heritage Impact for Thornes Bridge prepared by John Armes & Associates (refer Appendix G). With regard to Thornes Bridge, the specific findings of the report were:

Thornes Bridge is one of a group of 21 Allen Truss - type bridges. It has been ranked as being regionally significant and is ranked as the 20th - most significant Allen Truss - type bridge in NSW and is a representative example, rather than rare example, of this type of bridge. When all types of timber bridges are combined, it ranks as the 56th - most significant timber bridge in NSW.

The review states that Thornes Bridge has varying degrees of significance for its historical, aesthetic, social and technical values. The regional significance of the bridge would be recognised as its part of a group of timber bridges in the region, including the Lansdowne Bridge (Goulburn), the bridge over the Goodradigbee River (Wee Jasper), bridge over Yass River (Gundaroo) and several others.

The review also states that the bridge would be recognised for its relationship with nearby historical places and its contribution to the formation of a cultural landscape which includes the following places: Garroorigang Homestead (Register of the National Estate); Goulburn Brewery (Register of the National Estate); South Hill (LEP Heritage Item); Lansdowne Bridge (Register of the National Estate); Wynella Homestead; Brisbane Grove; The Towers; Southern railway line; and (possibly) the weir wall downstream of Thornes Bridge.

Environmental Impacts

The environmental impacts in relation to the heritage significance of Thornes Bridge are dependent on whether the bridge is retained or removed.

The Statement of Heritage Impact and the attached review undertaken by John Armes & Associates (refer Appendix G) concludes that significant local heritage values would be lost by removal of Thornes Bridge. The bridge is situated in an area with high historical and aesthetic value and its retention would sustain this feature of the region, it would preserve a local example of an Allen Truss - type bridge as well as provide educational opportunities. The aesthetic value would be diminished by the construction of the proposed new bridge adjacent to it.

If the bridge is retained then the values mentioned above would not be lost. However, funding for the maintenance of Thornes Bridge would be required. Mulwaree Shire Council supports the removal of the Thornes Bridge however, Goulburn City Council raised concerns about its removal in terms of its historical context.

The Statement of Heritage Impact recommends that Thornes Bridge be retained due to its regional significance.

7.3.12 Indigenous Heritage

Thornes Bridge is situated within the boundaries of the Pejar Local Aboriginal Land Council (LALC). Vivienne Courto on behalf of Rob Paton Archaeological Services undertook an archaeological sites assessment within the study area on behalf of NECS. A full report is attached in Appendix H. The review included a literature review, a search of the NPWS Archaeological

Sites Register, consultation with the Pejar LALC and a field survey of the site of the new bridge with a member of the Land Council.

No Aboriginal heritage sites or artefacts were located during the survey, despite the fact that previous archaeological investigations (Koettig, 1983; 1987; Paton, 1990) revealed that the area surrounding the Mulwaree River was an attractive one to Aboriginal groups, providing a permanent source of water and consequently a good supply of animal and vegetable food resources. Environments such as that found in the vicinity of Thornes Bridge were favoured for camps, with well-situated campsites being utilised by many successive generations. A study by Koettig (1983), approximately one kilometre north east of Thornes Bridge identified 22 open artefact scatters, including two (G17 and G20) which contained over 100 artefacts. G17 was considered to be highly significant because of its artefact density and raw material range as well as its location in a sand body, which enables artefacts to be easily dated. A subsequent excavation of the site G17 (Paton, 1990) revealed that the site had been periodically occupied for over 5000 years and contained a large number of artefacts.

The report states that it is unusual that no artefacts were located in the study area. However, the report explains that this could be due to the very small study area, the poor visibility in a lucerne paddock to the north west of the bridge which would be disturbed for the realignment of the northern approach, and the disturbed nature of the ground, particularly on the southern side of the bridge. Difficulty in viewing the ground within the lucerne paddock may have obscured any isolated artefacts turned up by ploughing, however, the report states that this does not guarantee the absence of artefactual deposits below the level of the ploughed earth.

Based on previous reports, such as Koettig (1983) and Paton (1990), the area around the Mulwaree River can be considered to be of moderate to high archaeological significance, mainly due to the existence of sites such as G17, which are located in sand bodies and therefore have the potential to provide well-stratified sequences of cultural deposits.

Environmental Impacts

No Aboriginal archaeological sites were found in the immediate vicinity of Thornes Bridge. Due to low visibility in the lucerne paddock to the north west of the bridge, it is not known whether any sub-surface cultural deposits underlay the topsoil in this area. Therefore test-pitting would be undertaken on the north western side of the bridge, where the road would be realigned for the northern approach. If any deposits are found, then members of the Pejar LALC would be consulted as site monitors during construction of the new bridge.

If during construction any archaeological sites are located, work would stop immediately and NPWS and the Pejar LALC would be notified. Activities which may disturb the site would not recommence until approval is received from NPWS.

7.3.13 Landscape and Visual Considerations

Thornes Bridge is located south of the City of Goulburn on the floodplain of the Mulwaree River on Braidwood Road. It is therefore highly visible from a range of vantage points in the area. In order to present an understanding of the landscape and visual impact of a new bridge over the Mulwaree River, photographs were taken of the existing bridge, from the main viewing locations in the area. Plates 1 and 2 show the northern and southern approaches to the bridge along Braidwood Road.

The Towers property is located about 700 m upstream of the bridge on the southern side of the river. The new bridge would be located to the west of the existing bridge and thus slightly closer to The Towers residence. The residence is, however, well screened by existing vegetation and only the tower of the residence is visible above the treeline and consequently would have views of the bridge site.

The closest residences are two houses about 200 m north of the bridge on the Braidwood Road. Both these houses are close to the road and Plate 3 shows the view towards the existing bridge from the front of the houses. Plate 4 shows the view of the bridge for travellers along Brisbane Grove Road, to the south east of the bridge, near the entrance to the property Wyadra. The residence on the Wyadra property is also approximately 700 m to the south east. The South Hill Bed and Breakfast establishment is shown in Plate 5. It is located about one kilometre north west of the bridge.

Apart from residences in the vicinity, the main viewers would be either road or rail travellers. Travellers to and from Braidwood and other locations to the south, cross the bridge and thus have the opportunity to view the structure at close quarters. Plate 6 shows the view from the railway viaduct over Sloane Street, which is to the north west of the bridge. The bridge would be visible to railway travellers across the floodplain. Plate 7 shows the view from the road towards the bridge from Sloane Street north of the railway viaduct.

The bridge is about 600 m south of the Hume Highway bypass. Plates 8 and 9 show the bridge in the middle distance when viewed from the bypass. The main view from the bypass to the south along Braidwood Road is obscured by a noise barrier and the photographs were taken from the eastern and western ends of the barrier. Traffic is travelling relatively fast along the highway and only glimpses of the bridge would be seen.

Environmental Impacts

The proposed bridge would be visible from local residences, users of Braidwood Road and travellers on the Highway bypass.

If the existing bridge is retained, the new bridge would detract from the visual characteristics of the existing bridge although the overall appearance would not be markedly different to that currently existing. If the existing bridge is demolished, the form, scale and size of the new bridge would not significantly change the visual character of the area.

While construction activities would result in the removal of vegetation to the west of the existing bridge, revegetation and landscaping would be undertaken in the road reserve once construction activities are completed. These plantings would augment the existing vegetation and would obscure views of the bridge from some locations and lessen the extent of disturbance.

7.3.14 Noise and Vibration Effects

Noise measurements were taken to determine the background noise levels at the bridge and in its vicinity in December 1999. Measurements were taken at the nearest residential dwelling (211 Braidwood Road) and at the bridge, and one measurement was taken at the Wyadra property, approximately 700 m away to the south east. This dwelling is approximately the same distance away as The Towers property and was considered to be representative of noise at both locations. However, factors to take into consideration are the train line and highway which are closer to The Towers property.

Factors which affected noise results on the day were the high number of trucks on the morning of monitoring because of a weekly sheep sale. Many trucks use Braidwood Road to enter Goulburn from the south. There were gusty winds in the afternoon, which affected the noise readings. Noise readings taken are presented in Appendix I.

Generally, the background noise in the area is high due to the continuous noise from the highway. From the nearest residential property, the L90 measurements at 6 am and at 8:30 am were 56 decibels (dB). The L90 measurement at 1:15 pm was 64 dB from this location, however this reading was affected by increasing wind conditions.

Some noise readings of vehicles travelling over the bridge were taken from the nearest residential property and the noise levels ranged from 57 dB to 72 dB.

Environmental Impacts

Noise

As described above, the background noise level in the vicinity of Thornes Bridge is high and is affected primarily by traffic on the highway 600 m to the north, trains and vehicles on Braidwood Road.

Traffic noise already affects these residences close to the road and these residences would be temporarily affected by increased noise associated with the construction of the bridge.

Following the construction of the new bridge, noise from vehicles crossing the bridge, in particular heavy vehicles, would be reduced. At present, the timber planks on the existing bridge rattle when vehicles cross and vehicles are required to slow down or stop before crossing. The two nearest houses would benefit from this reduction of noise as well as drivers and passengers in the vehicles crossing the bridge.

A study was carried out using the TNoise computer programme, which is based on the CRTN noise prediction model. Results were assessed with the EPA Environmental Criteria for Traffic Noise to determine their impact. The report of this study is attached at Appendix I.

Residences adjacent to MR 79 and close to the bridge are treated as Type 3 developments (Redevelopment of existing freeway/arterial road) in accordance with the Environmental Criteria for Road Traffic Noise.

If the criteria are exceeded, then the development should be designed so as not to increase existing noise levels by more than 2 dB. The criteria for a Type 3 development show the following noise level objectives listed in Table 7.3.

Table 7.3
Criteria for Type 3 Developments

	Noise Level (dB)
Base level – day time 7 am to 10 pm Leq (15 hr)	60
Base level – night time 10 pm to 7 am Leq (9 hr)	55

The existing timber bridge approach segments include a special adjustment of +3.5 dB, as there is an audible increase in noise when vehicles drive over the bridge deck.

For the Open Grade Asphalt results, a factor of -2.5 dB was adopted in TNoise.

Calculations for existing conditions included a traffic speed of 60 kph. Traffic speeds of 80 kph and 100 kph were adopted for the design calculations. The tables below show the difference in decibels when the road surface is changed for the two houses close to the bridge shown in Figure 1.1.

Table 7.4
Calculated Noise Levels for House at Station 30

Residence	Calculated Existing Levels		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
	Leq(15)	Leq(9)				
Results for 80 kph						
House at Stn. 30	58.5	53.1	60.1	55.0	*DG AC	Yes
House at Stn. 30	58.5	53.1	63.6	58.5	*F/S	No
Results for 100 kph						
House at Stn. 30	58.5	53.1	61.9	56.9	*DG AC	No
House at Stn. 30	58.5	53.1	65.4	60.4	*F/S	No
House at Stn. 30	58.5	53.1	59.4	54.4	*OG AC	Yes

*DG AC = Dense grade asphalt

*OG AC = Open grade asphalt (refer to Item 2. Traffic Noise Criteria)

*F/S = Flushed Seal

Table 7.5
Calculated Noise Levels for House at Station 80 (Closest to the Bridge)

Residence	Calculated Existing Levels		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
	Leq(15)	Leq(9)				
Results for 80 kph						
House at Stn. 80	58.7	53.3	60.5	55.3	*DG AC	Marginal
House at Stn. 80	58.7	53.3	64.0	58.8	*F/S	No
Results for 100 kph						
House at Stn. 80	58.7	53.3	62.2	57.2	*DG AC	No
House at Stn. 80	58.7	53.3	65.7	60.7	*F/S	No
House at Stn. 80	58.7	53.3	59.7	54.7	*OG AC	Yes

*DG AC = Dense grade asphalt

*OG AC = Open grade asphalt (refer to Item 2. Traffic Noise Criteria)

*F/S = Flushed Seal

Noise impact to the residential locations adjacent to the proposed work has been assessed and it is concluded that the house on MR 79 at Stn. 80 closest to the bridge is the most sensitive. If a speed zone of 80 kph is adopted then Dense Grade Asphalt road surface is acceptable, however, if a speed zone of 100 kph is adopted then Open Grade road surface must be used.

Vibration

The two nearest houses on Braidwood Road could potentially be affected by vibration during road and bridge construction.

Roadworks would be undertaken up to the nearest residence on Braidwood Road to the north of the bridge. Work on the 100 m of roadway closest to the house would not involve major earthworks or the use of compaction equipment. Over the 100 m of roadway up to the bridge compaction equipment would be used. To minimise vibration a vibrating roller would not be used on the northern approaches to the bridge.

On the southern side of the river, the residence at The Towers is located about 800 m from the bridge and roadworks and would not be impacted by vibration associated with roadworks.

The bridge piers would be installed using pile driving equipment. Some vibration may be experienced within 150 m of pile driving activities. There are no residences within this distance.

On this basis it is not expected that vibration would affect the nearest residences. However, vibration attenuation can be affected by factors other than distance. To ensure residents are not adversely affected, the RTA would undertake building inspections before commencing construction and after completion. Any damage caused by vibration would be repaired.

7.4 Cumulative Impacts

Consultation with Goulburn City Council and Mulwaree Shire Council and a review of current development applications indicated that there are no existing or proposed developments in the vicinity of the bridge site. The RTA has no other proposed or current road developments in the area.

Consequently, there would be no cumulative impacts associated with the construction of the proposed bridge and other developments.

8.0 IMPLEMENTATION STAGE

8.1 Summary of Proposed Safeguards

The following summary of the proposed safeguards forms the basis of an EMP for the project. These safeguards are:

- Licences, Permits and Approvals
 - Consultation with Telstra concerning removal of infrastructure; and
 - Consultation with DLWC regarding a licence to extract water for construction activities from the Mulwaree River.

- Waste Disposal

- All possible pollutant materials would be stored well clear of any flood-prone or streambank areas and would be stored in a designated area;
- Removed vegetation would be disposed of by chipping or mulching for use in future landscaping. Dense grass cover would be removed from the site and could be disposed of at the local landfill;
- Waste collection bins and facilities for sorting garbage would be provided on site; and
- Vehicle and equipment maintenance would be undertaken off site if possible or if on-site, in a designated, bunded area. Inspections would be undertaken to ensure leaks and spills are rectified and cleaned immediately.

- Works Compound and Storage Site

- Any works compound site and stockpiles of gravel or topsoil would be located on cleared land within the road reserve. It would be located no closer than 50 m from the river bank;
- The site would be fenced and a gravel/hardstand surface constructed prior to its use for any purpose;
- Erosion control and sediment retention measures would be put in place; and
- The site would be self-contained for fire-fighting.

- Mulwaree River

- Soil erosion control measures would be implemented as outlined in the Soil Erosion and Sediment Control Plan.

- Water Quality, Erosion and Sedimentation

- Refer to Soil Erosion and Erosion Control Plan which outlines construction of sediment fences, early implementation of sediment containment wall etc; and
- Possible pollutant materials would be stored well away from the river in a suitably bunded area.

- Air Quality

- Dust would be suppressed during construction activities. The construction site and approaches would be watered regularly in order to minimise dust and any soil stockpiles on the site would be stabilised; and
- Exposed areas would be progressively revegetated and stabilised against erosion.

- Vegetation

- Cleared local native trees and shrubs would be chipped and stockpiled for use as mulch. Other species would be disposed of by other means;

- Compacted areas such as stockpile sites would be ripped to increase water penetration for plant growth;
 - Revegetation would be carried out in two stages: with a temporary cover crop and then with more permanent riparian species; and
 - Follow up programmes of maintenance of revegetation works and control of weeds would be carried out.
- Heritage
 - If Thornes Bridge is retained, funding to cover its maintenance costs would need to be considered;
 - If sub-surface archaeological material is located during construction activities, work would cease immediately in that area and the NPWS would be contacted immediately. No work would resume at the site until a clearance is given to do so by NPWS.

8.2 Implementation Process

The proposed safeguards outlined in this REF, including the Soil Erosion and Sediment Control Plan, provide the basis for environmental management of the construction of the bridge.

SECTION C – FINALISATION

9.0 SUMMARY OF KEY ISSUES

9.1 Major Beneficial Effects

The major beneficial effects as a result of the proposed replacement of Thornes Bridge are summarised as follows:

- There would be increased safety for vehicles due to the widening of the structure. This is especially important for heavy vehicles;
- The new bridge would be wider and stronger than the existing bridge, therefore, heavy vehicles would no longer have to wait until another heavy vehicle on the bridge has crossed over. This would result in decreased travel times into and out of Goulburn;
- The new bridge would be able to cope with the predicted increase in the weights of heavy vehicles using Braidwood Road;
- Bridge maintenance costs would decrease if the timber bridge is replaced by a concrete bridge; and
- The noise from vehicles crossing the existing bridge would decrease as vehicles use the new bridge.

9.2 Major Adverse Effects

- The replacement of the new bridge would result in the removal of some vegetation. Removal of ground cover could potentially cause bank erosion and lead to a deterioration in the water quality of the river, however, with the proposed preventative measures, these impacts would be minimised;
- During construction of the new bridge, there would be some noise disturbance and possibly some minor vibration effects at the two houses north of the site. These effects would be temporary, during the construction of the new bridge and approaches, and discussions would be held with the residents to advise them of the timing and duration of the work. Construction activities would take place between the hours of 7 am to 6 pm on weekdays and 7 am to 1 pm on Saturdays. These timings are in accordance with the EPA's *Environmental Noise Control Manual*;
- Noise impact due to traffic to the residential locations adjacent to the proposed work has been assessed and it is concluded that the house on MR 79 at Stn. 80 closest to the bridge is most sensitive. If a speed zone of 80 kph is adopted then Dense Grade Asphalt road surface is acceptable, however, if a speed zone of 100 kph is adopted then Open Grade road surface must be used; and
- Traffic movement along Braidwood Road would be affected during construction of the new bridge and approaches.

9.3 Characteristics

The construction of the new bridge and approaches would take place within the existing road reserve and land purchased for this purpose.

Some vegetation would need to be removed when preparing the approaches to the new bridge. Exotic trees and shrubs would be removed on land to the west of the new bridge. Erosion and sediment control measures would be implemented during the construction phase in order to prevent sedimentation and any deterioration of water quality of the Mulwaree River.

There would be an improvement in road safety, particularly for heavy vehicles due to the increased width of the bridge structure. In addition, the new bridge would support increased vehicle weights.

The visual character of the site would experience minor changes as a result of the construction of the proposed bridge. If the existing bridge is retained, its visual amenity would be reduced by the presence of the adjacent new bridge structure. If the existing bridge is demolished, the form, scale and size of the new bridge would not significantly change the visual character of the area.

The proposed bridge would not result in any increase in upstream flood levels.

9.4 The Extent of the Impacts

The replacement of the timber bridge with a more stable concrete bridge would improve the safety and travel time for vehicles using Braidwood Road. The beneficial effects of this proposal are seen to outweigh the potential impacts of the proposal, providing the mitigation measures outlined in this proposal are implemented.

The surrounding vegetation comprises mainly exotic species and grasses on rural land which has been cleared for grazing. It is proposed to improve the riparian environment by revegetation and landscaping with native species. In order to prevent deterioration in water quality of the river the proposed safeguards outlined in the REF would be put in place. Other impacts, such as the impact of noise on nearby houses and any disruption to traffic flow during the construction of the new bridge, would be temporary.

In the event that the construction of the proposed new bridge does not proceed, maintenance activities associated with the existing bridge would increase over time and result in increased environmental impact on the river.

9.5 The Nature of the Impacts

The revegetation measures proposed and the installation of the permeable sediment basin and spill containment ponds would be monitored over time to ensure that the vegetation is stabilising the banks and that sediment is not entering the Mulwaree River.

10.0 ECOLOGICALLY SUSTAINABLE DEVELOPMENT

Ecologically Sustainable Development (ESD) consists of four principles which are to some extent inter-related:

- The Precautionary Principle;
- Inter-generational Equity;
- Conservation of Biological Diversity and Ecological Integrity; and
- Improved Valuation and Pricing of Environmental Resources.

10.1 The Precautionary Principle

This Principle is defined as *"that if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation"*.

The proposed bridge is in accordance with the Precautionary Principle. The major cause of possible degradation is the effect of the proposed activities on the health of the river system. A Soil Erosion and Sediment Control Plan has been prepared so that these impacts are minimised (Appendix C).

10.2 Inter-generational Equity

Inter-generational Equity is defined as *"that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations"*.

The site contains a range of exotic species and it is proposed to increase diversity by revegetation of native riparian species.

10.3 Conservation of Biological Diversity and Ecological Integrity

This is a key component of ESD and a minimal requirement of Inter-generational Equity.

There is the potential for biological diversity to improve in the vicinity of the bridge due to revegetation and further downstream by implementation of the revegetation initiatives supported by Goulburn City Council.

10.4 Improve Valuation and Pricing of Resources

The need to determine proper values for the utilisation of natural resources is the basis for the "user-pays" and "polluter-pays" principles. Prices for natural resources use are to cover the associated full social and environmental costs.

Social and environmental costs associated with continued use and maintenance of the existing bridge would continue to rise. The short term costs associated with increased natural resource use in the construction of the new bridge would be outweighed by the long term advantages associated with reduced maintenance of the bridge itself, wear and tear on vehicles and increased fuel efficiency (vehicles not slowing and stopping at the bridge which now occurs).

11.0 CLAUSE 82 CHECKLIST

FACTOR	REFERENCE IN REF
Community impact	4.2
Transformation of locality	7.3.13
Impact on ecosystems	7.3.7, 7.3.8, 7.3.9
Reduction of environmental quality	7.3.6
Effect on locality, place or building	7.3.1, 7.3.11, 7.3.13, Appendix G, Appendix H
Impact on habitat of fauna	7.3.9
Endangering of species of life	7.3.8, 7.3.9

FACTOR	REFERENCE IN REF
Long-term effects on the environment	7.4
Degradation of the environment	7.3.1 - 7.3.14, 7.4
Risk to safety of the environment	7.3.6 and Appendix C
Reduction of beneficial uses	7.3.10
Pollution of the environment	7.1.5, 7.3.6 and Appendix C
Waste disposal problems	7.1.5 and Appendix C
Demands on resources	7.1.6
Cumulative effects	7.4

12.0 DECLARATION

This Review of Environmental Factors provides a true and fair review of the proposal in relation to its potential effects on the environment. It addresses to the fullest extent possible all matters affecting or likely to affect the environment as a result of the proposal.

Signed

13.0 APPENDICES

The following appendices are attached to this REF.

- Appendix A Correspondence
- Appendix B Hydraulic Calculations
- Appendix C Soil Erosion and Sediment Control Plan
- Appendix D Water Quality
- Appendix E Aquatic Biology
- Appendix F Flora and Fauna Species
- Appendix G Statement of Heritage Impact
- Appendix H Indigenous Heritage
- Appendix I Noise

14.0 REFERENCES

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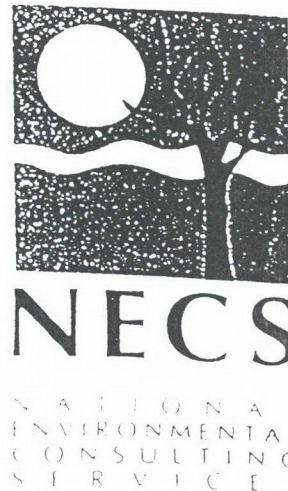
Sinclair Knight and Partners (1985) *Hume Highway Goulburn Bypass, Environmental Impact Statement*.

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APPENDIX A

CORRESPONDENCE

EXAMPLE OF LETTER SENT



14 December 1999

Daniel Ouma-Machio
Department of Urban Affairs and Planning
(Illawarra Region)
Level 1, 84 Crown Street
WOLLONGONG NSW 2500

Dear Mr Ouma-Machio

Re: REF for Replacement of Thornes Bridge over Mulwaree River at Goulburn

National Environmental Consulting Services (NECS) has been commissioned by the Roads and Traffic Authority to prepare a Review of Environmental Factors (REF) for the replacement of Thornes Bridge over the Mulwaree River at Goulburn.

The proposal involves replacing the timber bridge with a concrete one, and will also require a realignment of the northern approaches within the existing road reserve. Approximately 0.5 ha of land will need to be acquired for the southern approaches and a Telstra cable will need to be relocated. The proposal allows for the retention of the existing bridge if required, as it may have regional heritage significance.

Mitigation measures will be developed for construction and operation of the bridge.

A map showing the location of Thornes Bridge is attached.

NECS is seeking any comments or requirements that your organisation may have on this proposal. Due to the tight timeframe, we would appreciate your comments by 15 January 2000.

Yours sincerely,

Lynn Bain

CO59 08

WILLIAMSON & PARTNERS
WILLIAMSON & PARTNERS
PO BOX 247 GERRARD ST
WILSON VIC 3200
Telephone 06 247 460
Facsimile 06 247 461
Email nees@per.apc.o
ACN 065 713 58





AGL Gas Networks Limited
ACN 003 004 322

Network Design Services

18 Rodborough Road,
Frenchs Forest NSW 2086
PO Box 6300 Frenchs Forest
Delivery Centre 1640

To: YOJANA
Company:
Fax no: 00295506689

Date: Monday, January 17, 2000 11:27:08 AM
No of pages including cover: 02

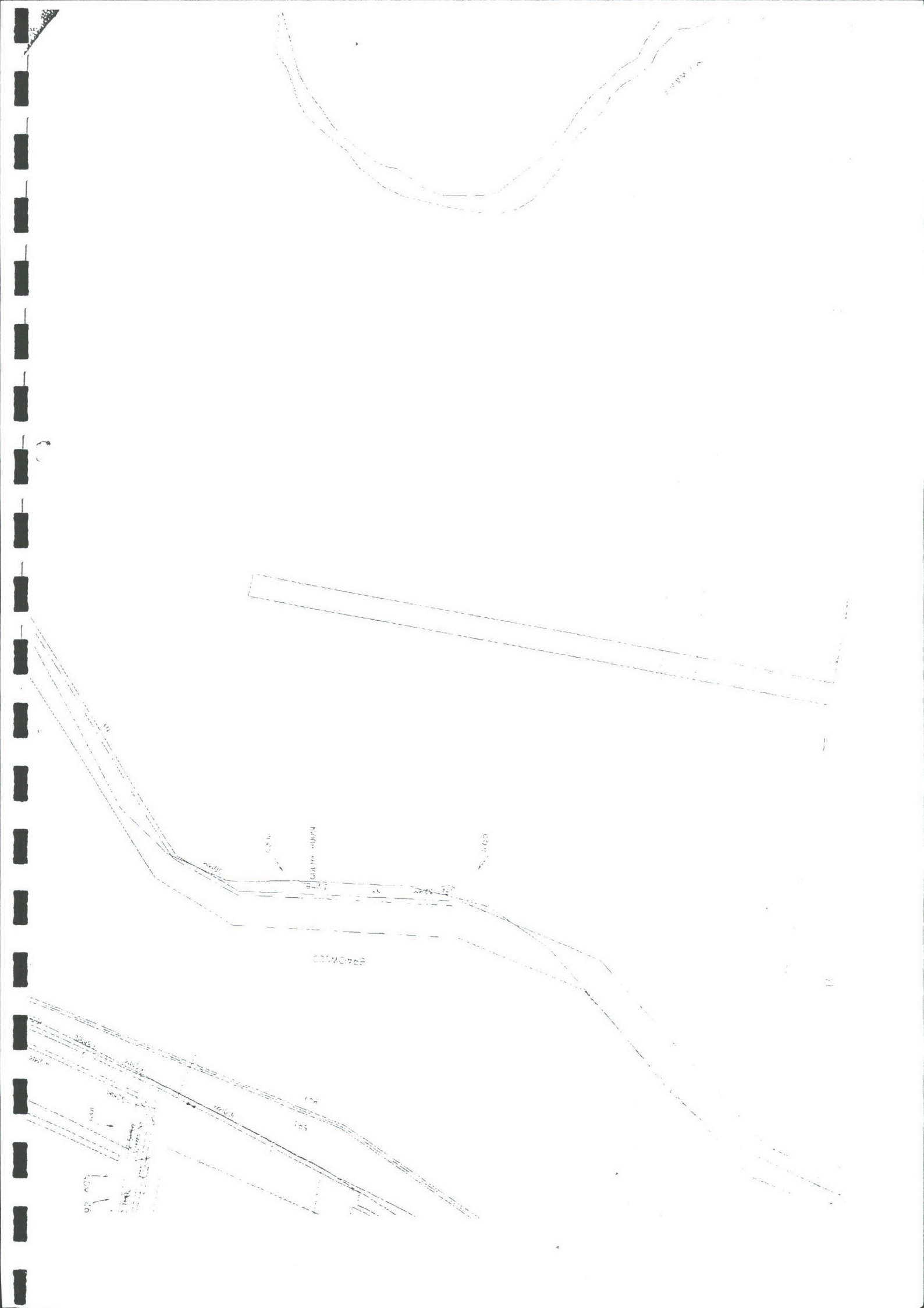
From: Andrew and Kasha

Tel: 02 8977 6539
Fax: 02 8977 6821

SOCS Enquiry Number BRAIDWOOD

In reply to your enquiry there are no gas mains at the location of your intended work.

In Case of Emergency Phone 131909 (24 hours)



To: YOJANA
Company:
Fax no: 00295506689

Date: Monday, January 17, 2000 11:07:40 AM
No of pages including cover: 02

From: Andrew and Kasha

Tel: 02 8977 6539
Fax: 02 8977 6821

SOCS Enquiry Number: MAP REQUESTED

In reply to your enquiry there are gas mains at the location of your intended work as per the attached map. For an explanation of the map please see the key below. The following excavation guidelines apply:

Excavation Guidelines

If you are going to excavate/bore within 0.4m of the gas main location as indicated on the map you must excavate carefully by hand. If you can't locate the main contact the local depot.

Alexandria: (ph) 9565 7149

MAXIMUM ALLOWABLE OPERATING PRESSURE			KEY	
— T —	HIGH PRESSURE TRUNK MAIN	7000 kPa	✕	VALVE
— P —	HIGH PRESSURE PRIMARY MAIN	3500 kPa	□	SYSTEM PRESSURE REGULATOR
— S —	HIGH PRESSURE SECONDARY MAIN	1000 kPa	⋮	SIPHON
— — — — —		300 kPa	6NB	6 INCH CAST IRON MAIN
— — — — —		210 kPa	150MMI	150MM STEEL MAIN
— — — — —		7 kPa	110MM PE NY	110MM POLYETHYLENE/NYLON MAIN
— 400 —		400 kPa	⑥ NB 50MM NY	50MM NYLON INSERTED INTO 6NB MAIN CAST IRON MAIN
— 100 —		100 kPa	1.2MBL	DISTANCE IN METRES OF MAIN FROM BUILDING LINE (TOLERANCE OF 0.4M)
— — — — —		2 kPa	🏠	HOUSE NUMBER
← — — — — — →	PROPOSED MAINS			

Warning: This Company's plans show the position of its underground gas mains and installations in public gazetted roads only, individual customers' services are not included on these plans. These plans have been prepared solely for the Company's own use and may show the position of such underground mains and installations relative to fences, buildings etc., as at the time the mains etc were installed and not necessarily corrected to take account of any subsequent change in particular. AGL will accept no liability for inaccuracies in the information or lack of information on such plans for any cause whatsoever arising. Persons excavating or carrying out other earthworks will be held responsible for any damage caused to the Company's underground mains and equipment.

In Case of Emergency Phone 131909 (24 Hours)



**CABLE & WIRELESS
OPTUS**

Cable & Wireless Optus Limited
ACT 052 933 206

Michelle Ramsden
Telephone 02 6221 0006
Mobile 0411 432202
Fax 02 6221 0006
Email michelle.ramsden@optus.com.au

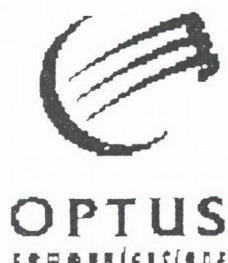
To: LYNN BAIN
Company: NECS

Fax No: 02-6241 4680
Date: 16 December 1999
No of Pages: 2

Attached are as built drawings of the area around Thornes bridge.

Yours sincerely

Michelle Ramsden
Fibre Technician



Asset Analysis Centre

65 Epsom Road
Rosebery NSW 2018

Ph: 1800 505 777
Fax: 1300 307 035

LYNN BAIN

Fax: 0 0262474680

Company: NECS

Pages: (including this sheet): 1

Date: 16/12/1999

Underground Asset Location Reply

Sir/Madam,

In reference to your enquiry of 16/12/99

Address of location

THORNES BRIDGE ON BRAIDWOOD ROAD
X/ROAD SALTPETRE LANE
GOULBURN
NSW

Optus asset location No.

COMMS1023813

One Call System No.

267384

Customer No.

In referring to Optus existing asset plans, Optus find that within the vicinity of the proposed works:

there are existing Optus assets.

Optus representative will contact you, so as to further discuss your proposed works, due to Optus assets within the vicinity of your works. It is your responsibility and is required that you obtain Optus approval prior to commencement of works so as to ensure that the security and integrity of Optus assets are maintained.

Thank you for your enquiry and appreciate your continued use of the local One Call Service and/or Optus Asset Analysis Service.

If you require further information please contact Optus on 1800 505 777

This reply relates only to the location indicated above and is valid for 14 days from the date of this reply. Where additional works are planned that have not been specified within this acknowledgment, Optus require that an additional location request be submitted. In the case of no additional location request being submitted, Optus will hold the relevant party responsible for any damage to Optus plant and all expenses incurred by Optus as a result of asset damage.

Cable & Wireless Optus
Limited
ACN 052 833 203

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If you have it in error, please notify us and shred this document. Thank you



Environment
Protection
Authority
New South Wales

National Environmental Consulting Services
(Attention: Ms Lynne Bain)
PO Box 97
WATSON ACT 2602

WO294/16:WOF3136:AW

NSW Government Offices
84 Crown Street
Wollongong NSW 2500
PO Box 513
Wollongong East
NSW 2520

Telephone (02) 4226 8100
Facsimile (02) 4227 2348
www.epa.nsw.gov.au

Contact: Amiette Wakenshaw (02) 4226 8100

Dear Madam

**REVIEW OF ENVIRONMENTAL FACTORS (REF) FOR THE REPLACEMENT OF
THORNES BRIDGE OVER MULWAREE RIVER AT GOULBURN**

We refer to your letter dated 14 December 1999 seeking the Environment Protection Authority's (EPA) requirements for an REF for the replacement of Thornes Bridge over the Mulwaree River at Goulburn.

The EPA appreciates the opportunity to provide requirements for the REF however, we will be unable to offer comment before 31 January 2000.

Should you have any further enquiries, please contact Amiette Wakenshaw.

Yours faithfully

Trevor Jones 24/12/99

TREVOR JONES
Head, Regional Operations Unit
for Director-General

(N\AW\WOF3136 NECS.DOC)



Goulburn Office

NSW Agriculture

Your Ref: LB

Your File: CO59.07

Our Ref: AJD:JH

Our File: 4E 2/20

159 Auburn Street
PO Box 389
GOULBURN NSW 2580

Telephone (02) 48230616
Facsimile (02) 48223261
<http://www.agric.nsw.gov.au>

21st December 1999

Ms Lyn Bain
NECS
P O Box 97
WATSON ACT 2602

Dear Lyn

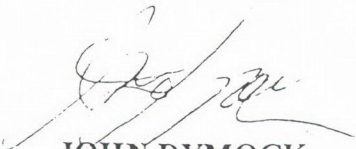
**Re: Replacement of the Ageing Thornes Bridge over the
Mulwaree River at Goulburn**

NSW Agriculture does not have any significant concerns over this replacement. The old bridge has served the community well for over 100 years.

The following minor issues will need to be considered in the Review.

1. Loss of any agricultural land when the road alignment is changed.
2. The control of siltation to prevent any loss of water quality in the river. It needs to be pointed out that this stream forms part of the Sydney Catchment.
3. The revegetation of any disturbed areas created when the bridge is being constructed.
4. The retention of the old bridge as a historical piece is to be commended.

Happy Christmas


JOHN DYMOCK
AGRICULTURAL ENVIRONMENT OFFICER
GOULBURN



Policy and Guidelines

for Bridges, Roads, Causeways, Culverts and Similar Structures 1999





Contents

This document is a complete extract of Section 5.4 of NSW Fisheries (1999) Policy and Guidelines Aquatic Habitat Management and Fish Conservation (Eds. A.K. Smith and D.A. Pollard) NSW Fisheries, Sydney. This document should be referred to for further information on NSW Fisheries requirements.

Written and edited by Sarah Fairfull and Scott Carter
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The Policy and Guidelines should be referenced as:

NSW Fisheries (1999)

Policy and Guidelines for Bridges, Roads, Causeways, Culverts and Similar Structures. (Eds. S. Fairfull and S. Carter) NSW Fisheries, Sydney, 19pp.

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I. Acknowledgements

This document was initially developed by Scott Carter and later Sarah Fairfull of NSW Fisheries Office of Conservation. The need for this document was recognised by the authors after discussions with local Council and NSW Roads and Traffic Authority planners and engineers, and from a workshop which was held between NSW Fisheries and Project Managers and environment staff of the Pacific Highway Development Office in July 1998.

Earlier drafts have been revised and improved by a number of both internal and external experts. The authors would like to thank staff of NSW Fisheries Office of Conservation, in particular John Holliday, Allan Lugg, Rodney James, John Pursey, Graeme White, and Adam Smith for providing detailed comments.

We would also like to thank the following external reviewers for their invaluable feedback and comments:

- NSW Roads and Traffic Authority staff from the Pacific Highway Development Office (Environmental and Project Management), Country Operations (Environmental Services and Western Region), Major Projects (Design and Project Management) and Environmental Policy.
- Mr Peter Wem (Department of Land and Water Conservation)
- Mr W B Peyton (Project Manager, Hume Freeway Project for Vic Roads)
- Mr Russell Cowgill and staff of the Sustainable Forest Management Team of State Forests
- Mr Rob Shaw (Local Government Engineering Services Pty Ltd)
- Mr Grant Witheridge (Catchments and Creeks Pty Ltd)

1. About this document

This document is a complete extract of Section 5.4 of the *NSW Fisheries (1999) Policy and Guidelines Aquatic Habitat Management and Fish Conservation*. It has been reprinted as a separate stand alone document so that it can be easily used by planners, engineers and works supervisors from councils, public authorities, consultants and private road contractors who are specifically involved in the planning, design, construction, and maintenance of roads and watercourse crossings in NSW.

It has been developed with external input from planners and engineers from councils, public authorities and engineering consultants (see Acknowledgements section) so that the document can assist these parties in understanding NSW Fisheries requirements for the conservation of fish and fish habitat when designing, constructing, building, or maintaining bridges, roads, causeways, culverts and similar structures. Please note, from now on bridges, causeways, culverts and similar structures will be referred to as "watercourse crossings".

This document summarises NSW Fisheries requirements in relation to roads and watercourse crossings outlined in the:

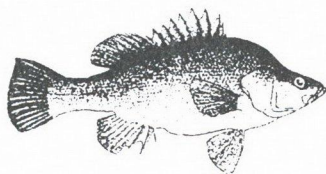
- *Fisheries Management Act 1994* (from now on referred to as "the Act");
- *Fisheries Management (General) Regulation 1995*;
- *NSW Fisheries (1999) Policy and Guidelines Aquatic Habitat Management and Fish Conservation*;
- *Fish Habitat Protection Plan No.1*;
- *Fish Habitat Protection Plan No.2 – Seagrasses (which aims to protect NSW seagrasses)*; and
- *Fish Habitat Protection Plan No.3 – Hawkesbury – Nepean River System*.

The document shall be revised and updated annually, or in line with changes to legislation, or NSW Fisheries policy and guidelines in relation to roads and watercourse crossings.

While the purpose of the document is to outline how roads and watercourse crossings can be designed and constructed in a "fish friendly" way, NSW Fisheries is also aware of the many other factors that must be considered such as:

- social constraints (i.e. what the public demands)
- economic constraints
- safety considerations
- legal considerations (e.g. requirements of other Acts and public authorities)

Therefore, NSW Fisheries realises that each road and watercourse crossing project must be assessed on a case-by-case basis, taking into account all of these factors. However, it is hoped that this document will provide councils, public authorities and private contractors or consultants with an understanding of the importance of fish and fish habitat when planning, designing, constructing and maintaining roads and watercourse crossings in NSW.





1.1 Definitions

Under the Act, "waters" refers to all waters that are within the limits of the State and can include tidal waters below mean high water mark as well as perennial (flowing) streams, ephemeral (irregularly flowing) streams, gullies, rivers, lakes and coastal lagoons, wetlands and other forms of **natural** or **man-made** water bodies both on public and private land.

Under the Act, NSW Fisheries is given legislative responsibility to manage "fish" and "marine vegetation" in NSW. The term "fish" under the Act not only refers to fin fish, but includes **all aquatic animals whether alive or dead** (e.g. worms, shellfish, snails, aquatic insects etc.). However, it does not include marine mammals

(whales, dolphins etc.), reptiles, birds or amphibians (frogs) which are covered under legislation enforced by the NSW National Parks and Wildlife Service. The term "marine vegetation" under the Act includes **mangroves**, **seagrasses** and all **macroalgae**, commonly known as seaweeds (including all red, green and brown varieties), that are native to NSW marine and estuarine waters.

2. How do roads and watercourse crossings affect fish?

Roads and watercourse crossings have the potential to impact both directly and indirectly on fish and fish habitat during their construction and subsequent use. These impacts are summarised in *Table 1*.

TABLE 1: POTENTIAL IMPACTS ON FISH AND FISH HABITAT FROM ROADS AND WATERCOURSE CROSSINGS

1. barriers to fish passage

- Road structures can cause major barriers to fish passage by creating a blockage in the watercourse.
- The blockage can be a physical blockage (e.g. causeway that fish cannot swim over during low flow) or a hydraulic blockage. Crossings alter the natural velocity and local hydraulics of a stream by changing the cross-sectional area and invert level of the watercourse. Increased velocity or changes to local hydraulics can create a barrier to the upstream migration of fish as they may be unwilling or unable to swim upstream or downstream through these structures.
- Roads and crossings can also alter the frequency of flooding events on floodplains by altering bank heights (i.e. roads built as part of levee systems, raised bridge approaches). Floodplains provide important food sources and spawning grounds for fish during floods, and allow fish to move between rivers, creeks and wetlands.

2. water pollution

- **Sedimentation** – approximately 80% of freshwater fish species lay eggs on the river bed, either in gravel beds, amongst vegetation, or in other irregularities on the river bed which provide some level of shelter from water flow and predators. Sedimentation and erosion can smother the eggs. The loss of eggs can have greater impacts on the continuing viability of some fish species than fish kills. Infilling of gravel beds and deep pools from increased sedimentation can also reduce available pools for shelter. A range of aquatic flora and fauna such as worms, snails and fine weeds are found living amongst the substrate of river bed sediment. As sediment particles settle out of the water column, they can smother these organisms, thereby reducing the amount of food available to resident fish.
- **Turbidity** – turbid water has been linked to reductions in fish diversity and numbers for several kilometres downstream of road works (Richardson 1985). It has also been found to irritate the gills of fish in extreme cases causing breathing problems, and even mortality.
- **Nutrients** – road fill may contain levels of nutrients and other contaminants (e.g. from decomposing plant and animal matter, fertilisers, or animal wastes). High levels of phosphorus and nitrogen can result in blooms of algae, some of which can be toxic (e.g. blue green algae). Algal blooms can also cause fish kills by depleting the levels of dissolved oxygen in the water.

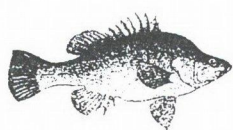




TABLE 1: POTENTIAL IMPACTS ON FISH AND FISH HABITAT FROM ROADS AND WATERCOURSE CROSSINGS cont.

2. water pollution	• Acid Sulfate Soils – fish kills and fish diseases can also occur through disturbance and release of acid water from acid sulfate soils. • Oils and Heavy Metals – stormwater runoff from roads and watercourse crossings can carry oils, grease and heavy metals (e.g. from tyres, brake pads and bitumen) into a watercourse, thereby reducing water quality.
3. loss or changes to fish habitat	• A number of important aquatic habitats can be affected by roads and watercourse crossings. These include instream vegetation and snags (or fallen hollow logs) which provide shelter for fish and fish eggs, and gravel beds which are important spawning grounds for native fish. In estuarine areas, important fish habitats such as mangroves and seagrasses may be affected either directly (physical removal) or indirectly (e.g. shading) by watercourse crossings. • Watercourse crossings can also change the water flow pattern and morphology of the river, resulting in changes to fish habitat.
4. loss of riparian vegetation	• Riparian vegetation provides shelter for aquatic fauna from flow and sunlight. Plant debris and insects which are attracted to the vegetation can also provide a food source for fish and other aquatic fauna.
5. impacts on threatened species	• Some roads and watercourse crossings may occur within the distribution range of "threatened species" which are listed under Part 7A of the <i>Fisheries Management Act 1994</i>. Potential impacts on the range and habitat of these species must be considered during the planning phase and is further discussed in sections 2.4 and 3.6.

While each of the impacts in *Table 1* is of concern to NSW Fisheries, some are more serious than others, and these are further discussed below.

2.1 Restricting fish passage

The majority of Australian native fish species have adapted to a mobile life style due to the dry and seasonal nature of water flow in this country. Fish need to be able to move up and down streams or even between river systems (e.g. during overland floods or via the ocean) in order to access food, shelter or breeding grounds. Many freshwater species also migrate to estuaries or the sea to breed. A number of fish species are territorial and as juvenile fish they must move out from breeding grounds in order to establish their own territorial range.

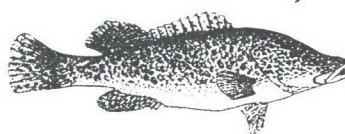
Increased flows, flooding conditions and/or rises in water temperature (e.g. seasonal changes in the weather) can trigger fish migration and breeding. Fish also need to move during low flow periods to access food and shelter. Therefore, it is important to ensure that roads and watercourse crossings are designed to

allow fish passage during both high and low flow conditions so that options for movement are maximised.

A major problem with past and some present road building practices is the impact they may have on fish passage. This can be due to the over-riding emphasis on the engineering aspects of bridge, culvert and causeway construction, with little thought to the ecological needs of fish and aquatic species. Obstacles to fish passage can reduce the diversity of fish species within a catchment by limiting the reproductive capability and movement of fish populations.

Fish passage can be impeded and/or prevented by a crossing structure if:

- the water velocity is too high;
- the water turbulence is too great;
- the culvert is too dark, long or narrow;
- the water in, or over, the crossing is too shallow;
- there is a drop on the upstream and/or downstream side of the crossing;
- the culvert surface is too smooth, especially if water depth is shallow;





- the crossing has been placed at too great a slope; and
- the crossing has not been maintained (e.g. in a state of disrepair, full of debris) (Cotterell 1998)

Australian native fish, unlike their European and American counterparts, are not able to jump up major obstructions in order to move upstream. Fish may make several attempts to swim through a stream crossing. If the velocity is too great, their energy levels may be severely depleted which may prevent or delay them from reaching spawning grounds upstream (Cotterell 1998).

2.2 Erosion, turbidity and sedimentation

As outlined in *Table 1*, soil erosion, turbidity and sedimentation from the construction of new roads and watercourse crossings, or during maintenance works (especially dredging and/or reclamation works) for existing structures, can have both direct and indirect impacts on fish. Summarised, they include:

- deterioration in water quality, and therefore damage to, or degradation of, fish health and habitat;
- damage to, or smothering of, aquatic vegetation;
- damage to, or smothering of, gravel beds;
- loss of riparian vegetation;
- infilling or smothering of deep holes and pools; and;
- pollution impacting on commercial and recreational fisheries or aquaculture activities.

2.3 Loss of aquatic habitat

An important consideration in the planning, design, construction and maintenance of roads or watercourse crossings is the potential impacts on fish habitat. Impacts from roadworks and watercourse crossings on fish habitats are summarised in *Table 1*.

While all fish habitat is important, some habitat elements are essential for the survival of native fish species. These include riparian vegetation, gravel beds, bed irregularities, pools and snags in freshwater environments, and mangroves and seagrass in estuarine or marine environments. Riparian and aquatic vegetation and deep pools provide shelter for fish from predators, sunlight and heat, while gravel beds, bed irregularities and snags can also provide important spawning grounds for native freshwater fish. Many of these habitats have been damaged or destroyed in the past. Every effort is

now being made to conserve those habitats which remain, and rehabilitate changed habitats where possible.

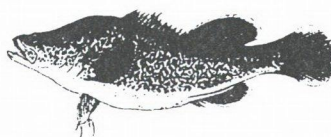
Mangroves and seagrasses in estuarine areas provide important nursery areas for juvenile fish species. They are also an intrinsic part of the estuarine food chain, providing the main source of nutrient and energy input. Often watercourse crossings may intersect a mangrove or seagrass habitat, and the project may require the removal or trimming of mangroves. Specific approvals, and policy and guidelines apply to such activities and these are discussed further in sections 3.5 and 4 of this document.

Snags (or "Large Woody Debris") consist of whole trees, limbs or root masses that have fallen or been washed into a watercourse and are now partly or wholly submerged by water. Rocks and rock bars act in the same way as snags. Snags are not generally removed during the construction of watercourse crossings, however ongoing maintenance activities of water crossings may require the removal of snags which are threatening their structural integrity.

Snags have an essential role to play in the ecological functioning of creeks, rivers and estuaries (Gippel *et al* 1998) by:

- providing flow refuges for fish and aquatic invertebrates (i.e. places to rest out of the main current flow),
- providing cover for fish and aquatic invertebrates (i.e. sites to hide from predators and avoid direct sunlight),
- armouring stream banks thereby preventing erosion,
- increasing the submerged surface area, thereby providing greater opportunities for algal, fungal and bacterial, macroinvertebrate and vertebrate communities to colonise,
- increasing the physical complexity or diversity of the stream,
- providing breeding sites for species such as river blackfish and murray cod which lay eggs onto hard substrates.

Removal of snags from watercourses is an environmentally damaging process which is likely to impact upon aquatic biodiversity, ecosystem functions and fish populations both directly and indirectly. Direct impacts include the loss of substrate, resting, feeding or breeding sites. Indirect impacts could include increased turbidity and long-term changes in stream morphology.





Where snags must be removed for safety concerns (e.g. threatening the structural integrity of a bridge) options in order of preference include lopping, re-alignment, relocation and then removal of the snag. Approval requirements and options for snag management are discussed in detail in section 5.7 of NSW Fisheries (1999) and are briefly referred to in sections 3.5 and 4 of this document.

2.4 Impacts on threatened species

Many species of aquatic flora and fauna in NSW are under stress due to a range of factors including habitat loss, restriction of fish passage, introduction of exotic species and over fishing. These stresses have resulted in some species being faced with the threat of extinction.

On 1 July 1998, the *Fisheries Management Act 1994* and several other acts, including the *Environmental Planning and Assessment Act 1979*, were amended to include threatened species provisions for aquatic species. These provisions provide for the protection, conservation and recovery of threatened species, populations and ecological communities, the declaration of "critical habitat" and the listing of "key threatening processes" associated with these species, populations and communities.

Roads and watercourse crossings have the potential to impact on threatened species or "critical habitat" during construction and maintenance phases of a project. Further discussion on threatened species provisions is found at sections 3.6 and 4.

3. Addressing the impacts

NSW Fisheries aims to minimise these impacts through the implementation of the Department's requirements for aquatic habitat management and fish conservation, which were summarised in section 1. This section provides further detailed information on these requirements which should be considered as part of the planning, approval, design, construction, and maintenance phases for any road building or works adjacent to, over, or within NSW waters.

3.1 The planning phase

One of the major problems in controlling or minimising impacts on fish and fish habitat from road and watercourse crossings is the failure to address these

issues in the planning and design phases. In the past, environmental assessment documents such as Environmental Impact Statements (EIS), Review of Environmental Factors (REF) and Statement of Environmental Effects (SEE) have not adequately taken into account the impacts of works on aquatic flora and fauna that may be present. Consequently, these documents fail to inform the design engineers of the requirements for fish and fish habitat in the design and construction stages. One of the main reasons for this is the lack of guidance to the road industry on how to address these issues, which is why this document has been developed. To assist this process, a close working relationship should be developed between NSW Fisheries and councils, other public authorities, consultants and private road contractors. Contact details for your regional Office of Conservation staff are listed in Appendix 1.

3.1.1 Aquatic flora and fauna assessment

As well as addressing all requirements outlined in Section 3 of this document, the Department of Urban Affairs and Planning have developed a document entitled, "Guidelines for Assessment of Aquatic Ecology in EIA" (1998) which should be referred to by any road planners or consultants in assessing flora and fauna impacts during the preparation of an EIS, REF or SEE.

The aim of an aquatic assessment should be to define the presence of fish habitat within both the study site and regional area, upstream or downstream of any proposed road or crossing sites. There may be a range of potential fish habitats that could be expected to be crossed or otherwise impacted by a particular stretch of road. Some points to consider in assessing aquatic habitats include:

- the geomorphological characteristics of the watercourse (e.g. Is it a gully, intermittent stream, major river? Does it have deep pools or instream gravel beds? Is it a wetland? Does the watercourse interconnect with other watercourses or wetlands upstream or downstream?)
- the flow regime of the watercourse (e.g. Is it an intermittent or permanently flowing stream? What is the water velocity of the flow?)
- what is the water quality like? (e.g. discolouration, sedimentation, turbidity, pH, dissolved oxygen, nutrients)
- what are the types of land use along the watercourse? (e.g. agricultural, urban, aquaculture)





- is riparian vegetation present or absent? (i.e. Are the species native or exotic? What condition are they in?)
- is instream vegetation present or absent? (i.e. Are the species native or exotic? What condition are they in?)
- are there wetlands nearby? (e.g. instream or offstream)
- what is the substrate type? (e.g. rock, sand, gravel, alluvial substrates)
- the presence of refuge areas (e.g. Are there wetlands nearby which could be interlinked by the watercourse during flow? Are there pools of water above or below the crossing which could be fish habitat?)
- the presence of spawning areas (e.g. Are gravel beds, riparian vegetation, snags (fallen trees) present?)
- the presence of natural or artificial barriers to fish passage both upstream and downstream (e.g. weirs, dams, waterfalls or cascades, other causeways or culverts)
- the types of migratory fish or other aquatic species likely to inhabit the area (based on their known distribution range within the scientific literature)
- whether any threatened aquatic species are present (see section 3.6 for more information)
- whether the area has been declared a "critical habitat" under the threatened species provisions of the Act? (see section 3.6 for more information)
- the timing of construction (i.e. Will construction coincide with a migratory season for fish or other aquatic fauna?)

In most cases, in areas where fish and/or other aquatic fauna are well documented, and no threatened species are recorded, a site inspection and desktop review of the study site and regional area may be the required level of assessment. This may preclude the need for a detailed scientific aquatic survey. However, this decision must be justified in the EIS, REF or SEE by the proponent or determining authority. Consultation with staff from the Office of Conservation is also advised during the planning phase to determine the required level of assessment. A contact list is supplied in Appendix 1.

3.1.1.1 When do I need to undertake an aquatic survey?

During the completion of the planning phase for a new project, the decision must be made on the need for a detailed aquatic survey. The Department of Urban

Affairs and Planning have developed a guideline entitled, "Guidelines for Assessment of Aquatic Ecology in EIA" (1998) which should be referred to for assessing flora and fauna impacts during the preparation of an SEE, REF, EIS or Species Impact Statement (SIS).

NSW Fisheries recommends that the need for a detailed aquatic survey should be undertaken:

1. where the project is on a **Class 1 or 2 watercourse** (see Table 2), or where an '8 part test' has identified that there may be a **significant impact** on a listed **threatened species** (under the Act and an SIS is required (see section 3.6 for further information);
2. where the project area crosses through, over or within a "**critical habitat**" and an SIS is required; and;
3. **only after direct consultation with staff from NSW Fisheries Office of Conservation** (note: permits are required for sampling aquatic fauna (refer to Section 4)).

After the aquatic survey is completed, the next step is to design the type of engineering solution and construction method of a road or crossing that will minimise the impacts on fish.

3.2 Classification scheme for watercourse crossings and fish habitat type

In order to assist councils, other public authorities, consultants and private road contractors with a way of assessing the most appropriate crossing for each watercourse type, NSW Fisheries have developed a classification scheme outlined in Table 2. This scheme aims to take some of the guess work out of determining when a road design will require better engineering solutions for watercourse crossings in order to minimise impacts on fish and fish habitat. The scheme will also be used to determine whether permits or approvals are required from NSW Fisheries for works in watercourses (refer to section 4). **It should be noted that this scheme may not be useful in all cases and is a guide only. Consultation should be sought with staff from the Office of Conservation if there is some doubt.** In borderline cases, adopt a precautionary approach and choose the higher category (e.g. if you are unsure if the fish habitat is a Class 2 or 3, then choose Class 2).

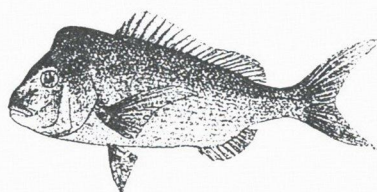
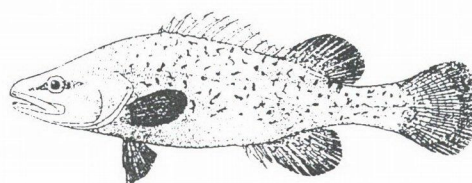




TABLE 2: CLASSIFICATION SCHEME FOR WATERCOURSE CROSSINGS OVER DIFFERENT FISH HABITAT TYPES

Classification	Characteristics of Watercourse Type	Minimum Preferred Engineering Solutions
Class 1 – Major fish habitat	Large named permanently flowing stream, creek or river. Threatened species habitat or area of declared "critical habitat" under the threatened species provisions of the Act. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.	Bridge or tunnel crossing only. Pre-formed spans or arches are the preferred option (up to 30m width of stream) to minimise instream construction impacts. Refer to section 3.3 for further design considerations.
Class 2 – Moderate fish habitat	Smaller named permanent or intermittent stream, creek or watercourse. Clearly defined drainage channels with semi-permanent to permanent waters in pools or in connected wetland areas. Marine or freshwater aquatic vegetation is present. Known fish habitat and/or fish observed inhabiting the area.	A large box culvert or a bridge crossing. Cross-sectional area of structure should aim to equal the cross-sectional area of the watercourse. Refer to section 3.3 for further design considerations.
Class 3 – Minimal fish habitat	Named or unnamed watercourse with intermittent flow, but has potential refuge, breeding or feeding areas for some aquatic fauna (e.g. fish, yabbies). None to minimal defined drainage channel. Semi-permanent pools, ponds, farm dams or wetlands nearby, or form in the watercourse after a rain event. Watercourse interconnects wetlands or stream habitat.	Culverts required and designed to allow fish passage. Invert should be designed to ensure it is below the bed level of the watercourse, and that ponding can occur. Refer to section 3.3 for further design considerations.
Class 4 – Unlikely fish habitat	Named or unnamed watercourse with intermittent flow during rain events only, little or no defined drainage channel, little or no free standing water or pools after rain event finishes (e.g. dry gully, shallow floodplain depression with no permanent wetland aquatic flora present). No aquatic or wetland vegetation present.	Causeway, floodway or culvert with allowance for flow of water to downstream areas unhindered. Refer to section 3.3 for further design considerations.





3.3 Maintaining fish passage – design considerations for watercourse crossings

There are a number of important considerations to be addressed in the design of a watercourse crossing. For example, a recent study by Warren and Pardew (1998) examined the impacts of four types of watercourse crossings on the fish passage of 21 species of fish in small streams. The crossings examined included culvert, slab, box and ford (low level) crossings. The study found that "fish passage was an order of magnitude lower through culverts than through other crossings or natural streams (i.e. no crossings present), except no movement was detected through the slab crossing". "Open-box and ford crossings showed little difference from natural reaches in overall movement of fish". "Water velocity at crossings was inversely related to fish movement: culvert crossings consistently had the highest velocities and open-box culverts had the lowest".

Sections 3.3.1 and 3.3.2 further discuss design considerations which should be addressed in the design phase of any watercourse crossings in NSW waters.

3.3.1 General design considerations for watercourse crossings

- *Watercourse hydrology and velocity* – the velocity of water flow through the structure should remain unchanged. An important consideration here is ensuring that the cross-sectional area of the crossing structure mimics the cross-sectional area of the watercourse as much as possible so that the mid to low flow velocity remains unchanged (i.e. for flows up to and including 2 m/s). Natural tidal flows in coastal areas, and inundation of estuarine areas should also be maintained.
- *Invert level of the crossing* – often pipes or box culverts are placed above, or on top of, the stream bed or existing causeway, or may have a slight gradient which can effectively create a waterfall or barrier to fish passage on the downstream side. The invert level of culverts should mimic the natural invert level of the stream bed so that water flow velocities both through, and downstream of, the culvert are the same as the natural flow rates upstream of the crossing (i.e. no detectable difference in flow rates). This will ensure that a discontinuity in the flow of the stream is avoided. Where possible, crossings should be placed in parts
- of the stream where the slope is minimal to assist in achieving the desired invert of the culverts (Cotterell 1998).
- *Habitat within the culvert* – pipes or box culverts can create a foreign riverbed and dark environment for fish to negotiate. Fish may even avoid passing through the crossing as it is an alien environment. Where possible, the base of the pipe or box culvert should be set into, rather than on, the stream bed. Natural sediments from the site (i.e. mud, sand, gravel, rocks etc.) should be placed inside the culvert to cover the bottom, in order to provide a similar fish habitat. Alternative approaches should also be considered, such as roughening the top surface of the base of a box culvert at the concrete pouring stage. Small depressions which are created by the roughening process can allow natural sediments to be trapped in the base of the culvert, creating a more natural substrate for fish. The height of the culvert must be considered in order to achieve the best result so that the creation of fish habitat does not constrict water flow in the culverts. Fish also need a minimum water depth of 0.2-0.5m within a culvert to ensure successful fish passage (Cotterell 1998).
- *Light penetration* – some fish are unable to travel through long, dark structures. Natural light penetration underneath or through a bridge, culvert or causeway structure can be enhanced by minimising the width of the structure (e.g. maximum 10 metres), incorporating open or mesh grates/holes or sky-light type structures in the top of the structure. The use of grid bridges, constructed from railway lines and welded beams are also a potential option.
- *Modification to existing structures* – planners should also consider whether there are existing structures that are likely to be limiting fish passage. These structures may require extension, widening or replacement during a road construction project, or during maintenance works programs. Williams and Watford (1996) can also be referenced for information on culverts which have been identified as restricting fish passage in NSW coastal areas. Contact your nearest regional Office of Conservation for further information on this report.

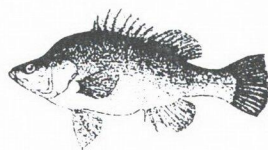




FIGURE 1: PIPE CULVERT ON A CLASS 1 WATERCOURSE. INVERT LEVEL OF CAUSEWAY IS TOO HIGH CREATING A "WEIR" EFFECT. NOTE HIGH VELOCITY FLOW THROUGH PIPES WHICH WOULD BE IMPASSABLE TO FISH MOVING UPSTREAM.

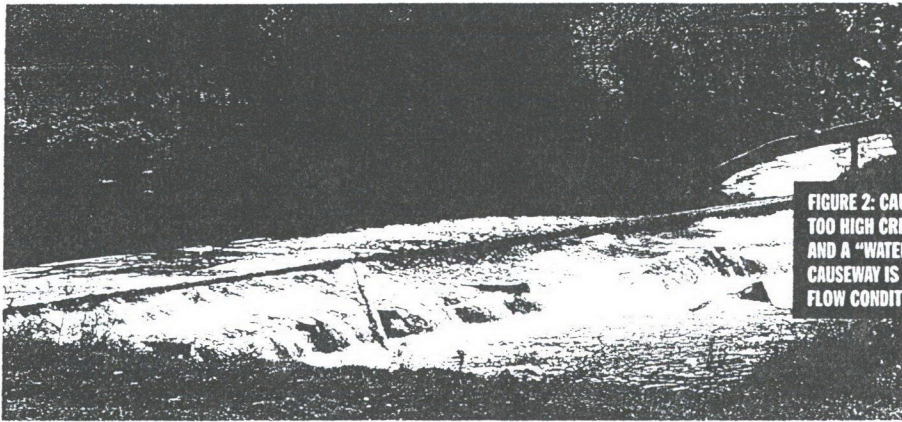
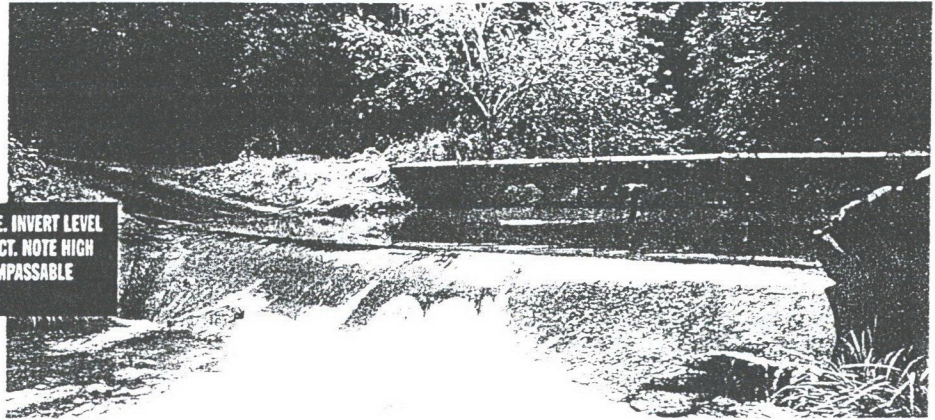


FIGURE 2: CAUSEWAY ON A CLASS 1 WATERCOURSE. INVERT LEVEL IS TOO HIGH CREATING A "WEIR" POOL EFFECT ABOVE THE CAUSEWAY AND A "WATERFALL" EFFECT ON THE DOWNSTREAM SIDE. THE CAUSEWAY IS A BARRIER TO FISH PASSAGE IN THE MAJORITY OF FLOW CONDITIONS.

FIGURE 3: BOX CULVERT DESIGN. ONGOING MAINTENANCE OF BOX CULVERTS IS NEEDED TO ENSURE THAT THE CULVERT IS WORKING EFFECTIVELY. DEBRIS CAN ALSO CREATE A BARRIER TO FISH PASSAGE.

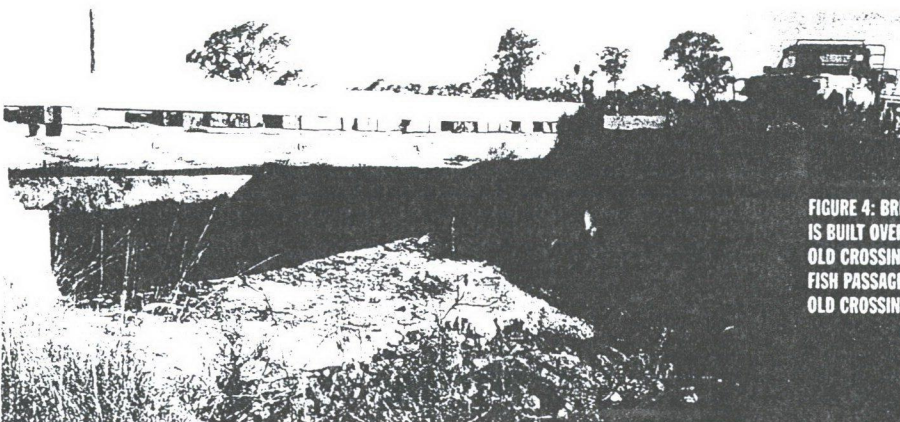
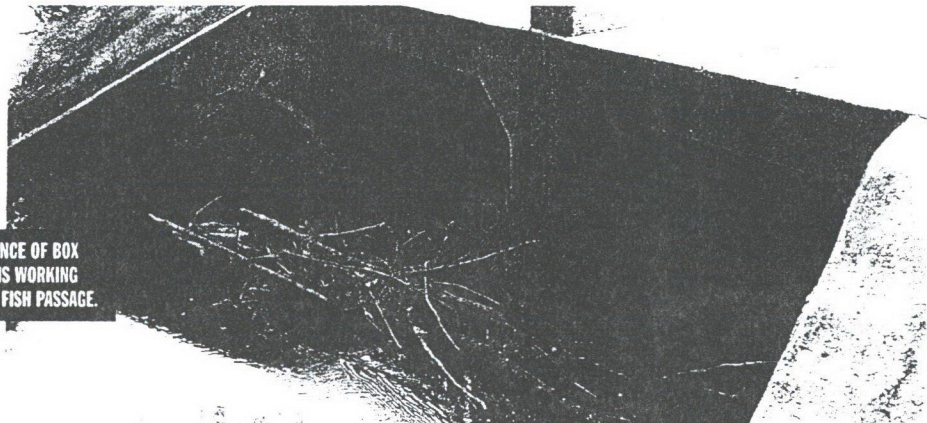


FIGURE 4: BRIDGE CROSSING OVER AN OLD CAUSEWAY. IF A BRIDGE IS BUILT OVER OR NEAR AN EXISTING CAUSEWAY OR CULVERT THE OLD CROSSING SHOULD BE REMOVED TO ALLOW FOR IMPROVED FISH PASSAGE. IT IS ALSO RECOMMENDED THAT THE SITE OF THE OLD CROSSING BE REHABILITATED TO A NATURAL STATE.



FIGURES 5 & 6: MULTI-CELL BOX CULVERTS (FIGURE 6) ARE PREFERRED OVER SINGLE CELL BOX CULVERTS (FIGURE 5) IN ORDER TO MAINTAIN THE CROSS-SECTIONAL AREA OF THE WATERCOURSE. HIGH FLOWS THROUGH THE CELL IN FIGURE 5 ARE A BARRIER TO FISH PASSAGE.

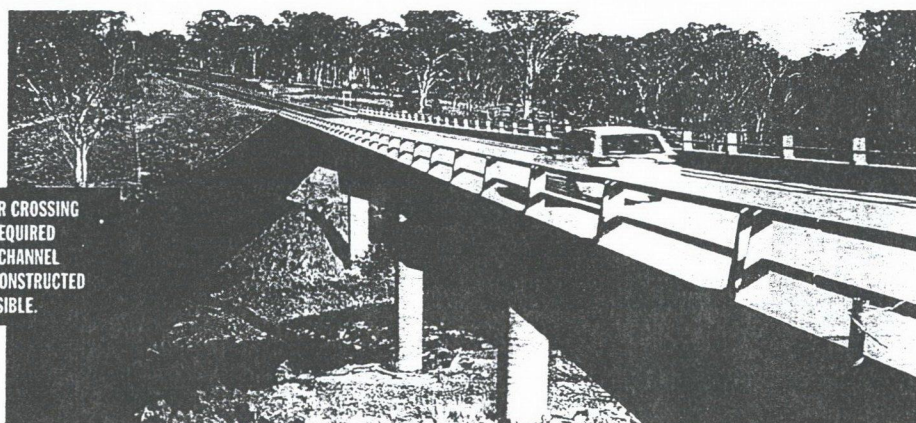
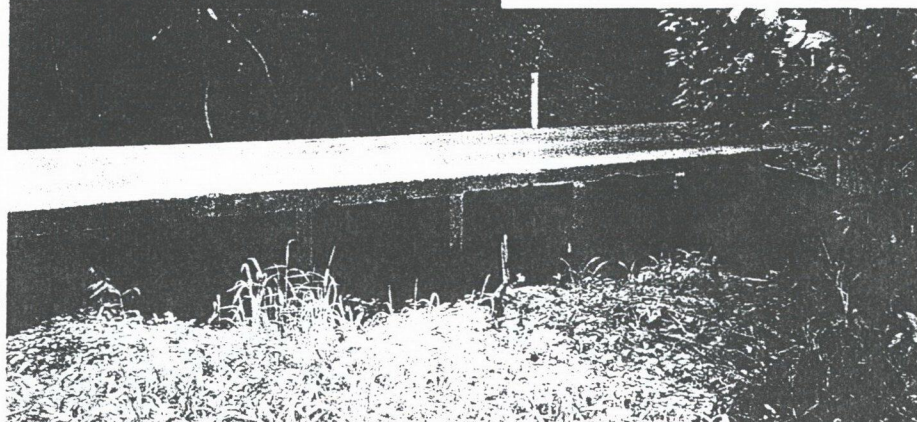


FIGURE 7: SINGLE SPAN BRIDGES ARE PREFERRED FOR CROSSING WATERCOURSES. WHERE MULTI-SPAN BRIDGES ARE REQUIRED THE PYLONS SHOULD BE LOCATED OUT OF THE MAIN CHANNEL (SEE PHOTO RIGHT). ABUTMENTS SHOULD ALSO BE CONSTRUCTED ABOVE THE BANK OF THE WATERCOURSE WHERE POSSIBLE.

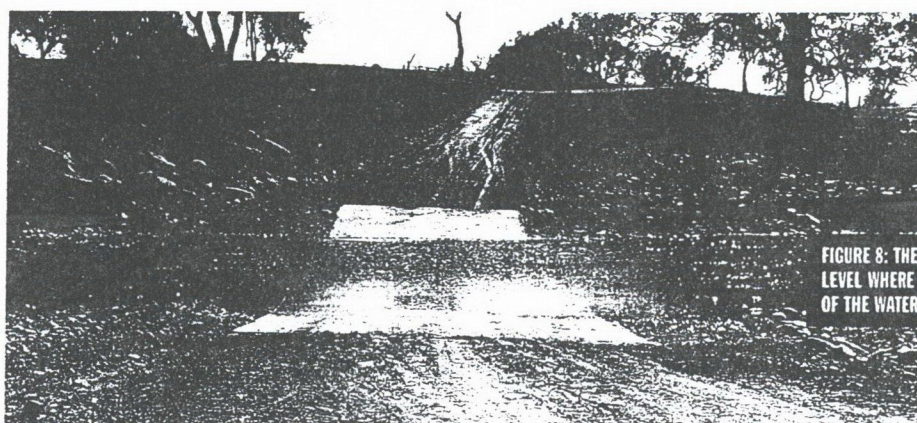


FIGURE 8: THE INVERT LEVEL OF A CAUSEWAY SHOULD BE AT BED LEVEL WHERE POSSIBLE. THIS ALLOWS THE CROSS-SECTIONAL AREA OF THE WATERCOURSE, AND FLOWS, TO REMAIN UNCHANGED.



3.3.2 Preferred watercourse crossing types

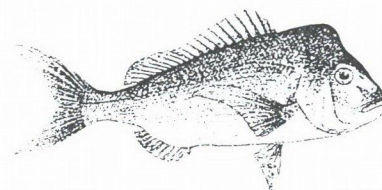
– are listed in order of preference below:

- *Bridges and tunnels* – these structures are the preferred watercourse crossing option in terms of fish passage as they do not generally alter the cross-sectional area of a watercourse. As outlined in Table 2, these structures are recommended for all permanent watercourses, or where threatened species or “critical habitat” are present (i.e. Class 1 and 2). Single span bridges are the preferred option on streams less than 30 metres wide as they pose no barrier to fish passage and do not alter fish habitat in stream. Where pylons are required, only the minimum number should be used to minimise eddying and scouring effects within the watercourse. Where possible bridge abutments should also be constructed back from the banks of the watercourse. This allows the cross-sectional area, flows and banks of the watercourse to remain unchanged, and allows flood flows to escape onto the floodplain.
- *Arch and box culverts* – culvert designs that retain natural morphological features of stream width, stream bed composition, slope and cross-sectional area are preferred. A series of large culvert cells built to mimic the cross-sectional area of the stream is more beneficial to fish than a single cell culvert, as they will allow water velocity to remain similar to natural conditions. However, the height of the cells of the culvert must also be sufficient to ensure that debris and sedimentation do not block or reduce the functional area of the cells. The height should be determined after examining the watercourse and considering the likely natural sediment loads and debris in stream which may flow through the culvert.
- *Low level crossings (causeways or fords)* – during low flow periods low-level crossings that are constructed at an invert that is higher than the bed level of a stream create a weir effect. Fish will be unable to pass over the structure until the water level rises. These structures should be designed to have the same invert level as the stream bed to overcome this problem. If the crossing is built on a stream with a significant gradient, modifications to allow vehicle passage (e.g. concreting) could result in the creation of a downstream drop or waterfall (Cotterell 1998). The design of causeways should also plan to minimise the long-term scouring on the downstream edge of the causeway in order to avoid the creation of a “waterfall” effect.
- *Pipe culverts and pipe causeways* – create more problems for fish passage than arch and box culverts as they reduce the width of the stream, and tend to scour on the downstream side, creating a drop or “waterfall” effect. In most instances, pipes are also less useful as they funnel flows and are generally dark providing a less inviting habitat for fish to pass through. Where used, a series of pipes should be considered to mimic the cross-sectional area of a watercourse. These crossing types should normally only be used on Class 4 watercourse types.

3.3.3 Construction considerations for watercourse crossings

The construction phase of a road or watercourse crossing can have significant impacts on fish and fish habitat. The following issues should be addressed in the planning, design and construction phases of such projects:

- *Fish passage* – accessing bridge pylons, getting machinery into the watercourse to build a structure, and removing old crossing structures may require the restriction or redirection of water flow. Every effort should be made to ensure that fish passage is not blocked or impeded at any time during construction. Instream construction works should also be completed as quickly as possible to minimise impacts on fish and fish passage.
- *Rainfall seasons* – less impact on fish and fish habitat will occur if work is performed during a dry period. Every effort should be made to ensure that work in watercourses is conducted during periods of zero to low flow, and avoided during rainfall events. Forecast climatic information such as the occurrence of wet and dry seasons should also be considered in the long-term planning of road and watercourse crossing projects (e.g. bridge replacement programs) to minimise works in stream in known wet seasons.
- *Migratory seasons* – timing of works must take into account the migratory seasons of fish and other aquatic fauna. Construction should be avoided when aquatic fauna are migrating (refer to section 2.1 for further information). Information on aquatic fauna migratory periods can be obtained from relevant scientific literature.





3.4 Dredging and reclamation works in watercourses

In general, all watercourse crossings involve dredging or reclamation works under the Act. Dredging works may be required to access a source of fill (such as gravel for side tracks) or to construct pier foundations for a bridge. Reclamation works include constructing and replacing pylons and abutments for bridges, constructing or rehabilitating culverts and causeways in a watercourse or creating a construction pad in a watercourse to access works in stream. These works may be a necessary part of roadworks, but must be managed to mitigate or minimise any impacts on fish and fish habitat.

Part 7 (Divisions 1, 3, 4 and 5) of the Act deals with requirements for dredging and reclamation works in NSW waters. Permit requirements are addressed in section 4. *Table 3* summarises the minimum assessment requirements which should be addressed in the SEE/REF/EIS process for both new roadworks, or maintenance works on existing structures in order for NSW Fisheries to assess the potential impacts of the works on fish and fish habitat.

TABLE 3: INFORMATION REQUIRED TO ASSESS POTENTIAL IMPACTS OF DREDGING AND RECLAMATION WORKS FOR ROAD WORKS AND WATERCOURSE CROSSINGS

Information Required	Explanation of Requirements
Description of the locality and habitat of the proposed dredging and reclamation works (i.e. site and region)	• map of site location and photographs where possible • name of watercourse • total area of watercourse to be directly affected by the works • location of recognised commercial or recreational fishing grounds and oyster/aquaculture leases • site and regional habitat description (e.g. watercourse morphology, riparian vegetation, presence of marine vegetation (seagrass, mangroves), gravel beds or snags, deep pools and riffles, seasonal flow regime) • classification of watercourse type (see Table 2 above) • presence of any threatened species
Description of proposed dredging and reclamation works	For dredging works: • description of substrate type of area to be dredged (e.g. sand, gravel, mud, acid sulphate soils) • location of dredge spoil stockpile in relation to the watercourse • description of vegetation type or substrate type on which the extracted material is to be placed • method of dredging • proposed slope of the bank batters upon completion For reclamation works: • description of substrate type or vegetation of the area to be reclaimed • type(s) and sources of fill/material to be used • method of reclamation
Description of environmental safeguards	• how will soil erosion, sedimentation and turbidity be controlled? • how will damage to fish habitat be mitigated or minimised? • will fish passage be maintained at all times? • use of buffer zones from watercourses for stockpiling of spoil and fill (note: minimum of 50 metres required by NSW Fisheries) • other environmental safeguards to be adopted • description of environmental monitoring to be undertaken (e.g. water quality, fish passage) • timing of works to avoid migratory species



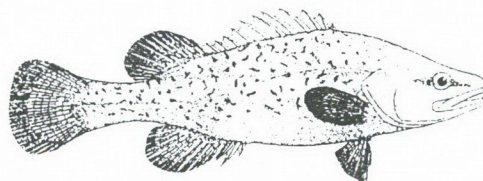
TABLE 3: INFORMATION REQUIRED TO ASSESS POTENTIAL IMPACTS OF DREDGING AND RECLAMATION WORKS FOR ROAD WORKS AND WATERCOURSE CROSSINGS cont.

Information Required	Explanation of Requirements
Consultation with affected stakeholders, where applicable	• have commercial and recreational fishers been consulted? • has NSW Fisheries been consulted? • have approvals been sought and given from other departments/councils?
Habitat Rehabilitation and/or Environmental Compensation (refer to section 3.8 for further information)	• description of proposed habitat rehabilitation after completion of proposed works (including names of species to be used) • is environmental compensation/bond proposed for the contractor in case of unforeseen environmental damage? • how will the compensation be administered?

3.4.1 Policy for fish friendly dredging and reclamation road works

NSW Fisheries policy for dredging and reclamation road works is:

- a) reclamation will generally not be permitted if it covers marine or estuarine habitats including mangroves, seagrasses, and macroalgae.
- b) **spawning grounds**, such as gravel beds in areas where salmon or trout are likely to occur, and **snags**, must not be dredged or removed from within a watercourse unless prior notification (i.e. for councils and public authorities) has been made (in the case of snags) and/or a approval has been sought from NSW Fisheries (in the case of gravel bed disturbance).
- c) *Seagrass – Fish Habitat Protection Plan No.2 – Seagrasses* provides additional protection and management for the states' seagrasses. Under the Plan, dredging and reclamation activities affecting seagrasses will require a permit from NSW Fisheries. Applications to dredge areas containing *Posidonia* seagrass beds will generally not be approved. *Posidonia* species are particularly susceptible to impacts and do not generally recover. Applications to dredge areas containing other species of seagrass are also generally not permitted, unless effective rehabilitation or compensation is provided so that there is no "net loss" of seagrass (see sections 3.8 and 4 for further information).
- d) the construction of bunds or sediment ponds in all watercourses should be discouraged.
- e) all possible care should be taken to ensure that sediment from roadworks does not enter any watercourses. Sediment and erosion control plans must be developed and copies made available to NSW Fisheries on request.
- f) fill or excavated material must not be stockpiled in flood prone areas in order to minimise sedimentation. Particular care should be made in siting stockpiles and dumps. Preferred sites should be situated either above mean high water mark, or be secure from a 1 in 10 year flood level and have effective sediment control works to contain any runoff.
- g) fish passage must not be restricted at any time, unless prior approval has been sought from NSW Fisheries. The timing of the works should also be determined so as not to interfere with the possible migration of fish into the streams. If a project requires fish passage to be temporarily blocked, and no feasible alternative exists, then NSW Fisheries must be informed, and approvals gained before the works are commenced.
- h) sediment ponds should be installed as a matter of course and properly maintained.
- i) sediment controls should be left in place beside the watercourses after the construction phase is completed, and until the site has been fully stabilised by replanted vegetation to stop sediment entering the watercourse.
- j) project works should be sequenced so that instream works are completed as quickly as possible.





3.4.2 Guidelines for fish friendly dredging and reclamation road works

- a) sediment to be used in dredging or reclamation should be tested for contaminants prior to any works (see ANZECC 1996). Contaminated fill or dredge spoil containing toxic substances such as heavy metals, organochlorines, acid sulphate soils, dinoflagellates etc. must not be dredged or used in reclamation.
- b) dredging or reclamation works should aim to have no net impact upon the receiving watercourse. Water quality assessments should include analysis of dissolved oxygen, pH, turbidity, temperature, nutrients and salinity as a minimum, and should take into account the existing water quality status of the receiving watercourse.

3.5. Aquatic habitat management

The planning phase for any new road or watercourse crossing requires the identification of possible location options for the proposed structure. The site selection process should consider the following issues in order to identify and minimise impacts on fish habitat:

- what classification of watercourse is the proposed site (i.e. Class 1, 2, 3 or 4 in Table 2)?
- what types of fish habitat are present? (e.g. mangroves, seagrass, riparian vegetation, snags, pools, gravel beds etc.)
- are they in a degraded or healthy state?
- will these habitats be damaged, destroyed or modified by the new structure or can the impacts be controlled or minimised on site? (e.g. trimming or transplanting of mangroves)
- are there feasible alternative sites available with less of these habitat types present?
- are threatened species or "critical habitat" likely to be present at the proposed site? (i.e. check against habitat preferences and potential distribution for all listed threatened species, and check listings of "critical habitat").

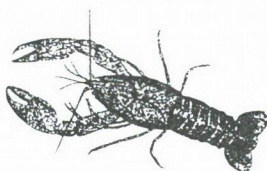
3.5.1 Policy for aquatic habitat management

The following policies should be applied when planning and assessing new roads or watercourse crossings in, adjacent to, or across NSW waters.

- a) Roads and watercourse crossings shall be constructed to minimise habitat loss, changes in sediment transport and stream siltation, and to maintain natural tidal exchange or river flow hydraulics.
- b) Instream gravel beds must not be removed from within a Class 1-3 watercourse without prior approval from NSW Fisheries (see section 4).
- c) **Harm to mangroves, live seagrass or macroalgae (e.g. via shading or removal for pylon or culvert placement) is not allowed without a permit from NSW Fisheries (see section 4).**
- d) Where **trimming of mangroves** is considered, only Grey (*Avicennia marina*) and River (*Aegiceras corniculatum*) mangroves will be permitted to be trimmed. Mangroves should not be trimmed below 2 metres in height. Trimming may only occur with a prior permit from NSW Fisheries (see section 4).
- e) Removal of marine vegetation, such as mangroves and seagrass, will not be permitted by NSW Fisheries from SEPP 14 wetlands.
- f) Where aquatic habitats are designated "critical habitat" then the waters of that habitat must automatically be designated Class 1, and will be subject to the preferred engineering solutions outlined in Table 2.
- g) **Snags – Fish Habitat Protection Plan No.1** – Generally, where a snag is in the site of the proposed watercourse crossing, lopping should be considered as the first priority for the management of snags. Where lopping will not solve the problem, re-alignment should be considered as the next possibility, followed by relocation. Removal of a snag is the least desirable alternative and should only be adopted as a last resort. Refer to section 4 for further information on notification requirements for snag management.

3.6. Threatened species

On 1 July 1998, the *Fisheries Management Act 1994* and several other acts, including the *Environmental Planning and Assessment Act 1979*, were amended to include the new threatened species provisions for aquatic fauna and marine vegetation (i.e. via the Amendment Act). Since this date, planning for any new road works, watercourse crossings, or maintenance programs for existing structures **must** take into





consideration their impacts on threatened species (e.g. completion of an '8 part test' and possibly a Species Impact Statement). The '8 part test' (a series of eight legislative questions) is normally required to be completed in order to assess the significance of the impact of the proposed works on listed threatened species, populations or ecological communities. Further information on how to complete an '8 part test' can be obtained from your regional Office of Conservation (see Appendix 1).

The lists of threatened aquatic species, populations and ecological communities which need to be considered are contained in schedules 4, 5 and 6 of the Act. Check with your local NSW Fisheries office for the latest listings if required.

3.6.1 Policy for works which may affect threatened species

The following policies should be followed when planning and assessing new road works and watercourse crossings in, adjacent to, or across NSW waters in the range of a threatened species, population or ecological community or a designated "critical habitat".

- a) Where a project is identified as being in the potential range of a threatened species, population or ecological community, and the area has not been declared a "critical habitat" the following should apply:
 - i. if the determining/consent authority determines that the project will not have a significant impact after considering an '8 part test', then the proposed watercourse crossing(s) will be accepted, subject to the general aquatic habitat protection issues contained in this guideline, and any other relevant approvals, including those required from NSW Fisheries.
 - ii. if the determining/consent authority determines that the project will have a **significant impact** via the '8 part test', then the proposed project should be **modified** where possible (e.g. causeway crossing changed to a culvert crossing, culvert changed to a bridge crossing, new site selected) and the '8 part test' reapplied. If the modified project still results in a significant impact, then the watercourse shall be classified as a Class 1 watercourse as per *Table 2*, and the need for a bridge or tunnel crossing only will apply. A Species Impact Statement (SIS) must also be prepared for the project.

- iii. if the determining/consent authority determines that the project will have a **significant impact** via the '8 part test' (even after the completion of step II above) the watercourse shall be classified as a Class 1 watercourse as per *Table 2*. A SIS must also be prepared for the project.

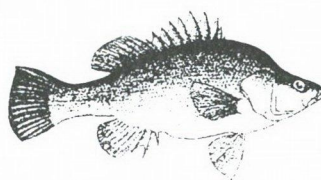
- b) Where a project is identified as crossing through, over or within a designated "critical habitat" for a threatened species, population or ecological community, then the watercourse shall be classified as a Class 1 watercourse as per *Table 2*. A SIS must also be prepared for the project.
- c) For any future maintenance programs for roads and watercourse crossings, councils and public authorities should review and prioritise those structures which are likely to be significantly impacting on threatened species or "critical habitat" for upgrading or replacement. The planning for any upgrade or replacement should be subject to the requirements of the '8 part test'. The '8 part test' assessment shall be subject to guidelines a) and b) above.

3.7 Runoff from roads

Stormwater runoff from road surfaces can carry significant quantities of nutrients, heavy metals, grease and other pollutants. Roads also increase the surface area of impermeable surfaces, thereby increasing the volume and velocity of runoff waters. Surface runoff can also increase the amount of suspended material that enters nearby streams, particularly during road construction works when soils are exposed.

Every effort should be made to ensure that the design and construction phases of the project minimise the volume of sediment and silt to be disturbed. Surface runoff should be directed to sediment control ponds and not direct to watercourses where possible. Care should also be taken to ensure that the sediment control works are functioning appropriately, particularly after a rainfall event.

Scuppers within bridge decks are another point source of runoff of polluted water into major watercourses. This is not a suitable treatment method for surface runoff. Runoff from bridges should also be treated before being released into watercourses (e.g. drainage to sediment treatment pond).





Environmental planning, risk assessment and design phases of a road project should also plan for managing any potential spills arising from car or truck accidents (e.g. release of oils, bulk materials or chemicals) which could possibly enter a watercourse. The need for intercept traps, detention basins or similar works should be considered along major drainage lines or from bridges to direct polluted water away from major watercourses (i.e. Class 1 and 2 watercourses – Table 2). A recent example of the need for such controls was the 1998 chlorine spill from an overturned road tanker on the Pacific Highway bridge crossing over the Brunswick River, at Brunswick Heads, northern NSW. The spill resulted in a large fish kill.

3.8 Habitat rehabilitation and environmental compensation

The costs of environmental compensation are considered to be part of the cost of the development and are to be met by the developer. In both the *Environmental Planning and Assessment Act 1979* and the *Fisheries Management Act 1994* there are provisions for the ordering of rehabilitation and compensation works.

Where a road project is likely to involve the loss of aquatic habitat, NSW Fisheries can request that habitat rehabilitation or environmental compensation be used to mitigate the damage. **Habitat rehabilitation** involves repairing damage caused by past activities.

Environmental compensation is the creation of aquatic habitats or enhancement of fish resources in order to compensate for anticipated adverse or actual environmental effects of proposed developments.

A detailed description of NSW Fisheries requirements for habitat rehabilitation and environmental compensation is contained in section 6.4 of NSW Fisheries (1999). Please refer to this document for further information on this requirement.

4. Summary of requirements and approvals

4.1 Permit, approval and notification requirements

In summary, for the planning, design, construction or maintenance of any roads or watercourse crossings within or adjacent to NSW waters, the following legislative and assessment requirements must be addressed as a minimum:

- a) All of the requirements outlined in sections 1-3 should be considered and addressed, where relevant, within any planning documents (e.g. SEE, REF, EIS or SIS) before approval of such works is granted by the consent/determining authority.
- b) Consultation must be sought from NSW Fisheries during the planning, design, and construction phases of a project to ensure compliance with NSW Fisheries legislation, policy and guidelines and other requirements.
- c) The following legislative requirements may apply to any proposed watercourse crossings:
 - i. A permit is required under section 37 of the *Fisheries Management Act 1994* for any physical sampling of fish and other aquatic organisms (e.g. aquatic surveys).
 - ii. **Local government authorities or private contractors and individuals** will require a permit to carry out any dredging and reclamation works (i.e. any road works or watercourse crossing works in any watercourse) **unless** the work is authorised under the *Crown Lands Act 1989*, or work is authorised by a relevant public authority (other than a local government authority). A **public authority** must, before it carries out or authorises the carrying out of any such works, give the Minister for Fisheries written notice of the proposed works, and consider any matters raised by the Minister concerning the proposed work within 28 days after giving notice.
 - iii. The determining/consent authority for any works must complete an assessment under the threatened species provisions of the Act and the *Environmental Planning and Assessment Act 1979* to determine whether there is likely to be a significant impact on a threatened species, population or ecological community, or a "critical habitat".
 - iv. Any works involving "harm" to marine vegetation (namely seagrass, mangroves or seaweeds) will require a permit under sections 204 and 205 of the Act. The same permit is required for mangrove trimming and transplanting, subject to compliance with the guidelines outlined in section 3.5, and the document "Guidelines for planting, trimming and removing mangroves" (Holliday, 1998).





- v. Local councils and other public authorities are required to notify NSW Fisheries of any proposed works which involve the removal or relocation of a snag (refer to *Fish Habitat Protection Plan No.1* for further details).
- vi. A permit is required under Part 5 (ss 111-114) of the *Fisheries Management (General) Regulation 1995* for any works which may involve the use of explosives, electrical devices or other dangerous substances. This may include blasting works to access pylons, or to create road cuts.
- vii. A permit is required under section 219 of the Act for any works which may result in the temporary or permanent blockage of fish passage within a watercourse.
- viii. Any habitat rehabilitation or environmental compensation related to the proposed works.

Permit application forms can be obtained from NSW Fisheries (1999) or your nearest NSW Fisheries office. See Appendix 1 for contact details.

4.2 Emergency protocol for roads and watercourse crossings

While most road and watercourse crossing projects can be planned for in advance, there are exceptional circumstances where public authorities and road contractors may be required to complete such works in an emergency situation (e.g. high flow events washing away crossings, flooding events, major unforeseen structural failures of bridges etc.) to reinstate essential access routes.

In such exceptional circumstances NSW Fisheries should be notified of the proposed emergency repair works **prior to their commencement**. Basic information such as the location of the works, class of the watercourse where the works are to be completed (i.e. *Table 2 – Class 1, 2, 3 or 4*), need for the works and proposed construction methods can be outlined either by phone or facsimile to your nearest regional Office of Conservation (see Appendix 1). NSW Fisheries will generally be able to issue a permit within 24 hours of notification via facsimile. The permit will be issued subject to the receipt of full documentation (in line with this document) and relevant permit fees as soon as possible after the emergency works have been completed. As most emergency works are of a temporary nature, the full documentation should also address how the structure will be permanently repaired (where relevant).

Once works are completed, a site inspection must be arranged with NSW Fisheries to ensure that permit conditions are adhered to, and to discuss options for permanently repairing the works, where relevant.

References

- Anon. (undated). *A guide to transplanting mangroves*. A joint publication by the State Pollution Control Commission and NSW Fisheries, Sydney, 8pp.
- ANZECC (1996). *Draft Guidelines for Environmental Assessment of the Sea Disposal of Dredged and Excavated Material*. Australian & New Zealand Environment and Conservation Council, Canberra.
- Cotterell, E. (1998). *Fish Passage in Streams – Fisheries Guidelines for Design of Stream Crossings*. Queensland Department of Primary Industries, Brisbane, 40pp.
- Holliday, J. (1998). *Guidelines for Planting, Trimming and Removing Mangroves*. NSW Fisheries, Port Stephens, 11pp.
- Lincoln-Smith, M. (1998). *Draft Guidelines for Assessment of Aquatic Ecology in EIA*. Department of Urban Affairs & Planning, Sydney.
- Gippel, C., Finlayson, B. and O'Neill, I. (1998). *Managing Snags in Rivers*. The Land and Water Resources R&D Corporation, Canberra.
- NSW Fisheries (1998). *Policy and Guidelines Aquatic Habitat Management and Fish Conservation*. (Eds. A.K. Smith and D.A. Pollard), NSW Fisheries, Sydney, 76 pp.
- Richardson, B.A. (1985). *The impact of forest road construction on the benthic invertebrate and fish fauna of a coastal stream in southern NSW*. Aust. Soc. Limnol. Bull. **10**, 65-68.
- Warren, M.L. and Pardew M.G. (1998). *Road crossings as barriers to small-stream fish movement*. Transactions of the American Fisheries Society, **127**, 637-644.
- Williams, R.J. and Watford, F.A. (1996). *A summary of aspects of FRDC Project 94/041 "Restoration of estuarine fisheries habitat" relevant to tidal structures in New South Wales estuaries*. Report to Fisheries Research and Development Corporation. Fisheries Research Institute. Cronulla, 109 pp.



Appendix 1: CONTACT DETAILS FOR NSW FISHERIES STAFF

Local or District Fisheries Officers
– general environmental issues or inquiries

Far North Coast Zone

Tweed	07 5523 1822
Richmond (Ballina)	02 6686 2018
Clarence (Maclean)	02 6645 2147
Coffs Harbour	02 6652 3977

North Coast Zone

Hastings (Port Macquarie)	02 6583 1102
Manning (Taree)	02 6552 6799
Wallis Lake (Tuncurry)	02 6554 6078

North West Zone

Central Tablelands (Bathurst)	02 6331 1428
Far West (Broken Hill)	08 8087 6483
Peel (Tamworth)	02 6765 4591
New England (Inverell)	02 6722 1129
Macquarie (Wellington)	02 6845 4438

Central Zone

Newcastle	02 4927 6548
Hunter (Swansea)	02 4971 1201
Port Stephens (Nelson Bay)	02 4982 1311
Central Coast (The Entrance)	02 4332 2147

Metropolitan Zone

Hawkesbury (Brooklyn)	02 9985 7256
Sydney North (Wollstonecraft)	02 9439 3148
Sydney South (Sans Souci)	02 9529 6021

Illawarra/Shoalhaven Zone

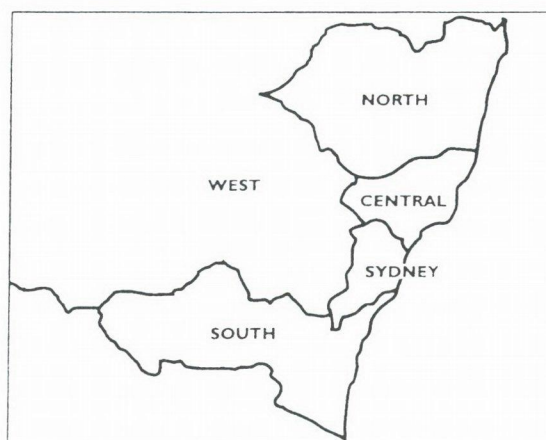
Illawarra	02 4295 1809
Shoalhaven (Nowra)	02 4423 2200

South Coast Zone

Batemans Bay	02 4472 4032
Montague (Narooma)	02 4476 2072
Far South (Eden)	02 6496 1377

South West Zone

Hume (Albury)	02 6021 2954
Monaro (Cooma)	02 6452 3996
Yass	02 6226 3867
Riverina (Deniliquin)	03 5881 6036
Lower Murray (Buronga)	03 5023 5204



Region covered by NSW Fisheries conservation managers

Regional Office of Conservation staff
– for regional planning and environmental management issues

Conservation Manager (North)

PO Box 154
Ballina NSW 2478
Ph: (02) 6686 2018
Fax: (02) 6686 8907

Conservation Manager (Central)

Port Stephens Research Centre
Taylors Beach Rd,
Taylors Beach NSW 2301
Ph: (02) 4982 1232
Fax: (02) 4982 1107

Conservation Manager (Sydney)

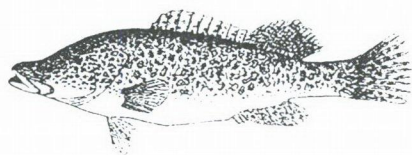
Locked Bag 9
Pyrmont NSW 2009
Ph: (02) 9566 7844
Fax: (02) 9692 9418

Conservation Manager (South)

PO Box 456
Nowra NSW 2541
Ph: (02) 4423 2080
Fax: (02) 4423 2007

Conservation Manager (West)

PO Box 99
Wellington NSW 2820
Ph: (02) 6845 4438
Fax: (02) 6845 4452



20 December, 1999

National Environmental Consulting Services
PO Box 97
WATSON ACT 2602

Attn: Lynn Bain

Dear Ms Bain,

Subject: Review of Environmental Factors (REF) for Replacement of Thornes Bridge over Mulwaree River at Goulburn

Thank you for the opportunity to comment on safeguards for the replacement of Thornes Bridge at Goulburn.

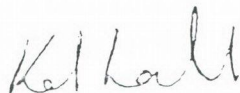
The above proposal is located wholly within the Warragamba Outer Catchment Area as proclaimed under the Sydney Water Catchment Management Act 1998. The Sydney Catchment Authority is concerned that activity in this area has a neutral or beneficial effect on water quality in the Mulwaree River.

The proposed bridge REF should include, but not be limited to, a soil and water management plan approved by the Department of Land and Water Conservation prior to construction activity. In addition the REF should include appropriate location and safeguards for fuel storage, location of areas to be cut and filled and traffic diversion details.

Sydney Catchment Authority looks forward to receipt of the REF and will provide more detailed comment and specific conditions for the project.

If you require additional information or wish to discuss this matter further, please contact Mr. Kelvin Lambkin at Sydney Catchment Authority on 02 47252136. Any correspondence should be sent to SCA P.O. Box 323 Penrith Business Centre Penrith NSW 2751.

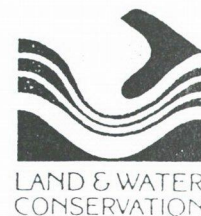
Yours faithfully,



Kelvin Lambkin
A/Landuse Planning Manager

Our Ref. GBNDO R7
Your Ref. CO59.04

National Environmental Consulting Services
PO Box 97
Watson ACT 2602



Attention: Lyn Bain

Dear Lyn,

***Re: R.E.F. Requirements for Replacement of Thornes over Mulwaree River at
Goulburn***

Thank you for your letter dated 14 December 1999, seeking this Departments comments and requirements for the above-proposed REF.

The Departments vision is to facilitate *clean, healthy and productive catchments for the twenty-first century*. As part of this vision, the Department advocates the principles of ecologically sustainable development, and intergenerational equity.

The Departments comments are broad in nature to cover a variety of circumstances. Some of these comments may not be relevant to your proposal.

Rivers and Foreshores Improvement Act.

If there is any river, creek, drain, channel (artificial or natural), depression, etc. which conveys water, or there is a foreshore, consideration is needed to determine if a Part 3A Permit is required from the Department under the *Rivers and Foreshores Improvement Act* (RFI) to:

- (1) **Excavate** or remove material from the bank, shore or bed of any stream, estuary or lake, or land that is not more than 40 metres from the top of the bank or shore of protected waters (measured horizontally from the top of the bank or shore). "**Protected waters**" as defined under section 22A of the Act means a river, lake into or from which a river flows, coastal lake or lagoon (including any permanent or temporary channel between a coastal lake or lagoon and the sea
- (2) **Build erosion control works** and other structures in a river, estuary or lake
- (3) **Place any fill material** in a river, estuary or lake

When assessing developments that require a Part 3A permit under the RFI Act, the Department will consider whether the proposal is consistent with the NSW State Rivers and Estuaries Policy. A condition of consent to a Part 3A permit may include the establishment of a buffer zone along a "river". The Department is unlikely to issue a Part 3A Permit for works that degrade watercourses and their environment

It is the Departments aim that a minimum of a 20m vegetated buffer be kept or established on either side of any "river". A greater width may be required, depending upon to site and the surrounding area

On-line/in-stream water quality structures such as water quality ponds, trash racks and GPT's are strongly discouraged, as they will affect the continuity and corridor function of streams and result in the loss of riparian vegetation and habitat.

The channelisation, piping and/or relocation of streams and the construction of on-line\in-stream structures and culverts for stream road crossings are strongly discouraged. Developments that propose such actions must have the necessary approval of DLWC and are unlikely to receive support

The Department recommends that the proponent contact Garry Hogan Catchment Manager, at the Goulburn Office, phone number, (02) 4823 0747 for details and possible inspection.

Hawkesbury Nepean catchment -Embargo

The Department currently has an embargo in the Hawkesbury \Nepean catchment, on the following;

- The construction of all dams that require a licensee under the Water Act. This includes all dams of any size whose primary function is other than watering stock. This excludes dams that function only to capture polluted waters from a development.
- New applications for licenses to extract water from rivers, lakes and wetlands. New users, on regulated rivers, can only gain access to this water through the purchase of entitlements from existing licence holders. If the river is unregulated, then the right to use water can only be gained by the purchase of the land with an existing water licence.
- The construction of bores for commercial purposes or bores within forty metres of a river.
- The construction of a dam greater than seven megalitres (7000 cubic metres).
- The construction of any dam on a "river" or within "protected lands" of a "river" as defined within the Rivers and Foreshores Improvement Act.

The Department will not accept the separate licenses or permits required. Alternative water supply sources will need to be investigated if necessary.

Currently there are many new changes concerning the requirements for licences. It is recommended that the proponent contact Mr Bruce Watts, Regional Licensing Officer at Parramatta office, phone number (02) 9895 7780, to determine the most recent requirements, if these type of works are being considered.

NSW State Rivers and Estuaries Policy - General.

The NSW Government has a policy to encourage sustainable development of the natural resources of the State's rivers, estuaries, wetlands and adjacent riverine plains. This is to reduce and where possible halt;

- declining water quality,
- loss of riparian vegetation,
- damage to river banks and channels,
- loss of biodiversity, and
- declining natural flood mitigation;

and to encourage projects and activities which will restore the quality of the river and estuarine systems such as;

- rehabilitating remnant habitats,
- re-establishing vegetation buffer zones adjacent to streams and wetlands,
- restoring wetland areas,
- rehabilitating of estuarine foreshores, and
- ensuring adequate streamflows to maintain aquatic and wetland habitats.

This includes ensuring the construction of any wetland or detention structure off-line, so as not to degrade the functions of that natural resource.

Crown Land Matters

Matters the proponent needs to consider when undertaking development adjoining Crown land include:

- Stormwater - overland flows should not be concentrated or diverted from their natural flowline. Roofwater shall not be discharged directly onto Crown land.
- The velocity and volume of stormwater flows to Crown land must be no greater than those before the proposed development.
- Any stormwater control structure must be designed and constructed in accordance with:
Managing urban Stormwater, Soils and Construction. NSW Dept of Housing, 3 Ed. (1998).
- Any excavation or fill is to be contained entirely on the proponents' property and shall not jeopardise the longevity of any vegetation on Crown land. Where fill is proposed adjoining the common boundary it shall be properly drained and retained or battered back and revegetated to prevent the escape of any material onto Crown land.
- Access to any part of the proponents property is not to be over Crown Land. Should the proponent wish to construct a Crown road, permission in writing must first be obtained from the Department.
- Any fire reduction zone required by a development, that adjoins Crown land is to be completely within that development boundary.
- Any other matters that may adversely impact upon the Crown land.

Soil Conservation Act (1938)

The Soil Conservation Act (1938) and amendments provides for the conservation of soil and farm water resources and for the mitigation of erosion within NSW. Any land use activity that disturbs a vegetative ground cover creates an erosion hazard, which requires measures to minimise environmental degradation.

In relation to soil erosion, sedimentation and land degradation in general the Department advises that the Review of Environmental Factors (REF) should address at least, but not be limited to the following issues:-

- ⇒ topography
- ⇒ landform
- ⇒ soil type
- ⇒ soil erodibility
- ⇒ site capability
- ⇒ vegetation management
- ⇒ erosion and sediment control strategy including techniques

Erosion and Sediment Control Plan

An integrated site development plan needs to be prepared, incorporating an Erosion and Sediment Control Plan for the REF. This plan shall cover the life of the proposed site extension, rehabilitation and closure, ensure land stabilised to standards of the Department and Consent Authority. The plan at the REF stage should be detailed enough to enable any reviewer to determine that the concepts for control are sound and practical. The sizes and location of control works should be according to design and the accepted policies, and the revegetation/ landscape plan will enhance the native vegetation biodiversity of the site. It is expected that the following detail will be made available upon request, if required. This same detail is what will be required before the Building Application stage.

- ⇒ Soils investigation to determine erosion and sediment control design
- ⇒ Details on proposed erosion control practices
- ⇒ Details on proposed sediment and pollution control practices
- ⇒ Discharge calculations for diversionary works
- ⇒ Design specifications for banks and sediment basins
- ⇒ Detailed rehabilitation practices including selection of tree, shrub and cover crop species and implementation method
- ⇒ Maintenance and monitoring program for sediment and pollution control structures

- ⇒ Assessment of off-site impacts for surface flow from the development
- ⇒ Rehabilitation proposal for existing erosion on or adjacent to the site
- ⇒ Plans at suitable scale and with diagrams and notation clearly displayed
- ⇒ Details of development works for sequence and staging
- ⇒ Location of critical areas (water bodies, drainage lines, unstable slopes, rock outcrops, hard cover areas, flood plains and wet areas).
- ⇒ Location of all earthworks including roads, areas of cut and fill or land regrading
- ⇒ Diversion of uncontaminated up-site runoff areas to be disturbed
- ⇒ Existing and final contours
- ⇒ Revegetation program

The latest edition *Managing Urban Stormwater, Soils and Construction*. NSW Dept of Housing. 3 Ed. (1998) should be used.

This department will be happy to comment on the REF when it is completed. Could you please forward three copies of the document to the Environmental Review Co-ordinator at PO Box 867 Wollongong 2520.

I trust the above comments will be useful in the preparation of the REF. Should you have any questions please contact Garry Hogan, Catchment Manager in Goulburn office ph: 4823 0747.

Yours sincerely,

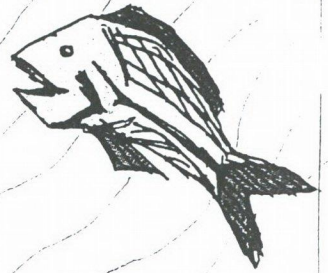


Garry Hogan
 Catchment Manager, Goulburn
 Sydney/South Coast Region
 Date 20th December 1999

P

PEJAR LOCAL ABORIGINAL LAND COUNCIL

81 Bourke St Goulburn NSW 2580
Phone (02) 4822 3552 • Fax (02) 4822 3551
Internet: pejar@goulburn.net.au



Ms Vivienne Courto
Archaeologist
66 Currong Street
BRADDON ACT 2612

Dear Ms Courto

RE: PROPOSED NEW THORNS BRIDGE – GOULBURN

We the Pejar Local Aboriginal Land Council attended a Site Survey conducted at the proposed site of the New Thorns Bridge.

We recommend that:

- Test Pitting be done on various sections of the area.
- Soil samples be taken from an area where there is a ring of mushrooms. We would like this done as to see whether there is any salt present in the soil.

We wish to have 1 or 2 representatives from this Lands Council present during the Soil testing and the test pitting.

If there is anything further that you may require, please do not hesitate to contact me on the above numbers.

Yours sincerely

Delise Freeman
Co-ordinator

FEB 1 2000

Lotus



Domino Fax Server

Domino Fax Server Cover Page

To: **LYNN BAIN**

Subject: Telstra Plant Location Details. Seq. No. 267384

Date:

Pages: 8, including cover page

From:

Company: Telstra

Address:

Phone:

Fax:

Plant Location Details



To	LYNN BAIN	From	Telstra Data Management
Company	NECS		Centre
Address	PO BOX 97	Sequence No	267384
	WATSON 2602	Date	17/12/99
Fax Number	0262474680	Send Type	N/A

The following sketch/plan(s) is/are provided from Telstra's records in response to your request to show the approximate location of Telstra's installations within the vicinity of

Location THORNES BRIDGE (MULWAREE RIVER)
GOULBURN DC 2580
Side of Street B
Intersection SALTPETRE LA

IMPORTANT:

- Please read and understand all the information and disclaimers provided below
- Sketches and Plans provided by Telstra are circuit diagrams only and indicate the presence of telecommunications plant in the general vicinity of the geographical area shown. exact ground cover and alignments cannot be given with any certainty and cover may alter over time. Telecommunications plant seldom follow straight lines and careful on site investigation is essential to uncover and reveal its exact position
- Due to the nature of Telstra plant and the age of some cables and records, it is impossible to ascertain the location of all Telstra plant. The accuracy and/or completeness of the information can not be guaranteed and accordingly Telstra plans are intended to be indicative only

"Duty of Care"

When working in the vicinity of telecommunications plant you have a legal "Duty of Care" that must be observed. The following points must be considered -

1. It is the responsibility of the owner and any consultant engaged by the owner, including an architect, consulting engineer, developer, and head contractor to design for minimal impact and protection of Telstra plant. Telstra will provide free plans and sketches showing the presence of its network to assist at this design stage.
2. It is the owner's (or constructor's) responsibility to -
 - a) Request plans of Telstra plant for a particular location at a reasonable time before construction begins
 - b) Visually locate Telstra plant by hand digging (pot-holing) where construction activities may damage or interfere with Telstra plant (see "Essential Precautions and Approach Distances" section for more information)
 - c) Contact Telstra's Network Integrity Group (see below for details) if Telstra plant is wholly or partly located near planned construction activities

DAMAGE:

ANY DAMAGE TO TELSTRA'S NETWORK MUST BE REPORTED TO 132203 IMMEDIATELY.

- The owner is responsible for all plant damage when works commence prior to obtaining Telstra plans, or failure to follow agreed instructions
- Telstra reserves all rights to recover compensation for loss or damage to its cable network or other property including consequential losses

CONCERNING TELSTRA PLANS:

- Phone 1100 - Dial Before You Dig for free plans of Telstra plant locations. Please give at least 2 business days notice
- Telstra plans and information provided are valid for 60 days from the date of issue
- Telstra retains copyright in all plans and details provided in conjunction with your request. These plans and or details should be disposed of by shredding or any other secure disposal method after use
- Telstra plans or other details are provided for the use of the applicant, its servants, or agents, and shall not be used for any unauthorised purpose
- Please contact the Network Integrity Help Desk (see below for details) immediately should you locate Telstra assets not indicated on these plans
- Telstra, its servants or agents shall not be liable for any loss or damage caused or occasioned by the use of plans and or details so supplied to the applicant, its servants and agents, and the applicant agrees to indemnify Telstra against any claim or demand for any such loss or damage

ESSENTIAL PRECAUTIONS and APPROACH DISTANCES:

NOTE: If the following clearances cannot be maintained, please contact the Network Integrity Help Desk (see below for details) for advice on how best to resolve this situation.

- 1 On receipt of plans and sketches and before commencing excavation work or similar activities near Telstra's plant carefully locate this plant first to avoid damage. Undertake prior manual exposure such as potholing when intending to excavate or work closer to Telstra plant than the following approach distances
- Where Telstra's plant is in an area where road and footpaths are well defined by kerbs or other features a minimum clear distance of 600mm must be maintained from where it could be reasonably presumed that plant would reside
- In non established or unformed reserves and terrain this approach distance must be at least 1.5 metres
- In country/rural areas which may have wider variations in reasonably presumed plant presence, the following minimum approach distances apply

a) Parallel to major plant 10 metres (for IEN optic fibre and copper cable over 300 pairs)

b) Parallel to other plant 5 metres

Note: Even manual pot-holing needs to be undertaken with extreme care, commonsense and employing techniques least likely to damage cables. For example, orientate shovel blades and trowels parallel to the cable rather than digging across the cable.

- If construction work is parallel to Telstra plant, then careful hand digging (pot-holing) at least every 5m is required to establish the location of all plant, hence confirming nominal locations before work can commence

- 1 Maintain the following minimum clearance between construction activity and actual location of Telstra Plant

Jackhammers/Pneumatic Breakers	Not within 1.0m of actual location.
Vibrating Plate or Wacker Packer Compactor	Not within 0.5m of Telstra ducts 300mm compact clearance cover before compactor can be used across Telstra ducts
Heavy Vehicle Traffic (over 3 tonnes)	Not to be driven across Telstra ducts (or plant) with less than 600mm cover Constructor to check depth via hand digging
Mechanical Excavators, Boring and Tree Removal	Not within 1.0m of actual location. Constructor to hand dig (pot-hole) and expose plant

- All Telstra pits and manholes should be a minimum of 1.2m in from the back of kerb after the completion of your work.
- All Telstra conduit should have the following minimum depth of cover after the completion of your work -

Footway 450mm

Roadway 450mm at drain invert and 600mm at road centre crown

- For clearance distances relating to Telstra pillars, cabinets and RIMs/RCMs please contact the Network Integrity Help Desk (see below for details)

FURTHER ASSISTANCE:

Over-the-phone assistance can be obtained by calling the Network Integrity Help Desk below.

Where on-site location is provided, the owner is responsible for all hand digging (pot-holing) to visually locate and expose Telstra plant.

If plant location plans or visual location of Telstra plant by digging reveals that the location of Telstra plant is situated wholly or partly where the owner plans to work, then Telstra's Network Integrity Group must be contacted through the Network Integrity Help Desk to discuss possible engineering solutions.

The contact numbers for the Network Integrity Help Desk are as follows -

Phone: (0x) 1800625597 This operates between 8 am to 4.30 pm 5 days per week

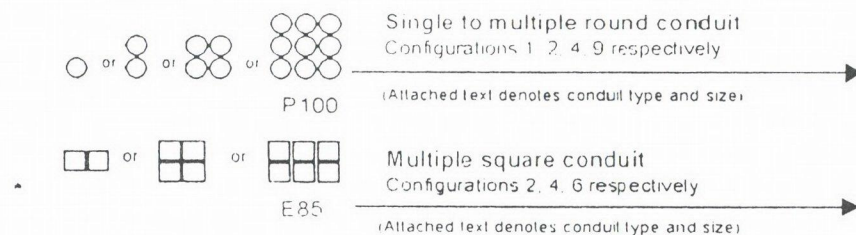
Fax: (0x) 1800646692 24 hours per day 7 days a week

NOTE:

If Telstra relocation or protection works are part of the agreed solution, then payment to Telstra for the cost of this work shall be the responsibility of the principal developer or constructor. The principal developer or constructor will be required to provide Telstra with the details of their proposed work showing how Telstra's plant is to be accommodated and these details must be approved by the Regional Network Integrity Manager prior to the commencement of site works.

A GUIDE TO READING **Telstra** PLANS

Telstra Corporation
Limited
ACN 051 775 556

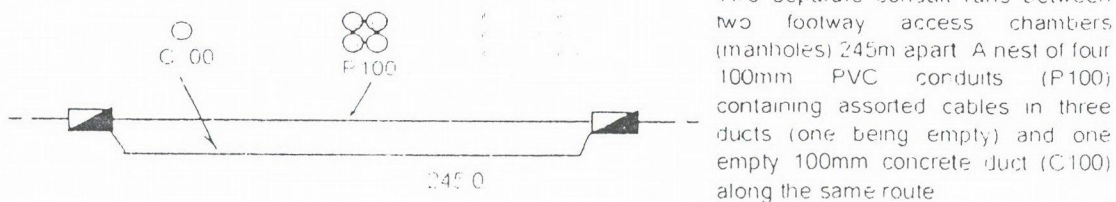
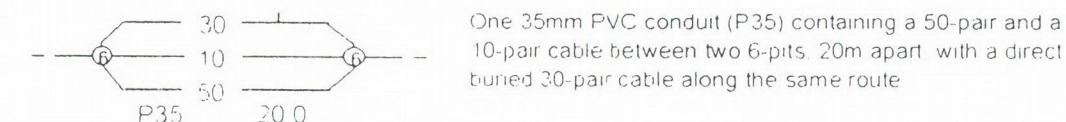


Some examples of conduit type and size:

A - Asbestos cement, P - PVC / plastic, C - Concrete, GI - Galvanised iron, E - Earthenware
Conduit sizes *nominally* range from 20mm to 100mm

P100	100mm PVC Conduit	P50	50mm PVC conduit
A100	100mm asbestos cement conduit	E 85	85mm earthenware conduit

Some examples of how to read Telstra plans:



WARNING: Telstra's plans show only the presence of cables and plant. They only show their position relative to road boundaries, property fences etc. at the time of installation and Telstra does not warrant or hold out that such plans are accurate thereafter due to changes that may occur over time.

DO NOT ASSUME DEPTH OR ALIGNMENT of cables or plant as these vary significantly.

The customer has a DUTY OF CARE when excavating near Telstra cables and plant. Before using machine excavators, TELSTRA PLAN™ MUST FIRST BE PHYSICALLY EXPOSED BY SOFT DIG (potholing) to identify its location.

Telstra will seek compensation for damages caused to its property and losses caused to Telstra and its customers.

Sequence Number 267384
Comment Distribution Plan

Map Number Map 1 of 4

Map Reference

N

Braidwood Rd

Thomes Bridge

100/0 b4
F100
83 3

100/0 b4
A100
112 1

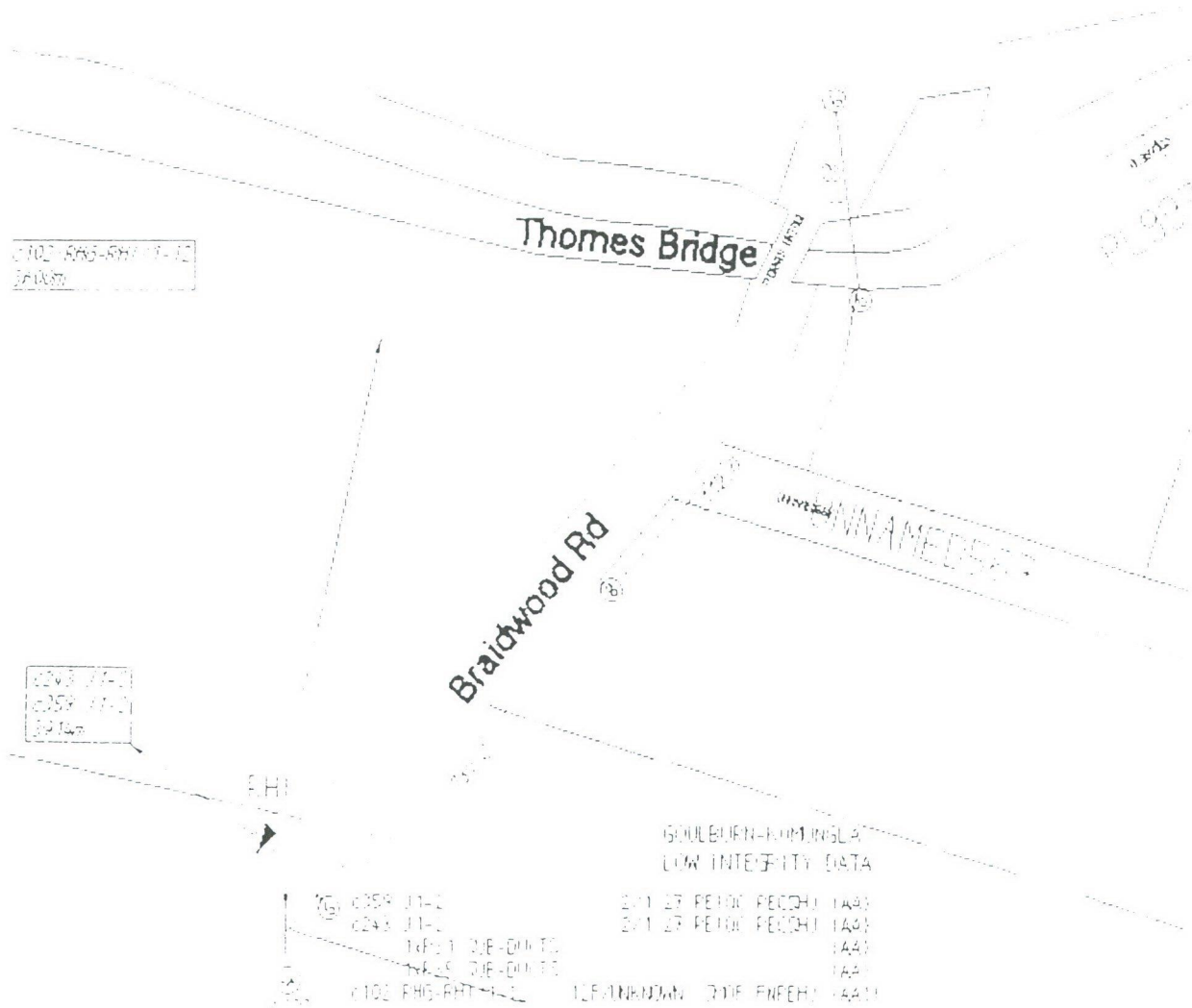
100/0 b4
P30
30 11

100/0 b4
P30
30 11

UNNAMED 567

WARNING - MAJOR CABLES and/or OPTIC FIBRE IN THE AREA

N



WARNING - MAJOR CABLES and/or OPTIC FIBRE IN THE AREA

Sequence Number 267384 Map Number Map 3 of 4 Map Reference
 Comment Main Cable Plan (CAC) Left Side

N

Left Side
 Join Here

c102:RH5-RHI/1-12
 3500m

126/UNKNOWN SMOF ENPEHJ
 c102:RHI-DUM1/1-12

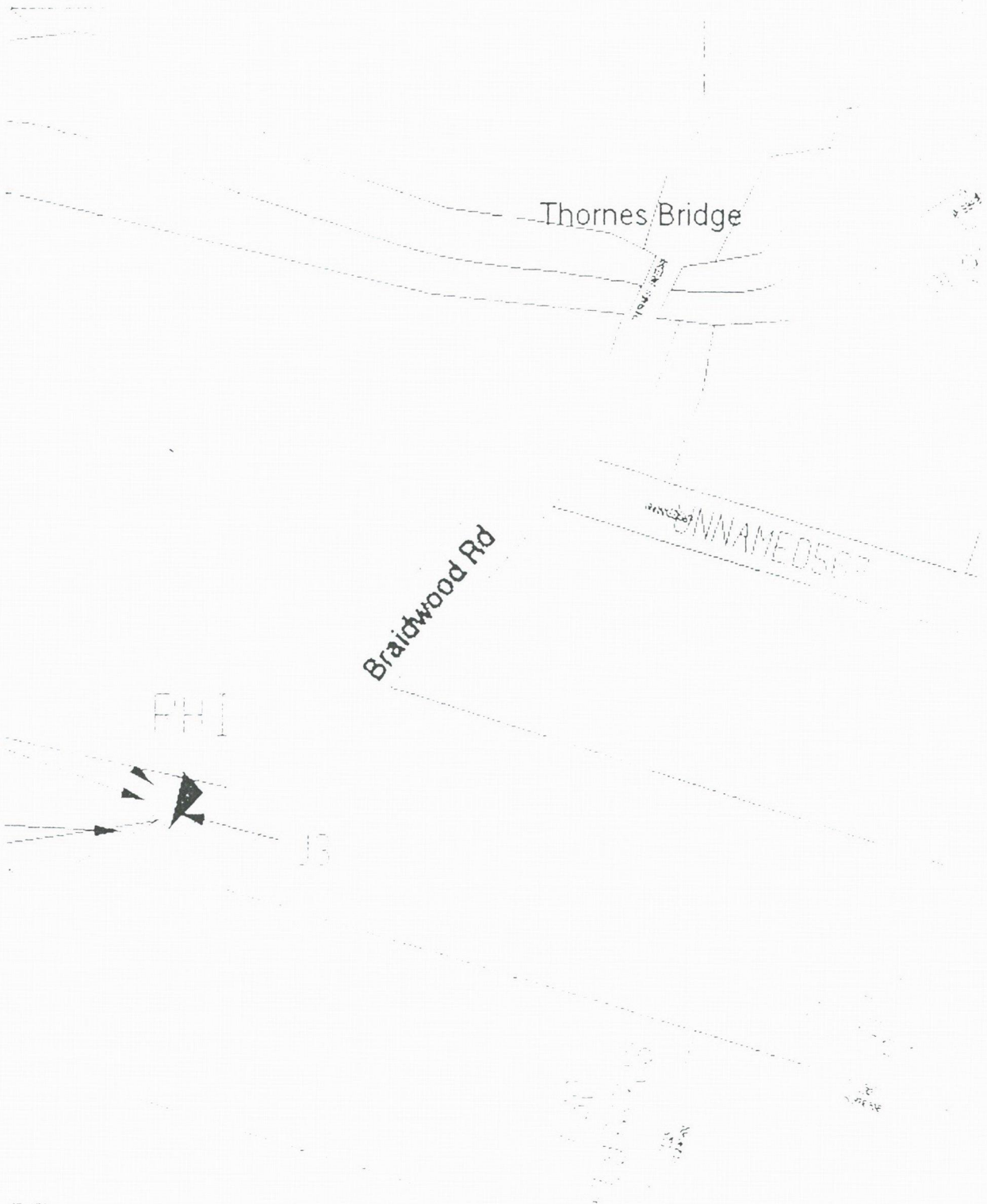
GOULBURN-KOMUNGLA
 LOW INTEGRITY DATA

c243:J1-2
 c359:J1-2
 3914m

WARNING - MAJOR CABLES and/or OPTIC FIBRE IN THE AREA

Sequence Number 267384 Map Number Map 4 of 4 Map Reference
 Comment Main Cable Plan (CAC) Right Side

Right Side
 Join Here



WARNING - MAJOR CABLES and/or OPTIC FIBRE IN THE AREA



TransGrid

Network/Southern Region/Yass

Telephone: 02 62269 666

Our reference: MAINS/THORNES/MMC:REH

The Manager
NECS
PO Box 97
WATSON ACT 2602

Southern Area - Yass

Perry Street

PO Box 139 Yass

New South Wales 2582 Australia

Facsimile (02) 6226 9603

Telephone (02) 6226 9666

Web <http://www.tg.nsw.gov.au>

Attention: Lynn Bain

Dear Ms Bain,

REPLACE OF THORNES BRIDGE OVER MULWAREEE RIVER - GOULBURN

The replacement of Thornes Bridge over Mulwaree River at Goulburn may have an impact on Great Southern Energy's 971 Yass-Goulburn 132kV Transmission line.

This line is operated and maintained on Great Southern Energy's behalf by TransGrid.

Would you please advise any ground line changes or developments on the 45 metre easement to this office?

Further enquires can be discussed with Engineering Officer Mains, Michael McManus on 62269615

Yours sincerely

D.G. BELL
MANAGER/SOUTHERN REGION
17 February, 2000



Quality
Standard
Company
No. 40012-000
TransGrid Australia



Winner
Engineering Excellence Awards 1997 and 1998

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APPENDIX B

HYDRAULIC CALCULATIONS

**CITY OF GOULBURN - MAIN ROAD NO. 79 BRIDGE OVER
MULWAREE RIVER -(THORNE'S BRIDGE) AT GOULBURN.**

(Additional Waterway Calculations)

Wollongong Office has requested that an additional waterway calculation be undertaken is required for the proposed improvement of the road alignment at the subject site. The road geometry for design speed of 80km/hr and 90 km/hr have been considered (see attached). The following four options were investigated.

- (a) 80 km/hr, With Existing Bridge Retained
- (b) 80 km/hr, With Existing Bridge Removed
- (c) 90 km/hr, With Existing Bridge Retained
- (d) 90 km/hr, With Existing Bridge Removed

Summary of the results are given in the table below.

Option	Estimated 1% Flood Level (m) AHD	Flood Velocity Under The Bridge (m/sec)	Freeboard House No.1 Floor Level = 633.11m	Freeboard House No.2 Floor Level =633.21m
(a) 80 km/hr - Existing Bridge Retained	632.84	2.69	0.270	0.370
(b) 80 km/hr - Existing Bridge Removed	632.82	2.84	0.290	0.390
(c) 90 km/hr - Existing Bridge Retained	632.86	2.90	0.250	0.350
(d) 90 km/hr - Existing Bridge Removed	632.83	2.75	0.280	0.380

From the above table, the difference in flood levels between (a) and (c) is only 20 mm. This is due to the availability of waterway areas on both approaches.

By removing the existing bridge and reinstating the abutments to the natural condition, the difference in flood levels between (b) and (d) is only 10mm. The waterway area of the proposed bridge is fully utilised.

The table below also compares the flood levels for the existing condition to the above four conditions.

	(a) 80 km/hr - Existing Bridge Retained	(b) 80 km/hr - Existing Bridge Removed	(c) 90 km/hr - Existing Bridge Retained	(d) 90 km/hr - Existing Bridge Removed
1% Flood level- Proposed	632.84	632.82	632.86	632.83
1% Flood Level - Existing	632.85	632.85	632.85	632.85
Proposed - Existing	-10 mm	-30 mm	+10 mm	-20 mm

4 Recommendation

The proposed 4 x 30m span bridge is considered acceptable for the crossing. However, Option (c) is not recommended as the flood level upstream of the bridge increases by 10mm. All other options are considered satisfactory.

Phanta Khamphounvong
Waterway Engineer
Bridge Branch

04/01/99

ARCHER Ian

From: ARCHER Ian
To: KHAMPHOUNVONG Phanta
Subject: RE: Thornes Bridge
Date: Tuesday, 8 December 1998 4:15PM

Phanta

As discussed, we would like you to investigate a further option for Thorne's Bridge. This involves a regrading of the bridge and approaches to a higher design standard than the existing approaches, but different to the recommended profile in the Lyall & Macoun report. I am sending a longitudinal section of the proposed grading under separate cover for your information.

The proposal is a combination of a 80km/hr and 90 km/hr vertical alignment using the 4 x 30m span bridge. The finished surface levels are noted on the plan. Where no finished surface level is given, it can be assumed that the natural surface level (ie the existing road level) is the finished surface.

We suspect that this proposal will have an adverse affect on the freeboards at the two houses upstream. If this is the case, would you please advise what additional waterway area is required to limit the freeboard at the two houses to no less than 150mm. Rather than provide an additional span to the bridge, it is considered that culverts in the approaches may be a cheaper way to control the flooding.

If you have any questions please do not hesitate to call.

Regards
Ian Archer

From: KHAMPHOUNVONG Phanta
To: ARCHER Ian
Subject: Thornes Bridge
Date: Friday, 20 November 1998 9:59AM
Priority: High

Ian,

Please see attached. This is a supplementary report on the waterway investigation for the subject bridge. Your comment is appreciated.

< <File Attachment: THORNES.DOC> >

Regarding Penmbula Bridge, I would like to come down next week. Can you confirm the date ?

Phanta

**CITY OF GOULBURN - MAIN ROAD NO. 79 BRIDGE OVER
MULWAREE RIVER -(THORNE'S BRIDGE) AT GOULBURN.****Hydraulic Calculations (Revised)****1 Introduction**

This is a supplementary report on the waterway investigation for the subject bridge. The previous report is attached. The scope of the additional report is to carry out detailed hydraulic calculations for the subject bridge.

It is proposed to construct a new bridge immediately upstream of the existing. The existing bridge will be retained for historical purposes. The proposed bridge is a 4 x 30 m span structure and has a waterway area slightly larger than the existing.

2 Assumptions and Data

Survey of the stream cross sections are obtained from the previous flood study supplied by Wollongong Office. The HEC2-RAS backwater program is used to model the hydraulic calculations.

The study area is extended over a length of 800 upstream and 270m downstream. Survey of the existing road and the cross section of the bridge is taken from Drawing 0079.172.RC.0527.

Manning's roughness for the channel is 0.035 and 0.040 corresponding to for floodplain conditions.

Only the 1 in 100 average recurrence interval flood is considered in the analysis as the impact of this flood is sensitive on the two properties upstream of the bridges. The 1 in 100 year flood discharge is estimated to be 1109 m³/sec. Since the flood level downstream of the existing bridge is not known the slope area method is used to derive the rating curve of the creek.

3 Results

Three cases have been considered in the analysis and are as follows:

- a) Existing condition
- b) Proposed condition with existing bridge retained
- c) Proposed condition with existing bridge removed

There is no proposed change in road vertical alignment on the approaches.

The table below summarises the results from the analysis.

Case	Estimated 1% Flood Level (m) AHD	Flood Velocity Under The Bridge (m/sec)	Freeboard House No.1 Floor Level = 633.11m	Freeboard House No.2 Floor Level =633.21m
a) Existing Condition	632.85	2.67	0.260	0.360
b) Proposed Condition With Existing Bridge Retained	632.88	2.80	0.230	0.330
c) Proposed Condition With Existing Bridge Removed	632.86	2.74	0.250	0.350

From the above table, the difference in flood levels between (a) and (b) is only 10mm. This is due to the availability of waterway areas on both approaches.

Removing the existing bridge and reinstating the abutments to the natural condition will reduce the backwater by 50mm as the waterway area of the proposed bridge is fully utilised.

4 Recommendation

The proposed 4 x 30m span bridge is considered acceptable for the crossing. However, removing the existing bridge would increase the freeboard of the two houses by 20mm.

Retaining the existing bridge would reduce the freeboard from existing conditions by 30mm. The proposed level of the road approaches for the new bridge should be similar to the existing.

Phanta Khamphounvong
Waterway Engineer
Bridge Branch

~~12/02/99~~

20/11/98

NOT

POSSIBLE

**CITY OF GOULBURN - MAIN ROAD NO. 79 BRIDGE OVER
MULWAREE RIVER -(THORNE'S BRIDGE) AT GOULBURN.****Review Of Waterway Calculations****1 Introduction**

This report reviews the waterway investigation for a proposed new crossing of Main Road No. 97 over Mulwaree River at Goulburn. The original flood investigation for the subject bridge was carried out in 1989 by Lyall and Macoun, Consulting Engineers.

The proposed new bridge is immediately upstream of the existing bridge. The approaches of the new bridge will be raised to provide an improved level of service. The existing bridge is to be retained for historical purposes.

2 Scope

RTA Wollongong Office has requested that a review of original flood investigation be carried out for the subject bridge site. It is also requested that a 4x30m span bridge be investigated for its suitability at the site while retaining the existing bridge.

3 Existing Bridge

The existing bridge configuration is given below

Bridge Type	Timber Truss with Approach Spans
Length	100.8m
Main Span	28m
Approach (North)	3 x9.1m Spans
Approach (South)	5x9.1m Spans
Deck Level	634.78 m AHD
Northern Approach Level	632.21 m AHD (Lowest Point)
Southern Approach Level	632.00 m AHD (Lowest Point)
High Flood Level	632.75 m AHD

4 Proposed Bridge (By Consultant)

The bridge configuration proposed by Lyall and Macoun is as follows:

Bridge Type	Concrete
Length	150m
Main Span	2x30m Span
Approach (north)	4x10m Span
Approach (south)	5x10m Span
Deck Level	634.78 m AHD
Northern Approach Level	632.40 m AHD with 110m long overflow section
Southern Approach Level	632.40 m AHD with 95m long overflow section
High Flood Level	632.90 m AHD

5 Design Constraints

There are two houses on the upstream side of the northern approach. The house floor levels and their respective freeboards are given below.

House	Floor Level m AHD	Freeboard (1) (mm)	Freeboard (2) (mm)
No. 1	633.11	360	210
No. 2	633.21	460	310

Freeboard (1) High flood level of 632.75 as taken from drawing - Registration No. 0079 172 RC 0527

Freeboard (2) High flood level of 632.9 as taken from the consultant's report

6 Review Of Waterway Calculations

Runoff calculations for the subject bridge catchment have been carried out using the "Probabilistic" Rational method to obtain calculated discharges for various average recurrence intervals. The calculations are attached. The 1% flood is estimated to be 1109 m³/sec. This compares with the estimated value of 1130 m³/sec calculated by the consultant.

Hydraulic calculations have not been carried out due to the lack of site information. However, it is noted that the Manning's roughness adopted in the consultant report is too high for a depth of flow of more than 7m. The high roughness value will give an over-estimate of high flood level.

7 Proposed 4x30m Span Bridge

Assuming that the hydraulic calculations carried out by the consultant are correct, the 4x30m span bridge can be adopted for the site provided that the level of the road approaches is lowered from 632.4m to 632.35 m AHD. The minimum length of the

RTA Technology

Bridge Over Mulwaree River
At Goulburn

overflow section on the road approaches is to be maintained as specified in Section 4 above.

8 Recommendation

The 150m bridge recommended by the consultant is satisfactory provided that the length of the overflow section at RL 632.4 on the northern and southern approaches are at least 110 & 95m respectively.

The 4x30m span bridge can also be adopted to the crossing as long as the levels of the overflow sections and the road approaches are set at RL 632.35m. If this bridge configuration is to be adopted, it is recommended that a bridge site survey be carried out and hydraulic calculation rechecked. This will confirm the new flood level for the crossing.



Phanta Khamphounvong
Waterway Engineer
Bridge Branch
12/10/98

APPENDIX C

SOIL EROSION AND SEDIMENT CONTROL
PLAN

EROSION AND SEDIMENT CONTROL PLAN

1.0 INTRODUCTION

This plan has been prepared to describe the measures to be undertaken at the construction site for Thornes Bridge, which would mitigate soil erosion and control pollution of sediment, nutrients and other pollutants to the land and water in the vicinity of the bridge, including the Mulwaree River over which the bridge extends.

In general, the risk of erosion is directly proportional to how much soil is exposed to erosive elements through loss of vegetative cover. Rainfall is another major factor affecting erosion risk.

The area of work includes the northern and southern approaches to the bridge which will be both 150 metres (m). The new bridge will be 0.5 m to the west of the existing bridge at the northern abutment. The bridge span is 125 m.

Drainage works are required to the south of the bridge because of the problems associated with the entrance to The Towers property and access to the property will require relocation.

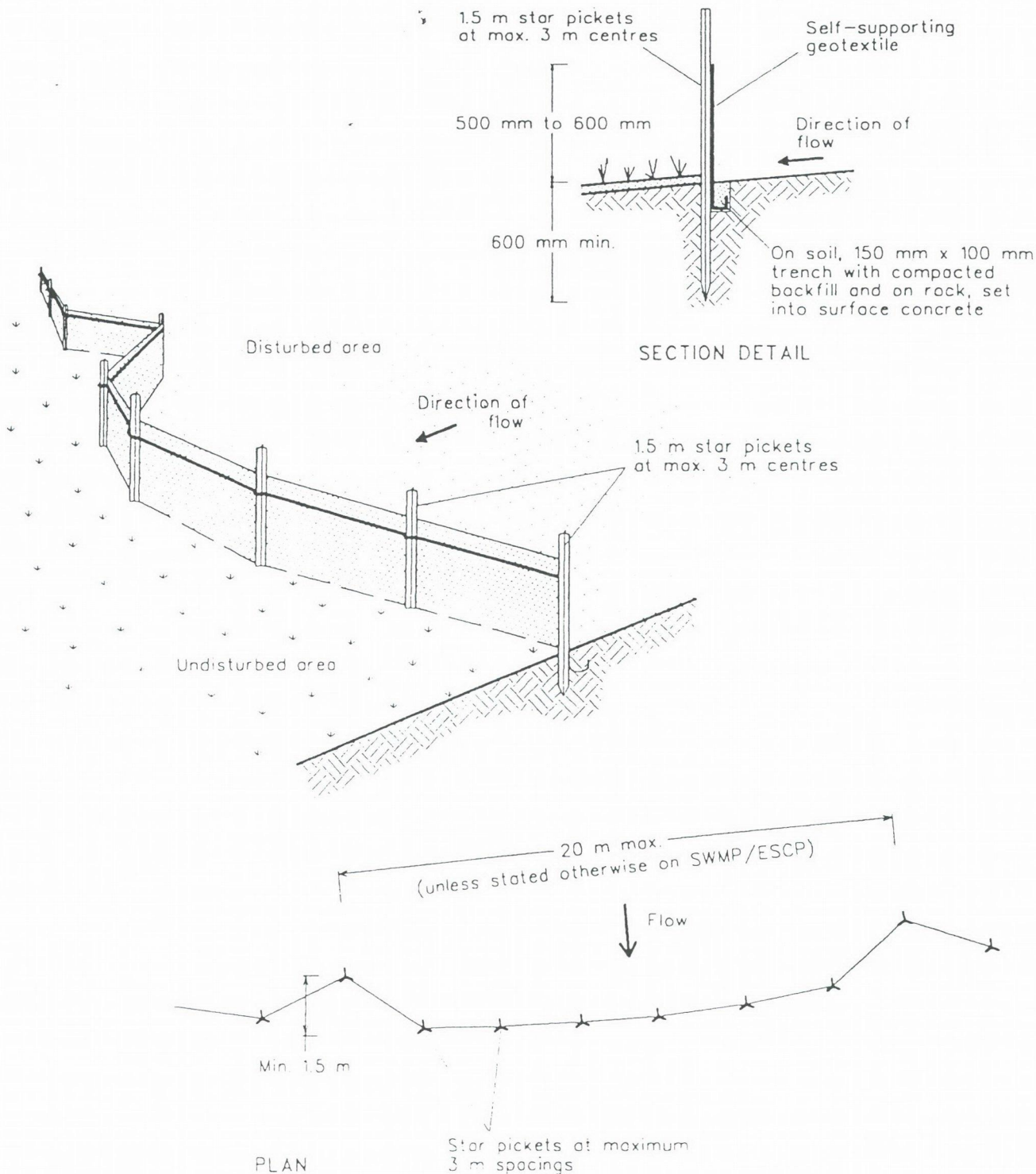
2.0 EROSION CONTROL

Roadworks and excavation in the vicinity of the proposed bridge will generate significant sediment loads which must be controlled so that water quality in the river is not affected. A sediment fence consisting of geotextile or hay bales should be placed downslope of the proposed works. It should be placed as close as possible to parallel to the contours of the site. The details of the construction of the fence are shown in Figure 1. The location of the temporary sediment fence will be very close to the river. The fence should be regularly inspected and reviewed following rain events greater than 15 millimetres (mm).

A drain on the western side of the proposed bridge will grade towards the river on a 0.5% slope. An 8 m long sediment containment wall with the inner wall faced with geotextile, will be located at the end of the open drain and will act as a permeable siltation basin. It would be advantageous if these drainage works could be implemented early during the works as a means of reducing the sediment load flowing into the river, particularly from the southern side, where more roadworks associated with the bridge approaches are located.

It is unlikely that large amounts of topsoil will be removed during construction, however, it should be stored as far as possible from the river and stabilised with a cover crop or surrounded by a silt fence to capture any soil moving from the pile. Trees and shrubs to be removed should be mulched, however, there is no need to reserve any grass cover as the majority is exotic species and of little value for end of work landscaping.

The potential for the river flooding the construction area whilst work is in progress should be taken into account in the finalisation of timing for construction of the bridge.



Construction Notes

1. Construct sediment fence as close as possible to parallel to the contours of the site
2. Drive 1.5 metre long star pickets into ground, 3 metres apart
3. Dig a 150 mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched
4. Backfill trench over base of fabric
5. Fix self-supporting geotextile to upslope side of posts with wire ties or as recommended by geotextile manufacturer.
6. Join sections of fabric at a support post with a 150 mm overlap.

SEDIMENT FENCE

FIGURE 1

3.0 SEDIMENT AND WASTE CONTROL

Sediment Control

Avoidance of pollution of receiving waters is a high priority for these construction works because of the proximity of the works to the Mulwaree River. A review of water quality data for the river shows that it is already affected by stormwater runoff and pollution from industry.

Silt fences will reduce the possibility of sediment entering the river and stabilisation of disturbed surfaces should be carried out as soon as practicable after works are completed eg. construction of the access way to The Towers property.

The construction of the siltation basin early in the construction period will assist with sediment control in both the short and long term to the south of the bridge.

Works are being undertaken over the summer period and watering of the approach roads to the bridge will be necessary to prevent dust generation.

Waste Control

Safe waste disposal practices of materials such as concrete slurry, toilet effluent, cleared vegetation and garbage, should be applied. The *Protection of the Environment Operations Act 1997* makes it an offence to allow any of the above materials to leak, spill or escape from the site where it might harm the environment.

All possible pollutant materials should be stored well clear of any flood-prone or streambank areas. Such materials should be stored in a designated area, under cover where possible. Containment bunds should be constructed with provision for collection and restorage of any spilt material.

Removed vegetation should be disposed of by chipping or mulching for use in future landscaping, however the dense grass cover may need to be removed from the site, if there is a large quantity. This could be disposed of at the local landfill.

Waste collection bins with facilities for sorting the garbage should be provided on site. Bins for food waste should have secure lids to prevent scavenging from birds and animals or infestation by vermin.

Vehicle and equipment maintenance should be undertaken off-site if possible or if on-site in a designated, bunded area. Regular checks should be undertaken to ensure leaks and spills are rectified and cleaned immediately.

4.0 REVEGETATION

Temporary revegetation may be necessary to stabilise bare areas before more substantial landscaping can be undertaken. Work is scheduled to commence in June 2000, so that sowing of a sterile annual cover crop would be feasible in spring. This option should be considered given the proximity of the works to the river and the need for a fast-growing ground cover to stabilise the exposed banks of the river.

The works are expected to finish in March 2001. At this time permanent revegetation can be undertaken utilising riparian species endemic to the area. A range of species would be suitable including:

- Ribbon Gum - *Eucalyptus viminalis*;
- River Bottlebrush - *Callistemon sieberi*;
- Early Black Wattle - *Acacia decurrens*;
- Late Black Wattle - *Acacia mearnsii*;
- Blackwood - *Acacia melanoxylon*;
- Green Wattle - *Acacia parramattensis*;
- Black Sallee - *Eucalyptus stellulata*; and
- Spiny Matrush - *Lomandra longifolia*.

Other species which could be included as scattered specimens include:

- Apple Box - *Eucalyptus bridgesiana*;
- Yellow Box - *Eucalyptus melliodora*; and
- Candlebark - *Eucalyptus rubida*.

There are a number of water plants along the edge of the river and these plants are likely to colonise the lower parts of the river banks and stabilise them further as well as creating a natural filter for sediment. Mulch retained from earlier tree removal should be utilised to surround planted tubestock to reduce water loss and prevent weed invasion. Tree guards will be necessary as there is a large population of rabbits in the area, particularly under the existing Thornes Bridge.

5.0 MAINTENANCE

Proper maintenance of erosion and sediment control structures plays an important part in their management. The sediment control fences should be checked regularly and always after a rain event of greater than 15 mm. Any catch drains that have become blocked with sediment should be cleared to enable water to drain away from the road to flatter areas for absorption.

The quality of runoff water from the site must be of an acceptable standard under law and the proximity of the works to the river make regular inspection and maintenance of controls imperative.

Rainfall or storm events that could cause the river to rise should be monitored and equipment moved from flood hazard areas and sand bags put in place if the works may be affected.

Temporary groundcover should be watered if necessary, particularly soon after planting to ensure a quick and effective temporary cover.

Dust should be controlled on unsealed roads and other exposed surfaces, such as unprotected earth or soil stockpiles, by watering. Surfaces should be kept moist rather than wet.

All erosion and sediment control measures should be maintained until all earthwork activities are completed and the site stabilised. Additional erosion and/or sediment control works may become necessary as works progress, so ongoing changes to this plan may be necessary.

6.0 REVIEW

A check sheet should be developed for the site. This would list the works to be checked, the condition of the works on inspection and remarks which would include maintenance requirements or improvements.

APPENDIX D

WATER QUALITY DATA

Water Quality Data

	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (mS/m)	PH	Phosphorus (mg/L)	Turbidity (NTU)	Ammonia (mg/L)	Faecal Collform (No./100ml)	Total Coliform (No./100ml)
July 1990	6.1	9.2	225	7.3	0.41	55	0	1750	TNTC
August 1990	7.3	9.5	155	7.76	0.06	55	0.61	770	7200
Sept 1990	11.4	9.8	3.5	8.15	0.03	13	0.14	340	1600
Oct 1990	15.8	8.2	250	-	0.15	20	0.24	480	TNTC
Nov 1990	19.4	7.8	300	8.2	0.08	10	0.15	50	TNTC
Dec 1990	21.6	8.8	320	8.22	0.1	7	0.11	100	12000
Jan 1991	23.1	4.8	350	7.6	0.07	12	0.11	40	34000
Feb 1991	24	7.6	350	7.9	0.09	12	0.08	20	TNTC
March 1991	21.5	6	260	7.73		25	0.25	750	4500
April 1991	16.9	10.1	360	7.97	0.06	12	0.16	40	10000
May 1991	10	8.3	850	7.25	0.05	10	0.18	70	2000
June 1991	9	9.3	300	7.31	0.35	70	0.92	110	14000
July 1991	8.9	9.6	180		0.1	35	0.49	67	2000
Aug 1991	7	10	475		0.02	40	0.49	110	4100
Sept 1991	12.2	7.9	600	7.3	0.08	20	0.36	40	
Oct 91	17.5	8.4	350	7.8	0.02	18	0.21	0	9000
Nov 91	17.5	7.7	450	7.2	0.2	16	0.22	30	2000
Dec 91	20.4	6.7	390	8.2	0.06	5	0.016	0	300
May 92	12.6	6.5	225	7.8	0.06	5	0.21	0	0
June 92	8.6	7.7	220	7.8	0.03	5	0.14	20	100
July 92	7.1	9.5	145	7.9	0.02	9	0.04	10	100
Aug 92	8.3	9.7	300		0.07	5	0.09	10	10
Sep 92	11.4	8.6	410		0.07	6	0.11	20	200

	Temperature (c)	Dissolved Oxygen (mg/L)	Conductivity (mS/m)	PH	Phosphorus (mg/L)	Turbidity (NTU)	Ammonia (mg/L)	Faecal Coliform (No./100ml)	Total Coliform (No./100ml)
Oct 92	13.9	8.7	150		0.06	62	0.67	180	4100
Nov 92	17.7	5.2	450	7.8	0.04	10	0.24	0	100
Dec 92	18.9	5.6	390	8.5		13	0.19	30	12100
Jan 93	23.5	6.2	420	7.9		2	0.12	50	100
Feb 93	22.8	3.8	440	7.6	0.04	10	0.15	0	0
Mar 93	19.2	9.6	440	8	0.03	5	0.18	60	300
Apr 93	16.6	3.1	440	7.8	0.04	5	0.03	10	100
May 93	11.6	4	445	7.7	0.08	18	0.28	80	100
June 93	8.2	7.3	400	7.8	0.05	5	0.1	50	100
July 93	8.9	9.5	496	7.7	0.06	11	0.16	80	400
Aug 93	9	6	400	7.3	0.02	17	0.32	0	200
Sep 93	11.3	7.8	240	7.33	0.07	43	0.59	0	100
Oct 93	14.3	7.7	270	7.35	0.16	27	0.6		700
Nov 93	17.1	6.2	210	7.55	0.11	18	0.22	0	0
Dec 93	21.3	5.7	280	7.5	0.05	5	0.18	0	200
Jan 94	21.2	4.83	330	7.73	0.04	18	0.28	50	400
Feb 94	24.5	2.3	300	7.53	0.05	7	0.24	0	300
Mar 94	20	4.02	305	7.54	0.07	5	0.16	0	0
Apr 94	cancelled								
May 94	12.4	2.32	175	6.84	0.075	11	0.42	0	100
Jun 94	10.8	3.85	200	7.33	0.1	11	0.24	60	800
Jul 94	8.1	6.67	200	7.15		10	0.22	70	300
Aug 94	6.6	10.51	240	7.96		9	0.14	0	400

	Temperature (c)	Dissolved Oxygen (mg/L)	Conductivity (mS/m)	PH	Phosphorus (mg/L)	Turbidity (NTU)	Ammonia (mg/L)	Faecal Coliform (No./100ml)	Total Coliform (No./100ml)
Sep 94	11.9	7.92	250	7.92	0.05	7	0.16	20	20
Oct 94	13	8.21	245	7.83	0.3	4	0.17	0	100
Nov 94	12.2	7.86	250	7.82	0.03	9	0.21	100	200
Dec 94	18	8.54	260	8.05	0.02	5	0.16	0	0
Jan 95	20	4.99	275	7.29	0.05	4	0.08	0	TNTC
Feb 95	21.1	6.25	400	7.44	0.05	4	0.08	60	100
Mar 95	19.3	7.29	390	7.65	0.02	8	0.2	0	100
Apr 95	10.2	8.15	405	7.84	0.04	8	0.9	170	200
May 95	11.09	6.01	410	7.46	0.05	10	0.09	TNTC	200
Jun 95	9.2	7.78	410	7.09	0.08	7	0.09	70	100
Jul 95	6.9	8.77	350	7.2	0.1	10	0.14	40	100
Aug 95	6.1	8.76	400	6.98	0.03	10	0.13	0	0
Sep 95	12.5	7.73	425	7.12	0.01	3	0.05	0	0
Oct 95	15.4	8.86	360	6.64	0.08	20	0.32	0	0
Nov 95	17.6	7.58	400	7.34	0.01	9	0.9	62	100
Dec 95	20.4	5.68	290	6.46	0.11	13	0.29	1	100
Jan 96	22.3	5.76	350	6.28	0.11	8	0.22	10	100
Feb 96	18.9	8.02	155	6.51		10	0.23		0
Mar 96	17.9	6.99	110	6.68		21	0.25	0	0
Apr 96	14.9	5.67	105	6.8	0.1	11	0.18	0	0
May 96	11.2	5.42	150	6.81	0.07	15	0.3	0	100
Jun 96	8	7.38	400	7.14	0.025	11	0.45	3	TNTC
Jul 96	6.2	10.01	280	7.05	0.33	8	1	2	10

	Temperature (°C)	Dissolved Oxygen (mg/L)	Conductivity (mS/m)	PH	Phosphorus (mg/L)	Turbidity (NTU)	Ammonia (mg/L)	Faecal Coliform (No./100ml)	Total Coliform (No./100ml)
Aug 96	8.3	7.49	370	7.04	0.07	28	0.19	2	0
Sep 96	9.6	9.35	350	6.86	0.03	19	0.51	0	100
Oct 96	16.1	7.23	210	6.79	0.05	36	0.76	10	100
Nov 96	15.8	7.28	155	7.38	0.05	13	0.59	0	0
Dec 96	20.3	5.58	275	7.48	0.04	5	0.4	20	100
Jan 97	19.3	6.08	275	6.98	0.05	2	0.36	0	0
Feb 97	23.2	5.09	275	7.46	0.06	3	0.48	0	0
Mar 97	19.6	6.45	290	7.69	0.07	4	0.38	10	100
Apr 97	15	7.35	300	7.52	0.19	14	0.23		300
May 97	11.8	5.62	300	7.29	0.1	9	0.4	20	400
Jun 97	4.7	3.53	335	7.3	0.14	12	0.26	0	400
Jul 97	6.9	7.33	170	6.93	0.3	18	0.79	0	0
Aug 97	8.3	9.04	215	7.73	0.14	21	0.44	10	100
Sep 97	11.1	7.03	240	7.01	0.11	26	0.24	10	200
Oct 97	15.5	6.46	420	6.74	0.19	11	0.35	0	30
Nov 97	19.8	6.85	460	7.33	0.09	7	0.17	10	
Dec 97	22	6.56	455	7.83	0.15	9	0.13	0	200
Jan 98	22.6	6.76	457	7.35	0.13	5	0.08	20	300
Feb 98	21.1	4.42	470	7.43	0.11	5	0.14	0	100
Mar 98	19.6	9.97	495	8026	0.06	4	0.07	0	0
Apr 98	16	8.31	500	7.55	0.03	8	0.08	0	600
May 98	9.5	5.99	460	6.62	0.06	15	0.12	100	0
Jun 98	9.1	7.43	460	6.8	0.09	9	0.07	0	0

[illegible]

APPENDIX E

AQUATIC BIOLOGY

AQUATIC BIOLOGY – SURVEY RESULTS (1997 – 1998)

MULWAREE RIVER: THORNES BRIDGE

MACROPHYTES

Family	Genus/Species	Common Name	Date	No. of Species	Exotic
Allismataceae	Allsma plantago-aquatic	Water Plaintain	22.10.97, 1.12.97, 5.2.98		
Azoliaceae	Azola		1.12.97, 5.2.98	1	
Cyperaceae			22.9.97	1	
	<i>Cyperus eragrostis</i>	Umbrella Sedge	5.2.98		*
	<i>Cyperus involucratus</i>		1.12.97		*
	<i>Eleocharis acuta</i>	Common Spike-rush	22.10.97, 1.12.97		
	<i>Schoenoplectus validus</i>	River Clubrush, Great Bulrush	22.10.97, 5.2.98		
Gramineae	<i>Paspalum dilatatum</i>	Paspalum	5.2.98		*
Hydrocharitaceae	<i>Elodea canadensis</i>	Elodea	1.12.97, 5.2.98		*
Juncaceae	<i>Juncus usitatus</i>	Common Rush	22.9.97, 22.10.97, 1.12.97, 5.2.98		
Juncaginaceae	<i>Triglochin procerum</i>	Water Ribbons	22.9.97, 22.10.97, 1.12.97, 5.2.98		
Marsileaceae	<i>Marsilea mutica</i>	Nardoo	1.12.97		
Polygonaceae	<i>Rumex crispus</i>	Curled Dock	22.9.97, 22.10.97		*
Potamogetonaceae	<i>Potamogeton tricarlinatus</i>	Floating Pondweed	1.12.97		
Salicaceae	<i>Salix babylonica</i>	Weeping Willow	22.9.97, 1.12.97		*

MACROINVERTEBRATES

Taxon ID	Number of Taxa	Abundance	Score
22.9.97			
Atydae	1	3	21
Acarina	1	1	5
Physidae	1	2	6
Chironomidae	1	2	2
Poeciliidae	1	1	0
Cladocera	1	2	0
Copepoda	2	3	0
Oligochaeta	1	1	1
Caenidae	2	2	10
Leptophlebiidae	3	3	30
Coenagrionidae	2	2	14
Libellulidae	1	1	8
22.10.97			
Poeciliidae	1	2	0
Retropinnidae	1	1	0
Cordulidae	2	2	14
Gammaridae	1	2	12
Dugesidae	1	1	3
Sphaeridae	1	2	12
Tubificidae	1	3	3
Coenagrionidae	2	2	14
Physidae	1	3	9
Atydae	1	3	21
Lumbriculidae	1	3	3
Cladocera	1	2	0
Leptoceridae	1	3	21
Ecnomidae	1	3	12
Hydra	1	1	0
Naiddae	1	2	2
Ostracoda	1	2	0
Chironomidae	5	3	3
Caenidae	5	3	15
Dytiscidae	1	1	5

Taxon ID	Number of Taxa	Abundance	Score
1.12.97			
Acarina	2	2	10
Validae	2	1	4
Dytiscidae	2	2	10
Hydraenidae	1	2	14
Notonectidae	1	2	8
Corixidae	2	3	15
Culicidae	1	3	6
Cladocera	1	3	0
Sphaeridae	2	2	12
Physidae	1	3	9
Hirudnea	1	1	3
Planorbidae	2	3	9
Amphipoda	1	3	18
Coenagrionidae	1	3	21
Oligochaeta	2	3	3
Chironomidae	2	3	3
Dugesidae	1	1	3
Gyrinidae	1	3	15
Poeciliidae	1	2	0
Ostracoda	1	3	0
5.2.98			
Aeschnidae	1	2	12
Cordulidae	2	3	21
Poeciliidae	1	4	0
Magapodagrionidae	2	3	21
Lestidae	1	3	21
Amphipterygidae	1	1	8
Acarina	1	2	10
Naucoridae	1	1	5
Corixidae	2	3	15
Dytiscidae	3	3	15
Mesoveliidae	1	2	8
Stratiomyidae	1	1	2
Chrysomelidea	1	1	0
Prastacidae	1	3	21
Richardsonianidae	1	1	0

PHYTOPLANKTON

Genus	Abundance (no./ml)
22.9.97	
Dactylococcopsis	190
Scenedesmus	66
Microcystis	42
Navicula	30
Tetraedron	24
Fragilaria	24
Trachelomonas	15
Caretaria	6
Chodatella	6
Ankistrodesmus	3
Cyclotella	3
Golenkinia	3
22.10.97	
Chlamydomonas	620
Chroomonas	320
Botryococcus	190
Navicula	110
Cryptomonas	72
Dactylococcopsis	48
Scenedesmus	48
Tetraedron	48
Melosira	36
Pinnularia	24
Cyclotella	24
Haematococcus	12
Ankistrodesmus	6
Mallomonas	6
Caretaria	6
1.12.97	
Trachelomonas	57
Navicula	45
Gomphonema	21
Cryptomonas	18

Genus	Abundance (no./ml)
Cocconeis	12
Dactylococcopsis	12
Mallomonas	9
Fragilaria	6
Chlorogonium	3
5.2.98	
Chroomonas	7847
Trachelomonas	805
Scenedesmus	268
Cyclotella	268
Navicula	134
Dactylococcopsis	134
Fragilaria	67
Phacus	67

PERIPHYTON

Genus	Abundance
22.9.97	
Navicula	5
Fragilaria	5
Mallomonas	4
Trachelomonas	4
Cryptomonas	4
Gomphonema	3
Melosira	3
Scenedesmus	2
Chlamydomonas	2
Dactylococcopsis	2
Synedra	1
Peridinium	1
Aphanizomenon	1
22.10.97	
Melosira	5
Navicula	5
Gomphonema	4

Genus	Abundance
Oscillatoria	3
Dactylococcopsis	3
Stigeoclonium	2
Cosmarium	1
Closterium	1
1.12.97	
Fragilaria	5
Spirogyra	5
Rhizoclonium	3
Navicula	2
Cocconeia	1
Closterium	1
5.2.98	
Spirogyra	5
Trachelomonas	4
Oscillatoria	2
Aulosira	2
Mougeotia	1
Gomphonema	1
Euglena	1
Chlamydomonas	1
Phacus	1

APPENDIX F

FLORA AND FAUNA SPECIES LISTS

APPENDIX

FLORA AND FAUNA SPECIES LISTS

FLORA

Scientific Name	Common Name
<i>Aira</i> spp.	Hairgrass
<i>Avena sativa</i>	Wild Oats
<i>Bromus</i> spp.	Brome
<i>Chloris truncata</i>	Windmill Grass
<i>Cirsium vulgare</i>	Black Thistle
<i>Crataegus monogyna</i>	Hawthorn
<i>Cyperus eragrostis</i>	Umbrella Sedge
<i>Echium plantagineum</i>	Patterson's Curse
<i>Epilobium billardierianum</i>	Willowherb
<i>Erodium cicutarium</i>	Common Stork's-bill
<i>Foeniculum vulgare</i>	Wild Fennel
<i>Holcus lanatus</i>	Yorkshire Fog Grass
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort
<i>Hypericum perforatum</i>	St John's Wort
<i>Juncus usistatus</i>	Common Rush
<i>Ligustrum lucidum</i>	Large-leaved Privet
<i>Lolium perenne</i>	Perennial Rye Grass
<i>Lycium ferocissimum</i>	African Boxthorn
<i>Medicago sativa</i>	Lucerne
<i>Nassella neesiana</i>	Chilean Needle Grass
<i>Onopordum acanthium</i>	Scotch Thistle
<i>Paspalum dilatatum</i>	Paspalum
<i>Phalaris aquatica</i>	Phalaris
<i>Pinus</i> spp.	Pine
<i>Plantago lanceolata</i>	Ribwort Plantain
<i>Prunus</i> spp.	Plum
<i>Poa</i> spp.	Poa
<i>Rubus fruticosus</i>	Blackberry
<i>Rumex crispus</i>	Curled Dock
<i>Salix babylonica</i>	Weeping Willow

Scientific Name	Common Name
<i>Salix flagilis</i>	Crack Willow
<i>Sanguisorba minor</i>	Sheeps Burnet
<i>Senecio vulgaris</i>	Groundsel
<i>Sysymbrium officinale</i>	Hedge Mustard
<i>Trifolium arvense</i>	Haresfoot Trefoil
<i>Triglochin procerum</i>	Water Ribbons
<i>Ulmus procera</i>	English Elm

FAUNA

Scientific Name	Common Name
Birds	
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill
<i>Chenonetta jubata</i>	Australian Wood Duck
<i>Corvus coronoides</i>	Crow
<i>Fulica atra</i>	Eurasian Coot
<i>Geophaps lophotes</i>	Top Knot Pigeon
<i>Grallina cyanoleuca</i>	Australian Magpie Lark
<i>Gymnorhina tibicen</i>	Australian Magpie
<i>Hirundo neoxena</i>	Welcome Swallow
<i>Malurus cyaneus</i>	Superb Fairy Wren
<i>Passer domesticus</i>	House Sparrow
<i>Rhipidura fuliginosa</i>	Grey Fantail
<i>Sturnus vulgaris</i>	Common Starling
<i>Turdus merula</i>	Common Blackbird
Mammals	
<i>Oryctolagus cuniculus</i>	Rabbit

APPENDIX G

HERITAGE REPORT AND HERITAGE IMPACT
STATEMENT

1 Statement of Heritage Impact for:

Thorne's Bridge

2 Proposal :

A road deviation and construction of a new bridge adjacent to, and on the upstream side of the existing ('Thorne's') bridge.

3 Date :

13th April 2000

4 Reference :

Data in consultancy report for the RTA, New South Wales. McMillan, Britton and Kell ; Study of Relative Heritage Significance of Timber Truss Road Bridges in NSW ; Volume 1 (Appendix B) 1998

The bridge is not entered on any heritage registers.

5 Address and property description :

City of Goulburn, 3 kilometres south along Braidwood Road, crossing the Mulwaree River

The Bridge is a timber and steel, Allen type truss bridge, number 6463. Built in 1920.

6 Prepared by :

John Armes and Associates
'Trapalanda'
Yass NSW 2582
(T & F) 02 62264226 (m) 0419 263639
(email) armesj@cyberone.com.au

7 For :

RTA (NSW) and National Environmental Consulting Services

8 Method

The following questions are raised in the NSW Heritage Manual, as relevant to the preparation of this SOHI;

8.1 Change of use issues:

- 1 *Has the advice of a heritage consultant or structural engineer been sought? (See references and attachments for Statement of Significance)*
 - The RTA has commissioned a state-wide of timber road bridges to better understand the number and significance of these bridge types. (McMillan Britton & Kell). Further assessment was provided in a report by sub-consultant John Armes and Associates to NECS to summarise the significance of the bridge, on a comparative basis, and in the local/regional basis (attached). An archaeological report has also been prepared.
- 2 *Has the consultant's advice been implemented?*
 - The MBK study does not extend to detailed recommendations on each bridge. The NECS report recommended preparation of this SOHI and other heritage conservation strategies. The advice has not been fully implemented at this stage.
- 3 *If not why not?*
 - Design and construction parameters are still being set, and discussions with RTA design staff indicate a sensitivity to heritage values.
- 4 *Does the existing use contribute to the significance of the heritage item ?*
 - Yes, it continues its original use.
- 5 *Why does the use need to be changed ?*
 - The bridge has been assessed, and it has been determined that the bridge cannot meet current traffic needs.
- 6 *What changes to the fabric are required as a result of the change of use ?*
 - Removal of non-original barriers at the Goulburn-side approach.

7 *What changes to the site are required as a result of the change of use ?*

- Re-alignment of the road.
- Upgrading of batters, abutments and river banks.

8.2 **New development adjacent to a heritage item issues :**

1 *How is the impact of the new development on the heritage significance of the item or area to be minimised ? (See references and attachments for Statement of Significance)*

- The original bridge will not be demolished or altered.

2 *Why is the new development required to be adjacent to a heritage item?*

- The road alignment and the private property boundaries limit the opportunities for siting the new bridge. Owners of adjacent land are reluctant to sell acreage which is prime grazing pasture.
- There is an opportunity to further investigate a position for the new bridge to be built a little further west to better separate the two bridges.

3 *How does the curtilage allowed around the heritage item contribute to the retention of its heritage significance ?*

- The open space around the bridge is important to its aesthetic significance in the landscape.

4 *How does the new development affect views to and from the heritage item ?*

- The deck of the new bridge is approximately 600mm higher than the present bridge, and the new structure is minimal in design. Side barriers are minimal in height. When seen from most vantage points, the new bridge will not have an overbearing visual impact. This is not the case from the upstream (west) side.
- Generally, the historic bridge will remain the prominent feature of the river crossing when viewed from a distance. When the new bridge is viewed at a distance from the existing bridge, there will be a substantial visual prominence because of the proximity of the new structure.

5 *What has been done to minimise negative effects ?*

- The bridge has been kept as low as possible, to minimise visual intrusion.
- Options to locate the new bridge as far to the west as possible will be investigated.

6 *Is the development sited on any known, or potentially significant archaeological deposits? If so, have alternative sites been considered? Why were they rejected?*

- There has been an archaeological assessment for the area (Courto, Jan 2000). Test pitting is recommended for the area around the bridge, but as the site is substantially disturbed. Further comment is not appropriate until this testing is complete.

7 *Is the new development sympathetic to the heritage item?*

- Other than siting and height issues, this matter is not relevant.

8 *In what way (e.g. form siting, proportions height) ?*

- The height has been kept low to minimise the visual impact of the new structure.

9 *Will the additions visually dominate the heritage item? How has this been minimised ?*

- Not applicable.

10 *Will the public, and users of the item, still be able to view and appreciate its significance ?*

- Yes

9 **The following aspects of the proposal respect or enhance the heritage significance of the item or conservation area for the following reasons :**

- The proposal has been informed of heritage issues through previous consultancy reports, including a recommendation to have this SOHI prepared.

- The design of the new bridge (concrete "T" girders, cylindrical concrete piers and concrete transoms) is visually discrete, and allows a view to Thorne's bridge to remain from a number of vantage points. The two bridge levels are similar.
- Retention of the bridge provided opportunities for educational and recreational uses associated with the river corridor.

10 The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimise impacts :

- Replacing the bridge results in a loss of the original, uninterrupted use, which is a feature of its significance. It appears that maintenance costs, and engineering reasons to improve traffic movement and safety necessitate the construction of a new structure. The existing structure is not wide enough to satisfy these concerns.
- The change of use, in the sense that it will not continue its original purpose puts the bridge at risk unless appropriate maintenance resources are provided
- The proximity of the new bridge (approximately 1 metre at the northern end) is partly determined by the need to minimise road deviation costs, and the impact of road deviation on adjacent privately owned land.
- The proximity of the new bridge will affect the singular, landmark quality of the existing bridge

11 The following sympathetic solutions have been considered and discounted for the following reasons;

- Downstream (east) bridge locations have been discounted for cost reasons, some engineering issues, and the impact on the weir wall.
- Siting options have been considered to minimise impact on private adjacent land, and the impact of extensive re-alignment of the road.

Attachments

- sub-consultancy report to NECS by John Armes and Associates

References :

- McMillan, Britton and Kell ; Study of Relative Heritage Significance of Timber Truss Road Bridges in NSW ; Volume 1 (Appendix B) 1998 – Consultancy report for the RTA, New South Wales.
- Consultancy reports by National Environmental Consulting Services, including subconsultancy report by John Armes and Associates
- RTA drawings KD330CP1 sheet 1 of 1; 03p1000.dgn, sheet 3 ; 021s_m002.dgn sheet 2
- Heritage Office and Department of Urban Affairs and Planning of NSW Heritage Manual; Statements of Heritage Impact; 1996
- Courto Vivienne; An Archaeological Assessment of Proposed Replacement of Thorne's Bridge, Goulburn NSW for NECS January 2000

Introduction

This report reviews material provided from the McMillan, Britton and Kell study of the Heritage Significance of Timber Bridges prepared in 1998, and provides comment on the impact of the proposed replacement of the bridge

1 Review of MBK report

In general terms, the MBK report concludes that:

- All bridges are technically and historically significant for exhibiting the evolution of bridge technology in NSW, and the integral support of settlement of the State.
- Many bridges have landmark status, irrespective of scale or condition
- There are opportunities for adaptive re-use of the bridges that have reached the end of serviceable life.

With regard to Thorne's Bridge, the specific findings of the MBK report state¹:

- Thorne's Bridge is ranked 20th in a group of twenty-one Allen Truss - types that are ranked as Nationally significant (1-7), State significant (8-12), and Regionally significant (13-21). A further sixteen bridges are ranked lower as of only Local significance.
- It is assessed as a 'representative' example (rather than 'rare') of this type of bridge. When all types are combined, it ranks as the 56th most significant timber bridge in NSW
- It has varying degrees of significance for its historical, aesthetic, social and technical values. Technical and historical values give the Bridge Regional significance

2 Further Issues

This report finds that the Bridge has additional characteristics that need to be recognised and emphasised as part of considerations for the future of the Bridge

2.1 The Regional significance of the Bridge should be recognised as its part of a group of timber bridges in the region, including the Lansdowne Bridge (Goulburn), Bridge over Goodradigbee River (Wee Jasper), Bridge over Yass River (Gundaroo), Bridge over Rossi's Crossing (north of Goulburn). Bridge

¹ McMillan Britton and Kell Pty Ltd: 1998 report on NSW Timber Bridges

over Crookwell River, Foxlow Bridge (north of Captains Flat), and Charleyong Bridge (north of Braidwood)

2.2 The Bridge should be recognised for its relationship with nearby historical places, and its contribution to the formation of a cultural landscape which includes the following places:

Register of the National Estate items

- Garrongang Homestead
- Goulburn Brewery

Goulburn City Council Local Environment Plan - Heritage Items

- South Hill
- Lansdowne Bridge (Register of the National Estate)
- Wynella Homestead - ruin and Barn

Other historic sites

- Brisbane Grove
- The Towers
- Southern Railway line
- (possibly) the weir wall downstream of the bridge

2.3 Although the MBK report assesses the aesthetic value as low ('a small amount' ²). It is important to recognise Thorne's Bridge in terms of the agricultural, transport and settlement heritage of Goulburn and the area south of the City.

- 2.4 This report concludes that highly significant heritage values would be lost by removal of the bridge. It appears that there are alternatives to the position of a new bridge, and that road re-alignment would not be technically difficult.

3 Significance of Thorne's Bridge

On the basis of the information gathered for this report, the Bridge has **regional Importance** for its aesthetic, historic and scientific values.

It has,

- aesthetic value for its contribution to the surrounding cultural landscape;
- historic value for its role in regional transport and development;
- and scientific values as a representative example of bridge technology that made a profound contribution to the development of New South Wales.

4 Recommendations

4.1 In 1998 there were 37 Allen -Type bridges in NSW, and a few were earmarked for demolition. Given that the maintenance costs, and practical suitability of many of the remaining bridges are likely to threaten the long term retention of these structures, it is appropriate to **develop a strategy** to retain a number of these for historical, aesthetic, social and technical reasons. The strategy should not be numerically-based, but on the individual significance of the bridges in their geographical and historical context.

4.2 Thorne's Bridge is situated in an area with high historical and aesthetic value, and its retention will sustain and enhance this feature of the City of Goulburn. Opportunities exist for the Bridge to **serve a role** in broad tourism strategies for the Capital Region (11 Local Government Areas surrounding the ACT)

4.3 It is also possible for the Bridge to be incorporated into draft strategies for the development of the Mulwarree River Corridor as a **recreational and ecological asset** for the City and surrounding Region. Discussions with Goulburn City Council can provide further information in this regard

4.4 The Bridge can continue to demonstrate technical and design techniques, and in the context of other nearby timber bridges and other river crossing structures can **serve an educational role** for engineering and construction students.

4.5 The **significance of the weir wall** should be assessed as part of any consideration of the construction of a new bridge

4.6 It is recommended that a **Statement of Heritage Impact** be prepared in the form outlined by the NSW Department of Urban Affairs and Planning, found in the NSW Heritage Manual.

APPENDIX H

INDIGENOUS HERITAGE

**AN ARCHAEOLOGICAL ASSESSMENT OF PROPOSED
REPLACEMENT OF THORNES BRIDGE, GOULBURN, NSW.**

A REPORT TO NECS

By

Vivienne Courto

January 2000

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1.0 INTRODUCTION

National Environment Consulting Services (NECS) have been contracted to the New South Wales Road Transit Authority to prepare a Review of Environmental Factors (REF) relating to the replacement of Thornes Bridge on the southeastern outskirts of Goulburn. The REF covers an area of not more than 0.5 ha to the immediate west of the existing Thornes Bridge on both sides of the Mulwaree River.

An archaeological survey of the immediate environs of Thornes Bridge has been commissioned as part of the REF to ensure that no Aboriginal cultural materials or relics are damaged as a result of the construction works. Vivienne Courto was contracted to NECS to undertake this survey, the findings of which form the basis of this report.

2.0 ABORIGINAL CONSULTATION

The study area falls within the boundaries of the Pejar Local Aboriginal Land Council (LALC). Prior to the commencement of the fieldwork, the Land Council was contacted by telephone and informed of the project details, as well as being invited to participate in the project.

Although their office was shut for its summer break, the Pejar LALC arranged for a site officer, Mr Patrick Little, to participate in a field survey of the site of the new bridge. The fieldwork was undertaken on Wednesday, 12 January 2000. The findings of the survey and recommendation options for the area were discussed with Mr Little. Mr Little concurred with these findings but stated that he would consult further with other members of the Pejar LALC.

A letter confirming the final recommendations of the Pejar LALC will be supplied as soon as their office re-opens on January 24, 2000.

3.0 PROJECT SCOPE

3.1 Project Aims

The aims of this project are defined as follows:

- to undertake an archaeological survey – both in the field and of relevant literature - of the location of the proposed replacement bridge;
- to record and document any Aboriginal cultural sites or relics located in this area;
- to assess the significance of any sites or relics that may be affected by the proposed bridge construction; and
- to supply a written report formatted to accord with the standards and requirements set for such reports by the New South Wales National Parks and Wildlife Service (NPWS)

3.2 Project Methodology

The following three-stage methodology was applied to achieve the aims listed above.

Stage 1

Stage 1 comprised the background component of the project. This stage entailed:

- establishing communications with the Cultural Heritage Unit of the New South Wales NPWS;
- commencing liaison with the appropriate Local Aboriginal Land Council (LALC),
- reviewing the archaeological sites database for the study area;
- collating documentation relevant to the project, such as a 1:25 000 map of the study area, ethnohistorical and anthropological literature on the region, archaeological reports relating to the region and references to the land use history of the study area; and
- developing a research design to meet the specific project objectives and encompassing field survey strategies, data analysis techniques and project implications.

Stage 2

The second stage of the project was the fieldwork component. This took the form of a field survey performed at the proposed bridge site by Vivienne Courto and Patrick Little of the Pejar LALC on Wednesday, 12 January 2000.

Prior to the commencement of field work it was decided that the following details would be recorded for any sites and artefacts located during the course of the survey:

- Site location - to be recorded using a Global Positioning System device and subsequently plotted on the 1:25000 map.
- Site type - to be defined as an open artefact scatter (2 or more artefacts within 50m of each other); isolated find (single artefact); scarred tree (scarring of a tree caused by human agent); or other (if none of the previous).
- Environmental setting - the landscape in which the site is located, including topography, local vegetation, and distance from water
- Site size - the boundary of the site as defined by the limit of artefacts observable upon the ground surface.

- Artefact details – including artefact type (eg flake, core, blade); raw material type (eg quartz, silcrete, bone); colour; measurements (length, width and thickness recorded in mm) and comments on any distinguishing features (such as retouch, edge wear, percentage of cortex on a core, etc).

In addition to the above written record, any artefacts recovered would be photographed

Upon arrival at the site it was noted that an area some 200 – 250 square metres in size on the north-western side of the existing bridge had been marked with surveyors' pegs. The entire marked area lay in a lucerne paddock, with the result that ground surface visibility was generally very poor. As it was neither possible nor practicable to walk the whole of the area subject to development, a sampling strategy was employed. Five transects some 50m apart were walked through the marked area. In addition, a cleared gravel roadway running along the northern boundary of the marked area was also inspected, as were any areas of exposed earth, such as erosion scalds.

On the southwestern side of the existing bridge, a similar procedure was adopted. In this case, a relatively clear strip of land some 50m wide by 200m long running along the bank of the river was examined, as was a small entrance roadway and an exposed areas of earth at the base of a large tree adjacent to the existing bridge.

Stage 3

The third and final stage of the project involved the analysis of data obtained during Stage 2.

3.3 Project Constraints

The only real constraint encountered in the course of this project was ground surface visibility.

Ground surface visibility is an important factor as it affects how many sites will be found and has the potential to skew field survey results. If, for example, visibility conditions correlate with certain environmental zones, then few sites may be recorded in zones with poor visibility, but this may not be an accurate reflection of the presence/absence of sites in these zones. For this reason, other methods, such as sub-surface testing techniques, may be employed to ensure that a true picture of an area's archaeology is obtained.

Surface visibility on the northwestern side of the existing Thornes Bridge was generally very poor, ranging from 0 – 20% in the lucerne paddock. Although the small roadway was free of vegetation, it is likely that imported gravels had been used to surface it at some time, contributing again to a reduction in visibility.

Conditions were better on the southern side of the river, with a few exposed areas of over 90% visibility. Generally, in the grassy areas visibility was 30 – 50% or more, but the ground itself showed evidence of considerable past disturbance.

4.0 ENVIRONMENTAL SETTING

Thornes Bridge lies on the Braidwood Road, a 2-lane, sealed roadway. Some three hundred metres to the east of the bridge, on the northern side of the Mulwaree River, run the Main Southern Railway line. To the southwest, three 132kv power transmission lines pass within one hundred metres of the bridge.

The existing bridge passes over the Mulwaree River at a point where the river is some 30m wide. To the northeast of the bridge, the river is narrower. To the west, it continues at roughly the same width for approximately a kilometre before taking a more southerly turn and widening considerably. The surrounding country is typical of the sparsely vegetated, gently undulating landscape that characterises much of the Southern Tablelands (Flood 1980:7-8), and considering Goulburn's history as Australia's oldest inland city, has a relatively long history of use as farming land.

The land to the immediate west of the existing Thornes Bridge on the northern bank of the Mulwaree River has been cleared and fenced for agricultural purposes and, in the area to be affected by the proposed development, is currently used for lucerne cropping. A small gravel road (presumably leading to the property owner's residence) runs through the northern end of the area.

On the southern side to the west of the bridge is a cattle stud property. An area some 50m wide and bounded by a barbed wire fence along the southern bank of the river was found to contain evidence of considerable past disturbance, including imported gravel, corrugated iron, barbed wire and pvc pipe, all indicative of past construction or the possible demolition of old sheds. There were also a number of prints left by cattle. A small gravel entrance roadway separated this area from cattle paddocks to the south.

Previous construction of transport and power infrastructure and continuing agricultural/pastoral activities have left the land in the vicinity of Thornes Bridge in a highly disturbed state. This is particularly true at the southern end of the existing bridge, as evidenced by the debris discussed above.

5.0 PREVIOUS ARCHAEOLOGICAL RESEARCH

5.1 Previous Research in the Study Area

There have been a number of previous archaeological surveys conducted in the vicinity of the Thornes Bridge.

One of the first was Margrit Koettig's 1983 report to the Department of Main Roads, which focussed on the route of the Goulburn Bypass. Koettig's survey covered an area no more than one kilometre northeast of Thornes Bridge. During the course of this survey, Koettig located 22 open artefact scatters and 17 isolated stone artefacts, as well as two European historical sites. Of the 22 open scatters, two (G17 and G20) contained over 100 artefacts. Although little work had been undertaken in the Goulburn area at that stage, Koettig concluded on the basis of reports from other parts of the Southern Highlands (such as Witter's report on the Dalton area 1981 and Attenbrow's report from the Braidwood region, 1983) that the sites were fairly typical of the region, as most were located on well-drained land in close proximity to water (Koettig 1983:25). Sites located during the survey were distributed at a rate of 2 per kilometre and greater in some areas. Artefacts found at the sites were predominantly amorphous flakes and flaked pieces (Koettig 1983:26) and the main raw materials used were quartz and silcrete (Koettig 1983:18-19). The majority of sites exhibited some surface disturbance resulting from agricultural activities such as ploughing, clearing and stock movement.

One site, G17 was considered on the basis of its size (103 artefacts located on the surface) and "richness" in terms of artefact density and raw material range (Koettig 1983:6) was selected for test pitting to more accurately determine the boundaries of the site. Part of the site was threatened with destruction by the proposed highway development. Although some ploughing had occurred at the site, excavation revealed that the site was relatively intact. It was determined to be some 30 000 square metres in area, at least 70cm deep and contained 656 artefacts (Koettig 1983:70).

The significance of site G17 was considered to be high, not only because of its content and composition, but also due to its location in a sand body. Sites in sand bodies have the potential to provide stratified, and therefore readily datable, artefact deposits, and had been identified by NPWS for special management considerations due to the conflict of interest between cultural heritage and commercial interests in the form of sandmining (Paton 1990:2). A subsequent excavation of the site G17 (Paton 1990) revealed that the site had been periodically occupied for over 5000 years and contained approximately 4,500,000 artefacts (Paton 1990:28).

Further surveys conducted in the Goulburn area (Koettig 1987, Fuller 1989) have also contributed to the overall archaeological picture of the area as one offering good camp sites on well-drained, sandy soils in close proximity to permanent water and food resources

5.2 Previously Recorded Aboriginal Cultural Sites

A search of the New South Wales NPWS archaeological sites register revealed 19 sites within a three square kilometre area roughly centred on Thornes Bridge (see Figure 1 on page 9 of this report). Of these, 16 were found during Koettig's investigation of May 1983. Koettig recorded two further sites in this area during a subsequent survey in 1987, and a final site was located by Fuller in 1989. All sites located in the vicinity of the bridge were open artefact scatters. The basic details for these sites are listed in the table overleaf.

NPWS Site Number	Grid Reference (E)	Grid Reference (N)	Site Type
51-6-0007	746020	6148350	Open artefact scatter
51-6-0008	746320	6148400	Open artefact scatter
51-6-0009	746540	6148400	Open artefact scatter
51-6-0010	746800	6148400	Open artefact scatter
51-6-0011	746650	6148250	Open artefact scatter
51-6-0012	746750	6148200	Open artefact scatter
51-6-0013	746950	6148220	Open artefact scatter
51-6-0014	747010	6148230	Open artefact scatter
51-6-0015	747150	6148320	Open artefact scatter
51-6-0016	747070	6148310	Open artefact scatter
51-6-00017	747070	6148320	Open artefact scatter
51-6-0018	747150	6147200	Open artefact scatter
51-6-0019	747240	6148380	Open artefact scatter
51-6-0020	747310	6148400	Open artefact scatter
51-6-0021	748850	6148250	Open artefact scatter
51-6-0027	746800	6148250	Open artefact scatter
51-6-0032	746220	6148480	Open artefact scatter
51-6-0033	746480	6148500	Open artefact scatter
51-6-0040	746600	6148100	Open artefact scatter

Table 1: Aboriginal cultural sites located in a 3-kilometre square centred on the study area.

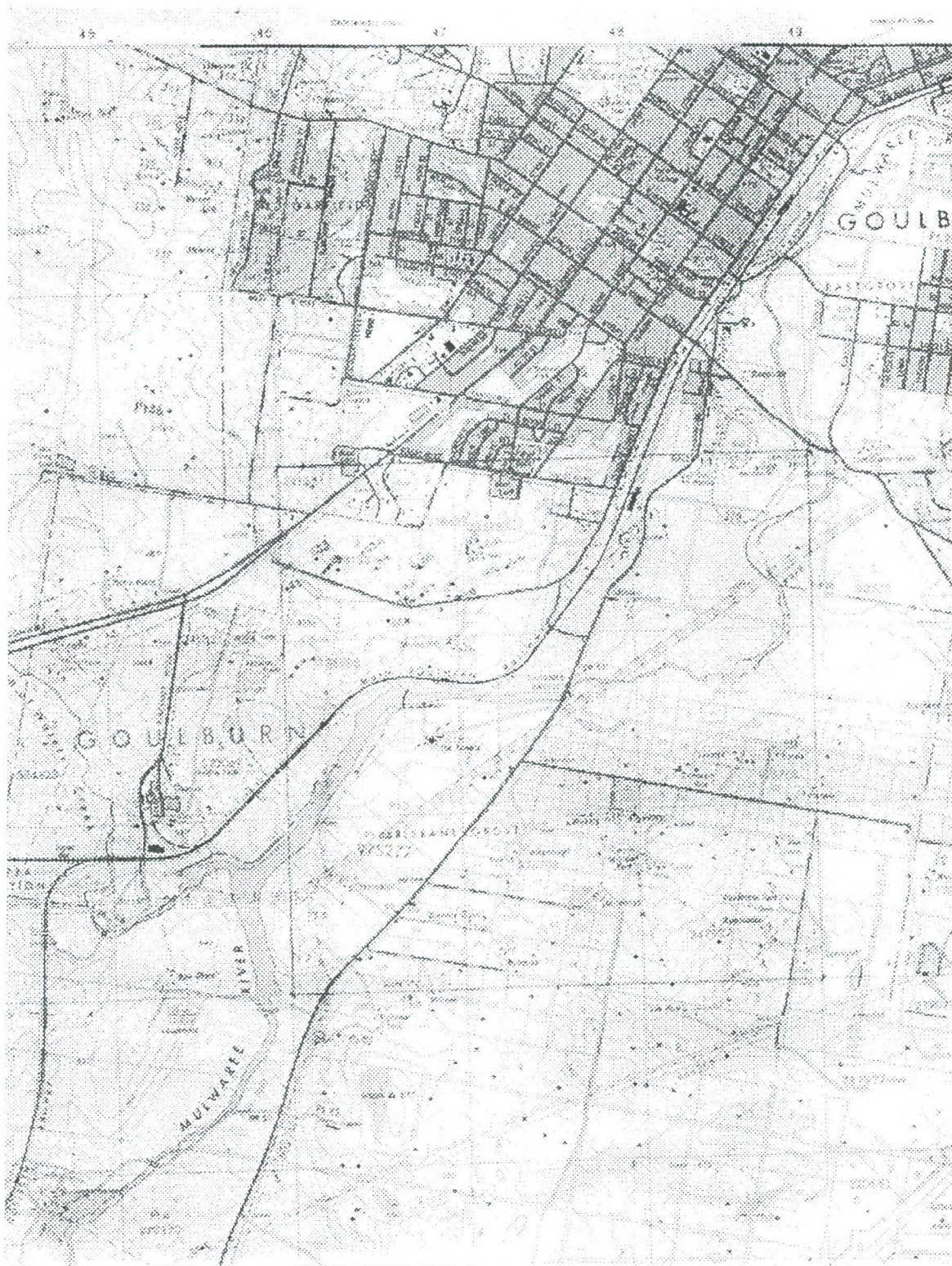


Figure 1: Excerpt from 1:25000 topographic map showing study area and locations of previously recorded archaeological sites. Thornes Bridge is highlighted in yellow; the heavier grid lines represent the 3km square area for which a survey of previously recorded sites was conducted. The locations of previously recorded sites are marked by a handwritten dot and a site number (eg as for G17 towards the top right margin of the defined search area).

6.0 RESULTS AND RECOMMENDATIONS

No Aboriginal heritage sites or artefacts were located during the course of this survey, despite the fact that previous archaeological investigations have revealed that the area surrounding the Mulwaree River was an attractive one to Aboriginal groups, providing a permanent source of water and consequently a good supply of animal and vegetable food resources. As demonstrated by previous research both in the Goulburn area and more generally throughout the Southern Tablelands, environments such as that found in this study area were favoured sites for camps, with well-situated campsites such as that at Site G17 being utilised by many successive generations.

In the light of these previous findings, it is unusual that no artefacts were located in the study area. Factors that may explain this include the very small size of the area under investigation, the poor visibility encountered during the survey and the disturbed nature of the ground, particularly on the southern side of the existing bridge. In the case of the lucerne paddock, poor visibility may have obscured any isolated artefacts turned up by ploughing, but this does not guarantee the absence of artefactual deposits below the level of the ploughed earth.

Based on previous reports, the area around the Mulwaree River can be considered to be of moderate to high archaeological significance. This is in part due to the existence of sites such as G17, which are located in sand bodies and therefore have the potential to provide well-stratified sequences of cultural deposits.

7.0 RECOMMENDATIONS

Based on the findings of this survey, the reports of previous archaeological surveys in the area and discussions held in the field with Mr Patrick Little of the Pejar LALC, we advise that the following measures be taken prior to the construction of a new bridge across the Mulwaree River:

- a program of subsurface testing in the form of test-pitting be conducted in the lucerne paddock on the north-western side of the existing bridge to ensure that no sub-surface cultural deposits underlay the topsoil in this area;
- members of the Pejar LALC be involved in any future archaeological investigation undertaken in this area;
- if sub-surface testing reveals sub-surface artefactual deposits, then members of the Pejar LALC be present as site monitors during construction of the new bridge;
- copies of this report should be provided to the Pejar LALC and to the Regional Archaeologist of the New South Wales NPWS.

Please note that these recommendations are made pending their endorsement in the form of a letter from the Pejar LALC. This letter will be available following the re-opening of the Pejar LALC office on Monday, 24 January 2000

8.0 BIBLIOGRAPHY

- Flood, J The Moth Hunters: Aboriginal Prehistory of the Australian Alps, Australian Institute of Aboriginal Studies, Canberra, 1980
- Fuller, N Goulburn City – An archaeological investigation of Aboriginal site location, 1989
- Koettig, M Survey for Aboriginal and historic archaeological sites along the proposed Goulburn Bypass, 1983
- Koettig, M Preliminary assessment of archaeological sites on lot 2, DP702730, corner of the Hume Highway, Garoorrigang Road and Goulburn, NSW, 1987
- Paton, R J Results of excavations at site G17, Goulburn, NSW, 1990

APPENDIX I

BACKGROUND NOISE ASSESSMENT



Roads and Traffic Authority

www.rta.nsw.gov.au

**M.R. 79 – BRAIDWOOD ROAD
APPROACHES TO THORNES BRIDGE OVER MULWAREE RIVER
SHIRE OF MULWAREE**

Noise Impact Assessment

Prepared for: Southern Region – Project Management Section
By Southern Technical Services - Design

March 2000

**MR79 – Braidwood Road
Shire of Mulwaree
Approaches To Thornes Bridge Over Mulwaree River
*Noise Impact Assessment***

1.0 Introduction

This noise assessment was requested by the Project Manager to be incorporated into the Review of Environmental Factors (REF) for the subject work.

The study was carried out using the TNoise computer program, which is based on the CRTN noise prediction model. Results were assessed with the EPA Environmental Criteria for Traffic Noise to determine their impact.

As a general rule, the worst case scenario has been adopted.

2.0 Traffic Noise Criteria

Page 6 of the Environmental Criteria for Road Traffic Noise (see attachment 1) states that the subject residences should be treated as **Type 3** developments (*Redevelopment of existing freeway/arterial road*).

If criteria is exceeded, then the development should be designed so as not to increase existing noise levels by more than **2 dB**. The criteria for a Type 3 development shows the following noise level objectives;

	Noise level (dB)
Base level – day time 7am to 10pm Leq (15hr)	60
Base level – night time 10pm to 7am Leq (9hr)	55

Existing timber bridge approach segments include a special adjustment of +3.5 dB, as there is an audible increase in noise when vehicles drive over the bridge deck.

For the Open Grade Asphalt results, a factor of -2.5 dB was adopted in TNoise as stated in Appendix B, Noise Prediction Table B1 of the Road Traffic Noise policy (see attachment 2).

3.0 Traffic Volumes and Speed

The hourly traffic volumes have been adopted for Leq (15hr) and Leq (9 hr) between 7am to 10pm and 10pm to 7am (see attachment 3). In addition, this volume has been estimated for the year 2006 at a lineal growth of rate of 4%. The EPA criteria suggest volumes up to 10 years after opening.

For calculation purposes, 50 vehicles per hour are the absolute minimum total vehicle volumes that TNoise permits. This total hourly volume was adopted in both the Leq(15hr) and Leq(9hr) where existing hourly traffic volumes were below the 50 range. Therefore the calculations are conservative in that they overstate the actual volume and predicted noise levels.

Calculations for existing conditions include a traffic speed of 60km/hr. Traffic speeds of 80km/hr and 100km/hr were adopted for design calculations on all segments. The table below shows the difference in decibels when the road surface is changed.

4.0 Calculated Noise Levels for House at Stn. 30

1. The following results were obtained for 80km/hr.

Residence	Calculated Existing Levels Leq(15) Leq(9)		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
House at Stn. 30	58.5	53.1	60.1	55.0	*DG AC	yes
House at Stn. 30	58.5	53.1	63.6	58.5	*F/S	no

2. The following results were obtained for 100km/hr.

Residence	Calculated Existing Levels Leq(15) Leq(9)		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
House at Stn. 30	58.5	53.1	61.9	56.9	*DG AC	no
House at Stn. 30	58.5	53.1	65.4	60.4	*F/S	no
House at Stn. 30	58.5	53.1	59.4	54.4	*OG AC	yes

* DG AC = Dense grade asphalt

* OG AC = Open grade asphalt (refer to Item 2. Traffic Noise Criteria)

* F/S = Flushed Seal

5.0 Calculated Noise Levels for House at Stn. 80

3. The following results were obtained for 80km/hr.

Residence	Calculated Existing Level Leq(15) Leq(9)		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
House at Stn. 80	58.7	53.3	60.5	55.3	*DG AC	marginal
House at Stn. 80	58.7	53.3	64.0	58.8	*F/S	no

4. The following results were obtained for 100km/hr.

Residence	Calculated Existing Level Leq(15) Leq(9)		Predicted Leq 15 hr (dB) 7am to 10pm (criteria 60 dB)	Predicted Leq 9 hr (dB) 10pm to 7am (criteria 55 dB)	Road Surface	Complies Yes/No
House at Stn. 80	58.7	53.3	62.2	57.2	*DG AC	no
House at Stn. 80	58.7	53.3	65.7	60.7	*F/S	no
House at Stn. 80	58.7	53.3	59.7	54.7	*OG AC	yes

* DG AC = Dense grade asphalt

* OG AC = Open grade asphalt (refer to Item 2. Traffic Noise Criteria)

* F/S = Flushed Seal

5.0 Conclusion

Noise impact to the residential locations adjacent to the proposed work has been assessed and it is concluded that the house at Stn. 80 is the most sensitive. If a speed zone of 80km/hr is adopted then Dense Grade Asphalt road surface is acceptable, however if a speed zone of 100km/hr is adopted then Open Grade road surface must be used.



Rodrigo E. Jaime
Road Design Officer
Class 2

22/3/2000



ATTACHMENTS

Table 1. Road traffic noise criteria for proposed road or residential land use developments

For an explanation of the terms used here, see the sections 'Guide to terms used in the tables' and 'Technical notes to the tables' immediately following the tables.

TYPE OF DEVELOPMENT	CRITERIA		
	DAY (7 am-10 pm) dB(A)	NIGHT (10 pm-7 am) dB(A)	WHERE CRITERIA ARE ALREADY EXCEEDED
1. New freeway or arterial road corridor	$L_{Aeq(15hr)}^{55}$	$L_{Aeq(9hr)}^{50}$	The new road should be designed so as not to increase existing noise levels by more than 0.5 dB. Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In some instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicles; greater use of public transport; and alternative methods of freight haulage.
2. New residential land use developments affected by freeway/arterial traffic noise	$L_{Aeq(15hr)}^{55}$	$L_{Aeq(9hr)}^{50}$	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design and construction of the development. Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impacts.
3. Redevelopment of existing freeway/arterial road	$L_{Aeq(15hr)}^{60}$	$L_{Aeq(9hr)}^{55}$	In all cases, the redevelopment should be designed so as not to increase existing noise levels by more than 2 dB. Where feasible and reasonable, noise levels from existing roads should be reduced to meet the noise criteria. In many instances this may be achievable only through long-term strategies such as improved planning, design and construction of adjoining land use developments; reduced vehicle emission levels through new vehicle standards and regulation of in-service vehicles; greater use of public transport; and alternative methods of freight haulage.

Table B1: Road surface corrections (relative to dense-graded asphaltic concrete)

Increase (+) or Decrease (-) in Traffic Noise Leq or L ₁₀ in dBA						
Surface type	ARRB Contract Report to RTA ⁽¹⁾ (Samuels and Glazier 1990)		Vic Roads Draft Traffic Noise Policy (1989) (at speeds > 70km/h)	Leach & Limb 1986 (Western Australia)	CORTN Model used for pre- dictions UK DoT (1988)	DoT Q'land (1991) (at speeds > 80km/h)
	Traffic Noise	Vehicle Noise		Traffic Noise	Traffic Noise	Traffic Noise
		Cars	Heavy Vehicles			
14mm Chip Seal		+3.6	+1.0	+5	+2.5 to +4	+2 to +4
7mm Chip Seal				+2	-1 to +1	+1 to +2
Shallow Random Grooved Concrete	+0.4	-0.1	-1.4	+2		+1 to +3
Dense-graded Asphaltic Concrete	0	0	0	0	0	0
Cold Overlay	-0.8	+2.4	+0.4			
Cement Concrete - hessian dragged ⁽²⁾	-2.6	-0.3	-1.0		+0.8	
Open-graded Asphalt (several years old)	-4.1	-3.6	-2.6	-2	-2 to -3 ⁽³⁾	-3.5
Open-graded Asphalt (Sealflex & Mobilplas)		-4.0		-2	-2 to -3	-3.5
Open-graded Asphalt (new condition)	-5.9	-7.7	-6.0		-2 to -3	-2 to -3

Notes:

(1) Roadside noise levels.

(2) Figures subject to further testing/refinement.

(3) Leach and Limb's work was on relatively new pavement surfacing.

☐ Recommended for application in CORTN traffic noise prediction (for speeds greater than 70 km/h).

(On the F3 Freeway: Wahroonga to Berowra Section, a variable but average difference of 3.6 dBA L₁₀ (18 hour) or 2.8 dBA L_{eq} (24 hour) (adjusted for varying traffic parameters) was measured at affected residences between hessian-dragged concrete and open-graded asphalt.)

counts?? background

CLASS IFICATI ON PR OFILE
 C:\DI SK_Z1\D ISK_4 2\017 .RTC
 MR79 @ SH2 O /BR G OULBU RN
 Area : 94 Site : 495 Lo

Sampl e from : 16: 00 19 99/03 /16 t o 09: 00 19 99/03 /24 fo r All Days

Class	1	2	3	4	5	6	7	8	9	10	11	12 Total	
0:00	1	0	0	0	0	0	0	0	0	0	0	0	1
1:00	1	0	0	0	0	0	0	0	0	0	0	0	1
2:00	0	0	0	0	0	0	0	0	0	0	0	0	0
3:00	1	0	0	0	0	0	0	0	0	0	0	0	1
4:00	2	0	0	0	0	0	0	0	0	0	0	0	2
5:00	2	0	0	0	0	0	0	0	0	0	0	0	2
6:00	13	0	0	0	0	0	0	0	0	0	0	0	13
7:00	26	2	2	0	0	0	0	0	0	0	0	0	30
8:00	60	3	5	0	0	0	0	0	1	0	0	0	69
9:00	59	1	2	1	0	0	0	0	0	0	0	0	63
10:00	60	2	3	1	0	0	0	0	1	0	0	0	67
11:00	53	2	2	1	0	0	0	0	1	0	0	0	59
12:00	50	4	2	0	0	0	0	0	1	0	0	0	57
13:00	50	3	1	0	0	0	0	0	1	0	0	0	55
14:00	54	2	2	1	0	0	0	0	1	0	0	0	60
15:00	58	5	3	1	0	0	1	0	1	0	0	0	69
16:00	59	6	3	1	0	0	0	0	1	0	0	0	70
17:00	56	8	4	0	0	0	0	0	1	0	0	0	69
18:00	41	4	2	0	0	0	0	0	1	0	0	0	48
19:00	24	0	1	0	0	0	0	0	0	0	0	0	25
20:00	12	2	1	0	0	0	0	0	0	0	0	0	15
21:00	6	0	0	0	0	0	0	0	0	0	0	0	6
22:00	5	0	0	0	0	0	0	0	0	0	0	0	5
23:00	3	0	0	0	0	0	0	0	0	0	0	0	3
24HRS	696	44	33	6	0	0	1	0	10	0	0	0	790

CLASSI	FICATI	ON PR	OFIL										
C:\DIS	K_Z1\D	ISK_4	2\016	.RTC									
MR79 @	SH2 O	/BR G	OULBU	RN									
Area :	94	Site	: 495	Lo	catio	n : 0	0 D	irect	ion :	Southb	ound		
Sample	from	: 15:	00 19	99/03	/16 t	o 09:	00 19	99/03	/24 fo	r All	Days		
Class	1	2	3	4	5	6	7	8	9	10	11	12	Total
0:00	2	0	0	0	0	0	0	0	0	0	0	0	2 ✓
1:00	2	0	0	0	0	0	0	0	0	0	0	0	2 ✓
2:00	1	0	0	0	0	0	0	0	0	0	0	0	1 ✓
3:00	1	0	0	0	0	0	0	0	0	0	0	0	1 ✓
4:00	1	0	0	0	0	0	0	0	1	0	0	0	2
5:00	4	0	0	0	0	0	0	0	1	0	0	0	5
6:00	10	3	2	0	0	0	0	0	0	0	0	0	15
7:00 ✓	27	5	5	1	0	0	0	0	0	0	0	0	38
8:00 ✓	42	3	3	0	0	0	0	0	0	0	0	0	48
9:00 ✓	42	4	2	0	0	0	0	0	1	0	0	0	49
10:00 ✓	45	2	2	0	0	0	0	0	1	0	0	0	50
11:00 ✓	50	3	2	0	0	0	0	0	0	0	0	0	55
12:00 ✓	54	3	3	0	0	0	0	0	1	0	0	0	61
13:00 ✓	56	3	2	1	0	0	0	0	1	0	0	0	63
14:00 ✓	55	3	2	1	0	0	0	0	1	0	0	0	62
15:00 ✓	60	4	5	0	0	0	0	0	1	0	0	0	70
16:00 ✓	64	4	2	0	0	0	0	0	1	0	0	0	71
17:00 ✓	61	2	2	0	0	0	0	0	1	0	0	0	66
18:00 ✓	39	1	2	0	0	0	0	0	0	0	0	0	42
19:00 ✓	27	1	1	0	0	0	0	0	0	0	0	0	29
20:00 ✓	21	0	1	0	0	0	0	0	0	0	0	0	22
21:00 ✓	16	0	1	0	0	0	0	0	0	0	0	0	17
22:00	11	0	0	0	0	0	0	0	0	0	0	0	11
23:00	5	0	0	0	0	0	0	0	0	0	0	0	5
24HRS	696	41	37	3	0	0	0	0	10	0	0	0	787

NOISE MONITORING

Introduction

Noise monitoring was undertaken to determine the background noise levels at the bridge and in its vicinity. Measurements were taken at the nearest residential dwelling (211 Braidwood Road), underneath the bridge, and one sample was taken at another residential dwelling which was further away. This dwelling is approximately the same distance away as the residence on The Towers property and was considered to be representative of noise at both locations. However, factors to take into consideration are the train line and freeway which are closer to The Towers property, however, there are a greater number of trees in The Towers property, acting as a buffer against the noise.

Measurements were taken for 15 minutes each, except for individual car or truck noise measurements, which were immediate measurements.

The results of the noise monitoring are presented below.

Meter Used

Integrating Sound Level Meter
SLS 95S

Note:

The number of trucks on the morning of monitoring was high because of a weekly sheep sale. Many trucks use Braidwood Road to enter Goulburn from the south.

There were gusty winds in the afternoon, which affected the noise readings.

MORNING

Date: 15/12/99

Time: 6:19 to 6:34

Location: 211 Braidwood Road, Closest Residential Dwelling,
Approximately 100 m north of the bridge

Wind: Very calm

Topography: Very flat between this site and the bridge

Noises: Approximately 8 cars, many birds, freeway noise

Results:

M	86.5	m	54.1
G	66.9	Lp	59.3
L01	90 dB	L10	64 dB
L50	59 dB	L90	56 dB

Some individual measurements were taken when vehicles passed the noise meter in front of the house. The noise levels were: 91.1 dB, 92 dB, 83.7 dB, 86.1 dB and 87.7 dB. One measurement was taken of a car going over the bridge from this location and the noise level was 72 dB.

Date: 15/12/99

Time: 6:42 to 6:6:59

Location: At the northern end of Thornes Bridge

Wind: Very calm

Topography: Very flat between this site and the bridge

Noises: Many bird calls, cars over bridge, freeway noise

Results:

M	95.5 dB	m	55.6 dB
G	76.1 dB	Lp	74.8 dB
L01	90 dB	L10	74 dB
L50	61 dB	L90	58 dB

Some individual measurements were taken when a vehicle(s) was crossing the bridge.

Car 79 dB
Trucks 95.7 dB
94.1 dB
92.4 dB

Date: 15/12/99

Time: 7:56 to 8:11 am

Location: Under the bridge

Wind: Very calm

Noises: Cars, freeway noise and some birds

Results:

M	89.4	m	53.7
G	72.4	Lp	77
L01	85	L10	75
L50	58	L90	55

Date: 15/12/99

Time: 8:20 to 8:35 am

Location: 211 Braidwood Road, Closest Residential Dwelling,
Approximately 100 m north of the bridge

Wind: Very calm

Noises: Traffic, including school buses, trucks, utility vans and cars,
birds, freeway noise, a couple of children waiting for school
bus directly in front.

Results:

M	90	m	54.4
G	70.8	Lp	57.2
L01	83	L10	72 dB
L50	59 dB	L90	56 dB

Some individual measurements were taken when traffic passed the noise meter:

Cars 74.2 dB, 72.5 dB
 Truck 91.4 dB, 87.2 dB
 Utility Van 89.7 dB, 82.4 dB
 Bus 78 dB, 71 dB, 86 dB

Cars crossing bridge, measured at the house: 57-58 dB.
 Truck crossing bridge, measured at the house: 58-61 dB.

AFTERNOON

Date: 15/12/99

Time: 1:28 to 1:33 pm

Location: 211 Braidwood Road, Closest Residential Dwelling,
Approximately 100 m north of the bridge

Wind: Strong north-easterly winds.

Topography: Very flat between this site and the bridge

Noises: Traffic, freeway noise, birds, wind noise, trees/grass rustling

Results:

M	92.8	m	56.0
G	75.9	Lp	
L01	86 dB	L10	79 dB
L50	70 dB	L90	64 dB

Some individual measurements of:

Cars 79-82 dB, 85 dB, 80 dB, 84 dB
Truck 94 dB
Wind and freeway noise 60-70 dB up to high 70's dB

Date: 15/12/99

Time: 3:04 to 3:19 pm

Location: In front of _ property on Brisbane Grove Road, off Braidwood
Road. Approximately similar distance (300 m) from the
Towers property.

Wind: Strong north-easterly winds

Noises: Freeway noise, few birds, wind, trees and grasses rustling, a
few cars, 1 plane went over

Results:

M	83.9	m	50.7
G	66.1	Lp	63.0
L01	77 dB	L10	68 dB
L50	59 dB	L90	54 dB

This single measurement was taken in order to get a rough indication of noise levels at residences such as this property and the Towers property, which are located further away than the closest 211 Braidwood Road house.

Date: 15/12/99

Time: 3:31 to 3:46

Location: 211 Braidwood Road, Closest Residential Dwelling,
Approximately 100 m north of the bridge

Wind: Strong winds, slightly less than previous measurement

Noises: Freeway, traffic, birds, wind, trees and grasses rustling

Results:

M	86.9	m	52.1
G	69.1	Lp	58.8
L01	80 dB	L10	70 dB
L50	60 dB	L90	55 dB

PLATES

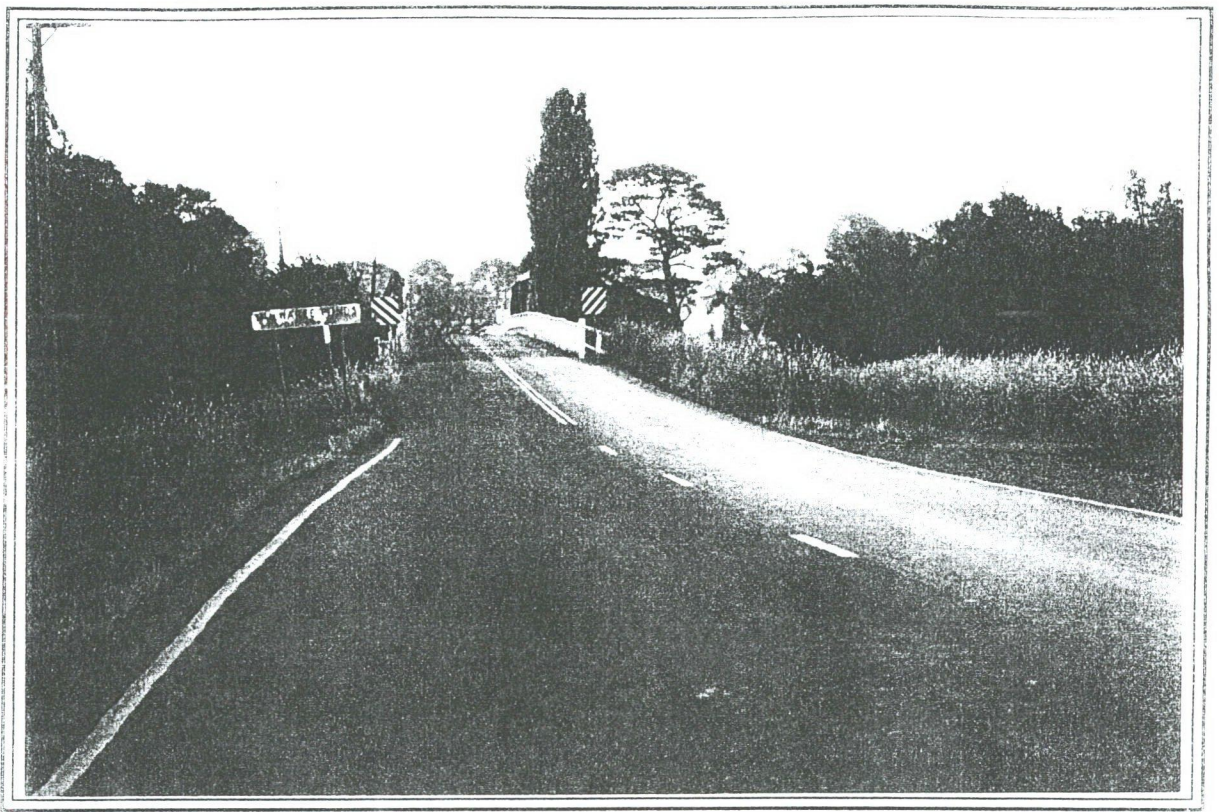


Plate 1 Northern approach to Thornes Bridge along Braidwood Road

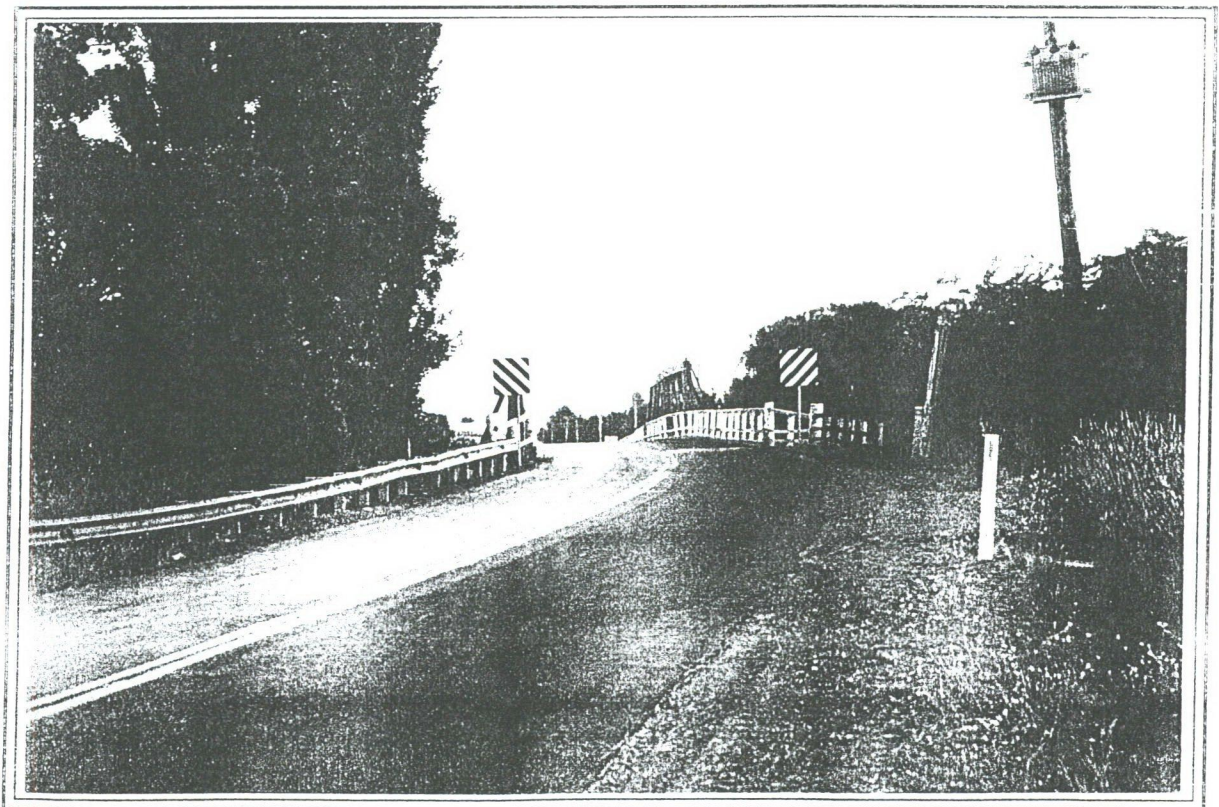


Plate 2 Southern approach to Thornes Bridge along Braidwood Road

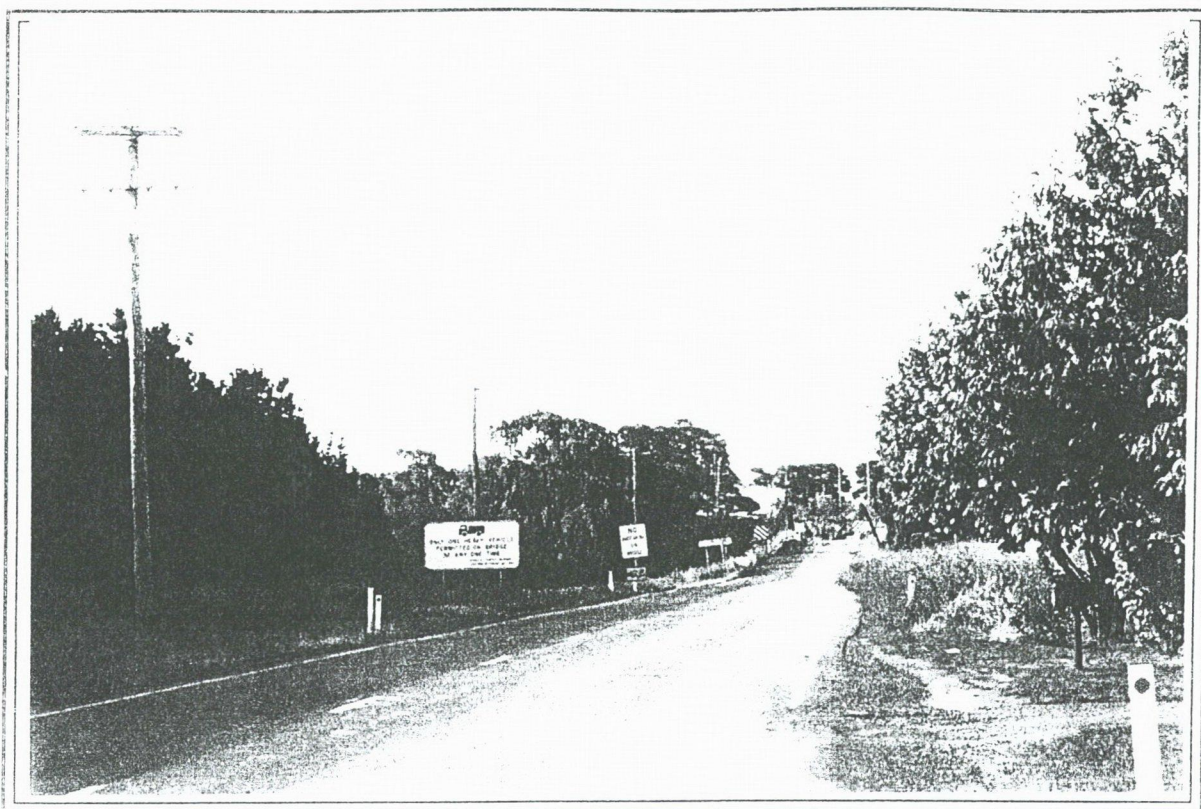


Plate 3 View towards Thornes Bridge from the front of the nearest houses

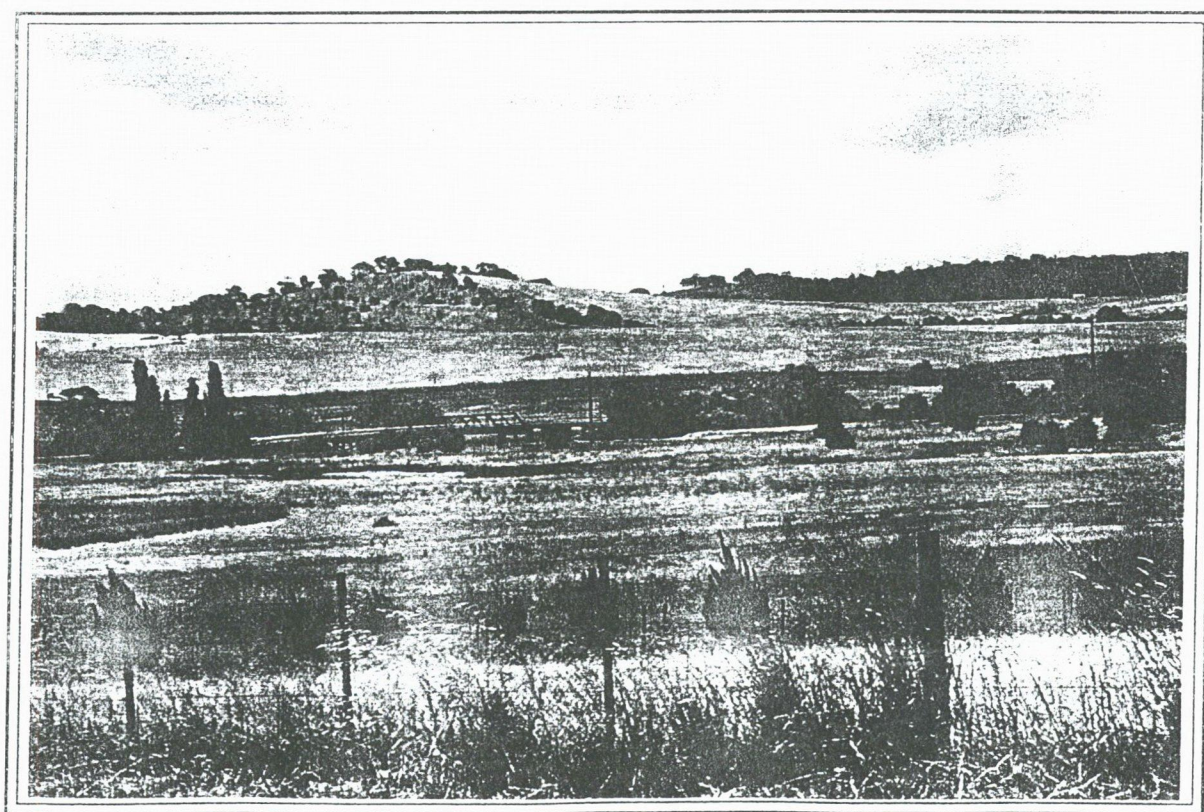


Plate 4 View of Thornes Bridge from Brisbane Grove Road, to the south east of the bridge



Plate 5 South Hill Bed and Breakfast, about 1 km north west of Thornes Bridge

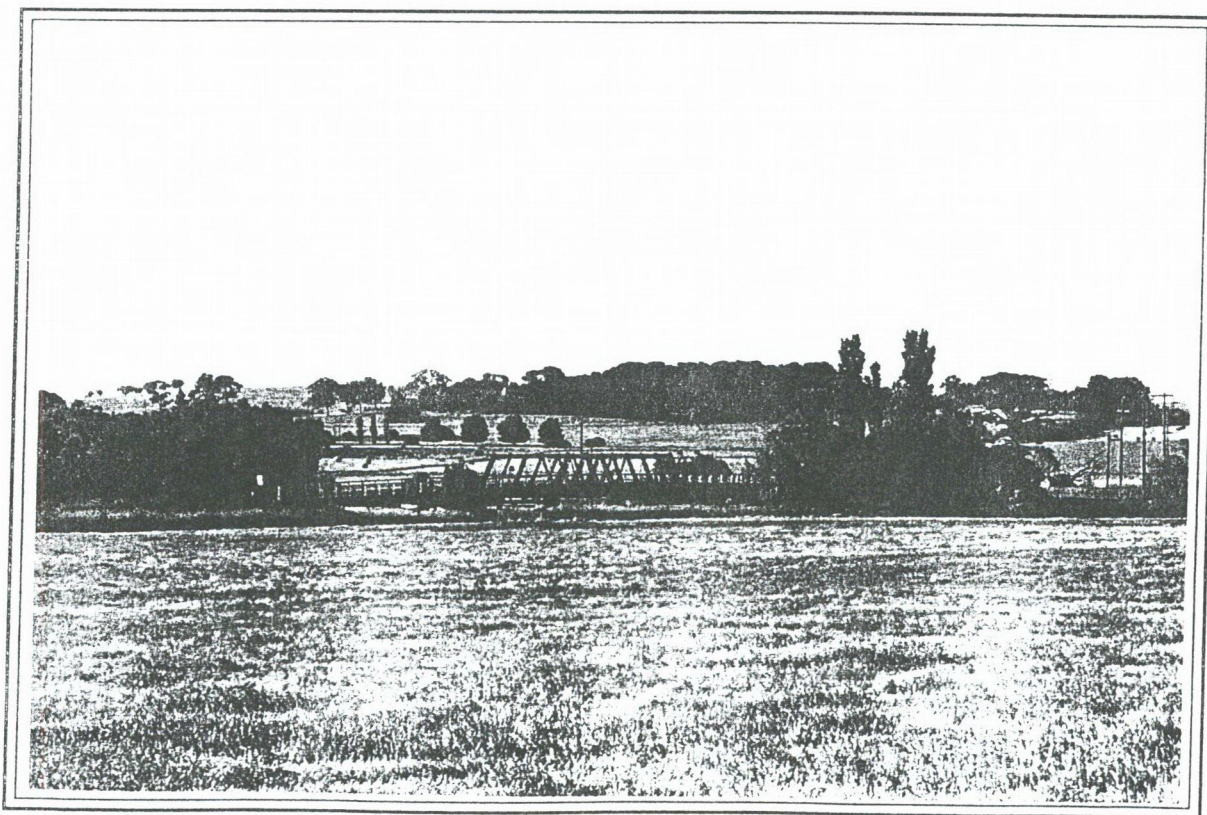


Plate 6 View from railway viaduct over Sloane Street, north west of Thornes Bridge

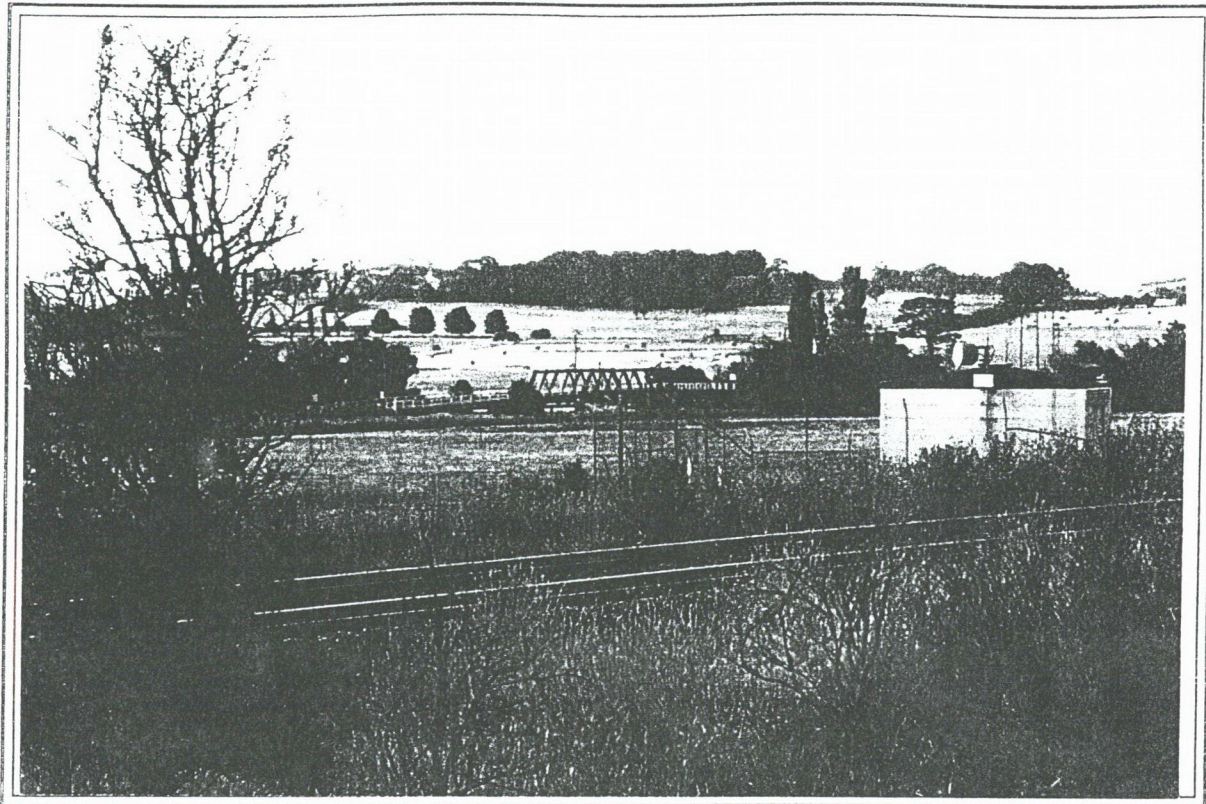


Plate 7 View of Thornes Bridge from Sloane Street, north of the railway viaduct

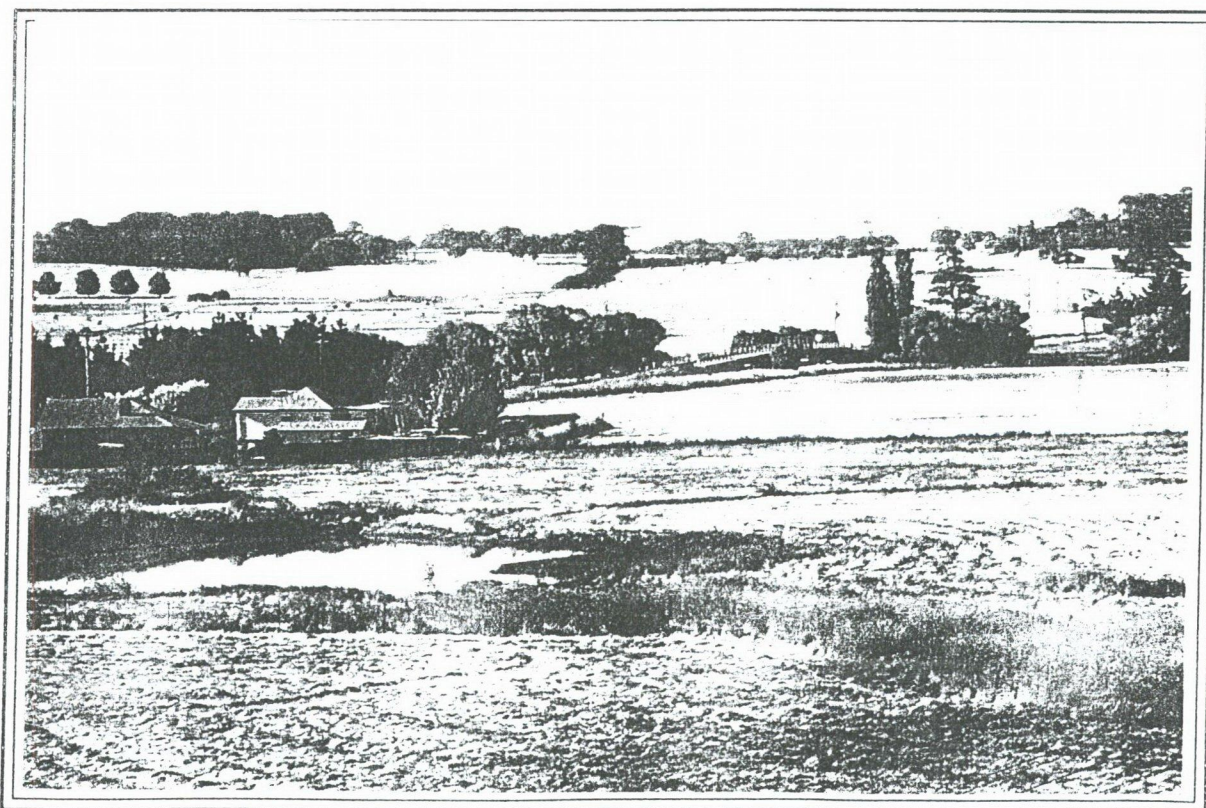


Plate 8 View of Thornes Bridge from the bypass

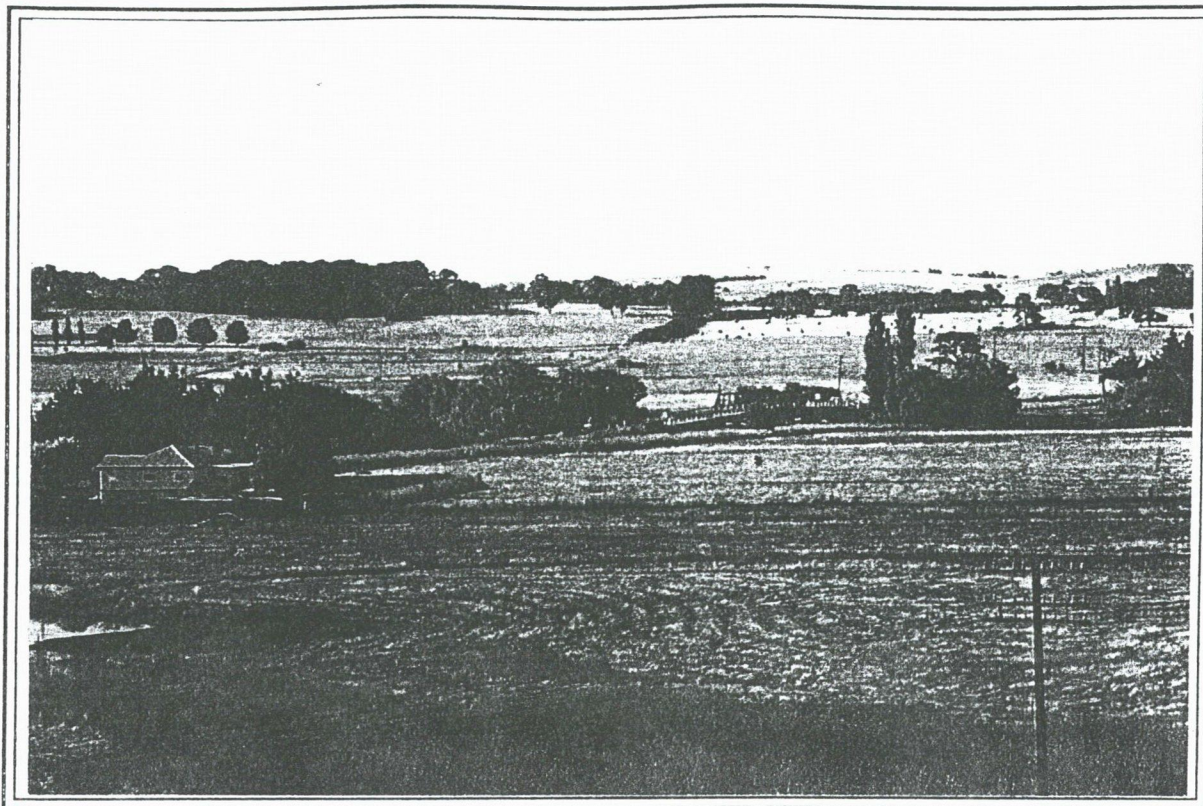


Plate 9 View of Thornes Bridge from the bypass