Australian Government

RTA

Kyeamba Hill

Hume Highway Duplication

DRAFT ENVIRONMENTAL ASSESSMENT

OCTOBER 2006

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SKM

Hume Highway Duplication

ENVIRONMENTAL ASSESSMENT

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Statement of Validity

Submission of Environmental Assessment
Prepared under Part 3A of the *Environmental Planning and Assessment Act 1979*.

Environmental Assessment prepared by

Name:

Qualifications:

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Surry Hills NSW 2010

In respect of: Hume Highway Duplication Kyeamba Hill

Applicant and land details

Applicant name: NSW Roads and Traffic Authority

Applicant address:

Land to be developed: Land generally required for the construction and operation of the proposed Hume Highway Duplication Kyeamba Hill as shown in Figure 4.1.

Environmental Assessment

Statement of Validity: I certify that I have prepared the contents of the environmental assessment in accordance with the Director General's Requirements dated 9 October 2006, and that to the best of my knowledge the information contained in the Environmental Assessment is neither false nor misleading.

Signature: _____

Date:

Summary

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Glossary

Afflux	Increase in existing flood level caused by an obstruction to the existing flow of floodwaters.
AHD	Australian Height Datum. The standard reference level used to express the relative evaluation of various features. A height given in metres AHD is essentially the height above sea level.
Alignment	A detailed geometric layout, in plan and profile, following a general route.
Alluvium	Unconsolidated deposit of gravel, sand or mud formed by water flowing in identifiable channels. Commonly well sorted and stratified.
Alluvial Plain	A relatively flat and gently sloping landform found at the base of a range of hills
Alluvial soil	Juvenile soils formed by deposition from still or moving water. Little pedological development beyond some accumulation of organic matter at the surface.
Ambient	The background level at a specific location, being a composite of all sources.
Amenity	The degree of pleasantness of an area or place.
Annual Average Daily Traffic (AADT)	Annual average daily traffic volume representing the total traffic in both directions at a specified location calculated from mechanically obtained axle counts.
Annual Exceedance Probability (AEP)	The probability of a rainfall or flood event exceeding a nominated level in a year. A one percent AEP is the probability of an event exceeding a nominated level in 100 years.
ANZECC	Australian and New Zealand Environment and Conservation Council
Aquifer	Geologic formation, group of formations, or part of a formation capable of transmitting and yielding economic quantities of water.
Aquifer properties	The characteristics of an aquifer that determine its hydraulic behaviour and its response to abstraction.
Arboreal	To live in, or be connected with, trees.
Archaeology	The scientific study of human history, particularly the relics and cultural remains of the distant past.
Archaeological Site	A site is defined as any material evidence of past Aboriginal activity that remains within a context or place that can be reliably related to that activity.
ARI	Average Recurrence Interval-average or expected period between exceedance of a flood.
Artefact	An object, normally portable, made or modified by human hands.

Asphalt or asphaltic concrete	A dense, continuously graded mixture of coarse and fine aggregates, mineral filler and bitumen usually produced hot in a mixing plant.
Attenuation	The reduction in sound pressure level magnitude during transmission (around a barrier or over a distance outdoors). (Unit: dB, dBA).
Average Recurrence Interval (ARI)	Average or expected period between exceedance of a flood.
Background Noise Level	The ambient sound pressure noise level in the absence of the sound under investigation exceeded for 90 percent of the measurement period. Normally equated to the average minimum A-weighted sound pressure level.
Batter	The side slope of walls, embankments and cuttings or the degree of such slope, usually expressed as a ratio of horizontal distance to one vertical height.
Bedrock	The unweathered rock that lies below loose surface deposits of soil and alluvium.
Benefit Cost Ratio	The ratio of the present value of benefits to the present value of costs of a project.
Bore	A cylindrical drill hole sunk into the ground from which water is pumped for use or monitoring.
Borehole	A hole produced in the ground by drilling or driving.
Boundary	A lateral discontinuity of change in the aquifer resulting in a significant change in hydraulic conductivity, storativity, or recharge.
BP	Before Present as applied to the dating of Aboriginal items.
Buffer	A physical barrier, structure or width of land which encloses, partially encloses or defines a particular environment. It serves to minimise the impacts of non-desirable external influences on the adjoining environment.
Bund Wall	A wall erected to prevent the escape of various emissions into the environment (liquids, noise or views).
Canopy	The uppermost layer of foliage formed by the crowns of trees.
Carriageway	One of the two sides of a motorway where traffic travels in one direction.
Catchment	The area drained by a stream or body of water or the area of land from which water is collected.
Colluvial soils	Stony clays which have been moved downslope by soil creep and slopewash but may include a proportion of windblown red clay ('parna') and higher terrace alluvium.
Compaction	The process of compressing individual grains in a soil or sediment in response to pressure.
Concentration	On release, emissions are transported and diluted resulting in a volume of pollutant (in the case of traffic) per volume of

	ambient air. Measured in parts per million or micrograms per cubic metre. Ambient air quality goals are expressed in terms of concentrations.
Concept Design	Initial functional layout of a concept, such as a road or road system, to provide a level of understanding to later establish detailed design parameters.
Confined aquifer	A completely saturated aquifer in which the upper and lower boundaries are relatively impermeable layers. The groundwater is contained under sufficient pressure to cause it to rise above the aquifer if the top impermeable layer is breached.
Confining bed	A layer of relatively impermeable material underlying, overlying, or adjacent to one or more aquifers.
Confluence	The place at which two streams flow together to form one larger stream.
Conservation	The management of resources in a way that will benefit both present and future generations.
Contaminant	Any physical, chemical. biological or radiological substance or matter in water or soil that is not of natural origin.
Contamination	The degradation of the natural environment as a result of human activities.
Culvert	One or more adjacent, enclosed channels for conveying a stream below road formation level.
Cumulative impact	The sum effect on the environment resulting from the successive effects of several different impacts.
Cut batters	The side slopes of cuttings.
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DEC	NSW Department of Environment and Conservation
Decibel	A scale unit used in the comparison of powers and levels of sound energy. The number of decibels is ten times the logarithm to the base of ten of the ratio of the powers.
Degree of Saturation	The ratio of the traffic volume entering an intersection in a specific period to the capacity of the intersection during that period.
Department of Planning	NSW Government department responsible for planning with a role in the assessment of the proposal and making a recommendation to the Minister for Planning whether it should proceed.
Department of Natural Resources	NSW Government department responsible for natural resource management and with a role in the assessment of the proposal and making a recommendation to the Minister for Planning whether it should proceed.
Design speed	A nominal speed used for the design of geometric features of

	the road, such as curves.
Discharge/Flow velocity	The rate at which liquid flows.
Drawdown	The difference between the observed water level during pumping and the pre pumping water level.
Dual carriageway	A highway or road with separated carriageways for traffic travelling in opposite directions.
Earthworks	The process of extracting, moving and depositing earth during construction.
Earthwork balance	Comparison of volume of material derived from the proposal as a result of cuts and the volume of material required as fill. Ideally these should be the same.
Ecology	The relationship between living things and their environment.
Ecologically Sustainable Development	Using, conserving and enhancing the resources of the community so that ecological processes on which life depends, are maintained and the total quality of life, now and in the future, can be increased.
Ecosystem	A functional unit of energy transfer and nutrient cycling in a given place. It includes all relationships within the biotic community and between the biotic components of the system.
Embankment	A mound or bank of earth or stone formed to support a roadway, serve as a protective barrier, or the like.
Emission	Discharge of a substance to the environment.
Environment	A term for all the conditions (physical, chemical, biological and social) in which an organism or group of organisms, including humans. exists.
Environmental Assessment (EA)	A formal description of a project and an assessment of its likely impact on the physical, social and economic environment. It includes an evaluation of alternatives and an overall justification of the project. The EA is used as a vehicle to facilitate public comment and as the basis for analysing the project with respect to granting approval under relevant legislation.
Environment Protection Licence	A licence that allows pollution of the environment under controlled conditions regulated by the Department of Environment and Conservation.
Eluvial deposit	A deposit formed as the result of in situ weathering of a rock. and located at its site of formation.
EMP	Environmental Management Plan
EPA	NSW Environment Protection Authority (now part of the Department of Environment and Conservation)
EPBC Act	Environment Protection and Biodiversity Conservation Act (Commonwealth)
Equivalent Continuous Sound Level (L_{Aeq})	The constant sound level which when operating over the same time interval as a fluctuating sound over an extended time, is equivalent to the same sound energy.

Erosion	The wearing away of the land surface by the action of water, wind and ice.
Excavate	Dig into natural material and remove using specialist machinery.
Extraction	A term referring to the removal of material from the earth synonymous with quarrying.
Evapotranspiration	Loss of water from a land mass through transpiration from plants and evaporation from the soil.
Fauna	All animals including birds, reptiles, marsupials and fish.
Fill batters	The side slopes of material placed in an embankment; the degree of such slope is expressed as a ratio of x horizontal to one vertical.
Floodplain	Large flat area of alluvium adjacent to a watercourse, characterised by frequent active erosion and aggregation by channelled and overbank stream flow.
Flora	All plants
Frequency	Similar to the pitch of a musical note in sound pressure fluctuations of cycles per second (Hertz). Most sounds comprise a composite of frequencies of varying sound pressure levels in the range of 20 Hertz to 20,000 Hertz.
Grade separation	The separation of a road, rail, or other traffic so that crossing movements, which would otherwise conflict, are at different elevations.
Gradient	Rate of change of a given variable with distance, such as temperature or elevation.
$g/m^2/month$	grams per square metre per month
Ground vibration	Representing the combined speed of ground oscillation at a point from a source of vibration such as a blast or piece of mobile plant (Unit: mm/s, m/s).
Groundwater	Subsurface water contained within the saturated zone.
Habitat	The place where an organism lives; habitats are measurable and can be described by their flora and physical components.
Head (hydraulic head)	Energy contained in a water mass produced by elevation, pressure or velocity.
Heritage	Things of value which are inherited from the past.
Hydraulic gradient	The change in static head per unit of distance in a given direction.
Hydrocarbon	Any organic compound, gaseous, liquid or solid, consisting only of carbon and hydrogen.
Hydrology	The study of rainfall and surface water run-off processes.
Hydrogeology	The study of subsurface water in its geological context.

Impact	The effect of human-induced action on the environment.
Infiltration	The process of surface water soaking into the soil.
Infrastructure	Supporting installations and services supplying the needs of a project.
Interchange	A grade separation of two or more roads with one or more interconnecting carriageways or ramps.
Introduced species	Plants and animals not native to Australia and known or thought to have been brought here by humans.
Isolated find	A single stone artefact, not located within a rock shelter, and which occurs without any associated evidence of Aboriginal occupation within a specified radius.
L/s	Litres per second
L_{A10}	The noise level which is exceeded for 10 % of the sample period. During the sample period, the noise level is below LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.
L_{A90}	The noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below LA90 level for 10% of the time. This measure is commonly referred to as background noise level.
L_{Aeq}	The equivalent continuous sound level. This is the energy average of the varying noise over the sample period and is equivalent to the level of constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.
Landform	A specific feature of the landscape or the general shape of the land.
Lens	Geologic deposit or body bounded by at least one curved, converging surface, giving it a lens-like appearance.
Level of Service (LoS)	A qualitative measure describing operational conditions within a traffic stream and their perception by motorists and/or passengers.
Lithology	Science of the nature and composition of rock.
Local road	A road or street used primarily for access to abutting properties.
Longitudinal section	The section drawn along the length of the route.
$\mu g/m^3$	micrograms per cubic metre
µs/cm	microsiemens per centimetre
micron	Unit of measure-one millionth of a metre.
mg/L	milligrams per litre
Mitigation measures	Measures put in place to reduce an impact.

ML/day	Megalitres per day
Modelling	Use of mathematical equations to simulate and predict real events and processes.
Monitoring	Regular measurement of components of the environment to understand their condition and establish if necessary standards are being met.
Native	Local inhabitant of a defined place.
NPWS	NSW National Parks and Wildlife Service (now part of the Department of Environment and Conservation)
Overbank deposit	A flood plain deposit.
Palaeochannel	An ancient river bed, often filled with more recent sediments.
Perched water	Unconfined groundwater separated from an underlying body of groundwater by an unsaturated zone and supported by an aquitard or aquiclude.
Permeable material	Material that permits water to move through it at perceptible rates under the hydraulic gradients normally present.
pH	A measure of acidity or alkalinity of a solution, numerically equal to 7 for neutral solution, increasing with increasing alkalinity and decreasing with increasing acidity. Originally stood for the words potential of hydrogen.
Porosity	The percentage of bulk rock, which is void space between rock particles.
Recharge	Addition of water to the zone of saturation; also the amount of water added.
Recovery	The difference between the observed water level during the recovery period after cessation of pumping and the water level measured immediately before pumping stopped.
Receptor / receiver	An environmental modelling term used to describe a map reference point where the impact is predicted. A sensitive receptor is a home, work place, school or other place where people spend some time. An elevated receptor is a point above ground level.
Rehabilitation	Preparation of a final landform following extraction and its stabilisation with vegetation.
Remnant vegetation	Native vegetation remaining after widespread clearing has taken place.
Residual drawdown	The difference between the observed water level during the recovery period following pumping and the pre- pumping water level.
Resource	Potentially usable material in a defined area that can be economically extracted.
RL	Reduced level, usually in metres to an arbitrary datum.
RTA	NSW Roads and Traffic Authority

Run-off	The proportion of precipitation discharged through surface water systems.
Salinisation	The process whereby soluble salts accumulate within the soil
Sand	Sediment comprising particles ranging between 0.063mm and 2mm.
Sandstone	A fine grained rock of sedimentary origin composed primarily of sand-sized particles (0.06 to 2 mm).
Saturated zone	That part of an aquifer in which all voids are filled with water under pressure greater than atmospheric pressure.
Screen	A type of lining tube or casing of special construction, with apertures or slots designed to permit the flow of water into a well while preventing the entry of aquifer or filter pack material.
Sedimentation basin	An area where runoff is ponded to allow sediment to be deposited. The longer the period that the runoff is held, the smaller the size of the sediment deposited. Such basins have to be regularly cleaned.
Shale	A laminated sediment in which the constituent particles are predominantly in the clay size.
Silt	Sediment comprising most particles between 0.004mm and 0.063mm.
Siltstone	A fine grained rock of sedimentary origin composed primarily of silt-sized particles (0.004 to 0.06 mm).
Slopewash	Sediment transport by overland flow, as a muddy suspension
Soil Creep	The slow, gradual movement of a hill's upper layers caused by the pull of gravity on loose stones, gravel, and soft topsoil.
Species	Taxonomic grouping of organisms that are able to interbreed with each other but not with other species.
Stakeholder	An individual or group with an interest in the proposal.
Stockpile	Mound used to store material.
Storage coefficient	The volume of water an aquifer releases from or takes into storage per unit surface area per unit change in head.
Stormwater	Rainwater which runs off catchments following rain events. The untreated water is carried into creeks, rivers and lakes.
Terrestrial	Relating to the land as distinct from air or water.
Tertiary	Geologic time at the beginning of the Cainozoic era, 65 to 2 million years ago, after the Cretaceous and before the Quaternary.
Topography	The physical relief and contours of the area.
Topsoil	The surface layer of a soil profile containing most of the organic material and viable life forms and seeds.

Total Dissolved Solids	The dissolved mineral content of groundwater, commonly expressed in milligrams/Litre.
Total Suspended Solids	A measure of suspended solids concentrations in a waterbody and expressed in terms of mass per unit of volume.
Tributary	A stream or river that flows into a larger stream or river.
TSC Act	Threatened Species Conservation Act (NSW)
Turbidity	A measure of light penetration through a water column containing particles of matter in suspension.
Unconfined aquifer	An aquifer in which the upper boundary of the saturated zone is at atmospheric pressure.
Unsaturated zone	That part of an aquifer between the land surface and water table.
USEPA	United States Environmental Protection Agency
Waterlogging	Soaking of land caused by a rising water-table or excessive irrigation.
Water quality	Degree or lack of contamination.
Water table	The surface of saturation in an unconfined aquifer at which the pressure of the water is equal to that of the atmosphere.
Well	A hole sunk into the ground and completed for the abstraction or injection of water or for water observation purposes. Generally synonymous with bore.
1 in 100 Year Flood Level	The flood which occurs on average once every 100 years. Also known as the 100 year Average Recurrence Interval of a flood.

1 Introduction

1.1 Proposal overview

The New South Wales (NSW) Roads and Traffic Authority (RTA) is proposing to upgrade five sections of existing single carriageway on the Hume Highway to four lane dual carriageways (two lanes in each direction) in the area from the Sturt Highway junction south to Albury.

The federal government has provided $800 million to the NSW Government to accelerate provision of dual carriageways in the sections listed below and illustrated in **Figure 1-1**.

- **Sturt Highway to Tarcutta** – from approximately 37 kilometres south of Gundagai to approximately 43 kilometres south of Gundagai, totalling approximately 6 kilometres in length.
- **Kyeamba Hill** – from approximately 67 kilometres south of Gundagai to approximately 76 kilometres south of Gundagai, totalling approximately 9 kilometres in length.
- **Little Billabong** – from approximately 85 kilometres south of Gundagai to approximately 93 kilometres south of Gundagai, totalling approximately 8 kilometres in length.
- **Yarra Yarra to Holbrook** – from approximately 98 kilometres south of Gundagai to approximately 110 kilometres south of Gundagai, totalling approximately 12 kilometres in length.
- **Woomargama to Mullengandra** – from approximately 131 kilometres south of Gundagai to approximately 141 kilometres south of Gundagai, totalling approximately 10 kilometres in length.

The RTA is the Proponent for these proposed Hume Highway Duplication works. This document comprises the Environmental Assessment for the Kyeamba Hill section of the Hume Highway Duplication (the Proposal), prepared in accordance with the process and requirements of Part 3A of the *Environmental Planning and Assessment Act 1979* (the EP&A Act). This section of the Hume Highway Duplication in the context of the entire duplication program is illustrated in **Figure 1-1**.

Following completion of the five sections listed above, the works currently underway on the Albury Wodonga Hume Freeway, the approved works between Table Top and Mullengandra, the Coolac bypass (12 kilometres) and Sheahan Bridge, Gundagai (2 kilometres), the only parts of the Hume Highway that will not be in a dual carriageway configuration will be the sections through the towns of Tarcutta, Holbrook and Woomargama. Any future development of bypasses of these towns to complete full dual carriageway standard between Melbourne and Sydney would be the subject of a separate environmental assessment and approval process.

1.2 Proposal development history

There have been long standing community expectations for the completion of duplication of the Hume Highway to provide a continuous high standard dual carriageway highway between Sydney and Melbourne. Dual carriageways were completed in Victoria in December 2005.

In 2004, the RTA completed a Hume Highway Strategic Planning Study to assess the long-term improvement strategy for the Highway between the Sturt Highway and Table Top. This study identified the need to complete the duplication of the Hume Highway in NSW.

Following the May 2006 federal budget, $800 million in funding was made available through a Memorandum of Understanding between the Australian and NSW Governments to complete duplication of the single carriageway sections of the Hume Highway south of its intersection with the Sturt Highway identified above. The areas of proposed duplication listed above are in the area from approximately 37 kilometres south of Gundagai to approximately 41 kilometres north of Albury.

On 4 September 2006 the Minster for Planning made an Order bringing the Hume Highway Duplication proposal under Part 3A of the EP&A Act. The Order was published in the NSW Government Gazette (No.114 at 7933) on 8 September 2006. A copy is of the signed order is included in **Appendix A**.

On 12 September 2006, the RTA submitted to the Department of Planning a Major Project Application for each of the five Hume Highway Duplication sections referred to in Section 1.1. A Project Application Report (incorporating a preliminary environmental assessment) was also provided. This represents the first step in the Part 3A approval process (described in more detail in Section 1.4 below). The Project Application Report was posted on the Department of Planning's website and provided to relevant NSW Government agencies by the Department of Planning.

1.3 Structure of this Environmental Assessment

This Environmental Assessment describes the Kyeamba Hill section of Hume Highway Duplication. It provides a description of the existing environment and an assessment of potential environmental impacts, and describes the management and mitigation measures that the RTA would employ to minimise the environmental impacts of construction and operation of this new section of dual carriageway highway. Cumulative impacts associated with construction and operation of all five proposed sections of dual carriageway listed in Section 1.1are also addressed.

This document is set out according to the following structure:

- Introduction – introduces the Proposal and provides an overview of the assessment, the need and strategic context and existing environment (Chapter 1, 2 and 3).
- Proposal Description – provides a description of the design and construction processes of the Proposal (Chapter 4).
- Consultation and Statutory Process – outlines stakeholder consultation and details the NSW and Commonwealth statutory requirements (Chapter 5 and 6).
- Environmental Assessment – identifies the environmental issues and assesses impacts and provides mitigation and management of those issues (Chapter 7, 8 and 9).
- Statement of Commitments – outlines the objectives and actions for managing environmental impacts of the Proposal (Chapter 10).
- Conclusion – justifies the Proposal and summaries environmental issues (Chapter 11).

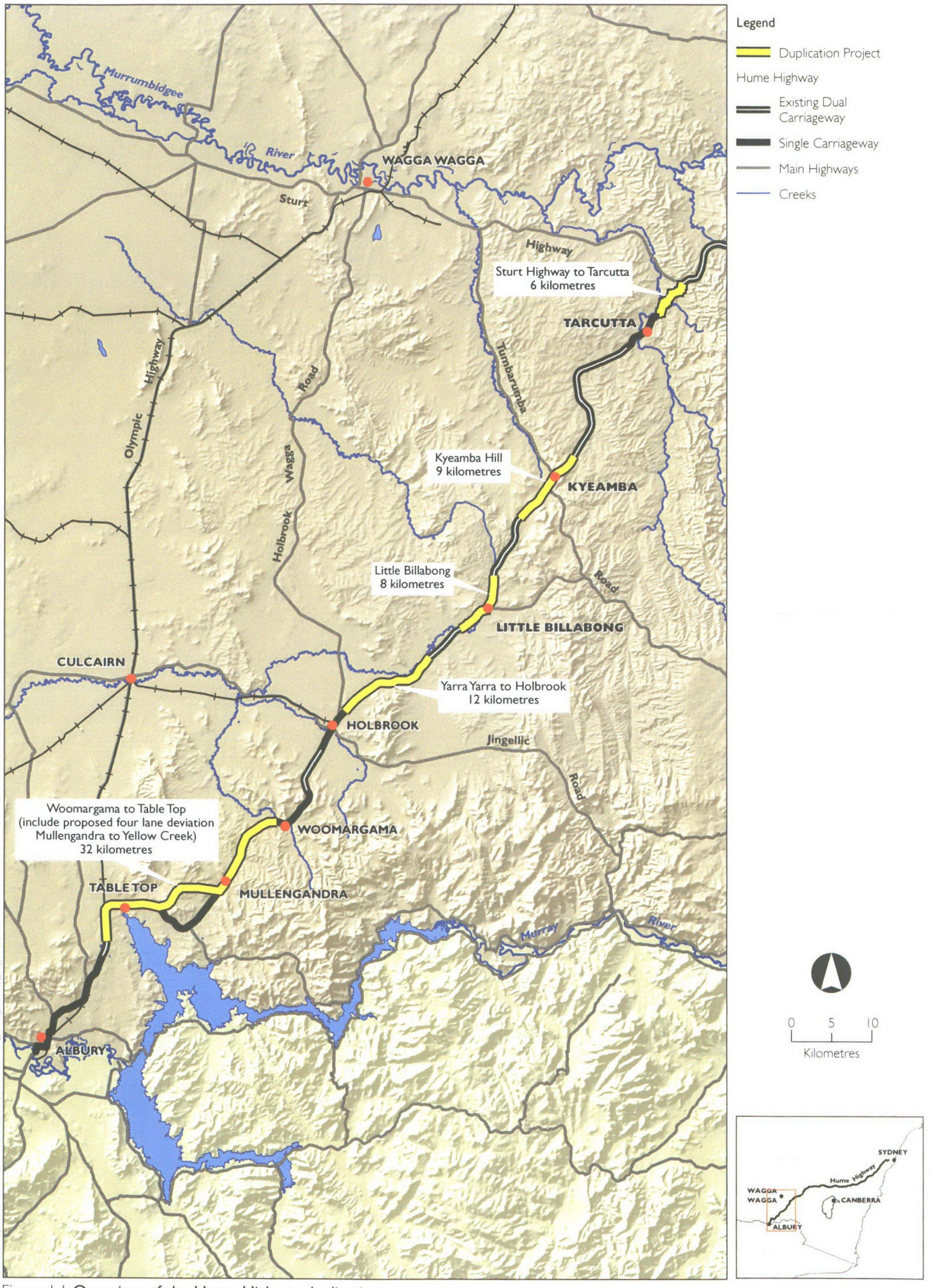

Figure 1.1 Overview of the Hume Highway duplication

A number of appendices are also attached, including the Minister for Planning's Order bringing the proposal under Part 3A, the Department of Planning's Environmental Assessment requirements (DGRs), technical working papers and supporting documentation associated with the assessment of the potential environmental issues. These are listed in the reports table of contents at the start.

In accordance with the objectives and requirements of Part 3A of the EP&A Act, all potential environmental issues identified during proposal planning and assessment are addressed in this document.

Those issues that are considered to be of particular significance and were identified in the formal Environmental Assessment requirements issued by the Director-General of the Department of Planning (see **Appendix B**) are described and assessed in detail in Chapter 8. A checklist of the DGRs with a cross-reference to the relevant section or sections of the Environmental Assessment is included in **Appendix C**.

Other issues that are important, but which can be managed by standard management and mitigation measures widely used in the construction industry have generally not been the subject of proposal specific investigations. These issues and mitigation requirements are described and assessed in Chapter 9.

1.4 Environmental Assessment process

This Environmental Assessment has been prepared in accordance the provisions of Part 3A of the EP&A Act. The Part 3A major project assessment and approval process is illustrated in **Figure 1-2** and described below.

Stage 1. Preparation of Major Project Application Report

The first stage in the Part 3A process required the Proponent (RTA) to prepare a Project Application Report describing the proposal and the results of a preliminary environmental assessment. This report was completed and submitted to the Department of Planning with a formal Major Project Application on 12 September 2006. This report is publicly available on the Department of Planning's website.

Stage 2. Agency and Council consultation and preparation of Environmental Assessment requirements

The second stage involved agency and stakeholder consultation facilitated by the Department of Planning leading to the development of formal requirements for Environmental Assessment. The Department of Planning convened a Planning Focus Meeting to commence the initial consultation with relevant agencies and local Councils. At this meeting the proposal was described and the stakeholder representatives had an initial opportunity to discuss important issues and to ask questions of the Proponent. The Planning Focus Meeting was held on 23 August 2006 at Holbrook.

The Project Application Report was also sent to relevant agencies and local Councils and they were invited to review it in detail and submit issues or comments to the Department of Planning for consideration prior to the Director General of the Department of Planning formulating the DGRs for the Proposal. The DGRs identify key issues to be addressed in the Environmental Assessment documents and the level of assessment required in relation to those issues.

Stage 3. Preparation of Environmental Assessment Report

The third stage involved preparation of a detailed Environmental Assessment Report (in accordance with the requirements of the DGRs) by the Proponent. This document includes a description of the Proposal, an assessment of impacts and a draft Statement of Commitments identifying the impact management and mitigation measures that would be applied to reduce the environmental impacts of construction and operation. The Environmental Assessment Report is submitted to the Department of Planning for a review of adequacy prior to acceptance.

Stage 4. Exhibition of Environmental Assessment Report

The fourth stage is the critical step of public exhibition of the Environmental Assessment Report for the Proposal. When the Environmental Assessment document is accepted by Department of Planning, it is publicly exhibited and submissions are invited. The statutory public exhibition period is 30 days. Public submissions are accepted during the exhibition period.

At the conclusion of the public exhibition, the Director General of the Department of Planning is required to provide the RTA copies of the submissions received or a summary of the issues raised. The RTA would then respond to the comments received in the form of a Submissions Report and would give consideration to whether changes to the proposal are needed to minimise its environmental impact. If significant changes to the proposal are required the Department of Planning may request a Preferred Project Report to be exhibited.

Stage 5. Consideration of submissions and Minister's Decision

The fifth stage of the Part 3A process requires the Director General of the Department of Planning to consider the Environmental Assessment Report and the submissions received and to prepare an Assessment Report to assist the Minister for Planning in deciding whether or not to approve the project. During the preparation of the Assessment Report further consultation with relevant public authorities is undertaken by the Department of Planning.

The final step in the process is a decision of the Minister for Planning on whether or not to approve the proposal. It is expected that the Minister for Planning would consult the Minister for Roads prior to making a decision.

If approval is given, it is usual practice for the approval to be accompanied by a schedule of Conditions of Approval to be met by the Proponent during the construction and operational phases of the project.

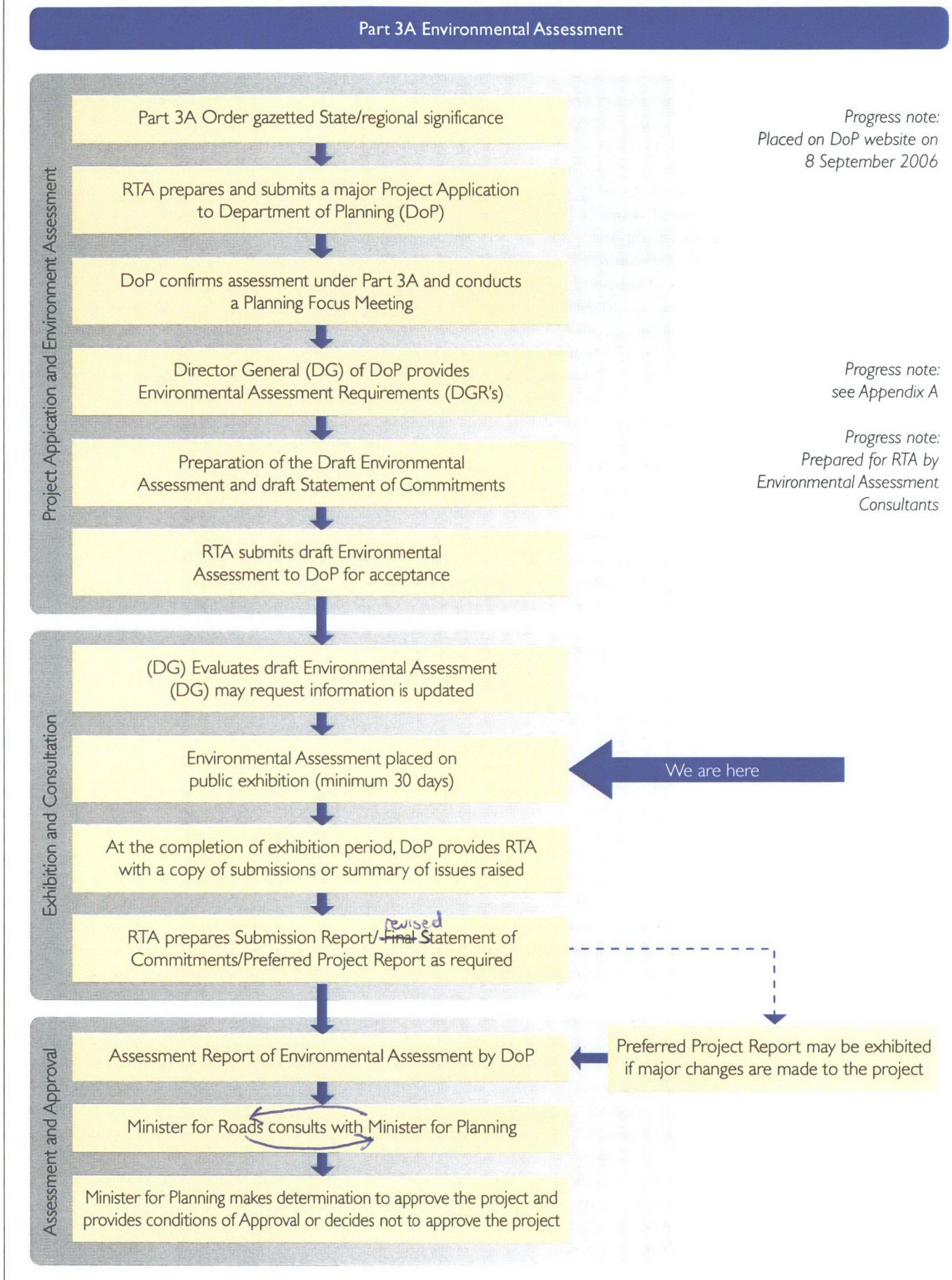

Figure 1.2 **Part 3A Process for the Hume Highway Duplication**

2 Strategic context and need for the Proposal

Chapter 2 identifies the relationship of the Proposal to strategic infrastructure planning in both the National and State context and provides the need for and objectives of the Proposal.

2.1 NSW State Infrastructure Strategy

Released in May 2006, the *State Infrastructure Strategy - New South Wales 2006-07 to 2015-16* (NSW Treasury 2006) provides strategic direction for planning and delivery of infrastructure in NSW. The State Infrastructure Strategy (SIS 2006) commits the NSW Government to funding of capital expenditure, links the planning embedded in the *Sydney Metropolitan Strategy* and other regional strategies with the budget, and delivers on identified infrastructure commitments. The SIS 2006 identifies investment priorities for transport and lists roadwork initiatives planned throughout NSW and acknowledges a need for additional funding to be sourced from the Federal Government. The Hume Highway Duplication has been listed within the SIS transport infrastructure plans for the next four years and acknowledges the $800 million contribution from the federal government to accelerate duplication by 2009.

2.2 Australian Government AusLink Program

2.2.1 AusLink White Paper

The *AusLink White Paper: Building Our National Transport Future* (the White Paper) is the federal government's formal policy statement on land transport that identifies national objectives for the AusLink investment program. AusLink is designed to achieve better national land transport planning, funding and investment decision-making.

The AusLink investment program seeks to promote sustainable national and regional economic growth, development and connectivity by contributing to development of an integrated National Network which:

- Improves national and interregional connectivity for people, communities, regions and industry.
- Improves national, interregional and international logistics.
- Enhances national, interregional and international trade.
- Enhances health, safety and security.
- Is consistent with the obligation to current and future generations to sustain the environment.
- Is consistent with viable, long-term economic and social outcomes.
- Is linked effectively to the broader transport network.

One of the key components of the AusLink process is the development of a strategy for each corridor of the AusLink National Network. The *Sydney-Melbourne Corridor Strategy* (currently in draft form and due for final release in mid-2007) identifies the Hume Highway an essential road link that services freight and passenger flows between the economies of Sydney, Melbourne and Canberra, regional centres such as Albury-Wodonga, and interstate through traffic to and from South Australia and Queensland.

2.2.2 Sydney-Melbourne Corridor Strategy

The Sydney-Melbourne corridor is vital to the Australian economy. It is the busiest inter-capital road corridor with approximately 40% of long-distance road freight movements on

the National Network using the Hume Highway for at least part of their journey. Interstate freight between Sydney and Melbourne is forecast to increase by nearly 70% over the next 20 years and by 2025 it is expected that 5-6,000 heavy vehicles will be moving along the Hume Highway each day.

The strategic priorities for the Sydney-Melbourne corridor are in two groups:

- Short-term (to 2013-14) – corresponding to the priorities for the next *National Land Transport Plan* and associated investment programme.
- Longer-term (from 2015) priorities.

The short-term priorities for the Sydney-Melbourne corridor centre around five strategic issues:

1) Road safety, especially on the unduplicated section of the Hume Highway;
2) The impact of urban sprawl on congestion and road transport efficiency;
3) Managing road use to achieve better performance from existing infrastructure;
4) The condition of road and rail infrastructure; and
5) The competitiveness of rail transport for interstate non-bulk freight.

The short-term priorities for the Sydney-Melbourne corridor, which relate to the Hume Highway Duplication include the duplication of the single carriageway sections and improved road safety, especially, improved fatigue management and management of local access intersections with the Hume Highway

The AusLink investment of $800 million announced in the 2006 federal budget will accelerate the Hume Highway Duplication, allowing completion of 67 kilometres of duplication by 2009. A further 20 kilometres of additional duplication, the bypasses of Tarcutta, Holbrook and Woomargama, are to be completed by 2012. These bypasses are not included in this Environmental Assessment and will be the subject of separate assessment and approval processes.

2.3 Hume Highway Strategic Planning Study

The *Hume Highway Strategic Planning Study* (Connell Wagner 2004) focused on approximately 120 kilometres the Hume Highway from its connection with the Sturt Highway (north of Tarcutta) to the Olympic Highway (north of Albury).. The study comprised an analysis of the existing and future transport needs within this section of the highway in relation to both road and rail modes to identify future upgrade strategies. The analysis indicated that the potential achievable shift of freight from the Hume Highway to the rail network would only be marginal (in terms of the total road freight transport task) even with relatively high levels of investment in rail infrastructure. Accordingly, the study concluded that road network improvements could be justified at any level of rail infrastructure investment.

Following the analysis, the remainder of the study focused on Hume Highway upgrade requirements and timing, based on identification of existing and future deficiencies along the highway. Recommendations from the study fell into two broad categories:

- Improvements required in the short term to address identified safety deficiencies.
- Longer-term improvements addressing a shortfall in capacity and associated performance (level of service) issues.

The longer-term requirements involving upgrading of the single carriageway sections to provide dual carriageways were identified as being necessary by 2010 or thereabouts.

Performance of the upgraded highway (from single to dual carriageway) is predicted to be acceptable until 2021 and beyond, with a maximum level of service of C estimated for 2021

(refer to Table 2.1 for a description of Levels of Service). Based on the traffic safety analysis undertaken, the dual carriageway sections together with a wide median would reduce accident rate and severity substantially, compared against the existing single carriageway sections.

2.4 Proposal need and justification

The Hume Highway is the main freight corridor between Melbourne and Sydney. Community expectation regarding the completion of the Hume Highway Duplication to provide a continuous, high standard dual carriageway between Sydney and Melbourne has existed for some time. Dual carriageways were completed in Victoria in December 2005, increasing the focus on the remaining single carriageway sections in NSW.

The completion of the Hume Highway Duplication would provide consistent conditions for road users, and improved level of service, road safety and freight efficiency. It would also accommodate the forecast growth in traffic on the highway. These conditions are further considered below.

2.4.1 Level of service

Level of Service (LoS) is a qualitative measure describing the perception by motorists or passengers operational conditions within a traffic stream. A LoS definition generally describes these conditions in terms of factors such as speed and travel time, freedom to manoeuvre (e.g. overtaking), traffic interruptions, comfort and convenience, and safety. In general, there are six levels of service, ranging from A, the best operating conditions to F, the worst operating conditions. The LoS definitions from A to F are described in **Table 2-1**.

Table 2-1 Level of Service definitions

Level of Service	Description
A	Good
B	Good with minimum delays and spare capacity
C	Satisfactory with spare capacity
D	Satisfactory but operating near capacity
E	At capacity and incidents will cause delays
F	Unsatisfactory and requires additional capacity

Source: *Austroads Guide to Traffic Engineering Practice Part 2 – Roadway Capacity*

As part of the *Hume Highway Strategic Planning Study* (Connell Wagner 2004), LoS calculations were undertaken based on 2001 traffic volumes and projected to 2006, 2016 and 2021 to reflect current and future performance. In 2006, the dual carriageway sections of the Hume Highway operate at LoS A, with significant capacity for traffic growth at this level. The single carriageway sections of the highway operate as high as LoS B for eight hours per day (2am to 10am) and as low as LoS D for up to five hours per day (8pm to 1am) with an average operation of LoS C. The reduction to LoS D corresponds to the peak period for heavy vehicles and reflects the high night-time percentage of heavy vehicle traffic on the Hume Highway.

Adopting a threshold for upgrading from single carriageway to dual carriageway as the point at which LoS deteriorates from C to D for a significant period justifies immediate upgrade of the highway. With no upgrade, by 2016 the single carriageway sections of the highway would deteriorate to LoS E during the period 9pm to 1am, with an average weekday LoS D. In

2021, this would further deteriorate to LoS E over a longer period (7pm to 2am), with an average of LoS D.

2.4.2 Road safety

The crash rates (in terms of travel per 100 million vehicle kilometres travel (Mvkt)) on the single carriageway sections of the Hume Highway between the Sturt Highway and Table Top are currently higher in all categories (fatal, injury and total), than crash rates in the adjacent dual carriageway sections, as indicated in **Table 2-2**.

Table 2-2 Crash rates for the Hume Highway, Sturt Highway to Table Top

Road section	Crash rate (per 100Mvkt)		
	Fatal	Injury	Total
Dual carriageway sections Sturt Highway to Table Top	1.09	7.9	24.6
Single carriageway sections Sturt Highway to Table Top	2.01	11.1	28.2
Combined Sturt Highway to Table Top	1.71	10.6	27.0

Source: *Hume Strategic Planning Study*, prepared for the RTA (Connell Wagner 2004)

The fatal crash rate on the single carriageway is approximately 85% higher than the dual carriageway, and the injury crash rate on the single carriageway is approximately 40% higher than on the divided carriageway. The proportion of overall accidents that involve either injuries or fatalities is 15% higher in the single carriageway sections.

Within the overall averages for the single carriageway between Sturt Highway and Table Top there is a marked variation in crash rate between individual sections as shown in **Table 2-3**.

Table 2-3 Crash rates for single carriageway between Sturt Highway and Table Top

Road section	Crash rate (per 100Mvkt)		
	Fatal	Injury	Total
Sturt Highway to Tarcutta	2.3	20	55.0
Kyeamba Hill	1.3	18	49.0
Little Billabong	4.7	11	36.0
Yarra Yarra to Holbrook	0.6	10	25.0
Woomargama to Table Top	2.5	8	18.0

Source: *Hume Strategic Planning Study*, prepared for the RTA (Connell Wagner 2004)

Road safety is a significant community concern. Based on these measures, some sections of single carriageway have significantly higher crash rates than the total Hume Highway as a route. As such, the proposed improvements are justified on the grounds of road safety.

2.4.3 Freight efficiency

Road freight on the Hume Highway currently moves between Sydney and Melbourne overnight predominantly between 8.00pm and 1.00am. There is a desire to reduce travel times and provide door to door delivery. This is severely affected by the reduced LoS on the existing single carriageways resulting from:

- Lower speed limits.
- Traffic congestion.
- Lack of overtaking opportunities.

There is a general industry desire to adopt higher efficiency freight vehicles i.e. B-double trailers. Further consideration and acceptance of such vehicles on the Hume Highway is dependent, amongst other matters, on the provision of high standard dual carriageway conditions.

The Hume Highway Duplication has the potential to significantly improve freight competitiveness (against rail freight) for existing vehicles and allow further consideration of higher efficiency freight vehicles.

2.5 Proposal objectives

The primary objective of the Hume Highway Duplication is to duplicate the existing single carriageway sections of the Highway between its intersection with the Sturt Highway to north of Albury (excluding the single carriageway sections through Tarcutta, Holbrook and Woomargama) by 2009.

Additionally, the Hume Highway Duplication adopts the objectives set for the AusLink National Network which support national economic growth by developing sustainable transport solutions that:

- Increase its infrastructure handling capacity and efficiency.
- Improve its safety and security.
- Improve transport productivity on its nationally strategic and export-oriented freight corridors.
- Improve the reliability of travel on interstate and interregional corridors.
- Are consistent with viable, long-term economic and social outcomes, and with the obligation to current and future generations to sustain the environment.

2.6 Implication of doing nothing

The implications of no action or deferral of the Hume Highway Duplication include declining traffic and safety conditions and deteriorating community amenity along the Hume Highway between the Sturt Highway and Table Top. Predicted traffic growth would further exacerbate the problems currently experienced within the existing road and traffic environment.

Without duplication of the Hume Highway between the Sturt Highway and Table Top, the predicted traffic growth would increasingly expose the deficiencies of the existing road environment over the forecast period. Specific consequences would include:

- The deterioration of traffic conditions to unacceptable levels.
- A likely increase in vehicle crashes.
- An increase in travel times.
- Inconsistency in road conditions along the Hume Highway.
- Failure to achieve the Proposal objectives and the broader objectives of planning and transport strategies, in particular the Australian Government's AusLink White Paper and the NSW State Infrastructure Strategy

3 Overview of the Study Area

Chapter 3 provides an overview of the existing environment of the study area for the Kyeamba Hill section, including the identification of key natural features and built attributes. The study area is considered to be the area which may be directly or indirectly affected by the proposal.

The primary focus of the investigations has been on an area approximately 200 metres either side of the highway centreline. However, it is recognised that the impacts of some aspects of the proposal may extend beyond this area and the area of assessment in some instances has been extended accordingly.

3.1 Location

The study area is located within the southwest slopes of NSW within the Wagga Wagga local government area (LGA). The proposal site is located on the Hume Highway approximately 401 kilometres south of Sydney and extends from approximately 67 kilometres to 76 kilometres south of Gundagai. The locality is known as Kyeamba Hill owing to the prominent hills located at the northern end of the study area. **Figure 3-1** illustrates the location of the proposal within a regional context.

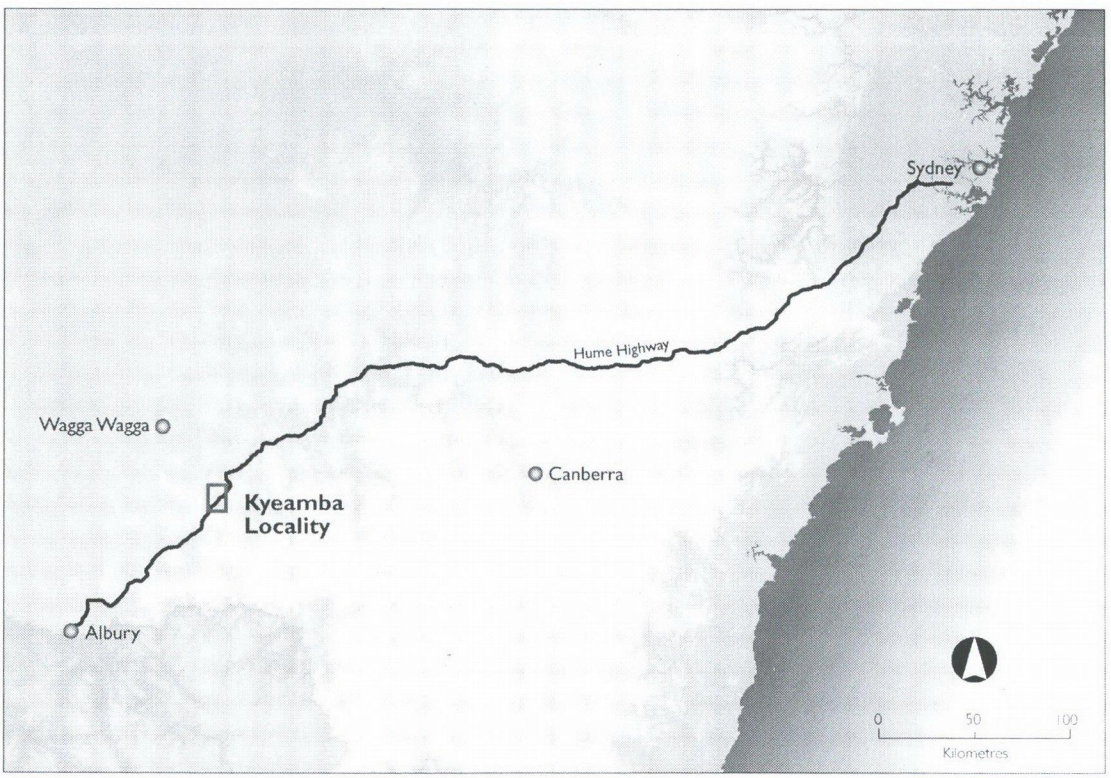

Figure 3-1 NSW Regional context of Proposal.

Figure 3-2 provides a locality plan and identifies important local features within the study area.

3.2 Landform, geology and soils

The highway corridor traverses low hills, valleys and alluvial plains typical of the western slopes of the Great Dividing Range. The existing highway has been generally located on lower footslopes but in places cross short sections of floodplain. In the north, the study area is approximately 400 metres AHD (Australian height datum) above sea level dipping toward the south to approximately 240 metres AHD midway through the proposal. Continuing south, the study area remains relatively level before rising to approximately 250m-260 metres AHD at the southern end. The highway within the study area passes through small cuttings at its northern and southern extremities, with the mid-sections largely on lower lying alluvial plains.

The predominant bedrock unit within the study area is composed of metamorphic and meta-sedimentary rocks such as slate, phyllite, metasandstone and metasiltstone. The rocks are of late Ordovician age, but have since been extensively deformed, regionally metamorphosed and intruded by granitic rocks. Both the bedding and metamorphic layering are steeply inclined and trend generally north to northeast. The rock mass has been fractured by faulting, jointing and possibly by stress relief.

The soil landscape units mapped on the Wagga 1:100,000 soils sheet can, to some extent, be extrapolated eastwards into the adjoining unmapped Tarcutta sheet area, which includes the highway corridor. The soil landscapes most relevant to the Proposal include:

- Colluvial soils of the lower gradient footslopes - These are stony clays which have been moved downslope by soil creep and slopewash (sediment transport by overland flow, as a muddy suspension), but may include a proportion of windblown red clay ('parna') and higher terrace alluvium. These soils include the most commonly encountered subgrade materials along the road. Because of their topographic situation, these soils have a tendency to become waterlogged and salinised in places.
- Residual soils of the upper slopes, hill crests and saddles - These are similar to the colluvial soils, but generally stonier and shallower (0.3-0.6 metres), with weathered bedrock beneath. Their main characteristic relevant to the proposal is that they may act as intake areas for shallow groundwater, which may cause waterlogging further downslope.
- Alluvial soils of the main floodplains - The surface soils are predominantly silts and clays, with some sand. Soil profiles are relatively deep (0.6-1.2 metres) and may be prone to flooding, waterlogging and shrink-swell behaviour.

3.3 Climate

The nearest NSW Bureau of Meteorology monitoring station to the study area is located at Murraguldrie State Forest (station 072035) approximately six kilometres southeast. Climate within the region can be described as dry and mild/temperate. Historical data regarding local rainfall and temperature patterns has been taken from the online metrological database (www.bom.gov.au) and is summarised below.

January is the hottest month with average daily maximum temperatures of 29.7°C and July the coldest month with average daily minimum temperatures of 1.6°C. Temperatures can occasionally fall below zero at night during the winter months. The lowest minimum temperature on record is minus 5°C which occurred in July, and the maximum recorded temperature of 43°C occurred in January.

Rainfall is variably distributed throughout the year, with an average annual rainfall of 891.7 millimetres. On average rainfall peaks in July, August and September, contributing 95.0

Figure 3.2 **Study Area Locality Plan**

millimetres 95.1 millimetres and 91.0 millimetres of rainfall, respectively. However, the highest recorded rainfall event occurred in autumn where over 300 millimetres of rain fell during the month of May. The driest months occur between December, January and February with 50.0 millimetres and 60.0 millimetres of rainfall falling on average during these months.

High humidity recorded during the winter morning hours are generally a manifestation of the frequent incidence of fog which occurs most often between the months of May and August.

3.4 Surface water and hydrology

The study area is within both the Kyeamba and Tarcutta Creek Catchments. Kyeamba Creek originates in the Kyeamba foothills and flows to the northwest until its confluence with the Murrumbidgee River near Wagga Wagga. The springs and minor tributaries that drain into the creek originate to the west of the highway at Kyeamba Hill. As a consequence, the highway is crossed by numerous small drainage channels, with these accommodated in the existing highway design via a combination of pipe and box culverts. The main Kyeamba Creek channel crossing occurs at chainage 75,400 at the southern end, running in a north-westerly direction.

At the time of a recent site inspection in September 2006, the main Kyeamba Creek channel was flowing. However, a small tributary of the Kyeamba Creek that also crosses the alignment within the study area was dry. A serves drought is currently affecting the study area and this has resulted in many creeks becoming ephemeral, with running water present only during flash flood events. Numerous springs are located on the eastern side of the existing alignment at chainage 68,500 and 69,000, with areas of seasonally waterlogged soils associated with these springs.

Water quality in the Kyeamba Creek system is influenced largely by the agricultural land uses, specifically grazing. Despite a search of the available literature for water quality data in the study area none was found that covered any part of the study area. This is possibly due to the fact that the creek originates within the study area and water quality sampling would more commonly be undertaken in the lower reaches of the creek system.

3.5 Groundwater

The Kyeamba Creek Catchment covers approximately 60 square kilometres and contains a dual aquifer system. The catchment lies within an intermediate-scale fractured rock aquifer and the overlaying valley fill alluvium provides a shallow secondary aquifer (local scale). Groundwater levels within the catchment are highly dependent on rainfall conditions (Cresswell et al. 2003).

Groundwater in the fractured rock aquifers cross the surface catchment divide between Tarcutta and Kyeamba. Groundwater flow is northward and the water levels in this aquifer are near the surface over the lower reaches of Kyeamba Creek near its confluence with the Murrumbidgee River (Cresswelll et al. 2003). Conversely, superficial waters follow the routes outlined by the alluvial sediments. The unconfined aquifers in the alluvial sediments are more commonly accessed for domestic and farm dam supplies and groundwater levels in the alluvial aquifers have remained steady over the last 30 years (Cresswelll et al. 2003).

Salinity is highly variable throughout the catchment (up to two orders of magnitude within a few kilometres) with deeper aquifers commonly being slightly fresher than upper aquifers (Cresswell et al. 2003).

Recharge occurs across the entire catchment. Groundwater recharge in the alluvium within the catchment is thought primarily to be through rainfall infiltration. However, where the Ordovician metasediments are in direct contact with the alluvial sediments at Kyeamba Creek near Wagga Wagga recharge into the alluvium is thought to occur from the valley sides and basement rock (DLWC 1999). The discharge zone of Kyeamba Creek is constricted by granite highs and therefore discharge of excess water is longer than the period of accumulation (Cresswell et al. 2003).

3.6 Air quality

The Hume Highway at Kyeamba Hill traverses through a sparsely populated rural area, dominated by agricultural and grazing land with some National Parks to the east. Consequently, while air quality monitoring has not been previously undertaken, air quality in the study area is anticipated to be good given the rural nature of the area and the absence of polluting industries in the surrounding areas. Some contributors to atmospheric pollution in the study area typically include:

- Intermittent wheel dust and exhaust emissions from vehicles travelling on the local road network.
- Dust from agricultural land activities such as land clearing and ploughing.
- Sporadic Bushfire.

These contributions are considered to have a negligible impact on air quality in the study area. Vehicle emissions from the highway are likely to be low given the relatively low average number of vehicles using the route (less than 10,000 per day) and the high rate of dissipation that can be expected in this environment. Air quality is expected to be well within air quality goals established by the NSW Department of Environment and Conservation (DEC).

3.7 Noise environment

The study area is located in a rural environment that has a low ambient noise level. The dominant ambient noise source in areas close to the existing highway is highway traffic. Road traffic noise would extend away from the road corridor for some distance with a relatively steady and continuous flow of traffic. As the surrounding environment is relatively flat to undulating, there is limited natural noise attenuation and noise levels would reduce relatively evenly as distance from the road increases. Road traffic noise would be noticeable at varying distances from the highway depending on topography and climatic conditions. Typically, road noise would be noticeable at distances up to several hundred metres from the road. Where the effect of natural topographic features such as hills and valleys occur, a reduction in noise would be apparent as the result of the localised shielding of the traffic stream.

There are a number of private residences located adjacent to the existing highway, some within 50 to 100 metres from the current road edge. The noise receptors of primary concern on the alignment are located around chainage 73,800. There are no other noise sensitive land uses such as schools or churches in the study area.

To obtain information on the existing levels of road traffic noise from residences located in proximity to the current highway alignment, baseline noise monitoring was undertaken. In summary, this investigation confirmed that daytime noise levels were low. However, nighttime noise levels exhibited high maximum noise levels caused by traffic passbys. This is to be expected given the close proximity of some residences to the highway and the fact that it is a major freight corridor between Sydney and Melbourne.

3.8 Biodiversity

The study area comprises a mix of low undulating hills and floodplains associated with the Kyeamba Creek, in addition to prominent granitic outcrops either side of the highway. The study area has a long history of vegetation clearance associated with agriculture and rural settlement. The vegetation remaining exists as a fragmented mosaic of small woodland remnants the larger of which are preserved in Travelling Stock Reserves (TSR), linear roadside reserves and riparian strips on private land.

A number of broad fauna habitat types occur in the Kyeamba study area, namely: dominant woodland and riparian habitats with derived grasslands, rocky hillslopes, and freshwater habitats (dams, creeks and wet depressions). Rocky hillslopes are a component of the woodland habitats, as they typically are covered with a sparse canopy of trees. Farm dams are scattered throughout the lower lying areas.

There are three broad vegetation assemblages within the study area. The vegetation within the study area is dominated by sparse to dense native remnant woodland and a groundcover of introduced grasses and weeds within the road reserve to cleared agricultural land with scattered mature trees within the adjoining private properties.
Within the region small patches of remnant woodland remain, however these are often widely dispersed. Nevertheless, the remaining woodland patches are highly important, in terms of providing refuge for terrestrial fauna beyond the cleared areas, connecting patches of larger, dispersed woodland stands, and in particular providing habitat for threatened woodland birds.

Much of the remnant vegetation within the study area belongs to the ecological community Box-Gum Grassy Woodland and Derived Native Grasslands (listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act, 1999*) and Box-Gum Grassy Woodland (listed as an Endangered Ecological Community (EEC) under the *Threatened Species Conservation Act, 1995*). A grassy understorey or 'Derived grasslands' is a constituent feature of this EEC, and this exists in small areas adjacent to woodland areas in the road reserve.

Vegetation within the road reserve consists of Box-Gum Grassy Woodland at various stages of growth, however juvenile and semi-mature species are more common. Many of the mature trees have hollows of various sizes which provide potential habitat for threatened fauna species known in the region including Squirrel Glider, microbats and hollow-nesting birds. In addition many of these trees have mistletoe, an important food resource for threatened bird species known to inhabit the region.

The majority of groundcover vegetation within the road reserve and adjoining properties comprises heavily grazed and degraded areas, dominated by introduced grasses and weeds. During this current study four noxious species were recorded in the Kyeamba Hill study area, including Blackberry (*Rubus fruticosus*), Serrated Tussock (*Nassella trichotoma),* Paterson's Curse (*Echium plantagineum*) and St John's Wort (*Hypericum perforatum*).

There is one large area of native vegetation to the west of the highway, known as the Kyeamba Travelling Stock Route (TSR). High quality vegetation is found at the Kyeamba TSR where there is a greater proportion of native species including orchid and lily species. The area consists of Box-Gum Grassy Woodland and is contiguous with vegetation in the road reserve which, in turn, is connected to smaller areas of vegetation along creek lines in adjacent properties.

A large area of commercial pine plantation is located further to the northwest at chainage 67,000. The habitat found at this location is not considered to make a notable contribution to local biodiversity.

Vegetation along the creek channels consists of scattered Eucalyptus, along with introduced shrubs and grasses. At the time of the current investigation the condition of Kyeamba Creek as habitat for native species was limited throughout the study area with some areas containing pools and other parts of the creek bed dry. In general, water quality was observed to be poor directly adjacent to road crossings, and exotic species within the riparian zone were prevalent.

3.9 Landscape and visual amenity

The Hume Highway is the dominant built feature within the study area and it meanders in a north-south alignment through mostly cleared rolling hill slopes. Particular landscape features include the granitic rock outcrops and hill formations found at the northern end of the alignment. The Proposal alignment begins north of the Kilgowa Mountain area situated to the west and traverses through the foothills of this area and the Kyeamba Hill areas situated to the east. The spot heights of these hill formations are 519 metres and 542 metres respectively, and are dominant features of the regional landscape. The road elevation in this area offers open views to the rural scene at lower elevations further south along the alignment.

In the northern part of this section of the highway the road passes around the rocky outcrop at chainage 70,000. This geological feature has necessitated a meandering section of the existing highway. South of this outcrop the highway travels in a south westerly direction through an alluvial flood plain area associated with Kyeamba Creek. The highway is relatively straight in this section and there is little variability in the visual environment. Through much of these lower areas, a stand of mature woodland trees exists adjacent to and within the highway road reserve, creating a scenic 'tree lined' experience for highway travellers. More distant views (beyond the road reserve) comprise open, undulating grazing lands with some remnant trees.

At the southern end of the alignment Mount Ratler is located to the east of the highway and at 650m this is the highest point in the vicinity of the highway. Vistas from the highway to Mount Ratler are provided between gaps in the vegetation for highway users travelling south.

There are two primary viewer groups being road users and local residents with views of the highway. A number of farmhouses and sheds are visible from the highway although the majority are set back from the road. The closest are located between chainage 74000 and 75000 and include the historic Travellers Joy Inn, which is located directly to the existing road. At the northern end the Kyeamba Hill shearing sheds are also within close proximity to the highway.

3.10 Aboriginal heritage

Information to be included once received from RTA.

3.11 Non-Aboriginal heritage

Development of the Hume Highway took off after 1928 when it was proclaimed a State Highway and named in honour of Hamilton Hume. Major works in the Kyeamba area occurred in the 1930s. Camps were set up for in excess of 200 construction workers engaged in upgrading this section.

The development of transport routes such as the Hume Highway was influenced by the spread of settlement. Road infrastructure such as bridges sometimes became sites for social interaction, linked with picnicking and swimming areas. Construction of the Hume Highway itself created substantial employment opportunities, the money earned contributing to the local economy.

A number of early alignments of the Highway are shown on the historical maps for the area. By 1935 the section of the Highway from Kyeamba to the Victorian border had been permanently aligned. The line from Tarcutta to Albury was bitumen surfaced in 1936.

The first Europeans to occupy the Kyeamba area arrived in 1839. By late 1839 John Smith had constructed bark huts in Kyeamba and thirty acres were under cultivation. His homestead located close to the Port Phillip Road, was converted to an inn, known as the Traveller's Joy, later also known as the Traveller's Rest and later still as Kyeamba Inn. The mounted police had an office in Kyeamba in the 1850s.

Kyeamba village developed along the line of the South Road including the Travellers Joy Inn. The Telegraph Station opened in 1861 and became a Post Office in 1891. The Post Office was destroyed by fire in 1916.

Thirty three heritage items have been identified within 100 metres of the existing highway. These include:

- Archaeological heritage – 18 sites of archaeological significance (K001-K010, K100-K108).
- Built heritage – five sites of built heritage significance (K201-K205).
- Landscape – 10 landscape items (K301-310).

Two identifiable archaeological sites of State heritage significance (K001, K103) and one potential archaeological site of State heritage significance (K107) have been identified in the assessment. Of these, the cemetery reserve (K107) would be affected by the proposal.

3.12 Land use and the community

The proposal site lies within the Wagga Wagga local government area and is located within the following land use planning zones under the Wagga Wagga Rural Local Environmental Plan (WWRLEP):

- Zone 1 (Rural); and
- Zone 2 (Village).

In addition, part of the proposed alignment passes either through, or very close to, an area of environmentally sensitive land marked on WWRLEP. Development for the purposes of the Proposal is permissible with consent within the zones under the WWRLEP.

Along the length of the route the highway runs adjacent to parcels of land owned by up to nine separate land holders. Detailed land ownership and land tenure accounts have not been provided within this report. Most of the potentially affected land is owned by:

- Roads and Traffic Authority.
- Department of Lands.
- Private landholders.

Predominant land uses in these areas include a mixture of rural dwellings and extensive rural landholdings. Agricultural pursuits, in particular grazing activities, are the main land use for the study area. Cattle and sheep grazing are the primary rural activities in the area with much of the surrounding landscape has been cleared for such purposes. The production and harvesting of fodder crops such as lucerne and oats, while second to grazing activities, are common throughout the region. There is one commercial softwood plantation adjacent to the present alignment at the northern end of the proposal site.

Kyeamba Hill itself was once a small township up until mid last century, however with the changing nature of the rural economy the town has seen a marked overall decrease population. This is exemplified by the abandoned transport depot and service station that is found at the Tumbarumba Road intersection, in addition to many abandoned farm buildings and ruins associated with the former school/police station.

The existing highway alignment passes adjacent to approximately eleven parcels of land, some of which have permanent residential accommodation in the form of rural homesteads. Notable homestead buildings on the alignment include the Travellers Joy Inn and the 'Koinglo' property, Kyeamba Park and the Kyeamba village buildings.

3.13 Road network

The Hume Highway is the primary road within local road network and is orientated generally north-south. The highway branches off from the Sturt Highway approximately 30 kilometres north of the proposal site. The Hume Highway at this location consists of an undivided dual lane single carriageway with a posted speed limit of 100 km/h. Current travel lanes are 3.5 metres wide and a 1 metre sealed shoulder either side is present.

There are two main intersections within the study area, one at 69.6 kilometres south of Gundagai with Tumbarumba Road (Main Road 384) and the other at 71.5 kilometres south of Gundagai, a continuation east of the Tumbarumba Road. Tumbarumba Road forms the key east – west link between Wagga Wagga in the northwest and Tumbarumba to the east.

On the existing highway there is a northbound overtaking lane at approximately 70.6 kilometres south of Gundagai which is approximately three kilometres in length. There is also an overtaking lane for motorists travelling south which is a continuation of the existing dual carriageway north of the study area.

The RTA has monitored traffic flows on the Hume Highway south of the intersection with the Sturt Highway and has published the results since 1982. Figures for 2003 show Annual Average Daily Traffic (AADT) levels of 8,376. Heavy vehicles constitute 40% of total traffic volumes, much of which occurs during night time periods. Maximum hourly traffic volumes during late evening/early morning are up to 900 vehicles per hour. Maximum hourly traffic volumes during daylight hours are less than 500 vehicles per hour.

Formal truck parking is provided at 71.8 kilometres south of Gundagai and there are numerous locations within the study area that currently are or have previously been used as roadside stockpile sites.

4 Description of the Proposal

4.1 Overview of the proposal

The proposal mainly involves duplication of the existing Hume Highway between two previously duplicated sections, extending from approximately 67 to 76 km south of Gundagai, a measured length of 9.1 km.

With the exception of the section between chainage 70000 and 73500, most of the highway duplication would be located within the existing road corridor, not withstanding the minor curve realignment required between 67000 and 68000. In addition, some adjustments to the vertical and horizontal alignment are proposed to correct existing geometric deficiencies in various locations. The proposed Kyeamba Hill alignment is shown in plan in **Figure 4-1a-h.**

A key feature of the Kyeamba Hill proposal is to relocate and realign the Tumbarumba Road (MR 384) intersection with the Hume Highway and separate the predominantly through-traffic along the two sections of Tumbarumba Road from the Highway to improve road safety. In addition, private access points along the proposed duplication would be maintained or upgraded so that traffic, including the local school buses, can enter and leave the Highway safely and more efficiently.

4.1.1 Timing and funding

Following the Commonwealth government budget announced in May 2006, funding was made available for duplication to the remaining single carriageway sections of the Hume Highway in NSW south of its intersection with the Sturt Highway. Funding is provided under the Commonwealth government's $800 million package to NSW for duplication of the Hume Highway. The strategic estimate for the proposal cost is approximately $111 million, assuming completion in 2009.

Specific construction timing is the responsibility of the contractor but the conditions of funding require completion by 2009. It is intended that detailed design of the alignment commences by November 2006 and that the RTA would be in a position to invite construction tenders by early 2007. The construction period is anticipated to be approximately 24 months with the completion date set for the end of 2009.

4.1.2 Delivery

The description of the Proposal is based on the current, well advanced, concept design. The next stage in design, known as detailed design, involves further refinement taking into account such aspects as issues arising from the Environmental Assessment and approvals process and information obtained during detailed geotechnical investigations.

The detailed design and construction of the Proposal will be delivered through an Alliance as opposed to other project delivery methods, such as Design and Construct. Alliances are an innovative form of project delivery which encourages the pursuit of opportunities for improved project performance that would not otherwise have been explored.

4.1.3 Existing and Forecast Traffic

The RTA has monitored traffic flows on the Hume Highway in the vicinity of Kyeamba Hill since 1982. Figures for 2003 show Annual Average Daily Traffic (AADT) levels of 8,378. Heavy vehicles constitute approximately 40% of total traffic volumes, much of which occurs during night time periods.

Legend

- Property Boundaries
- Road Embankment
- Road Cutting
- Design
- 100 Chainage

0 75 150

Meters

Sheet A

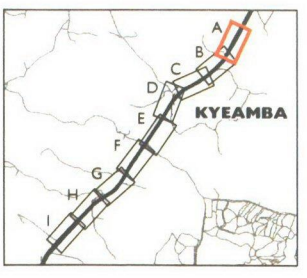

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Figure 4.1a **Horizontal alignment of the proposal**

Figure 4.1b **Horizontal alignment of the proposal**

Legend

Property Boundaries
Road Embankment
Road Cutting
Design
100 Chainage

0 75 150
Meters

Sheet C

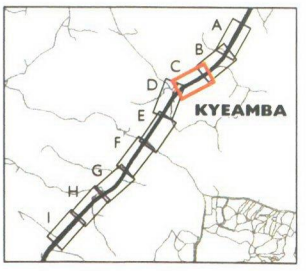

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Figure 4.1c **Horizontal alignment of the proposal**

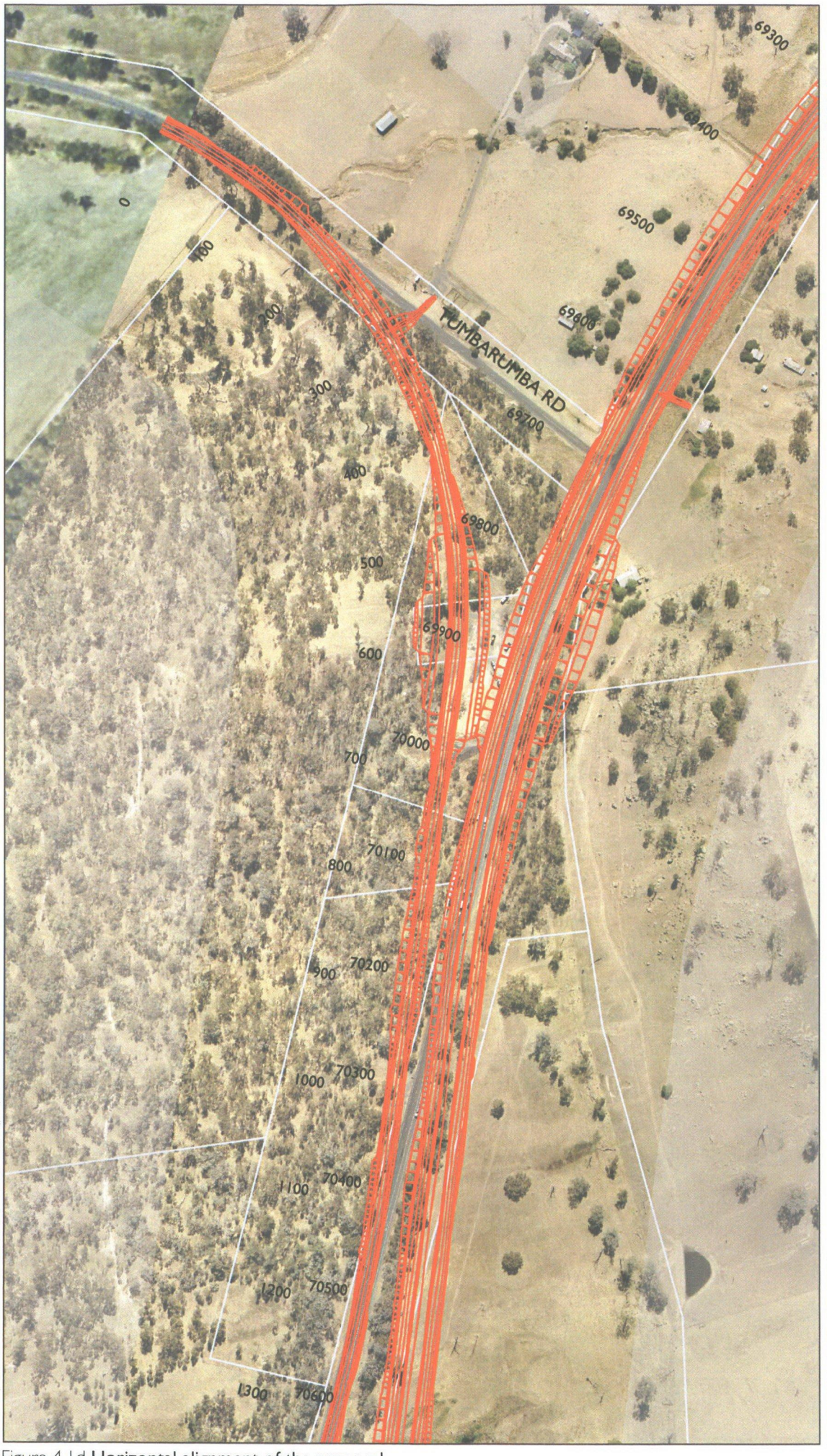


Figure 4.1d **Horizontal alignment of the proposal**

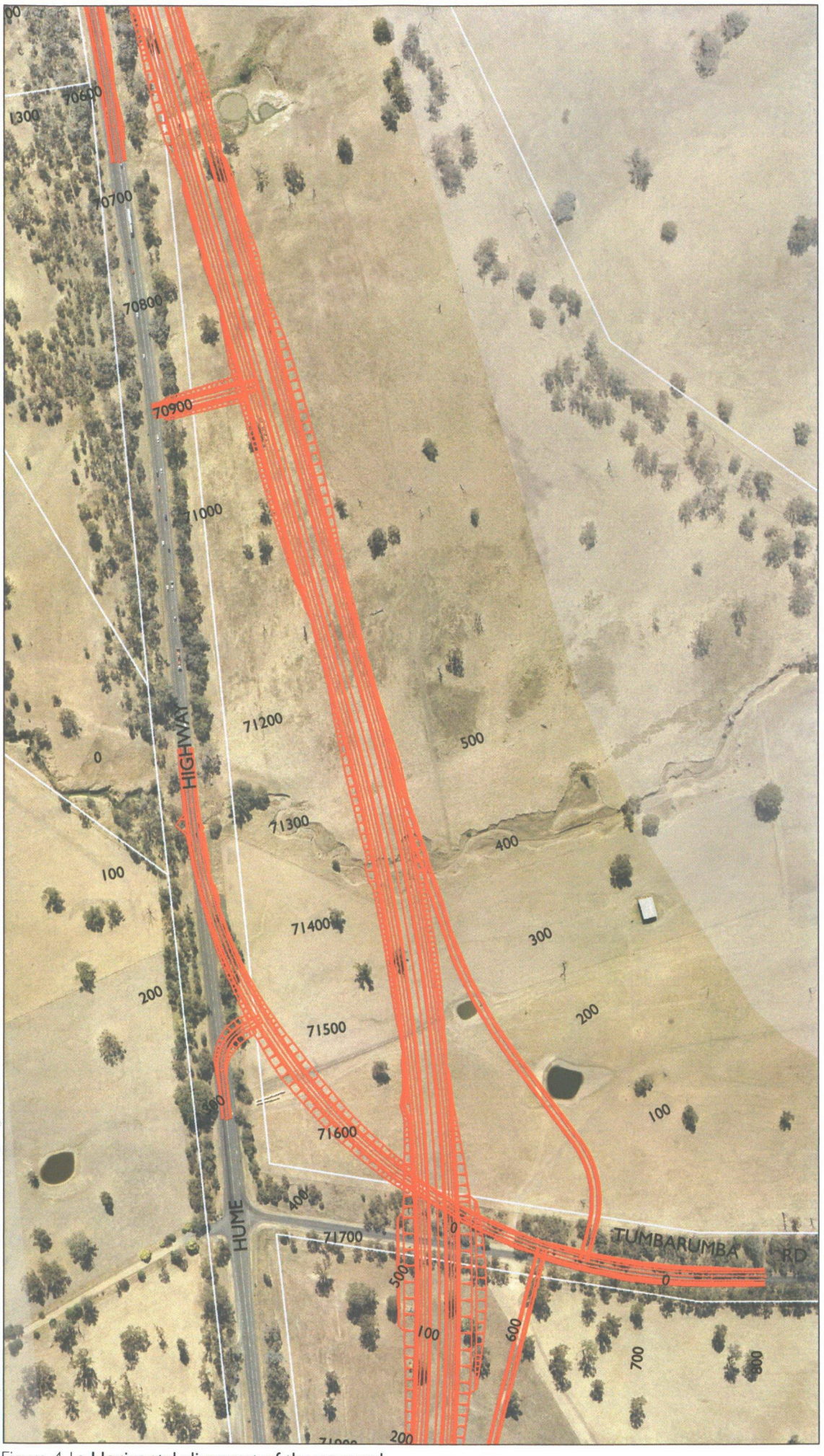


Figure 4.1e **Horizontal alignment of the proposal**

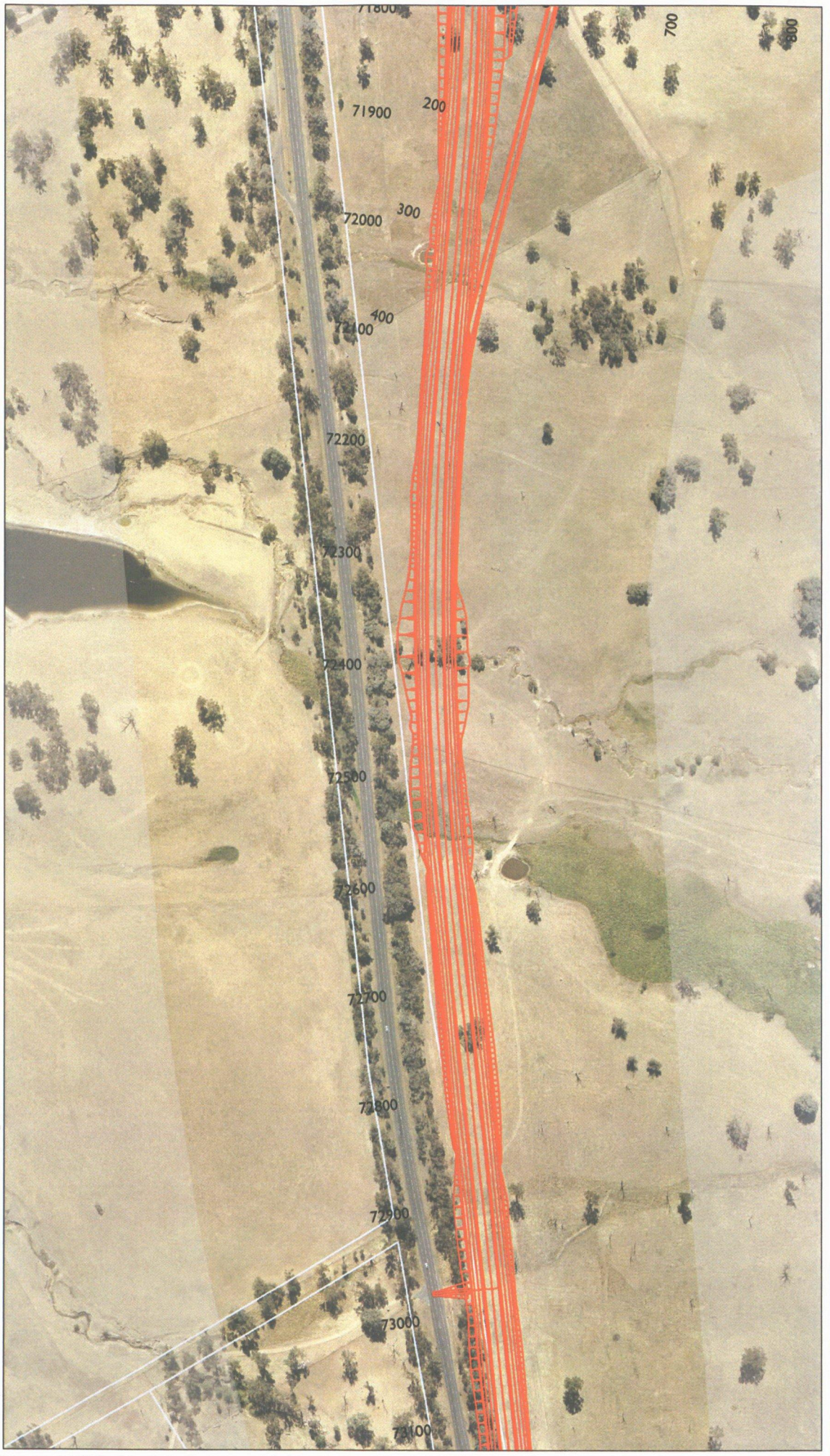
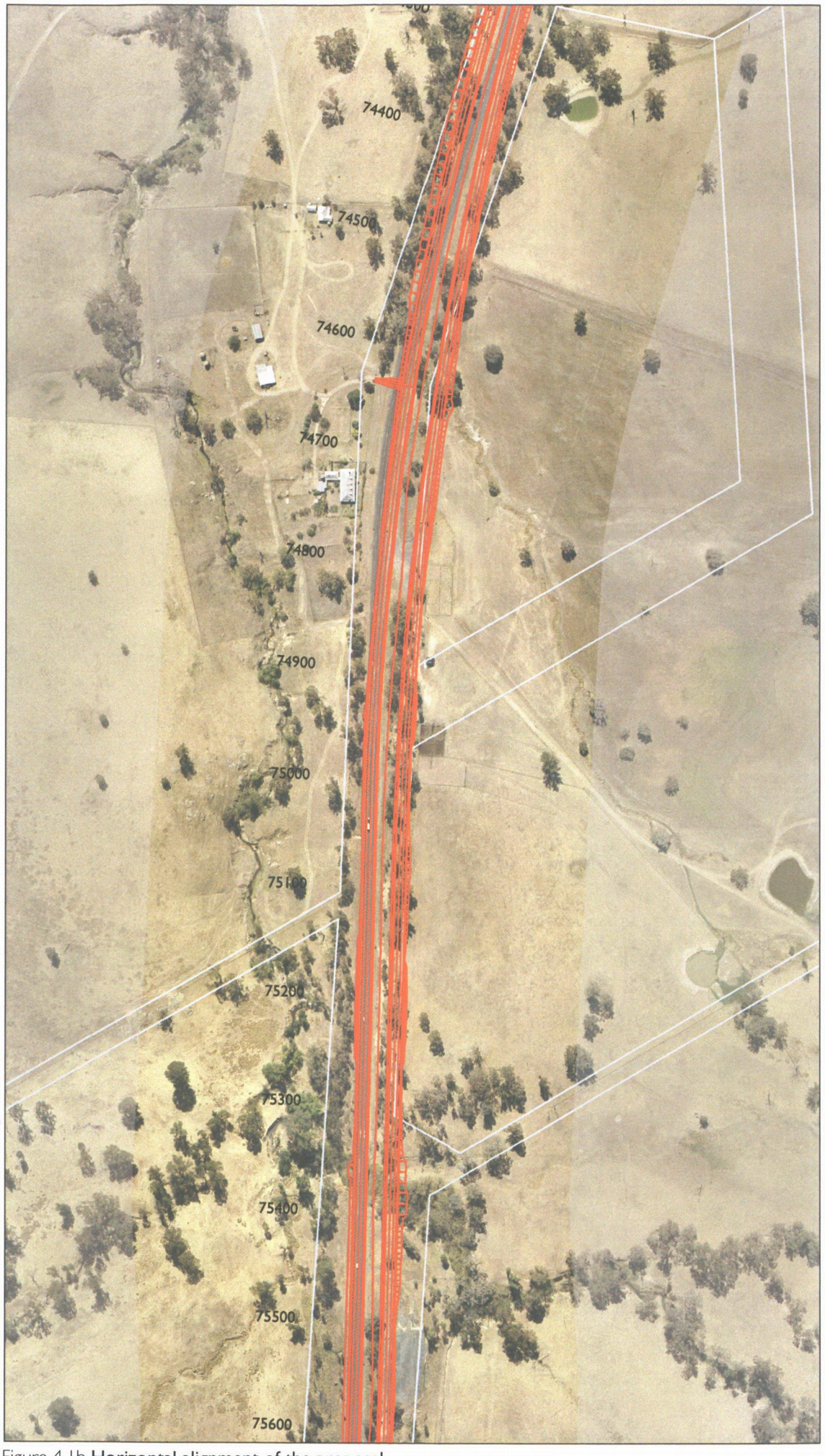


Figure 4.1f **Horizontal alignment of the proposal**

Figure 4.1g **Horizontal alignment of the proposal**



Legend

Property Boundaries

Road Embankment

Road Cutting

Design

100 Chainage

0 75 150

Meters

Sheet H

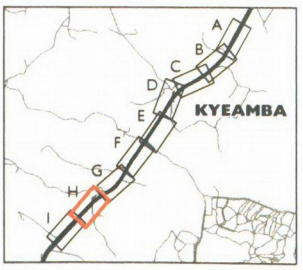


Figure 4.1h **Horizontal alignment of the proposal**

Legend

Property Boundaries

Road Embankment

Road Cutting

Design

100 Chainage

0 75 150

Meters

Sheet 1

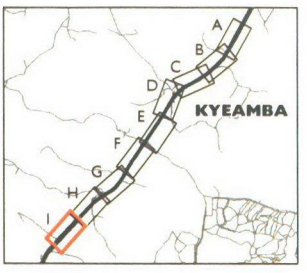


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Figure 4.1i **Horizontal alignment of the proposal**

4.2 Design decisions

Concept designs for the proposal have predominantly focused on the existing alignment linking to the existing dual carriageways at either end. They have included combinations of two new carriageways using the existing highway as one carriageway over part of the length. Greenfield options were rejected due to higher costs and property severance.

The location and form of the intersection of Tumbarumba Road with the highway was also investigated. Options have included at-grade intersections, grade separation of the Tumbarumba Road through-traffic with an at grade connection to the Hume Highway and a full grade separated interchange.

The preferred alignment adopts the existing route in the north and south but deviates from the highway to provide a full grade separated interchange on Tumbarumba Road.

As part of the options development phase for the proposal, design principles were developed which aimed to provide an overarching framework and direction for the concept design. **Table 4-1** details how the preferred option responds to the design principles established for the proposal.

Table 4-1 Response to design principles

Design Principle	Preferred Option Response
Compliance with RTA Road Design and AUSTROADS Design Guidelines	▪ Distances between crossovers and left in-left out turns maintained to achieve safe lines of site and avoid unsafe alignment curves. ▪ MR 384 radii above minimum and suitable for 100 km/h posting.
Balanced earthworks	▪ Deficit of 100,000 m^3 could be overcome using existing quarry adjacent to MR 384 east. ▪ Northern section alignment width reduced by narrow median, carriageway height offset and steepened cuts to reduce earthworks. ▪ MR 384 overpass at ground level with the highway cut through the ridge.
Minimise impacts to Aboriginal heritage items and respect values. This needs verification following receipt of Aboriginal heritage assessment.	▪ Impact on scarred trees possibly in the road corridor along the northern section reduced by use of narrow median, carriageway height offset and steepened cuts. ▪ Impact on scarred trees possibly in the road corridor along the middle section avoided by locating the highway to the east and retaining MR 384 on its existing alignment. ▪ Known scarred tree at intersection with MR 384 east avoided by improved design.
Minimise impacts to non-Aboriginal heritage items and respect values.	▪ Option to pass through the curtilage of historic Kyeamba Station west of highway abandoned. ▪ Preferred option moves the highway away from historic Travellers Joy Inn. ▪ Layout of the interchange has been designed to avoid impacts on historic Kyeamba Station entrance gates. ▪ Impact on shearing shed opposite MR 384 reduced by height differences between MR 384 and the highway and a narrow median. ▪ Option to extend MR384 to the east along historic road corridor east of the highway abandoned due to length and required rock excavation.

Design Principle	Preferred Option Response
Minimise impacts to threatened species	▪ Option to pass through Box-gum Woodland on Crown land west of the highway abandoned. ▪ Impact on Box-gum woodland in the road corridor along the northern section reduced by narrow median, carriageway height offset and steepened cuts. ▪ Impact on granite outcrop, potential habitat for Pink-tailed Worm Lizard opposite MR384 reduced by height differences between MR384 and the highway and a narrow median.
Minimise impacts to native vegetation	▪ Impact on trees in the road corridor along the middle section avoided by locating the highway to the east and retaining MR384 on the existing alignment. ▪ Potential for revegetation of residual land.
Minimise impacts to direct impact on waterways	▪ Preferred option provides a bridge (less than 34 metres) over Kyeamba Creek replacing the existing multi-cell culvert on the existing highway. ▪ Culverts provided at gully crossings. ▪ Preferred option has a narrow median to avoid impact on tributary of Kyeamba Creek.
Provide safe ingress and egress.	▪ Through-traffic separated from local traffic on MR384. ▪ MR384 interchange provides safe access from the highway. ▪ Stock underpasses between two parts of the adjoining properties provide safe movement for vehicles and stock. ▪ Safe cross over points provided near main entrance for several properties, access for others provided from local road.
Provide safe access for school bus.	▪ Preferred option removes some bus movements for the highway. ▪ Preferred option provides an exit ramp at the interchange, a seagull to re-enter the highway and a bus parking/turnaround area off the highway.
No increase in noise impacts at local residences.	▪ Preferred option moves highway away from Travellers Joy Inn and one other residence. ▪ New carriageways are located on the far side of the existing highway from local residences.
Minimise impacts to private land take.	▪ Options to the east of Kyeamba Hill would have severed large areas of private land. ▪ Option for MR384 to pass through Crown land and Kyeamba Station west of the highway would have severed private land. ▪ Lucerne paddock on the adjoining property avoided. ▪ Options for the MR384 interchange have been moved as far west as possible to reduce impacts on neighbouring property. ▪ Design of preferred option amended to avoid spring fed dam on one property and dams at the interchange relocated.
No increase in flooding impacts.	▪ Waterway crossings to be same or improved from current crossings.
Minimise construction costs while achieving other design objectives.	▪ Much of the existing highway retained in service as MR384. ▪ Full interchange avoided by addition of slip lane and seagull for northbound traffic. ▪ Option to extend MR384 along historic road corridor abandoned due to length and necessity for large amounts of rock excavation.

4.3 Design parameters

4.3.1 Road design criteria

The proposal has been designed to comply with current National Highway design standards and RTA design requirements. The design criteria are outlined in **Table 4-2**. Details of the typical cross sections for the duplication are shown in **Figure 4-2**.

Table 4-2 Key design criteria

Criteria	Proposal Standard
Design Speed	▪ 130 km/h Horizontal Alignment ▪ 100 km/h Vertical Alignment
Sight Distance	▪ 110 km/h Stopping Sight Distance – Desirable (2.5 second reaction time) ▪ 100 km/h Stopping Sight Distance – Minimum (2.5 second reaction time)
Horizontal Alignment	▪ 130km/h Horizontal Alignment Stopping Distance (2.5 second reaction time)
Grade	▪ Desirable maximum 4.5 per cent ▪ Grade maximum 6 per cent
Cross Section	Lane Width ▪ The basic configuration would be dual carriageways, each with two 3.5 metre travel lanes in accordance with National Highway standards. Shoulder Configuration ▪ The outside shoulder beyond the edge of the 3.5 metre travel lane would consist of a 2.5 metre shoulder and a 1.0 metre verge. ▪ Where there is a guard fence on the outside the arrangement would be 2 x 3.5 metre carriageway, 2.5 metre shoulder, 1.0 metre dish curb and a 1.0m verge encompassing the guard fence. ▪ The inside shoulder would consist of a 1.0 metre road edge and a 0.5 metre verge adjacent to the median area. Median Width ▪ Generally provide a desirable 12-23 metre depressed median with landscaping. Consideration to be given to the provision of Wire Rope Safety Barrier at critical locations. ▪ Adopt a five metre median with Wire Rope Safety Barriers and landscaping at locations where design dictates a major cost saving (e.g. chainage 73,500). All median breaks of crossovers with at grade intersections should accommodate articulated vehicle of 25 metres.
Embankments / cuttings	▪ Ratio of 2:1 (opportunities to increase batter/cutting grades would be investigated during geotechnical investigation)
Corridor Widths	▪ Nominally, to provide six metre width from tops of cuts and toes of fills to Controlled Access Boundary
Property Access	▪ Access control would apply on all sections of work when new boundaries are being established. On these sections, the number of access points would be kept to a minimum.
Bridges	▪ Width – as per the *RTA Road Design Guide* ▪ Load – as per *Austroads Bridge Design Guide*
Environmental Management	▪ The proposal should be designed and constructed having minimum practicable impact to the natural and built environment

4.4 Other key design features

4.4.1 Tumbarumba Road/Hume Highway intersection

The design of the proposal includes a grade-separated interchange within the central section of the alignment to provide improved access and safety for traffic using the highway and Tumbarumba Road. The design of this interchange necessitates a deviation of the highway alignment to the east for approximately 200 metres from the current corridor. This would allow through-traffic on both Tumbarumba Road and the highway to be separated in accordance with the safety objectives of the Hume Highway upgrade program. Tumbarumba Road would be designed for a sign posted speed of 100 km/h and include an overpass of the new highway alignment and long radius curves approaching from the west.

Access for northbound traffic to Wagga Wagga from the highway to Tumbarumba road would be via a deceleration lane under the overpass with an exit north of the interchange at chainage 71,100. This interchange would also provide for northbound traffic from Wagga Wagga to enter the highway and travel to the north or south. A cross-over would be provided at this point for traffic continuing along Tumbarumba Road. An exit ramp at the interchange would be provided for southbound traffic requiring access to Tumbarumba Road. A ramp would also be provided at the interchange for southbound traffic from Tumbarumba Road to access the highway and travel north. Local access off Tumbarumba Road just west of the interchange would be provided for Kyeamba Station and the property to the east of the highway at chainage 72,000. A detail of the proposed interchange layout design is shown in **Figure 4-3**

4.4.2 Bridges

A multi-celled box culvert crossing is currently located along the highway alignment at Kyeamba Creek (chainage 75,400). In accordance with current road design standards, the proposal would include the replacement of this culvert with a bridge to serve as the creek crossing for the northbound carriageway of the new alignment. This bridge would also incorporate a stock underpass. In addition, a separate bridge would be provided for the southbound carriageway crossing Kyeamba Creek.

The general characteristics of the proposed bridges and accompanying works are as follows:

Both bridges would be near identical in terms of construction and design. They would be approximately 34 metres long and 10.5 metres wide and constructed from pre-cast concrete planks and pier sections. The bridges would be a single span, with piers positioned so as to not impede water flow within the waterways. The stock underpass incorporated into the design would include exclusion fencing and raised walkway platforms to separate stock from the adjacent waterway.

It is not anticipated that substantial rock armouring of banks or pier columns would be required as the flow velocities of these waterways are anticipated to be relatively low.

4.4.3 Corridor requirements

The principal corridor criterion is to provide for a six metre width from the top of cuts to the toe of fills to the Controlled Access Road Boundary. This typically results in an average highway corridor design width of 50 metres. However, the design has taken into account constraints adjacent to the corridor and opportunities to reduce impacts on the surrounding environment. This has resulted in a variable corridor width along the alignment.

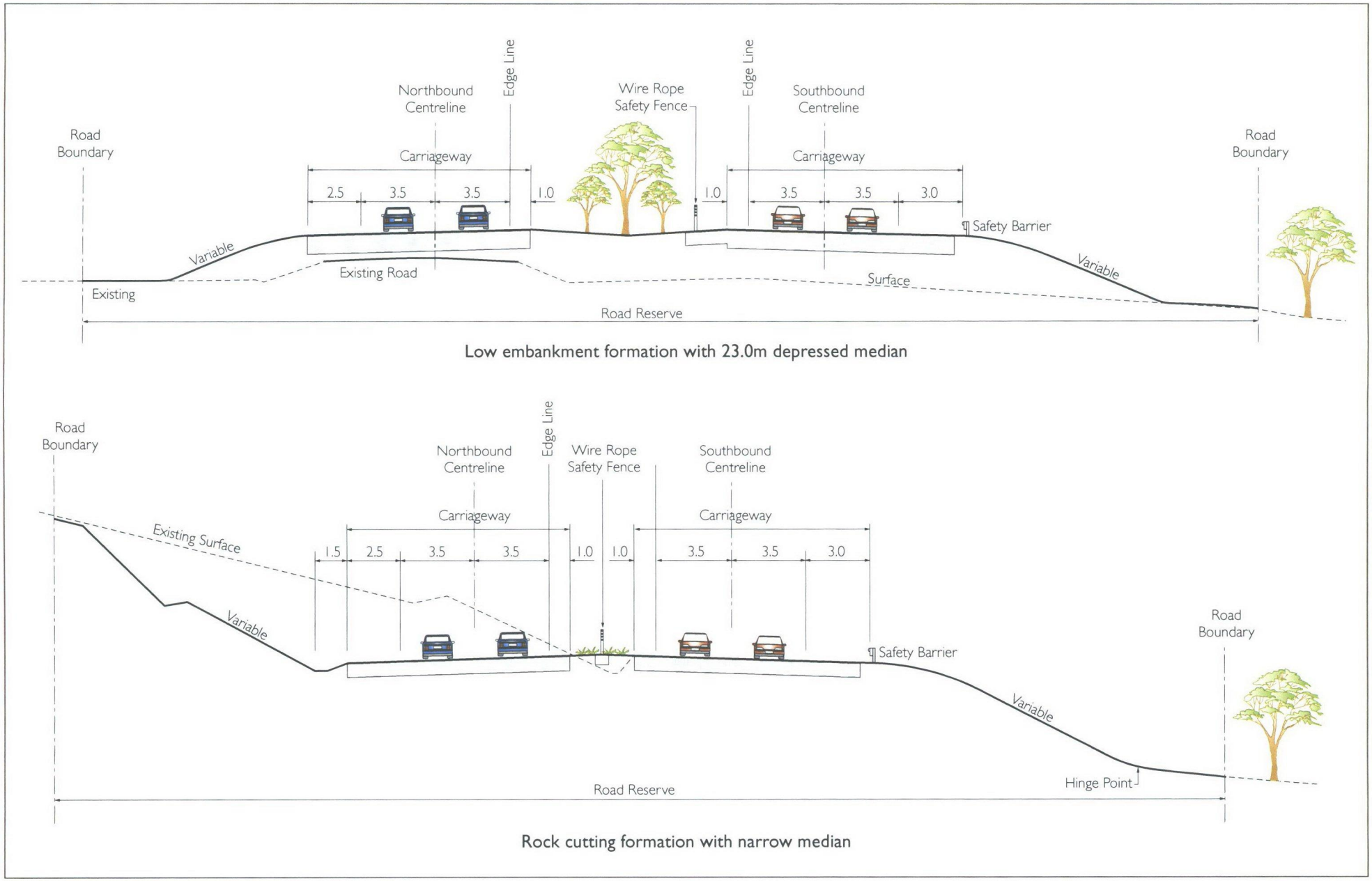


Figure 4.2 **Typical Cross-sections**

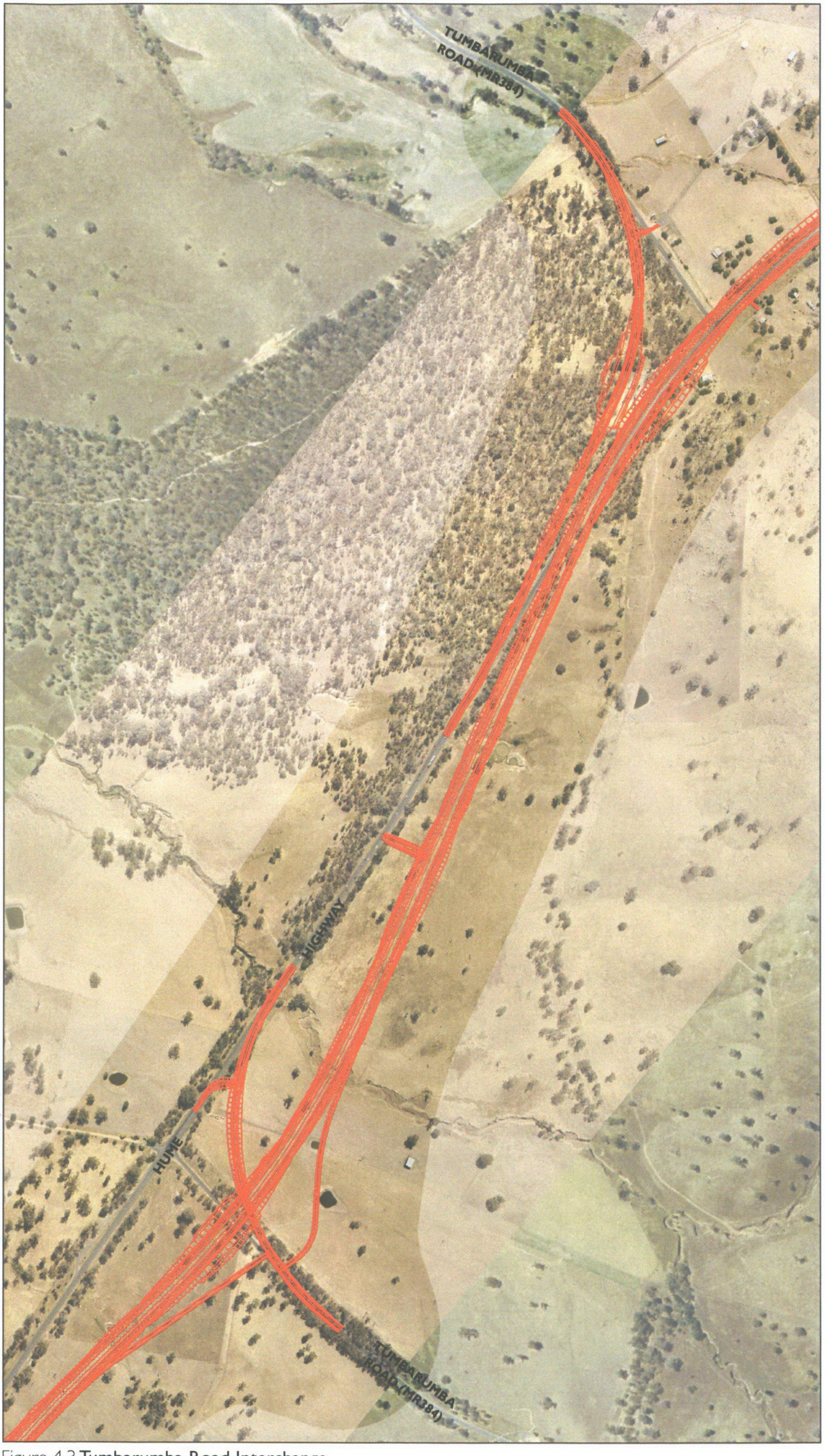


Figure 4.3 **Tumbarumba Road Interchange**

4.4.4 Drainage

Concrete dish drains would be the principal system for collecting surface water from the road pavement within areas of cutting. These drains would run parallel to the road and discharge into watercourses or to land via structures such as grass swales. Where the road alignment would be constructed on fill it is proposed to design the road pavement to direct runoff to the grass verge table drains adjacent to the shoulder lanes. The specific treatment to be adopted within the corridor would be identified during the detailed design.

In terms of cross drainage, the new highway carriageway would cross Kyeamba Creek at two locations and single span bridges would be required for these crossings, as indicated in Section 4.3.3. Numerous drainage channels, tributaries of Kyeamba Creek and other small gullies are located within the proposal area. Drainage for areas of new carriageway that run parallel to the existing road formation would be expected to mimic these existing structures so that current drainage patterns are maintained. New sections of carriageway would incorporate multi-celled box culverts and / or pipe cross drains where appropriate for the waterway to be traversed.

4.4.5 Traffic and access arrangements

Controlled access would apply to all sections of the highway alignment when new boundaries are being established, in accordance with National Highway standards. The guiding principle of keeping the number of access points to a minimum would be applied, while providing suitable access to all properties.

The main alterations to road traffic access would occur at the intersection of Tumbarumba Road. As a result of the reconfiguration of this intersection a number of changes to the local road network and existing access arrangements, would be required.

Specifically, the following alterations would be expected:

- The highway alignment at the intersection would be relocated some 300 metres further east outside of the current highway corridor.
- Part of the existing highway corridor would be utilised for part of the new Tumbarumba Road, to be constructed as a means of separating the two traffic routes.
- Tumbarumba Road would consist of a continuous road formation which would be grade separated from the highway at the intersection, via a bridge overpass.
- The existing highway formation made redundant by the new highway relocation would be made available as a local access road, providing access to properties for approximately one kilometre south of the intersection, with connection to the re-aligned Tumbarumba Road.
- Access to the highway for northbound traffic from Tumbarumba Road would be limited to left in and left out movements.
- An additional access point to and from Tumbarumba Road to the highway northbound carriageway would be provided at chainage 71000 including the provision of deceleration and acceleration lanes for highway traffic.

Private accesses to properties are located along the existing highway, predominantly within the southern part of the proposal. Of a total of eight property owners that currently have access to the highway approximately four of these would require alteration to access as part of the proposal. Access points for two properties in the northern section between chainage 66,000 and 69,000 would require adjustment to provide safer and more appropriate locations. In particular, access to the pine forest at approximately 67,500 would need to be designed to cater for B-double log truck movements. Access for two other properties at

approximate chainage 74,000 would be limited to left in left out due to the narrow median width at this location and associated road safety concerns.

Median crossover points would be provided at strategic locations along the alignment to allow access for those properties that would have access limited to left-in and left-out movements. These crossovers would be provided within one kilometre where current access has been restricted. Temporary access to these properties would be made available during the construction period. Provision to store a minimum length of articulated vehicle 25 metres long between property gate and traffic lane edge line would be provided at some property accesses to cater for log and stock trucks.

Tumbarumba Road (west) is currently used to provide an informal school bus drop off point near the existing intersection with the highway. There is currently poor visibility for bus movements across the highway. A new bus turnaround bay would be provided from the new Tumbarumba Road at chainage 71100 to allow school buses to stop clear of through-traffic. New bus shelters with seating would also be provided at the bus turnaround bay.

Underpasses would be provided to allow stock access between properties that straddle the existing and proposed highway. One underpass would be located between the redundant sections of the existing highway, adjacent to the existing TSR at chainage 73,300, north of the MR 384 overbridge. The second would be constructed as an integral component of the Kyeamba Creek Bridge crossing at chainage 75,400, as discussed in Section 4.3.3. The dimensions of stock underpasses would be determined during the detailed design phase, and would be sized to facilitate stock and related landholder needs.

A new multi-celled box culvert would be required for the realigned section of the existing highway that would become part of the Tumbarumba Road interchange. For each crossing, detailed information regarding the shape of the channel would be sought to determine culvert and pipe sizes and select structures that fit into the available area. This information would be sought during the detailed design stage.

4.4.6 Utilities

Some public utility services would be affected by the proposal. A fibre optic cable is located parallel to the highway on the eastern side for the full length of the proposal alignment. The new highway alignment would intersect this cable in a number of places, e.g. at Tumbarumba Road, and this cable would require relocation. However, the cable can only splice between nodes and clear of the alignment. It would therefore be necessary to relocate up to 10 kilometres of this cable as part of the proposal, in addition to smaller sections of cable spurs across the proposal area.

In addition, a domestic powerline is located adjacent to the highway on its western side from the northern extent of the proposal to the intersection with Tumbarumba Road (west,) this would need to be relocated. Underground Telstra utilities have also been identified close to the alignment, and two sections, each with an approximate length of two kilometres, would need to be relocated. The exact location these utilities would be determined during the detailed design stage. Approval from the relevant utility authorities and organisations would be sought for these relocations prior to the commencement of work.

4.4.7 Property acquisitions

In order to duplicate the highway, it would be necessary to acquire parts of some properties. Properties affected by the proposal and the details of the land areas where partial acquisition would be required are itemised in Table 4-3. Note these details are

approximate and are subject to change during the detailed design and following further negotiation with property owners.

Table 4-3 Property acquisition program

Property Ref. No.	Property Description	Land Acquisition (approximate)
KH 1	Lot 20, DP757237.	5.4 ha – private ownership
KH 2	Lots 31, 39, 74, 91 and 127, DP 757237.	2.4 ha – private ownership
KH 3	Lots 14, 51 and 65, DP757237.	0.6 ha – private ownership
KH 4	Lot 7001, DP 1027984. Lots 26, 27, 30 and 58, DP757238. Lot 1, DP 669165 public reserve.	3.6 ha – Dept. of Lands
KH 5	Lot 1 DP 669165, Lots 28, 41, 42, 48, 63 and 66 DP 757243, Lot 1, DP 367583 and Lot 11, DP 1021587	34.5 ha – private ownership
KH 6	Lot 1, 6, 22 and 43, DP 757238. Lot 1, DP 115695. Lot 9, DP 757243. Lots 9 and 10, DP 261932.	3.6 ha – private ownership

All property acquisitions would be conducted in accordance with the RTA's *Land Acquisition Policy*, and compensation in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Negotiations for property acquisition would include consultation on property adjustments where required to maintain farm management practices and provide continuous access to the road network.

4.4.8 Urban and landscape design

The urban and landscape design strategy for the Hume Highway Duplication has sought to "*....reflect the Highway's role as a national landmark route and a primary movement corridor between NSW and Victoria, sensitively located and formed in response to the intrinsic natural, historic and cultural qualities and features of the region*" (RTA 2006).

The urban and landscape design principles for the proposal are as follows:

- Provide a flowing highway alignment that is responsive to, and best fits with, the landscape.
- Provide a well-vegetated, natural road corridor which protects and enhances the natural systems and ecology of the corridor.
- Provide an enjoyable and memorable motoring experience which engages with the landscape of southern NSW, makes best use of views and vistas.
- Respect and respond to the communities along the corridor, and the historically and culturally significant aspects of the corridor.
- Achieve a simple palette of highway details, elements and components consistent throughout the whole corridor, which meet safety requirements and minimise ongoing maintenance costs.

During the development of the concept design the above design principles have been integrated into the engineering and environmental design.

The overarching landscape design objective for the proposal is to integrate the upgraded highway into the existing landscape. Related design objectives also aim to achieve optimal safety for all users of the roadway and to minimise amenity and land use impacts on adjacent lands.

The duplication of the Hume Highway at Kyeamba Hill is predominantly the duplication of an existing road within a rural setting. Construction activities would have no impact on any populations of significant size or built up areas. Therefore, the focus of the landscape design would be upon the interface between the rural landscape and the road corridor.

The landscape strategy for the proposal would aim to provide agricultural roadside landscapes that are complementary to the existing environment. While the retention of remnant vegetation, where possible within the road corridor and revegetation of some areas would be included within the strategy, it is aimed to balance this with the need to protect the prominent road vistas that are characteristic of the Hume Highway corridor. A mixture of sections of the road enclosed by remnant woodland and more expansive views of the surrounding rural landscape and more distant hills would be incorporated in the design.

Landscape works would be implemented as each stage of construction is completed in order to assist in soil conservation and erosion control, and to create an appropriate level of visual amenity within the road corridor. Opportunities for landscaping would be available within the median areas and batter embankments not constrained by rocky material. The landscape design would incorporate the use of locally occurring native species as appropriate. Landscaping would be used in the vicinity of houses that are close to the upgraded highway to reduce the extent of visual intrusion.

4.5 Construction activities

The following provides an indicative overview of the likely elements of the Proposal and the sequence in which they are expected to occur.

Pre-construction activities

- land acquisition;
- relocation of affected utilities prior to establishment on site, where possible;
- notification of residents of commencement of works; and
- survey set-out identifying construction footprint.

Establishment of site for construction

- establishment of compound site (including office accommodation and facilities);
- installation of environmental controls, and clear delineation of sensitive areas;
- clearing/grubbing/slashing of construction footprint area;
- fencing off area for construction and construction truck movements (including permanent controlled access boundary fencing); and
- fencing off areas to be used for stockpile sites.

Construction activities

- earthworks (excavation of cuttings, relocation of fill material, installation of noise mound structures);
- installation of permanent drainage (eg box and pipe culverts);
- relocation of utilities;
- pavement works
- conversion of construction stormwater basins into permanent basins;
- installation of permanent signage, safety barriers and line marking;
- landscaping of surrounding areas;
- site clean up; and
- open to traffic.

4.5.1 Earthworks

The proposal alignment has been designed to achieve a balance of cut and fill as far as practicable. Extensive geotechnical investigations are to be undertaken during the detailed designed stage in order to refine earthworks volumes. There are minor cuts and fills required along the entire length of the proposal. Major cuts would be required at two locations where the rock stratum is composed of hard granite:

- Near Kilgowla Mountain at the northern end of the proposal at chainage 67,500.
- Opposite Tumbarumba Road (west) at chainage 69,800 where a granite outcrop constricts the road corridor.

It is anticipated that blasting of the granite rock would be required during the construction of the cuttings at both these locations. The amount of rock to be blasted is estimated to be around 50,000 m^3 in total for the proposal. In addition, a major cutting is required at the intersection with Tumbarumba Road at chainage 71,600, where it is proposed to construct the highway alignment to allow the Tumbarumba Road to traverse the highway via an overpass.

In total it is anticipated that there would be approximately 550,000 m^3 of cut material generated during construction and approximately 650,000m^3 of fill material required as part of the road formation. The majority of the material excavated for the cuttings would generally be suitable for use as fill for the embankments and in particular construction of the overpass. However, the design is still expected to result in a shortfall of fill, currently estimated at approximately 100,000 m^3 (approximately 170,000 tonnes). This fill would be imported from suitable sites as close to the road corridor as is practicable.

4.5.2 Materials and quantities

The construction of the proposal would require a number of different materials. These materials and the estimated quantities are as follows:

- Cut/Fill - 308,782 m^3.
- Select Material Imported - 9,353 m^3.
- Imported Fill – 100, 000 - 130,103 m^3.
- Drainage Blankets - 15,431 m^2.
- Sub Base - 5,445 m^3.
- Base - 3,267 m^3.
- Concrete Sub Base - 35,389 m^3.
- Concrete Base - 57,787 m^3.
- Sealing - 468,964 m^2.
- Water (~108 ML).

4.5.3 Vegetation clearing

The Proposal would require the removal of native Eucalypt woodland communities. Specifically the proposal footprint would require the removal of the following amounts of vegetation community:

- White Box – Yellow Box – Blakely's Red Gum Woodland (Box-Gum Woodland) 11.83 hectares.
- Mugga Ironbark – Red Stringybark Woodland 3.7 hectares.

The remainder of the Proposal footprint is comprised of other vegetation including native and exotic pasture grasses.

4.5.4 Working hours

The following working hours would be adopted for the proposal:

Day	Start Time	Finish Time
Monday – Friday	7am	7pm
Saturday	7am	4pm
Sunday and Public Holidays	No work	

The extended hours for Saturdays is due to the Proposal being located within a rural environment (i.e. limited number of noise sensitive receivers). Where work would required outside of these hours, best management practices would be followed as described in the RTA *Environmental Noise Management Manual* (RTA 2001).

4.5.5 Traffic management during construction

Management strategies would be adopted to facilitate the safe passage of construction and through traffic within the Proposal site. These measures may include providing for traffic utilisation of temporary carriageways, and temporary reductions in speed limits through worksites. Control measures to manage traffic as a minimum would be consistent with the RTA Traffic Control at Work Sites (RTA 2003).

4.5.6 Construction compounds and work sites

Compound sites

A number of sites have been identified as suitable for a stockpile and/or compound sites. The location of these sites would depend on the final design and staging of the proposal and would be determined during detailed design.

Construction work sites would be required for personnel, materials and plant. At least one major site would be required at each end of each section of the duplication as well as a number of minor depot sites adjacent to structures such as the bridges and the Tumbarumba Road interchange. A major work site may require an area of at least 100 metres by 100 metres. Potential work sites would generally include:

- Residual land already owned by the RTA from previous construction works.
- Cleared areas within parts of properties acquired by the RTA from local landowners and the Department of Lands.
- Available land within the road reserve.

Work sites would accommodate portable offices, vehicle parking areas and machinery and plant storage areas. Available sites would be assessed in terms of their location on the basis of best-practice industry standards for environmental and construction criteria, examples of which are:

- Located more than 100 metres from waterways.
- Located within areas of low ecological and heritage conservation significance.
- No substantial clearing of native vegetation required or located where future clearing is required for future works.
- At least 200 metres (or at least 250 metres for a temporary batch plant) distance from dwellings or other activities that may be affected by noise or other plant impacts.
- Easy and safe access to the main road network.
- Relatively level ground elevated to assist drainage and allow treatment of runoff.
- Be located above the 20 year average recurrence interval (ARI) flood level unless a contingency plan to manage flooding is prepared and implemented.

Potential compound sites currently identified within the Kyeamba Hill proposal are:

- Site 1: Adjacent to the existing highway on the eastern side at chainage 75500, approximately 3.5 kilometres south of the Tumbarumba Road (east). There is an existing paved area that would be suitable for a fenced compound site.
- Site 2: Located between the existing highway and the proposed highway alignment on the eastern side at chainage 71000, where residual land would remain following proposed land acquisition.

Vegetation would need to be cleared at both these locations to cater for the compounds. A rock crusher may be required at the compound where excavated material would be crushed ready for re-use in the pavement construction. As a result, the site would cater for trucks entering and exiting from the construction lanes to offload spoil and pickup crushed material.

Stockpile sites

Several stockpile locations may be required along the proposal due to its length. Concrete batch plant sites would also need to be established at approved locations along the route. These would be used to store, prepare and distribute concrete and stockpile aggregate for road construction.

The location of these stockpiles would be finalised during detailed design. Some possible locations are within the existing highway corridor, on cleared Crown Land, or by arrangement with local landowners. As construction progresses it may be possible to use sections of the old road formation for aggregate stockpiles before the formation is rehabilitated.

Some possible locations identified are:

- Land owned by the RTA comprising the current stockpile and old truck depot adjacent to the intersection of Tumbarumba Road and the highway at chainage 71000.
- Upon residual land between the existing highway and the proposed alignment to the east in the vicinity of Tumbarumba Road (east).

Topsoil would require stockpiling before placement on medians, embankment slopes and shallow cut batters. Additional fill material imported from other sources may also require storage where there is a deficit of material from within an individual section of the duplication. The contractor would be required to protect stockpiles to prevent erosion and sedimentation.

Associated Construction Facilities

One batch plant would be required for the proposal, producing concrete or asphalt depending on the pavement type chosen. Batch plants require an area of approximately 100 metres by 100 metres. These could be located within either of the major depot sites towards each end of the proposal section.

During the earthworks phase of the construction period there would be a requirement for large quantities of fill material to be imported from offsite locations. At current estimates this fill importation is in the order of 100,000m^3, which would have to be brought in by truck from its sources.

A potential source of this fill material would be an existing quarry site located within the vicinity of Tumbarumba Road (east), approximately three kilometres east from the proposal site. This quarry site 'Sykes Pit Quarry' is located off Humula Eight Mile Road, and currently supplies schist rock material for the regional road maintenance requirements.

5 Stakeholder Consultation

The RTA has identified and engaged individuals, agencies, community groups and other stakeholders during investigation, design and Environmental Assessment of the Proposal. Exhibition of the Environmental Assessment will present an opportunity for stakeholders and the community to input ideas, raise issues and provide feedback. The approach to consultation drew from guidelines contained in the RTA *Community Involvement Practice Notes and Resource Manual* (RTA 1998).

The principle objective of the consultation is to keep stakeholders informed and involve them in the Proposal during each stage of its development. This entailed the following general activities:

- Preparing and distributing information about the Proposal and aspects of the assessment studies.
- Providing a range of opportunities for the two-way exchange of information where the RTA could provide information and answer questions.
- Providing stakeholders with the opportunity to convey issues through meetings, site visits and attendance at the Planning Focus Meeting (PFM).
- Addressing community concerns and issues in the Environmental Assessment.

5.1 Consultation during Proposal development

Consultation activities undertaken during Proposal development are provided in **Table 5-1**. Table 5.1 outlines activities undertaken with Government agencies, community groups, landowners, and other stakeholders, and the outcomes of consultation activities.

Table 5-1 Proposal development consultation activities

Date	Activity	Outcome
May 2006	Establishment of Hume Highway Office in Wagga Wagga	Dedicated office with local presence to enable effective consultation with local stakeholders and establishment of relationships.
July 2006	Distribution of Hume Highway duplication package community update. This update was distributed to residents and businesses in the Hume Highway Duplication postcode areas including: ▪ Gerogery 2642. ▪ Holbrook 2644. ▪ Woomargama 2644. ▪ Humula 2652. ▪ Bowna 2644. ▪ Mullengandra 2644. ▪ Table Top 2640. ▪ Tarcutta 2652. ▪ Carabost 2650. ▪ Kyeamba 2650. The update was also circulated to elected representatives, councils, libraries, media outlets and prominent points of distribution.	Local community informed about Proposal and whom to ring should they have any questions.
July 2006	Project contact details (telephone, email,	Community able to make enquiries

Date	Activity	Outcome
	fax and phone number) established and included in publicly distributed material. A Project internet page was also established through the RTA website.	directly to the RTA Wagga Wagga office.
Ongoing	General enquiries received by the RTA.	General enquiries responded to by the RTA Hume Highway Office.
18 August 2006	Project briefing with the NSW Department of Environment and Conservation to discuss Aboriginal heritage processes and consultation.	Dialogue with agencies started regarding Aboriginal heritage.
23 August 2006	Planning Focus Meeting attended by NSW Department of Planning, NSW Department of Environment and Conservation, NSW Department of Natural Resources, NSW Department of Primary Industries, Greater Hume Shire Council and Wagga Wagga City Council.	Identification of government agency items to be addressed in the Environmental Assessment provided by the Director Generals Requirements (DGR's). DGR's are provided in **Appendix B**.
September 2006	Stakeholder briefing with Hume Highway Action Group. The action group includes representatives of road user groups, local Councils and State and federal elected representatives.	Provision of information on the Proposal, receipt of stakeholder feedback..
September 2006	Construction industry briefing	Identification of design and delivery issues.
Ongoing	Media releases TV, radio and newspaper interviews.	Raise awareness of Proposal and options for receiving further information.
Ongoing	Discussions with adjacent landowners.	Identification of issues in informing design decisions and managing property impacts.

5.2 Consultation during Environmental Assessment preparation

Consultation with individuals, government agencies, community groups and other stakeholders was undertaken during the preparation of this Environmental Assessment. The objective of this phase of consultation was to identify stakeholder and community issues to be addressed in the Environmental Assessment. Consultation activities undertaken during the preparation of the Environmental Assessment are provided in Table 5-2

Table 5-2 Consultation during Environmental Assessment preparation

Date	Activity	Outcome
8 September 2006	Aboriginal Focus Group meeting with attendance of Department of Environment and Conservation.	Aboriginal registrants informed on background of the Proposal and the heritage assessment process. DEC informed on process.
13 and 14 September 2006	Site visit and environmental risk analysis by Environmental Assessment consultants accompanied by representatives Department of Natural Resources and Department of Environment and Conservation.	Identification of key issues falling within the agencies jurisdiction was identified. Scope and methodology relating to biodiversity assessment was discussed. Hydrology and groundwater issues were also discussed.
19, 20 and 21 September 2006	Project information stand staffed by RTA project managers at Henty Machinery Field Days.	Identification and discussion of issues raised by primary producers and heavy vehicle road users.

Date	Activity	Outcome
27 September 2006	Project briefing of media representatives in Wagga Wagga and Albury.	Raise awareness of Proposal and provide information for dissemination. Feedback provided on traffic impact communications.
28 September 2006	Meeting with the Commonwealth Department of Environment and Heritage	Briefing on Proposal and discussion of potential impact to items listed under Environment Protection and Biodiversity Conservation Act 1999.
6 October 2006	Site inspection and general risk assessment with Department of Primary Industry (Fisheries).	Identification of aquatic issues and potential mitigation and/or compensation measures.
Ongoing	Regular meetings during the preparation of the Environmental Assessment with the Department of Planning, Department of Environment and Conservation	Discussion and agreement of study approach, outcomes and management of issues.
Ongoing	Discussion with landowners adjacent to the highway to describe the context of the Proposal and to identify issues and proposed management techniques.	Identification of environmental issues and impacts of the Proposal.
15 September 2006	Letter sent to individual landholders informing them of the commencement of the Environmental Assessment and request for property access to undertake field work.	Landowners informed of the commencement of the Environmental Assessment.
27 September 2006	Media briefings with Wagga Wagga and Albury media outlets.	Media informed on Proposal.
Ongoing	Aboriginal group consultation	Aboriginal community consulted regarding findings from the site inspection and assessment of the findings.
11 October 2006	Briefing for quarry products industry and transporters.	Potential sources of construction materials identified by RTA.

5.3 Consultation during pre-construction and construction

Stakeholder and community consultation would be undertaken prior to and during the construction phase of Proposal. This would occur through the development and implementation of a Community and Stakeholder Consultation Plan which will be prepared in accordance with the *Community Involvement Practice Notes and Resource Manual* (RTA 1998).

Community involvement activities to keep the community informed prior to and during construction would include:

- Toll free telephone number.
- Community feedback.
- Display centre.
- Community updates.
- Construction advertisements.
- Traffic notices.
- Letterbox notifications.
- Information sheets.
- Project website

6 Statutory Requirements

7 Identification of Environmental Issues

Chapter 7 describes the approach followed in identifying and assessing environmental issues that may arise during construction and operation of the proposal.

7.1 Preliminary Environmental Assessment

A preliminary environmental assessment was undertaken during the preparation of the Project Application report. This study identified a number of key environmental issues based largely on desktop research and local input from environmental staff based in RTA South Western Regional Office. Key environmental issues identified as potentially requiring further, detailed investigations and research, included:

- Biodiversity – including impacts on threatened species, populations or ecological communities, the presence of aquatic ecosystems which may be sensitive to further disturbance, potential habitat for an endangered fish population and the possible presence of vulnerable flora species.
- Aboriginal heritage – including potential for artefact scatter sites, potential for scarred trees where old growth trees are present and cultural significance of landscape including creek lines, ridges and terraces which may be particularly sensitive.
- Non-Aboriginal heritage places and items listed on various planning instruments and registers or unlisted archaeological sites – including known heritage issues related to homesteads, woolsheds, Kyeamba Station structures and the historic Travellers Joy Inn.

These key issues have been investigated in detail as described in Chapter 8. Project specific impact mitigation and management measures are identified in Chapter 8 and in the draft Statement of Commitments in Chapter 10.

7.2 Planning Focus Meeting

A Planning Focus Meeting was convened by the Department of Planning and held on 23 August 2006 at Holbrook. Representatives of the following agencies attended:

- NSW Department of Planning;
- NSW Department of Environment and Conservation;
- NSW Department of Natural Resources;
- NSW Department of Primary Industries;
- Greater Hume Shire Council;
- Wagga Wagga City Council; and
- RTA.

The Planning Focus Meeting covered all five proposals that make up the Hume Highway Duplication from the Sturt Highway to Table Top. The purpose of the meeting was to provide information on the main aspects of the Proposal and enable representatives of each organisation to highlight issues that may require further investigation. The participants at the meeting discussed environmental issues for the Proposal. A summary of the environmental issues raised by each agency is provided in **Table 7-1**.

Table 7-1 Planning Focus Meeting environmental issues

Government Agency	Issue
Department of Planning	▪ Impact on travelling stock routes ▪ Socio-economic impacts of 67 kilometres of concurrent construction ▪ Construction hours

Government Agency	Issue
	▪ Resource requirements
Department of Environment and Conservation	▪ Vegetation clearing and potential impacts on threatened species and cultural heritage ▪ Management of sediment, erosion, dust and noise to be managed ▪ Survey and assessment for Aboriginal Heritage ▪ Consultation with the Aboriginal community and Local Aboriginal Land Council ▪ Survey and assessment of scar trees particularly where vegetation would be cleared ▪ Assessment should include background noise monitoring and consider noise goals ▪ Detailed construction noise assessment required if working outside of normal hours ▪ Consider operational impacts on residences due to changes to road alignment, traffic speeds and road surface
Department of Natural Resources	▪ Source and quantity of construction water ▪ Potential impact of any run-off of salty groundwater, if used ▪ Potential impacts on other groundwater users ▪ If groundwater intercepted during excavations, how would it be managed and disposed ▪ Potential impact on flood regimes, and impact on landholders ▪ Impact of increased run-off from new pavement ▪ Biological and biophysical in-stream impacts of crossings
Department of Primary Industries	▪ Landholder access (including stock access) ▪ Disturbed areas should be progressively rehabilitated ▪ DPI Fisheries standard conditions would apply
Greater Hume Shire Council	▪ Interruptions to utilities should be avoided ▪ Property access ▪ Access to villages and towns ▪ Justification for why some proposed intersections are at grade while others are not
Wagga Wagga City Council	▪ Impact of water use on local users ▪ Construction impacts on local community, particularly adjoining landowners ▪ Construction and traffic flow impacts on the local community ▪ Safety - how to reduce speed through towns as duplicated sections will increase speed up to the town areas ▪ Noise and vibration impacts on heritage items

7.3 Project Application and Environmental Assessment Requirements

The RTA submitted a Project Application, including the preliminary environmental assessment, to the Department of Planning on 12 September 2006 requesting the Director-General's Requirements for the Environmental Assessment. The Project Application was made available to the public on the Department of Planning's website and issued to relevant government agencies. The agencies were given a formal opportunity to consider the Proposal and provide comments to the Department of Planning to inform the development of the Director-General's formal Environmental Assessment Requirements.

The Department of Planning issued the Director-General's Environmental Assessment Requirements under the provisions of Part 3A of the EP&A Act on 9 October 2006. A copy of the requirements is provided in **Appendix A**.

7.4 Environmental Risk Review

Following the Planning Focus Meeting, a site visit and associated environmental risk review session was held on 13 and 14 September 2006. This session was attended by RTA EA consultants, DEC, DNR and representatives of the RTA. While this focussed on a similar set of issues to those identified at the Planning Focus Meeting, these were discussed and considered in more detail.

The environmental risk review for the Proposal followed the general methodology detailed in AS/NZS 4360:2004 *Risk Management* and HB 203:2006 *Environmental risk management – Principles and process*. The level of environmental risk was assessed through a consideration of the significance of the environmental effects of the Proposal and the ability to manage those effects to minimise harm to the environment. The significance of environmental effects reflects the characteristics of the receiving environment, the level of understanding of the type and extent of impacts, and community response to the environmental consequences of the Proposal.

This approach to environmental risk review is qualitative, however it serves as an important step in the planning process and assessment of environmental impacts. In particular, it is used to guide the assessment and project design, and assist decision making with regard to mitigation measures and management responses required. The identified environmental risk framework is summarised in **Table 7-2**.

Table 7-2 Environmental risk analysis framework

Environmental Aspect	Description of potential adverse environmental impacts	Outline of proposed management strategies, likely to be implemented in response to identified potential impacts	Consequence (severity rating)	Likelihood/ Frequency	Level of Risk
Biodiversity	▪ Clearing of Box-gum Woodland ▪ Loss of habitat for threatened species. ▪ Potential longer term impacts associated with increased habitat fragmentation. ▪ Residual impacts resulting from an influence of the proposal on local hydrological conditions	▪ Offset the loss of vegetation and habitat through a combination of measures including rehabilitation of degraded analogues, revegetation, re-instatement of habitat features, consideration and where possible implementation of justified fauna habitat linkages.	3	A	E
Aboriginal Heritage	▪ Disturbance of Aboriginal objects and places. ▪ Potential destruction of these objects and places. ▪ Impacts on Potential Archaeological Deposits, and cultural values associated with the landscape.	▪ Manage impacts in consultation with relevant Aboriginal stakeholders, and in accordance with DEC guidelines and RTA procedures.	3	C	H
Non-Aboriginal Heritage	▪ Disturbance of listed heritage items, and places. ▪ Potential to destroy heritage items or places not listed on any statutory registers.	▪ Prevent direct impacts on heritage items where possible. ▪ Conduct detailed heritage investigations and document in appropriate archival records, for items likely to be directly affected.	3	C	H
Resource management	▪ Impacts associated with the winning and transportation of additional fill and construction material requirements. ▪ Demand on resources, including select fill and construction materials (concrete, steel). Temporary impacts associated with transportation of these materials to the construction site.	▪ Additional fill requirements would be met by (in order of preference) surplus material from other Hume Highway Duplication work, locally licensed material suppliers, or through other sites adequately assessed in accordance with the requirements of DoP. ▪ Additional material requirements would be sourced from local approved suppliers where materials meet the design relevant criteria.	3	B	H
Hydrology	▪ Reduced land capability, resulting from changes to hydrological regimes, and associated waterlogging and salinity impacts. ▪ Decrease in water quality of surrounding	▪ Undertake detailed investigations prior to construction to determine appropriate water sources, and impacts associated with supply and delivery. ▪ Manage all potential sources of pollution stemming from	3	C	H

Environmental Aspect	Description of potential adverse environmental impacts	Outline of proposed management strategies, likely to be implemented in response to identified potential impacts	Consequence (severity rating)	Likelihood/ Frequency	Level of Risk
	watercourses. ▪ Increased impacts from flooding. ▪ Potential adverse impact on lifespan of existing and future infrastructure.	construction activities. ▪ Manage impacts on adjoining lands including impacts on existing land uses and environmental features dependant on water quality and availability. ▪ Implement safeguards to protect infrastructure from salinity and waterlogging.			
Traffic	▪ Delays to existing users from construction traffic, temporary changes to traffic conditions, and access.	▪ Implement traffic management planning in accordance with RTA QA Specification *G10 – Control of Traffic* in addition to other site specific measures to minimise traffic disruptions	5	B	M
Air Quality	▪ Dust pollution during construction, and minor relative increases in pollution from construction vehicle exhaust emissions. ▪ Generation of greenhouse gases related to construction activities.	▪ Measures to suppress dust generation and transmission ▪ Maintenance of construction vehicles and plant in accordance with relevant design standards and guidelines.	5	B	M
Noise and vibration	▪ Noise impacts on receivers during construction, and operation.	▪ Locate noisy activities away from receivers where possible, and implement measures outlined in RTA *Environmental Noise Management Manual.* Conduct any blasting or vibration impacts in accordance with relevant Standards.	5	B	M
Visual	▪ Removal of visually prominent native vegetation, creation of cuttings and fill embankments. Alteration to the existing rural landscape with addition of a new carriageway, and changed intersection arrangements.	▪ Design and construct proposal consistent with strategies outlined in the RTA *Urban and Regional Design Practice Notes*, and implement site specific treatments and management strategies as necessary.	5	B	M
Waste	▪ Generation of waste from construction activities, including building materials, excess unsuitable spoil material, vegetation material,	▪ Implementation of strategies to 'reduce, reuse and recycle'. Reuse materials as a priority, and conduct any recycling in accordance with the NSW Government's *Waste Avoidance and Resource Recovery Strategy 2006.*	5	B	M

Environmental Aspect	Description of potential adverse environmental impacts	Outline of proposed management strategies, likely to be implemented in response to identified potential impacts	Consequence (severity rating)	Likelihood/ Frequency	Level of Risk
Landform, geology and soils	▪ Disturbance of soils, and increased potential for soils to become susceptible to erosion. ▪ Disturbance of contaminated sites. ▪ Potential to contaminate soils though spillage of fuels or oils.	▪ Implement erosion and sedimentation controls in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom 2004). ▪ Manage any contamination in accordance with relevant guidelines, standards, and legislative requirements.	5	B	M
Land use and social	▪ Changes to property boundaries and temporary modifications to property access. ▪ Reduction in amenity for the local community during construction.	▪ Manage impacts in consultation with individual landholders, ▪ Provide alternative access arrangements (temporary and permanent) as necessary. ▪ Conduction land acquisition in accordance with RTA *Land Acquisition Policy*	5	C	L
Cumulative impacts	▪ Residual impacts across the High Highway Duplication after application of mitigation measures to proposal specific impacts identified above.	▪ In addition to proposal specific management strategies, coordinated Hume Highway Duplication program-wide management strategies would be implemented, to manage impacts relating to water use, identified heritage items, biodiversity, and traffic delays during construction,	3	B	H

Consequence (severity rating)		Likelihood/Frequency		Level of Risk	
1	Catastrophic	A	Almost Certain	E	Extreme Risk
2	Major	B	Likely	H	High Risk
3	Moderate	C	Possible	M	Moderate Risk
4	Minor	D	Unlikely	L	Low Risk
5	Insignificant	E	Rare		

Following consideration of the preliminary environmental assessment, the Planning Focus Meeting, the high risk issues identified through the environmental risk analysis and the Director General's Requirements for EA, the Key Environmental Issues for the Kyeamba Hill section of the Hume Highway duplication, are presented in **Table 7-3** and addressed in detail in Chapter 8.

Table 7-3 Key environmental issues and identified risks

Key Environmental Issues	Identified Risk
Biodiversity	▪ Direct and indirect impacts on habitat and flora and fauna. ▪ Cumulative impacts on communities in the region. ▪ Protection of key habitats and corridors and impacts on riparian zones. ▪ Success of mitigation measures.
Heritage	▪ Indigenous and non-indigenous heritage and natural areas directly or indirectly affected. ▪ Potential impacts on identified items and natural areas of heritage significance. ▪ Ineffective Aboriginal community consultation.
Resource management	▪ Extractive material needs of the proposal particularly any extractive material activities outside the proposal corridor.
Hydrology	▪ Flooding, salinity and/or waterlogging. ▪ Impacts of the proposal on flood behaviour.
Cumulative assessment	▪ Identification of cumulative impacts resulting from the total proposal and mitigation measures along the whole Hume Highway corridor including, but not limited to: - Changes to regional and local road network access, road usage, safety and performance. - Construction traffic management. - Biodiversity. - Demand on water resources. - Management of required changes to traffic access.

Chapter 9 of the EA provides a broad assessment of other issues, with identified lower risk values relating to the Proposal. These issues are not considered to be key issues requiring more detailed study and investigation at this stage of the planning process. The issues addressed in Chapter 9 are normally associated with road projects and are routinely managed through detailed design or by the implementation of measures aimed at ensuring that all necessary environmental criteria and guidelines are achieved. The other issues are outlined below:

- Land use.
- Soils.
- Noise.
- Air quality.
- Traffic and access.
- Visual impacts.
- Hazard and risk.
- Waste management.
- Social impacts.

8 Assessment of Key Issues

Chapter 8 presents the Key Environmental Issues outlined in the Director General's Requirements for Environmental Assessment. Key features of the existing environment, consideration of potential environmental impacts and relevant mitigation measures and management responses are provided

8.1 Biodiversity

The condition of vegetation, streams and habitats throughout the study area is variable but most are highly modified. A summary of key environmental features relevant to the Proposal is provided in the following sections. The detailed assessment of the impacts of the Proposal on biodiversity is contained in **Appendix D** and includes the methodology, species lists and assessment considerations.

8.1.1 Key features of the existing environment

Endangered Ecological Communities

Vegetation communities present throughout the study area occur primarily as a fragmented mosaic of small woodland remnants preserved primarily within the road reserve and Travelling Stock Routes (TSR). White Box (*Eucalyptus albens*) – Yellow Box (*Eucalyptus melliodora*) – Blakely's Red Gum (*Eucalyptus blakelyi*) Woodland (hereafter referred to as Box-Gum woodland) is listed as a critically endangered ecological community (EEC) under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and an endangered ecological community (EEC) under the NSW *Threatened Species Conservation Act 1995* (TSC Act). Remnants of this community are fragmented and occur within the road reserve and Kyeamba TSR. High quality vegetation is restricted to the TSR and moderate quality patches occur within roadside reserves. Lower quality vegetation comprises heavily grazed and degraded areas and these occupy the majority of the areas adjacent to the road reserve. Derived grasslands (a grassy woodland from which the trees have been removed) also form part of the Box-Gum woodland community and occur in small areas adjacent to woodland areas in the road reserve (see **Figure 8-1**).

Although not listed as an endangered ecological community, Mugga Ironbark - Red Stringybark Woodland is present within the study area and has been identified as having conservation significance (Priday and Mulvaney 2005).

Threatened Flora

No threatened flora species were recorded within the study area. However, potential habitat is present for 12 threatened flora species previously recorded within the region and this habitat would be affected by the Proposal. Species considered likely to be affected are:

- Yass Daisy (*Ammobium craspedioides*);
- River Swamp Wallaby Grass (*Amphibromus fluitans*);
- Claypan Daisy (*Brachycome muelleroides*);
- Sand-hill Spider Orchid (*Caladenia arenaria*);
- Crimson Spider Orchid (*Caladenia concolor*);
- Caladenia rosella (no common name);
- Small Scurf-pea (*Cullen parvum*);
- Tricolour Diuris (*Diuris tricolour*);
- Austral Pilwort (*Pilularia novae-hollandiae*);
- Button Wrinklewort (*Rutidosis leptorrhynchoides*);
- Woolly Ragwort (*Senecio garlandii*); and
- Small Purple-pea (*Swainsona recta*).

Legend

Hume Highway

Study Area

Vegetation Condition

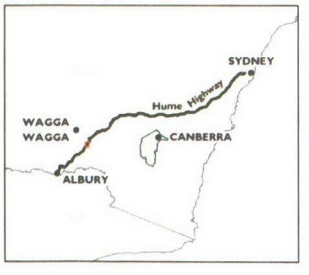
Good

Moderate

Low

0 0.5 1

Kilometres



October 13, 2006
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Figure 8.1 **Location of Box-Gum Grassy Woodlands and Derived Grasslands**

Threatened Fauna

Four broad fauna habitat types occur within the Kyeamba Hill study area:

- woodland;
- riparian habitats with derived grasslands;
- rocky hills, and
- freshwater habitats (dams, creeks and wet depressions).

These habitats provide potential foraging, nesting, roosting, basking and resting sites for a variety of fauna including the threatened Brown Treecreeper (*Climacteris picumnus*), Diamond Firetail (*Stagonopleura guttata*) and Squirrel Glider (*Petaurus norfolcensis*) which were recorded within the study area during the ecological surveys. Squirrel Gliders were recorded in two locations associated with the Kyeamba TSR (see **Figure 8-2**). The Brown Treecreeper appeared to be relatively abundant and widespread in the study area, occurring in all areas of Box-Gum woodland and River Red Gum (*Eucalyptus camaldulensis*) riparian habitat.

The Proposal has the potential to affect habitat for a number of other threatened and migratory species previously recorded in the region. Those species with the potential to be affected by the Proposal are:

- Brown Treecreeper;
- Diamond Firetail;
- Black-chinned Honeyeater (*Melithreptus gularis gularis*);
- Hooded Robin (*Melanodryas cucullata*);
- Speckled Warbler (*Chthonicola sagittata*);
- Turquoise Parrot (*Neophema pulchella*);
- Regent Honeyeater (*Xanthomyza phrygia*);
- Swift Parrot (*Lathamus discolor*);
- Superb Parrot (*Polytelis swainsonii*);
- Satin Flycatcher (*Myiagra cyanoleuca*)'
- White-throated Needletail (*Hirundapus caudacutus*);
- Squirrel Glider (*Petaurus norfolcensis*);
- Pink-tailed Worm Lizard (*Aprasia parapulchella*); and
- Striped Legless Lizard (*Delmar impar*).

Aquatic Ecology

Kyeamba Creek is a tributary of the Murrumbidgee River, entering the river a short distance upstream from Wagga Wagga. The condition of Kyeamba Creek is variable throughout the study area with some areas supporting water and others dry. Flow volumes and velocities are highly variable due to the small size of the watercourse and its position in the upper catchment, and this contributes to a variable aquatic habitat condition. In general, water quality is poor adjacent to road crossings and exotic species within the riparian zone are prevalent. Substrate is also variable with most areas supporting a sand/gravel substrate with the exception of Kyeamba Creek 2nd Crossing where pebble, cobble and a small proportion of boulder habitat are also present. Woody debris is also a common feature for the Kyeamba Creek.

The tributary of Kyeamba Creek supports small pools of water but was not flowing at the time of the survey. The substrate in this section is sandy with Carex sp. present on the banks. Habitat such as woody debris is limited in this area

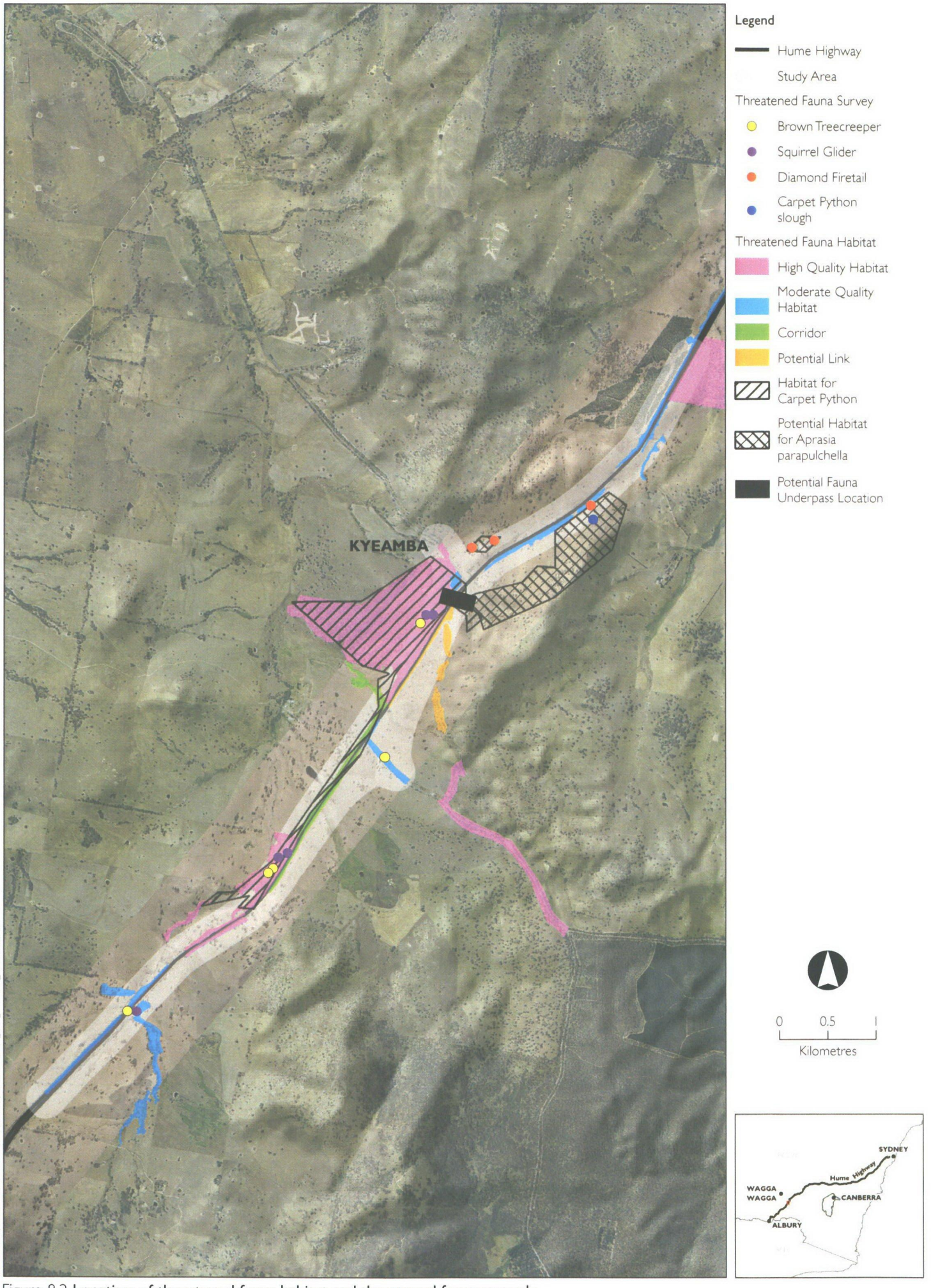

Figure 8.2 **Location of threatened fauna habitat and threatened fauna records**

Endangered Aquatic Communities and Threatened Fish

Kyeamba Creek and one of its tributaries are present within the study area and would fall within the natural drainage basin of the lower Murray River and therefore form part of the endangered Aquatic Ecological Community in the Natural Drainage Basin of the Lower Murray River Catchment. This community is listed as endangered under the TSC Act and *Fisheries Management Act 1994* (FM Act). The community includes "all native fish and aquatic invertebrates within all natural creeks, rivers and associated lagoons, billabongs and lakes of the regulated portions of the Murray River below the Hume Weir, the Murrumbidgee River below Burrinjuck Dam, and the Tumut River below Blowering Dam, as well as all their tributaries and branches." (NSW Fisheries 2002b). Impacts on this community are anticipated as a consequence of the proposed culvert extension/modification and new crossings upstream of Kyeamba Creek 2nd Crossing and over the Kyeamba Creek tributary.

A number of threatened fish species are known to inhabit the waterways of the Murray-Darling Basin, however potential habitat for most of these species is not present within Kyeamba Creek or its tributary due their small size and degraded nature.

While it is unlikely that threatened fish species or populations would occur within Kyeamba Creek those with the greatest potential to occur are:

- Purple Spotted Gudgeon (western population) (*Mogurnda adspersa*); and
- Southern Pygmy Perch (*Nannoperca australis*).

Murray Cod (*Maccullochella peelii peelii*) and Trout Cod (*Maccullochella macquariensis*) exist within the Murrumbidgee River downstream. Murray Cod is listed as vulnerable under the EPBC Act and Trout Cod is listed as endangered under TSC, EPBC and FM Acts. Both species are unlikely to populate the waterways in and around the Proposal corridor given their degraded nature, intermittent flows and small size. However, potential impacts on water quality and particularly sedimentation as a consequence of the Proposal may have downstream impacts on these species. Therefore, these species were also identified as potentially affected for the purposes of the impact assessments in Appendix D.

8.1.2 Assessment of potential impacts

The Proposal has the potential for direct and indirect impacts on biodiversity. The survey methodology and detailed assessment of potential impacts of the Proposal is included in Appendix D and has been summarised below.

Survey Methodology

Flora surveys throughout the study area included:

- traverses on foot and mapping of all vegetation types present within the study area;
- an assessment of the presence of Endangered Ecological Communities (EEC) scheduled under the EPBC Act and TSC Act. Remnants of White Box - Yellow Box - Blakely's Red Gum Woodland were identified using the key principals provided in the Identification Guidelines for Endangered Ecological Communities (NPWS 2002) and with consideration of the Department of Environment and Heritage (DEH) White Box-Yellow Box- Blakely's Red Gum Grassy Woodland and Derived Grassland assessment criteria (DEH 2006);
- specific flora transects and quadrats (20 m x 20 m plots) in each vegetation unit;
- targeted searches for any rare and/or threatened flora species for which potential habitat was present within the study area; and
- an assessment of vegetation condition using 20 m x 20 m quadrats in conjunction with general random meanders.

Surveys were conducted for fauna with the potential to occur within the study area using a variety of survey techniques including:

- standardised time-based (20 minute) diurnal bird surveys;
- mammal trapping using Elliot A and Elliot B traps;
- spotlighting for arboreal mammals and bats and listening for calls of megachiropteran bats;
- harp trapping for microchiropteran bats;
- ultrasonic bat detection;
- call playback for the Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Masked Owl (*Tyto novaehollandiae*) and Bush Stone Curlew (*Burhinus grallarius*);
- call playback for the Boorolong Frog (*Litoria boorolongensis*);
- visual searches for amphibians;
- targeted searches for the Striped Legless Lizard (*Delma impar*) and Pink-tailed Worm Lizard (*Aprasia parapulchella*) using the hand search technique (lifting of over 3,500 rocks); and
- fauna habitat assessments including 20 m x 20 m quadrats and hollow-bearing tree transects.

A visual habitat assessment of all streams likely to be traversed by the proposed highway duplication or within close proximity to the proposed construction area was conducted using the NSW AUSRIVAS field methodology.

Construction

Endangered Ecological Communities

Box–Gum Woodland of varying quality occurs throughout the study area. Based on the current Proposal footprint, it is anticipated that areas of Box-Gum Woodland, of varying quality, would need to be removed. The total estimated area of Box-Gum Woodland directly cleared for the Proposal is 11.3 hectares, and the majority of this has been assessed to be of moderate condition, as set out in **Table 8-1**.

Table 8-1 Impacts on the Box-Gum Woodland vegetation community

Vegetation Community	Condition	Vegetation clearing (Hectares)
White Box – Yellow Box – Blakely's Red Gum Woodland	Low	0.08
White Box – Yellow Box – Blakely's Red Gum Woodland	Moderate	8.35
White Box – Yellow Box – Blakely's Red Gum Woodland	High	2.90
TOTAL		**11.33**

The total area of Box-Gum woodland to be cleared does not take account of areas that may be required for construction machinery, works depots or stockpile areas. However, such sites would be located in areas where no clearing of native vegetation is required. The Proposal would also result in a small increase in isolation of vegetation on the eastern and western sides of the highway. Given that all remnants of Box-Gum Woodland are endangered and of conservation value, a strategy to offset the loss resulting from the Proposal and the entire Hume Highway duplication would be developed and as a minimum would include the measures outlined in **Table 8.2**.

The Proposal also has the potential for a number of indirect impacts on the Box-Gum woodland community if stringent management measures are not implemented. Potential indirect impacts include:

- increased weed invasion in adjacent areas due to edge effects;
- spreading of seeds of exotic species during soil disturbance for construction;
- hydrological changes due to vegetation clearance and due to localised changes arising from the new road carriageway; and
- encroachment from construction works.

Mitigation measures such as the installation of sediment detention basins and fencing of construction areas would minimise such impacts, and an outline of the measures that would be implemented for this Proposal is provided in Chapter 10.

Threatened Flora

Although no threatened flora species were recorded in the study area, potential habitat for a variety of threatened flora species was identified. As a consequence of the Proposal, it is estimated that 15.03 hectares of potential habitat would be removed. This was determined through calculating the footprint of the horizontal concept design, including batters and the amount of native vegetation it was likely to disturb. This does not take account of any areas that may be required for construction machinery, works depots or stockpile areas.

The potential indirect impacts outlined for vegetation communities would also be applicable to the habitat of threatened flora species. Mitigation measures to minimise direct and indirect impacts on threatened flora species are outlined in Chapter 10.

Threatened Fauna

Habitat for threatened fauna is patchy and fragmented throughout the Kyeamba Hill study area as a result of past clearing. High quality woodland remnants are mostly centred on two larger patches of vegetation associated with the Kyeamba TSR at chainage 70,000 and 73500 and roadside reserves along Tumbarumba Road. These larger fragments are considered to be high quality for threatened woodland birds and the Squirrel Glider (refer Figure 8.2). The removal of up to 11 hectares of woodland including 2.9 hectares of high quality habitat along the eastern edge of the Kyeamba TSR is required for the Proposal. Vegetation along the existing highway road reserve provides a significant link for Squirrel Gliders gaining access to the Kyeamba TSR but the Proposal is not expected to affect this link.

A potential wildlife corridor has been identified between the eastern and western extents of Tumbarumba Road. The current alignment of the dual carriageway would pass through this area, and result in the loss of some habitat. At this point the highway is in cut and therefore has the potential to restrict fauna movements, owing to the large footprint of the highway. Offsets including revegetation would be undertaken to mitigate this habitat loss. This would increase the total area of habitat in the study area and facilitate linkage of these isolated fragments. In addition, features such as large logs that may provide habitat for threatened fauna and occur within the proposed clearance areas, would be removed to adjacent areas to augment fauna habitat features within this area.

Hollow-bearing trees are present throughout the study area and form important roosting, breeding and nesting resources for a variety of fauna including woodland birds, gliders and microchiropteran bats. A staged approach to removal of vegetation where hollow-bearing trees are present would be implemented in order to minimise impacts on any fauna currently using the hollow-bearing trees within the path of the proposed route.

The current route is unlikely to have direct impacts on potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard. However, the current highway divides areas of

potential habitat for these species. Provision of an appropriate underpass is therefore required to minimise isolation and restriction of gene flow for the species.

Potential indirect impacts of the Proposal on fauna habitat and in particular habitat for threatened species during construction include:

- disturbance from noise associated with construction works particularly during blasting as this is known to disturb some fauna species;
- disturbance of adjacent areas by encroachment from construction works; and
- degradation of habitat due to uncontrolled runoff.

Where possible, measures would be implemented to minimise indirect impacts of the Proposal on threatened species as outlined in **Table 8-2**.

Endangered Aquatic Communities and Threatened Fish

Potential impacts of construction activities on endangered aquatic communities and threatened fish include:

- extension and modification of the current culvert crossings;
- disturbance associated with establishing a two span bridge crossing over the tributary of Kyeamba Creek and new culvert upstream of Kyeamba Creek 2nd Crossing;
- removal of a small area of limited potential habitat for Purple Spotted Gudgeon and Southern Pygmy Perch; and
- removal of riparian vegetation, although this is already highly modified.

Although these impacts are largely inevitable due to the natural flow paths of the streams passing under the highway, the culverts and bridges should be designed in accordance with Fish Passage Requirements for Waterways Crossings (Fairfull and Witheridge 2003) in order to reduce the likelihood of detrimental impacts on aquatic habitats.

A number of indirect impacts also have the potential to occur and these would be subject to management measures also to minimise detrimental impacts on threatened species and endangered communities as a result of the Proposal. Potential indirect impacts during from construction works include:

- barriers to fish passage;
- reduction of water quality;
- increased flows due to uncontrolled runoff entering the stream;
- degraded water quality and sedimentation of downstream areas with consequent adverse impacts on Murray Cod and Trout Cod; and
- Increased erosion due to increased flows and vegetation clearance.

Management measures to address these potential impacts are outlined in Table 8.2 and would be implemented during the construction phase of the Proposal.

Operation

Endangered Ecological Communities

Impacts on Box-Gum woodland as a result of the operation of the upgraded road are anticipated. Potential impacts include:

- Increased weed invasion due to edge effects or uncontrolled runoff; and
- Waterlogging and land salinity adjacent to the highway due to the larger impervious surface and associated groundwater changes.

Runoff would be managed primarily through the installation of sediment detention basins along the alignment complimented by the revegetation of areas adjacent to the proposed construction area to enhance the riparian zone, increase the stability of the highly erodible banks and act as an additional filter for runoff from the road surface.

Threatened Flora

Potential operational effects of the Proposal on threatened flora also include those listed for the EEC and would be managed using the same mitigation measures.

Threatened Fauna

A number of potential impacts may occur on threatened fauna species during the operational stage. Potential impacts likely during the operation of the upgraded road include:

- increased fragmentation of habitat in particular that for Gliders;
- increased isolation of areas of potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard on either side of the highway;
- Increases in weed invasion and hence quality of fauna habitat; and
- Increased potential for conflicts between fauna and traffic due to increase in the width of roadway.

However, mitigation measures such as strategically located revegetation works to increase the total area of habitat in the study area and link isolated fragments, the establishment of a minimum width median at appropriate locations and the provision of a fauna underpass, are proposed to minimise the operational impacts of the Proposal on threatened species, their habitats and movement pathways.

Endangered Aquatic Communities and Threatened Fish

Operational impacts of the Proposal on endangered aquatic communities and threatened fish species may include:

- increased flows in existing watercourses due to additional runoff from the impervious road surface and through new culverts;
- increased erosion and sedimentation due to increased flows;
- loss of or changes to aquatic habitats due to increased flow; and
- decrease in water quality due to road runoff.

Management measures would be implemented to ensure that all water entering streams from the Proposal, during construction and operation, would meet the water quality standards outlined in the ANZECC Guidelines (2000). Bridges and culverts are to be designed so as to maintain fish passage, and to retain flow regimes as close as possible to current conditions.

Legislative considerations

Detailed assessments of the likely impacts from the Proposal on endangered ecological communities, threatened species and their habitat within the study area have been undertaken and are included in Appendix D. The findings of these assessments have been summarised below within respect to the relevant Commonwealth and State legislation.

Commonwealth Threatened Species Assessment

An assessment of the likely impacts of the Proposal on Commonwealth EEC's, threatened species and migratory species, was undertaken with consideration given to the Matters of National Environmental Significance – Significant Impact Guidelines, to determine whether the Proposal requires the preparation of a Referral to the DEH Minister under the EPBC Act. The guidelines list a number of criteria that should be used to assess the likely significance of the potential impacts of the Proposal. The assessment of the potential impacts against each of the criterion is included in the detailed assessment in Appendix D.

Based on the assessment it was concluded that the Proposal has the potential to have significant impacts on the extent and quality of Box-Gum Woodland within the locality given

that 11.33 ha would be cleared. Therefore preparation of a Referral under the EPBC Act is required.

NSW Threatened Species Assessment

An assessment of the impacts of the Proposal on species, populations and ecological communities listed Schedules 1, 1A and 2 of the TSC Act and Schedules 4, 4A and 5A of the FM Act was undertaken. As the Proposal is to be assessed under Part 3A of the EP&A Act the impact assessment as detailed in the Ecological Assessment Report was undertaken in accordance with the Draft Guidelines for Threatened Species Assessment (DEC 2005).

Based on the assessment it was concluded that the Proposal was unlikely to have a significant impact on species listed under the TSC Act for the following reasons:

- The Proposal would not disrupt the lifecycle of any threatened species such that it would place them at risk of extinction;
- Ongoing weed management and monitoring would be undertaken to prevent edge effects on areas of potential habitat for threatened flora;
- Potential habitat for all species would remain within the study area;
- Measures such as the provision of a fauna underpass and strategic revegetation to enhance fauna habitat linkages would minimise the potential for isolation of potential habitat for threatened species;
- Stringent management measures would be implemented during construction and operation to ensure water quality is maintained;
- The design of bridges and culverts would be in accordance with NSW Fisheries requirements and would maintain fish passage in all waterways.

The Proposal is considered to have the potential to result in a significant decrease in extent and quality of Box-Gum woodland within the locality through the clearance of 11.33 hectares and additional indirect impacts such as increased weed invasion. Therefore offsets would be required to ensure there is no net loss of this community and stringent management measures implemented to prevent any potential indirect impacts on Box-Gum woodland within the study area. These measures are detailed in Chapter 10.

8.1.3 Mitigation measures and management response

The conservation value of the vegetation was considered in the design of the duplication of the Highway and the proposed footprint has been located to minimise removal of remnant woodland, as far as practicable.

Potential impacts on streams and aquatic habitats have been avoided where possible however, crossing of some watercourses is required. The current footprint has been designed to avoid additional impacts by extending and modifying existing road crossings where possible.

Construction of an additional crossing is required over Kyeamba Creek upstream of the Kyeamba Creek 2nd Crossing and over the tributary of Kyeamba Creek as the road alignment has been designed to create a safer intersection with the highway and Tumbarumba Road (MR384).

Although there is the potential for a number of direct and indirect impacts on endangered communities and threatened species, the majority of these can be mitigated or managed. Potential impacts for both the construction and operational phases of the Proposal are summarised in **Table 8-2** and proposed mitigation and management measures outlined.

Table 8-2 Summary of biodiversity mitigation measures and management responses.

Potential impacts	Mitigation measures and management responses
Pre-construction	
Increased potential conflict between fauna and traffic due to increase road width	▪ identify revegetation areas to increase fauna habitat linkages. • Reduce the median width to the minimum necessary for safe operation of the road in those areas where existing Glider movement occurs across the highway.
Barriers to fish passage	▪ Design culvert modification/extension and bridges in accordance with the requirements outlined in Fairfull and Witheridge (2003).
Increased isolation of areas of potential habitat for the Striped Legless Lizard and Pink-tailed Worm Lizard on either side of the highway	▪ Consider opportunities to utilise existing/future drainage infrastructure or stock underpasses as fauna underpass to link currently isolated sections of potential Striped Legless Lizard and Pink-tailed Worm Lizard on either side of the highway.
During construction	
Removal of Box-Gum Woodland and other vegetation including loss of fauna habitat	▪ Clearing of Box Gum Woodland would be kept to the minimum necessary to construct the road. Impacts would be avoided where possible and existing roadside vegetation would be maintained within the new median where safety and design are not compromised. ▪ Implement an offset approach to manage impacts through strategically placed revegetation works in the highway corridor. ▪ Rehabilitate abandoned sections of the existing road corridor through physical removal of weeds and replanting of Box-Gum woodland species using local native provenance. ▪ Native seed would be collected by a qualified bush regenerator prior to clearing, for use in the revegetation of disturbed areas. ▪ Where possible the landscaping of areas within the Proposal corridor would be undertaken with endemic species, thereby increasing the habitat value and visual amenity of the area. Landscaping of the area would include: ▪ Planting of a range of locally occurring native shrubs, trees and groundcover plants. Discussion would be held with Department of Environment and Conservation regarding the choice of species, with preference shown to those species characteristic of Box-Gum Woodland. ▪ Inclusion of logs, dead trees and other suitable habitat features in the landscaping works. ▪ Incorporation of existing natural vegetation where possible. ▪ Linking of bushland remnants. ▪ Maintenance of plantings for not less than two years and until revegetation has been successful (i.e. 85% of plants have become established). ▪ Place any transposable habitat features such as large logs and boulders in adjacent retained areas to allow their continuation as potential fauna refuge sites. ▪ Areas disturbed during construction would be progressively revegetated • Where clearing of vegetation and fauna habitats will take

Potential impacts	Mitigation measures and management responses
	place, a two stage clearing process would be followed, whereby non-hollow bearing trees would be felled first. • Clearing protocols would be implemented which involve checking hollow-bearing trees for the presence of bird nests and arboreal animals such as possums, glider and bats prior to felling or pushing. Animals found to be occupying trees would be safely removed before clearing of the trees. A qualified ecologist would relocate removed animals locally into nearby woodlands. • Areas of potential habitat for the Pink-tailed Worm-lizard and the Striped Legless-Lizard would be inspected by a qualified ecologist prior to construction works impacting upon it. If any Pink-tailed Worm-lizards or Striped Legless-Lizards are identified, they would be removed from the construction area to suitable adjacent habitat. • All hollow-bearing trees to be felled would be clearly marked and their species and approximate dimensions catalogued so that hollows or nest boxes can be affixed to similar standing trees. • Hollows or nest boxes would be attached to trees with consideration of aspect, height and location appropriate for the target fauna species. • Salvaged sections of hollows or nest boxes would be attached to trees in a way that allows for tree expansion and does not poison the tree. • In conjunction with the Department of Primary Industries (NSW Fisheries) develop a strategy to allow suitable trees removed as part of construction to be utilised in MBDC Program Re-snagging and riparian restoration – Hume Dam to Yarrawonga. • The location of each relocated hollow or nest box would be recorded using GIS equipment during installation.
Increased weed invasion in adjacent areas due to edge effects	▪ Undertake ongoing management of weed invasion within the remaining road reserve for a period of not less than 2 years to protect the integrity of the Box-Gum Woodland. ▪ Stockpile soil that may contain seeds of exotic species away from watercourses and vegetated areas and cover the pile to eliminate the spread of the soil and seed during rainfall and wind events.
Inadvertent disturbance of vegetation or fauna habitat outside construction area	▪ Clearly mark the limits of clearing and install temporary fencing around the construction footprint area to avoid unnecessary vegetation and habitat removal beyond this area. ▪ Restrict equipment and stockpiling of resources to designated areas in existing cleared or degraded land to minimise the overall impacts of the construction and avoid unnecessary vegetation and habitat removal.
Disturbance to fauna from noises (short, sharp noises such as sirens, blasting or the use of compressed air)	▪ Avoid blasting of rock or other activities associated with short, sharp noises during known breeding seasons for mammals and birds within the study area as necessary.
Hydrological changes due to vegetation clearance, including decreased surface water quality	▪ Install sediment detention basins and other stormwater treatment measures to trap runoff from construction areas in accordance with Managing Urban Stormwater:

Potential impacts	Mitigation measures and management responses
	Soils and Construction (Landcom 2004). ▪ Sediment basins would be located in existing cleared areas where possible to minimise the loss of habitat. ▪ Revegetate riparian zones to increase the stability of highly erodible stream banks, act as an additional filter for runoff from the road surface and minimise waterlogging and salinisation. ▪ Achieve ANZECC Water Quality Guidelines (2000) for all water discharge into the streams.
Barriers to fish passage during culvert upgrade and bridge construction	▪ Maintain fish passage at all times during the culvert extension and modification works and bridge construction.
During operation	
Increased weed invasion due to edge effects	▪ Undertake ongoing management and monitoring of weed invasion for a period of no less than two years following completion of the construction phase.
Waterlogging and land salinity adjacent to the highway due to the large impervious surface and associated groundwater changes	▪ Establish trees as well as a ground layer as part of revegetation works. ▪ Use plant species tolerant of wet conditions in areas prone to waterlogging.
Decreased water quality in surrounding watercourses	▪ Revegetation of riparian zones using local native provenance to stabilise soils and act as an additional filter for runoff from the road surface. ▪ Plant macrophytes along the stream banks to filter flow and enhance bank stability. ▪ Achieve ANZECC Water Quality Guidelines (2000) for all water discharge into the streams.
Loss of aquatic habitats due to increased flows	▪ Place woody debris downstream of culverts where necessary and so as not to obstruct potential fish passage.

8.2 Aboriginal heritage

8.2.1 Introduction

8.2.2 Existing environment

Figure 8-3
Figure 8-3 Location of Aboriginal heritage areas (indicative only)

8.2.3 Assessment of impacts

8.2.4 Mitigation measures and management response

8.3 Non-Aboriginal heritage

8.3.1 Introduction

Three separate heritage assessments have been undertaken to consider the direct and indirect impacts of the proposal on non-Aboriginal heritage, potential archaeological deposits and natural areas of heritage significance. The findings of these assessments are summarised in this section and full copies of the heritage assessment reports are contained in **Appendix F**.

Potential archaeological deposits – Historical archaeology

The historical archaeology impact assessment identified and assessed the cultural significance of relics (as defined in the *NSW Heritage Act 1977*) in the study area to determine the potential impact of the proposal (Archaeological and Heritage Management Solutions & Cultural Heritage Connections 2006). The assessment involved:

- review of heritage studies;
- review of topographic maps to identify landscape features and structures;
- review of historical aerial photographs;
- use of thematic and site specific historical research to develop a predictive model of known and potential historical archaeological sites within the study area;
- survey of all accessible sites within the study area (100m either side of the existing highway) to identify, record and assess archaeological sites identified by predictive modelling and any other previously un-identified sites;
- assessment of the cultural significance of sites in the study area (using State Heritage Assessment criteria);
- assessment of the impact of the Proposal on the sites; and
- development of management or mitigation measures.

Non Aboriginal heritage – Built heritage

The study of the built heritage environment identifies places of built heritage significance, including former road alignments, culverts and bridges with the potential to be affected by the proposal (Graham Brookes and Associates 2006). Built items have been defined as constructed as opposed to natural formations and in the context of the Hume Highway include dwellings, inns, farm structures, livestock compounds, fences, retaining walls, water management elements such as drains and elements such as bridges, surfacing and kerbs. The assessment involved:

- searches of heritage lists and relevant local government heritage studies;
- research in local archives and libraries;
- review of current and historical aerial photographs;
- consideration of information provided by the RTA;
- survey of the study area (100m either side of the existing road alignment); and
- review of existing heritage studies.

Natural areas of heritage significance – Landscape heritage

The study of the heritage values of the landscape considered places of heritage significance in relation to cultural landscapes associated with built elements and vegetation within 100 metres on either side of the existing carriageway (Taylor Brammer 2006). Landscape items considered include roadside plantings which form a definitive landscape element in the overall landscape context and are an integral part of the existing highway experience and plantings typically associated with homesteads and vehicular entry ways.

The assessment included:

- survey of the study area (100m either side of the existing highway) by foot or by car;
- review of aerial photographs;
- review of historic aerial photographs dated 1949; and
- topographic maps.

8.3.2 Assessment criteria

Heritage features/items identified were assessed against the Australian International Conference on Monuments and Sites (ICOMOS) Burra Charter, which defines cultural significance as *'aesthetic, historical, scientific, social or spiritual for past, present or future*

generations'. Assessments of significance are made by applying standard evaluation criteria. These criteria are:

- An item is important in the course, or pattern, of NSW's cultural or natural history (or the cultural or natural history of the local area);
- An item has strong or special association with the life or work of a person, or group of persons, of importance in NSW' cultural or natural history (or the cultural or natural history of the local area);
- An item is important in demonstrating aesthetic characteristics and/or a high degree of creative or technical achievement in NSW (or the local area);
- An item has strong or special association with a particular community or cultural group in NSW (or the local area) for social, cultural or spiritual reasons;
- An item has potential to yield information that will contribute to an understanding of NSW's cultural or natural history (or the cultural or natural history of the local area);
- An item possesses uncommon, rare or endangered aspects of NSW's cultural or natural history (or the cultural or natural history of the local area); and
- An item is important in demonstrating the principle characteristics of a class of NSW's cultural or natural places; or cultural and natural environments.

Impact is considered as follows:

High impact denotes that the proposed development will physically affect the item or some of its important elements. The building will be demolished or landscape features; garden setting or the visual connections between related buildings will be physically affected.

Moderate impact means that there will be a small reduction in the current physical extent of the item or a minor impact on the setting or visual curtilage of items of heritage significance.

Minimal impact indicates that the existing built structures represent low heritage significance or the proposed development will have no adverse impact on a significant component.

8.3.3 General history of the study area

Prior to 1928 the main overland route from Sydney to Melbourne, was known as the Great South Road. These early road routes were dictated by the need for water and pasturage; key features being natural contours water places and level, sheltered campsites. Road verges were wide to allow for feed for livestock.

Key features of such roads were natural contours, watering places and level, sheltered campsites. Initially, the alignment of the road avoided creek crossings which required bridges and obstructions were bypassed rather than built over. Large geological formations were avoided where possible, but the overall line was a compromise between practicality and cost.

Development of the road took off after 1928 when it was proclaimed a State Highway and named in honour of Hamilton Hume. Major works in the Kyeamba area occurred in the 1930s. This involved massive cutting and realignments. Camps were set up for the 200+ construction workers engaged in upgrading this section.

The development of transport routes such as the Hume Highway was influenced by the spread of settlement. Road infrastructure such as bridges sometimes became sites for social interaction, linked with picnicking and swimming areas. Construction of the Hume Highway

itself created substantial employment opportunities, the money earned contributing to the local economy.

Roads have radically altered landscape patterns, with cuttings through hillsides and the remnants of former lines leaving evidence of their passing. Landscapes adjacent to the road corridor have been constructed and re-constructed. Roads have encouraged the spread of weeds, however the associated travelling stock routes have preserved native vegetation when it has been extensively cleared on adjacent private holdings. Supplementary planting and preservation of roadside vegetation through community group activities has increased and encouraged biodiversity along the road corridor.

8.3.4 Key features

By late 1839 John Smith had constructed bark huts in Kyeamba and thirty acres were under cultivation. His homestead located close to the Port Phillip Road, was converted to an inn, known as the Traveller's Joy, later also known as the Traveller's Rest and later still as Kyeamba Inn. The mounted police had an office in Kyeamba in the 1850s.

Kyeamba village developed along the line of the South Road including the Travellers Joy Inn. The Telegraph Station opened in 1861 and became a Post Office in 1891. The Post Office was destroyed by fire in 1916.

Thirty three heritage items have been identified within 100 metres of the existing highway. These include:

- Archaeological heritage – 18 sites of archaeological significance (K001-K010, K100-K108).
- Built heritage – five sites of built heritage significance (K201-K205).
- Landscape – 10 landscape items (K301-310).

Two identifiable archaeological sites of State heritage significance (K001, K103) and one potential archaeological site of State heritage significance (K107) have been identified in the assessment. Of these, the cemetery reserve (K107) would be affected by the proposal.

One item, The Travellers' Joy Inn (K203) and its curtilage (K001) has been assessed as having State significance for built heritage values. This item would be moderately affected by the proposal.

The remaining items were considered to be of local significance. The items are described in **Table 8-3** and their location is shown in **Figure 8-4**.

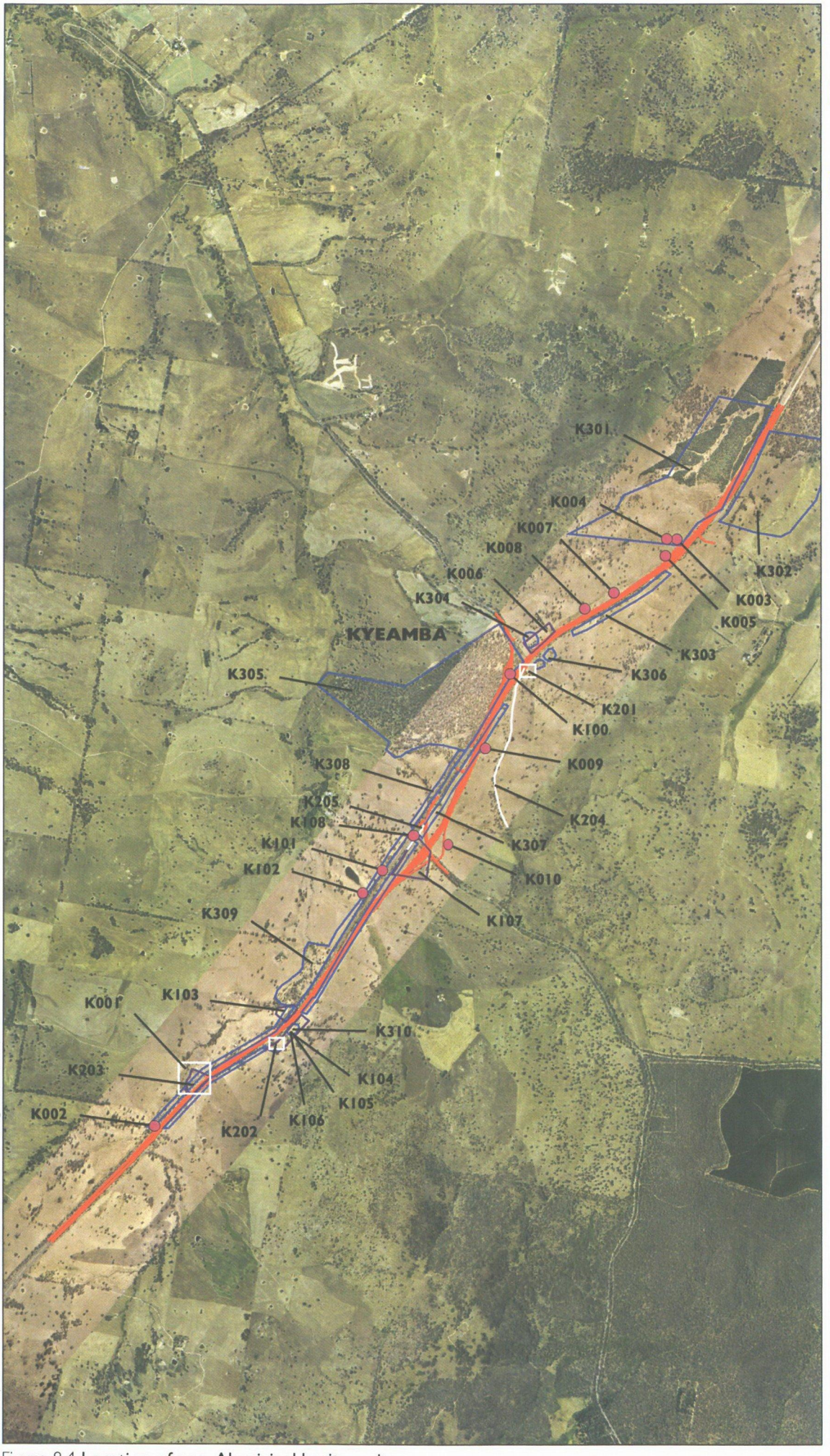

Figure 8.4 **Location of non-Aboriginal heritage sites**

Table 8-3 Heritage items within the study area

Item	Description	Assessment
Archaeology		
K001	Travellers Joy inn. This is also recorded in the built heritage assessment as **K203**. The site has a thick grass cover with limited surface visibility. There are no relics visible and no evidence of substantial landscaping and/or surface disturbance suggesting the soil profile in existence during the nineteenth century remains substantially intact. This is considered a potential archaeological landscape comprising four subdivisions which have graded significance: ▪ grassed and partially paved yards surrounding the former Inn building which have the highest potential to contain buried relics. ▪ carriageway and gates (to the north) including the tennis court area which appear to have no archaeological significance. ▪ area between north side of the former Inn and the tennis court. The easternmost building is marked as a blacksmith shop. Other buildings have indeterminate function but all predate 1858 and are considered to have high archaeological potential. ▪ soil deposits in the area to the north west of the form blacksmiths shop. Which are considered likely to contain remains of fenced enclosures recorded on site in 1858. Remains of these enclosures may be in situ. If so they have archaeological potential.	Site considered to be a potential archaeological landscape of State significance.
K002	Fence line comprising a barbed-wire and spilt hardwood post fence located on the western side of the Hume Highway. Likely to date to the nineteenth century.	Locally significant historic landscape feature but with no archaeological research potential.
K003	A benched platform cut into the side slope on the western side of the Hume highway. No visible building fabric was observed although survey visibility was low.	Locally significant item and a potential historical archaeological site.
K004	A benched platform cut into the side slope on the western side of the Hume highway. No fabric or structural remains were found and it is unclear whether the platform was purpose-made or whether it was formed by quarrying.	Locally significant item and a potential historical archaeological site.
K005	A small building platform but no fabric or structural remains were found. This site may be associated with sites **K003** and **K004**, although, its age, history and associations are not known.	Locally significant item and a potential historical archaeological site.
K006	Built remains and historic planting located within the allotments on the north-west corner of Tumbarumba Road and the Hume highway. A house occupied the site from 1908 to 1993 variously used as a coaching stop, accommodation, post office and residence. The site includes a former house platform, a small shed and remnant historic planting. This site has previously been cultivated and there is the potential for	Site of local heritage significance with limited archaeological potential due to soil disturbance.

Item	Description	Assessment
	archaeological relics to occur beneath the plough zone.	
K007	Earthen dam possibly installed after 1949.	No heritage significance.
K008	Earthen dam possibly installed after 1949.	No heritage significance.
K009	Earthen dam possibly installed after 1949.	No heritage significance.
K010	Earthen dam possibly installed after 1949.	No heritage significance.
K100	Visible structural remains of a former vehicle garage and service station constructed in 1943.	No archaeological significance
K101	Roadside memorial installed after 2001.	No archaeological significance
K102	Earthen dam installed prior to 1949.	Work of local heritage significance with no archaeological potential.
K103	Artefact scatter and potential archaeological deposits associated with a former Mounted Police Quarters. The artefacts date from the mid 19th century.	If this site contains buried archaeological relics associated with the Mounted Police Quarters they are likely to be State significant. Due to the lack of visible disturbance the site would have high archaeological potential.
K104	Visual structural remains and potential archaeological deposits associated with a building variously described as a gaol, cottage, school and police station. The remains comprise a standing remnant of chimney made of granite with brick infill. Between the footings, the house platform is largely undisturbed and has the potential to contain occupation deposits.	Site of local significance with high archaeological potential.
K105	Artefact scatters comprising ceramic and glass artefacts in a field north of Koinglo. The artefacts were identified as post-dating 1850. The area is currently under crop and artefacts in the plough zone are likely to have been disturbed.	Site of local significance.
K106	Site of the former post and telegraph office built in 1861, burnt down in 1916.	Site of local significance with low archaeological potential.
K107	This site is a cemetery reserve and is currently used as a grazing paddock. There are no physical indications that this site was every used as a cemetery.	Any relics associated with burial within this site would be State significant.
K108	Site of an old road running north-south within the road reserve. the date of which is indeterminate.	Locally significant built heritage item with no archaeological research potential.

Item	Description	Assessment
Built Heritage		
K201	Shed, stockyard and water tanks present on the Kyeamba Park property.	Some aesthetic value as a representative built component of the rural landscape.
K202	Stone chimney present on 'Koinglo' property. This is located amongst a group of buildings located 150-200m back from the road. It is a remnant of the school building and was original the police station and gaol..	Chimney of historic significance as a physical reminder of the 19th century Kyeamba village with some scientific significance
K203	Kyeamba South Homestead also included in the archaeological assessment (item K001). The original building was timber and rebuilt in stone in 1847. The building formed licensed premises until 1879 and was used as a school towards the end of the nineteenth century.	Building of historical and aesthetic significance at State level. One of the earliest hotels in the Wagga region, a substantial early building, which was (and is) an important land mark. The building also has social significance for its association with the Smith family.
K204	An old road remnant comprising a dirt track extending from Tumbarumba Road to its intersection (northern) with the highway identified by a line of trees. It follows the original course of Tumbarumba Road.	Remnant has historical significance as evidence of the historical evolution of the Hume Highway and the changing of its alignment since the 1830s. Moderately significant at a local level.
K205	An old road remnant within the road reserve on the eastern side of the existing carriageway of the highway at its intersection (southern) with Tumbarumba Road.	Remnant has historical significance as evidence of the historical evolution of the Hume Highway and the changing of its alignment since the 1830s. Moderately significant at a local level.
Landscape Heritage		
K301	Pine plantation on the west side of the highway, north of the Tumbarumba Road intersection.	Planting of aesthetic value but of low significance.
K302	Substantial roadside and private native vegetation on the east side of the road opposite **K301**. This planting has increased in density since 1949.	Vegetation of aesthetic value but of medium significance being representative of the native vegetation in the

Item	Description	Assessment
		area with re-growth having occurred in the later part of the 20th century.
K303	Native roadside vegetation along the east of the highway. The roadside vegetation is of aesthetic value as it demonstrates the retention of the roadside planting to this section and creates substantial landscape character.	Area of moderate significance.
K304	Cultural planting associated with Kyeamba Park Homestead is considered to be of aesthetic and historic value being cultural planting associated with a long established homestead in the area.	Area of moderate significance.
K305	Crown reserve to the south of the Hume Highway, Tumbarumba Road intersection.	Aesthetic value of moderate significance being representative of the native tree vegetation in the area.
K306	Cultural planting associated with Kyeamba Park. This is of aesthetic and historic value being cultural planting associated with a long established homestead of the area.	Vegetation of moderate significance.
K307	Roadside native vegetation planting.	Vegetation of moderate significance.
K308	Native Eucalypt specimen tree. This forms a significant visual element in the surrounding vegetation complex and probably predates much of the vegetation within this zone.	Roadside vegetation is of aesthetic value as it demonstrates the retention of the roadside planting and forms a substantial landscape character.
K309	Roadside native vegetation planting opposite the Koinglo Homestead. This reflects a landform associated with the creek and forms a mature landscape of native trees.	Vegetation of aesthetic value providing supplementary roadside vegetation and being representative of vegetation associated with creek lines in the area. Considered to be of moderate significance.
K310	Cultural planting associated with Koinglo homestead comprising mature cypress and other exotic plantings, probably dating prior to 1945. Vegetation of aesthetic value providing supplementary roadside vegetation representative of that associated with creek lines in the area.	Area of moderate significance.

8.3.5 Impact

Impacts on heritage items would occur predominantly during the construction phase. **Table 8-4** provides a summary of the items, their heritage significance and the potential for impact. Impacts during operation are only included where relevant.

Table 8-4 Summary of heritage impacts

Ref	Description	Significance	Impact
K001	Travellers Joy Inn	State significant archaeological research potential.	Construction: No direct impact Operation: No impact
K002	Fence line	Local heritage significance. No archaeological research potential.	Construction: No direct impact Operation: No impact
K003	Building platform	Local heritage significance	Construction: No direct impact Operation: No impact
K004	Building platform	Local heritage significance	Construction: No direct impact Operation: No impact
K005	Building platform	Local heritage significance	Construction: No direct impact Operation: No impact
K006	Buried remains and planting	Local heritage significance	Construction: No direct impact Operation: No impact
K007-010	Dams	No heritage significance	Construction: Direct impact on K009 and 010
K100	Remains of garage	Local heritage significance	Construction: No direct impact Operation: No impact
K103	Mounted police barracks	State significance	Construction: No direct impact Operation: No impact
K104	Police station/ruin	Local heritage significance	Construction: No direct impact Operation: No impact
K105	Artefact scatter	Local heritage significance	Construction: No direct impact Operation: No impact
K106	Telegraph office	Local heritage significance	Construction: No direct impact Operation: No impact
K107	Cemetery reserve	Potentially State significant.	Construction: Direct impact Operation: No impact
K108	Road remnant	Local heritage significance	Construction: No direct impact Operation: No impact
K201	Shed, stockyard and water tank	Local heritage significance	Construction: High impacts as the proposed cut will remove part of the stockyard and significantly reduce the foreground of the shed, diminishing the rural setting of the group.
K202	Ruined chimney	Local heritage significance	Construction: Minimal impact Operation: No impact
K203	Kyeamba South Homestead	Former Traveller's Joy Inn. State heritage significance	Construction: Moderate impact Operation: Moderate impact
K204	Road remnant	Local heritage significance	Construction: Minimal Operation: No impact
K205	Road remnant	Local heritage significance	Construction: Minimal Operation: No impact
K301	Pine plantation	Locally significant item	Construction: No impact
K302	Roadside	Locally significant item	Construction: Low impact

Ref	Description	Significance	Impact
	vegetation		
K303	Roadside vegetation	Locally significant item	Construction: Low impact
K304	Cultural planting	Locally significant item	Construction: Moderate impact
K305	Crown reserve	Locally significant item	Construction: Moderate impact
K306	Cultural planting	Locally significant item	Construction: Moderate impact
K307	Roadside vegetation	Locally significant item	Construction: Moderate impact
K308	Native tree	Locally significant item	Construction: Low impact
K309	Roadside planting	Locally significant item	Construction: Moderate impact
K310	Cultural planting	Locally significant item	Construction: Moderate impact

Archaeological items

Two of the eighteen sites of historical archaeological significance are considered to be of State significance (K001 and K003), but neither would be directly affected by the proposal. The Cemetery Reserve (K107), which is of potential State significance, does not appear to have received any interments. Further research is required to determine whether or not interment actually occurred and if so, within which part of the site.

The boundary of the new road reserve has not been confirmed. If items fall within the road reserve they would be listed in the RTA Section 170 heritage register. If any changes in the alignment are necessary prior to construction and potentially affect these sites, further archaeological investigation would be required to document any buried relics.

Built heritage items

One of the five items of built heritage significance identified, the locally significant set of farm structures (site K201), would be directly affected by the proposal. The road remnants (K204 and K205) fall within the new road reserve, as such they would be listed on the RTA Section 170 heritage register.

Landscape heritage items

Ten items have been identified as locally significant. Due to the nature of the works, moderate impacts have been identified for a number of the cultural plantings and roadside vegetation.

8.3.6 Management and mitigation measures

Management and mitigation measures for the built, archaeological and landscape features identified are provided in **Table 8-5**.

Table 8-5 Summary of heritage mitigation measures and management responses.

Potential impacts	Mitigation measures and management responses
Archaeological	
Indirect impact on K001 Travellers Joy Inn	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve. If proposed alignment is modified and item directly affected archaeological investigation required.
Indirect impact on K003 Platform/PAD	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve. If proposed alignment is modified and item directly affected archaeological investigation required.
Indirect impact on K004 Platform/PAD	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact on K005 Platform/PAD	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact ton K006 buried remains and historic plantings	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact on K103 artefact scatter (mounted police barracks)	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact on K104 ruin (school/police station)	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact on K105 Artefact scatter	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Indirect impact on K106 telegraph office site	▪ Avoid disturbance if in new road reserve. Brief construction works team to protect this asset during the construction phase. No action required if this site falls outside the new road reserve.
Loss/damage to K107 cemetery reserve site	▪ Further research required to determine whether interments received at the cemetery and in which location. Archaeological testing if research unsuccessful. If research fails to identify whether burials have occurred removal of soil deposits to be monitored by an archaeologist before road construction to identify any human burial or other cemetery related relics.
Built Heritage	
Loss/damage to K201 shed, stockyard and water tank	▪ Re-evaluate route alignment to move further away from this heritage item. If not feasible, prior to commencement of works undertake photographic archival recording to record group in its original rural setting in accordance with Heritage Office Guidelines.
Damage/disturbance to K203 Kyeamba South Homestead (Former Travellers' Joy Inn)	▪ Detailed design of fill formations to ensure visual impacts on this item are avoided. No noise barriers to be used in the vicinity of this item to retain uninterrupted views.

Potential impacts	Mitigation measures and management responses
Loss or damage to road remnants (K204 and K205)	▪ Assessment of remnants to determine potential to yield archaeological evidences. Although not directly affected by the proposal care to be taken not to disturb the remnants during site preparation or the course of the works.
Landscape Heritage	
Loss or damage to roadside vegetation associated with K302, K303, K307, K308, K309 & K310	▪ Retain significant road vegetation where possible. Where roadway passes through established roadside vegetation, disturbance to existing vegetation associated with the works is to be minimised.
Damage to cultural planting associated with Kyeamba Park homestead (K304)	▪ Assess the finished height of the proposed roadway in this location in relation to the associated landscape setting and the western side of the highway so that the relationship between the two complexes is retained. Further cultural planting to be undertaken.
Impact on Crown reserve (K305)	▪ Maintain integrity of vegetation.
Impact on cultural planting associated with Kyeamba Park (K306)	▪ Assess the finished height of the proposed roadway in this location in relation to the associated landscape setting and the westerns side of the highway so that the relationship between the two complexes is retained. Further cultural planting to be undertaken.

8.6 Surface water hydrology

8.6.1 Existing environment

The study area of Kyeamba is within the Kyeamba Creek Catchment which covers an area of approximately 600 square kilometres. **Figure 8-5** illustrates the rainfall catchment area for the Kyeamba area. Note this figure shows only that catchment which affects the area of proposed highway duplication which is around 55 square kilometres. Kyeamba Creek originates in the Kyeamba foothills and flows to the northwest until its confluence with the Murrumbidgee River near Wagga Wagga. The springs and minor tributaries that drain to the creek originate west of the highway at Kyeamba Hill. As a consequence, the highway is crossed by numerous small drainage channels, via a combination of pipe and box culverts. The main Kyeamba Creek channel crossing occurs at chainage 75,400 at the southern end, running in a north-westerly direction.

Flows within the drainage system are variable. At the time of a recent site inspection the main Kyeamba Creek channel was flowing although a small tributary of the Kyeamba Creek that also crosses the alignment within the study area was dry. Numerous springs are located on the eastern side of the existing alignment at chainages 68500 and 69000, with areas of seasonally waterlogged soils associated with them.

Kyeamba Creek is regarded as a waterway under stress (DNR 2004). Incised channels, eroding banks, declining water quality, degraded riparian zones and changing hydrology are common characteristics of streams within the Kyeamba catchment (Landcare Australia 2006).

The topography includes a mixture of hills and floodplains and the majority of the main streams have shallow gradients. There are areas of scattered forest within the catchment, both native and planted although the majority of the land has been cleared for agriculture.

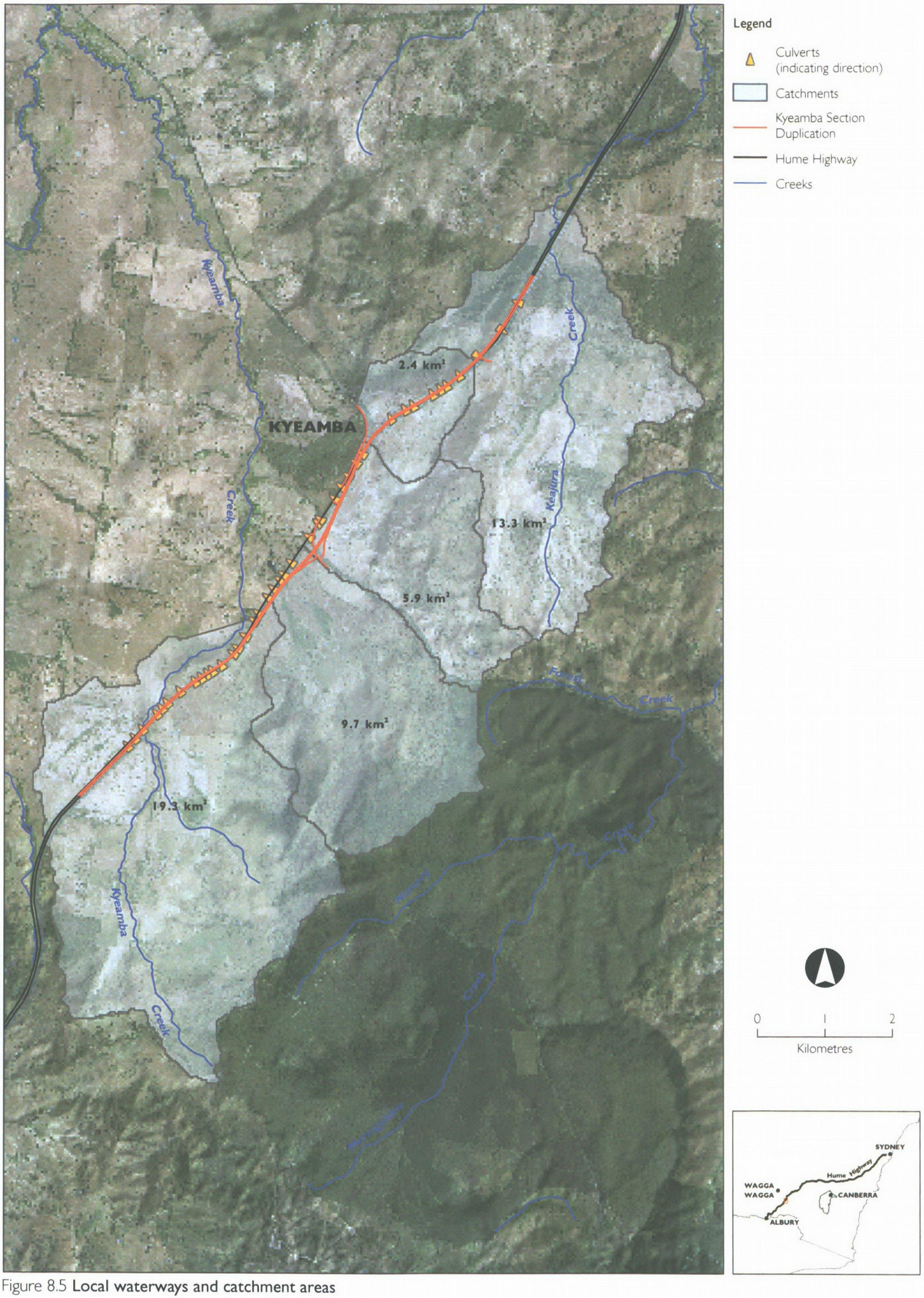

Figure 8.5 **Local waterways and catchment areas**

The Australian Rainfall and Runoff database indicates that catchments in this region typically have low rates of runoff, with the runoff coefficient for the 1 in 10 AEP flood event being between 10 and 20 percent. The low runoff coefficient is due to a number of factors such as:

- typically dry antecedent conditions prior to rainfall because of a relatively low annual rainfall, which produces relatively high infiltration losses;
- permeable soil conditions which encourage relatively high infiltration losses; and
- Low stream gradients and wide floodplains which provide large floodplain storage volumes that attenuate flood peaks.

As a consequence, records of flood inundation affecting the area are generally absent. Advice obtained from Department of Natural Resource indicates that the there are no local flooding issues and that the road is not overtopped in flood events. Localised waterlogging may occur in soils near to the highway and this may occasionally affect the road surface, however, this would not generally amount to actual flood events.

8.6.2 Assessment of impacts

Construction

During construction, the Proposal would have the potential to reduce water quality downstream through the discharge of sediment laden stormwater. Activities such as vegetation removal, earthworks and installation of drainage infrastructure would make underlying unconsolidated soils susceptible to both wind and water erosion. Measures including retention of vegetation where possible, progressive replanting of disturbed areas, sedimentation fencing and basins would be implemented as part of the Proposal to reduce the risk of dirty water discharges.

Measures implemented during construction and operation to manage surface water would serve to meet, as a minimum, the water quality requirements outlined in *the Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC) *2000*. Measures would be implemented in accordance with the RTA *Guide for Construction Water Quality Management* 2000.

Operation

The Proposal would result in an increase in impervious surfaces due to the duplication of the highway. The concentration of runoff could result in higher flow volumes and velocities that in turn would result in changes to in-stream morphology of the waterways. Potential impacts on water quality are also likely from substances such as oils carried from the road surface into adjacent streams.

Although the volume of surface water runoff from the highway would be approximately doubled as a result of duplication, the increase in impervious area as a proportion of the local catchment along the route and actual increase in flows is likely to be negligible and unlikely to represent a measurable increase in peak flows downstream of the Proposal.

The existing highway includes 40 crossings (culverts or bridges) over various waterways with Kyeamba Creek the largest. The new carriageway would require culverts or bridges over each of the 40 waterways and these would be sized following appropriate hydrologic and hydraulic investigations to maintain existing capacity. Duplication of the existing culverts is likely to be adequate in most cases and no change in afflux would be expected to result. Concrete dish drains (Type SO) coupled with piped drains would collect surface water from the road pavement within areas of cutting. Pavement runoff from fill embankments would be

directed over the road shoulder to be collected by grassed table drains running parallel to the road.

Scour protection and energy dissipation devices may be required downstream of the new culverts subject to soil conditions and hydraulic properties. However, the majority of openings would be designed to be the same size or larger than at present, and therefore any potential for waterway restriction and resulting scouring would be reduced. The reinforced concrete box culvert on the existing carriageway spanning Kyeamba Creek would be replaced by a new bridge to allow the natural channel form to be reinstated. A similar bridge would be constructed over Kyeamba Creek on the new carriageway. The embankments would be inspected during the detailed design stage, to determine if there is any need for extra protection against scour. Potential scour for the proposed new bridge over Kyeamba Creek may be an issue for extreme flood events. In accordance with standard design requirements the scour should be assessed for flood events up to the 1 in 2000 AEP and, if necessary, appropriate measures would be taken to confirm the structural stability of the bridge.

The Proposal would not have any residual impacts on flooding within the area as drainage infrastructure has been designed to maintain acceptable hydrological capacity. There is sufficient capacity for transverse drainage through the Proposal study area, and as such there would be no upstream flooding issues.

Ultimately, the duplication of the highway does not change flood behaviour as:

- no waterways are being redirected;
- additional structures would not further restrict flow; and
- additional impervious surface areas associated with the new carriageway are negligible in comparison to the total catchment area, (less than 0.2%).

The main potential operational impacts would be the possible addition of contaminants to the waterways in the vicinity of the works. The duplicated highway section would create a larger surface area for pollutants to accumulate during dry weather. However, the majority of pollutants are sourced from vehicles, and the duplication would not in itself result in increased traffic volumes. Therefore, essentially the same volume of pollutants such as oils, rubber, sediment and metals would be present, but spread over a larger area. Rainfall runoff that would suspend and transport pollutants would be of a higher volume (due to the larger surface area of the road) meaning that pollutants would be effectively diluted compared to the existing situation, and have less potential to impact on water quality.

While the Proposal would result in some increase in the volume of water discharged to local creeks and waterways, the addition of primary water treatment in the form of stormwater basins with oil and sediment retention capabilities, would result in no net change to runoff water quality from the dual carriageway road.

The greatest risk to the surrounding catchment is related to spills from accidents involving road tankers. The existing Hume Highway along this section does not include any water quality treatment or spill containment facilities. The duplication is likely to reduce the accident rate and therefore reduce the risk of spills. However, water quality treatment and spill containment facilities would be installed, compliant with current best practice. Consequently, all pavement runoff would pass through water treatment/spill containment basins (combining sedimentation and oil/water separation capabilities) prior to discharge to natural waterways. The spill containment basins would have a minimum storage capacity of 4,000 litres.

Improvements in carriageway alignment, improved motor vehicle efficiency and reduction in collision potential, would serve to reduce the likelihood and severity of accidents and associated accidental spillages.

8.6.3 Mitigation measures and management response

Table 8-6 Summary of surface water mitigation measures and management responses.

Potential impacts	Mitigation measures and management responses
During construction	
Waterway pollution /reduction in water quality/degradation of land	▪ Retain grass/shrub cover on the soil surface in the vicinity of drainage lines to minimise erosion and sedimentation impacts when clearing. ▪ Divert clean runoff around the site by installing diversion drains at the upstream limits of construction areas. ▪ Install sediment basins in the early stages of construction and divert as much dirty runoff to these basins as possible. Turbid runoff would be treated on-site with flocculants or other suitable measures to an acceptable quality for subsequent release. ▪ Install scour protection in creek/river banks areas at risk of erosion. ▪ Install culverts as early as possible in the construction process to ensure that transverse drainage is in place during early stages of construction. Permanent stream protection measures and other waterway structures requirements would also be completed as quickly as possible.
During operation	
Pollution of waterways /reduction in water quality/degradation of land	▪ Convert construction sediment basins to permanent water quality control ponds at conclusion of works. ▪ Install separators in permanent water quality control ponds that are also intended for use as spillage control ponds, to prevent discharge of oil and grease products.

8.7 Groundwater hydrology

8.7.1 Existing environment

Groundwater conditions

Section 3.2 of the Environmental Assessment provides a general description of the geology of the study area. The groundwater catchment lies within an intermediate-scale fractured rock aquifer. Overlaying valley fill alluvium provides a shallow secondary local-scale aquifer. There are three main components to the groundwater system in the region:

A. A shallow soil - regolith system composed of the residual soil profile and weathered rock profile down to a depth of several metres.

This through flow 'aquifer' is low yielding and extremely variable in salinity, with salinisation particularly prevalent within the surface 2 metres at localised flow cells. It is not, however, part of the hydrogeological system, since it lies generally above the main water table, but in places is important in flushing salt from the soil profile.

B. A deeper fractured rock aquifer (or complex of sub-aquifers) below the base of bedrock weathering, with its upper surface marked by the water table (Lachlan Formation).

This system is unconfined in its upper reaches, but becomes confined beneath colluvial clay blankets in footslope locations (where the Hume Highway alignment is most commonly located). In places artesian pressures may have developed in recent decades. The salinity of this groundwater is variable, but generally increases close to discharge areas (valley bottoms, gully floors and floodplain edges) due to evaporative concentration of dissolved salts.

Groundwater in the fractured rock aquifers crosses the surface catchment divide between Tarcutta and Kyeamba. Groundwater flow is generally northward and the water levels in this aquifer are increasingly shallow towards the lower reaches of Kyeamba Creek near its confluence with the Murrumbidgee River (Cresswell et al. 2003). In a regional sense, groundwater drawdown is concentrated towards the built up areas of Wagga Wagga and the Gumly Gumly towns, where a large component of domestic water supply is derived from the aquifer locally.

C. An alluvial sand and gravel aquifer, beneath the floodplains of the main watercourses up to 70 metres thick in buried channels (Cowra Formation).

Superficial waters follow the routes outlined by the alluvial sediments within the Tarcutta and Kyeamba catchments in particular. The unconfined aquifers in the alluvial sediments are more commonly accessed for domestic and farm supplies and groundwater levels in the alluvial aquifers have remained steady over the last 30 years (Cresswell et al. 2003).

These aquifers may be confined or semi-confined beneath a capping of recent clay and silt deposits locally several metres thick. This aquifer is likely to be the highest-yielding, with the best individual wells discharging up to one megalitre per day (ML/day). Riverina Water County Council has reported individual yields of up 110 L/sec in the East Wagga Wagga bores located in up to 76m of alluvial deposit, (RWCC, 2002). Water quality in this area is generally reported to be very good, with very low Total Dissolved Solid (TDS) values. Yields and aquifer thickness are expected to increase in a north westerly direction, as the buried channels deepen towards the Murrumbidgee River.

Sediments in the lower end of the Tarcutta and Kyeamba catchments are likely to vary between 20 and 50 metres in depth. Bores drilled in the lower reaches of these catchments would be expected to have a higher yield than those further upstream.

Regional water use

A DLWC (2000) study paper of the Kyeamba catchment provides an indication of water use patterns in the region. The study paper shows a total allocation of 1,834 ML, including 13 high yield licences. The average entitlement for an irrigation license is approximately 130 ML (DWLC 2000), and it is estimated that the annual usage of this allocation at Kyeamba is 1,596 ML, suggesting that there are a number of dormant licences (water allocations not being utilised), or excess water available under the allocation for other purposes. Almost 95 per cent of usage is taken up by irrigation with the remainder used for town water supplies.

Groundwater levels within the catchment are highly dependent on rainfall conditions with cumulative rainfall trends correlating strongly with groundwater trends (Cresswell et al. 2003). These trends are most apparent in shallow alluvium areas where rainfall and resulting stream flow is likely to influence groundwater levels (DLWC 2000). Since 2000, the area has experienced extended drought conditions, with the last 36 months to September 2006 showing serious to severe rainfall deficiencies based on rainfall percentiles (BOM, 2006).

Detailed hydrogeological information for the vicinity of the Proposal was obtained from a number of sources and included Department of Natural Resources (DNR) borehole location data base (DNR 2006). A corridor five kilometres wide on either side of the Hume Highway

between Tarcutta and Little Billabong Creeks contains 125 registered wells and boreholes. dating back to 1930, although only a small proportion of these would still be operational. Many of these bores were never licensed for use, although they are still registered by the DNR. The depth of many of the bores is less than 20 metres, with fewer than 10 per cent deeper than 50 metres. Standing water levels, where noted in the records, are mostly in the range of 2 to 25 metres, indicating the variability of the water table within the region.

Figure 8-6 details registered bores and known yield figures above 1L/sec within the region tken from the DNR database (2006). Standing water levels range from about two metres below ground in the Tarcutta and Kyeamba Creek alluvium, down to about 15 metres below ground at Gumly Gumly. Towards Billabong Creek, yields have been reported up to 12L/sec at depths of up to 25 metres, in alluvial deposits as recently as 2003.

Bore yields, given for only about 10 per cent of the sites, are in the range one to 15 litres per second (L/sec) (around 0.1 to 1.5 megalitres per day (ML/day)). About 80 per cent of these bores are located within broad drainage valleys where higher yielding bores have traditionally been located. There is alluvium of approximately 30 to 40 metres depth near Tarcutta which produces individual yields of up to 6L/sec of good quality water (RWCC, 2002). An apparent paleochannel approximately five kilometres west of the Hume Highway in the vicinity of Billabong Creek has been identified where yields of 50-60 L/sec have been recorded during previous logs. However, the precise location and extent of the paleochannel is uncertain at present (pers comm. DNR).

Bedrock wells are likely to be at the lower end of the discharge range, with granite bores less productive than ones in the metamorphic rocks. Historically the igneous rocks have low yields in the region of <0.3 L/sec and bore drilling should therefore be avoided in these rock formations. Salinity, where given in the data, is stated as <500 milligrams per litre (mg/L) TDS. However, it is likely that many of the bores are only of stock quality, with salinities in the range of 500 to 3000 mg/L. Nevertheless, the completion and equipping of a borehole is evidence that the water is of some useful quality.

Existing salinity and waterlogging

Dryland salinity and high salinity levels in local waterways are known environmental issues in the region. Salinity is highly variable throughout the catchment (up to two orders of magnitude within a few kilometres) with deeper aquifers commonly being slightly fresher than upper aquifers (Cresswell et al. 2003). Salinity mapping has been undertaken within the catchment with a section of Keajura Creek on the eastern side of the study area identified as supporting land subject to salinity (DLWC 2001).

Areas of localised salinisation have been found within the study area caused by poor drainage at the Hume Highway. Other areas of salt outbreak have been identified specifically along Tumbarumba Road to the east of the highway. Actual areas of waterlogging and salinity will be dependent on the nature of the soils and the presence and strength of a subsurface layer of clay material which can preclude the upward movement of water. Where this impact has been identified, it is probably caused by poor drainage of shallow lateral flows leading to saline outbreaks because of subsequent evapo-transpiration, rather than rising saline groundwater (RTA, 2006).

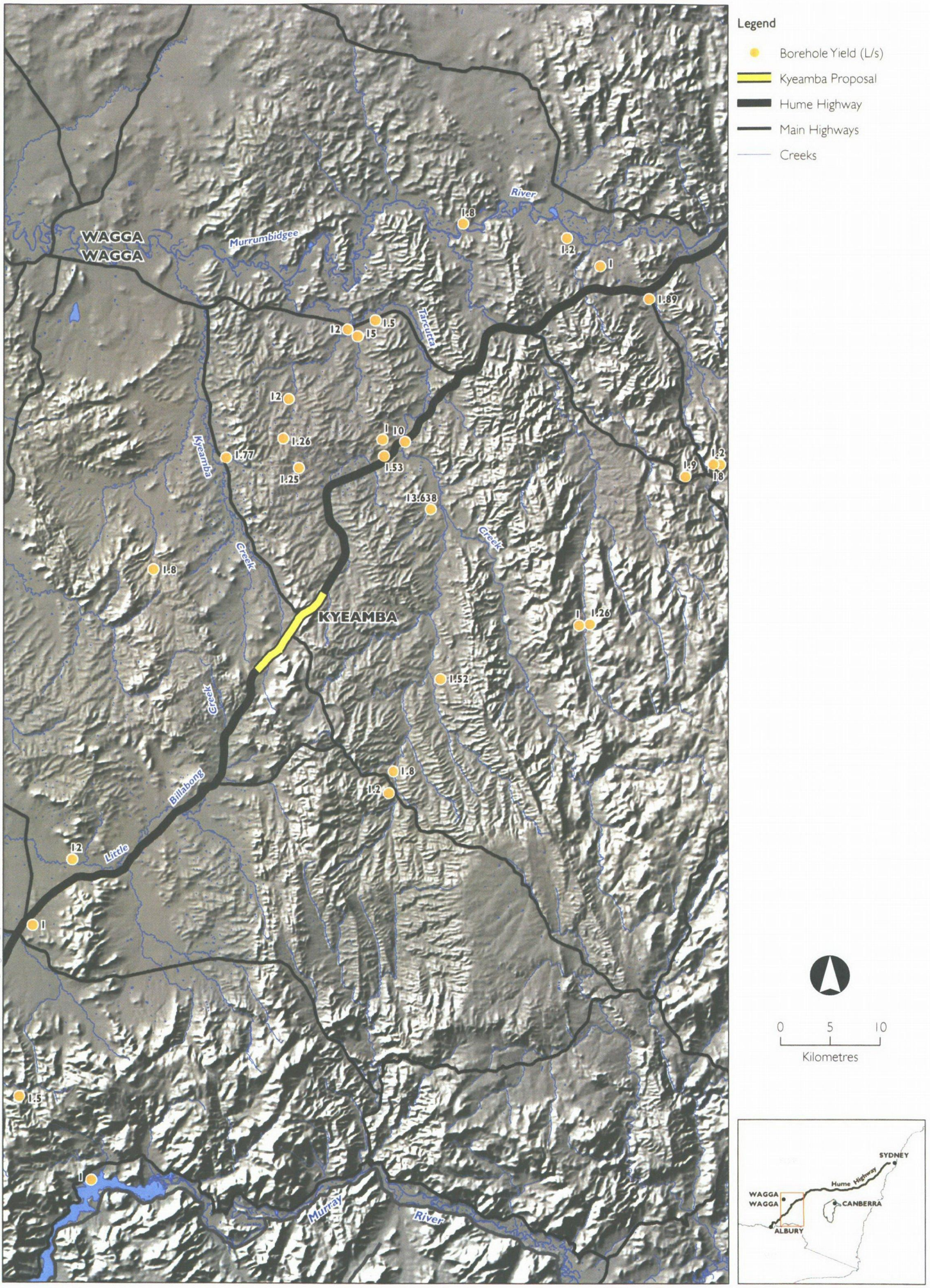

Figure 8.6 **Groundwater bore localities and bore yields**

8.7.2 Assessment of impacts

Construction

Water resource requirements

Large volumes of water would be required for the Proposal during construction. Experience from similar projects undertaken within the region has suggested that volumes of water required during construction can peak at approximately 300L/m^3 of earth moved during summer, and drop to somewhere between 50 to100L/m^3 during cooler months. These figures would equate to somewhere in the order of 1 to 2 ML/day during peak summer earthworks.

Using these likely water requirement figures, the earthworks phase can be expected to require approximately 93 ML of construction water, based on a total earthworks (cut and fill) estimate of 308, 782m^3 for Kyeamba. Water to manufacture concrete pavement would be additional to this, and total approximately 15ML, based on an expected requirement of approximately 1ML per kilometres of two lane highway) for the Proposal. Other water requirements, including site compounds and worker facilities, are expected to represent minor demands on water.

This water may be purchased from the Riverina Water County Council (RWCC), servicing Wagga Wagga and towns like Tarcutta and Woomargama. However, transportation of water from distant areas for construction is not considered feasible due to the large volumes of water required, and ancillary impacts and costs associated with carting the water to the construction sites. Given the limited volume of surface water within the study area catchment, particularly in the current drought conditions, it is likely that this construction water would need to be derived from groundwater stores. Potential impacts of using groundwater within the catchment would include its depletion within the catchment, and subsequent impacts on other groundwater users.

Pending the outcomes of the detailed hydrogeological assessment into the current conditions of the local groundwater, it would appear that based on historical figures regarding water use and water availability, the construction water requirements of the Proposal could be met, without significant impacts to groundwater stores.

Other water conservation measures such as construction water reuse, the use of surfactants to reduce water demand during compaction and dust suppression, undertaking compaction early in the day when evaporation rates are lower, and even dry compaction of lower courses of embankments, would reduce required water volumes for construction.

Water procurement and delivery

Should groundwater be considered to be a feasible source of water for construction, specific management measures would need to be implemented to prevent adverse impacts on other groundwater users within the catchment. A detailed hydrogeological assessment to identify the extent and nature of the groundwater system would aid in determining the most appropriate locations for any water extraction. This assessment would be undertaken in consultation with DNR, and would also consider delivery mechanisms required should suitable groundwater sources not be located within or immediately adjacent to the study area.

During construction, facilities would be required to transport and store water prior to use, including storage tanks, reservoirs and possibly temporary pipelines or tanker trucks to convey water from source to storage. Details relating to these facilities and activities would

be determined during detailed design and prior to construction. If reservoirs were chosen as the most appropriate type of water storage, consideration would be given to providing covers for these storages to reduce evaporative loss during the summer months.

Groundwater contamination

Pollution of the groundwater during construction may result from accidental spills or changes in the hydrological regime (for example during earthwork or placement of ancillary facilities). Groundwater vulnerability mapping has been undertaken for the Murrumbidgee Catchment (DLWC 1999). These maps indicate that within Kyeamba, the vulnerability of the aquifer system to contamination adjacent to the proposal is mainly low-moderate, with groundwater vulnerability potential being moderately high in the southern part of the study area **Figure 8-7** illustrates the groundwater vulnerability at Kyeamba in proximity to the highway alignment taken from this mapping.

In general, confined and semi-confined groundwater systems are considered less susceptible to contamination, because the less permeable boundary provides a barrier to groundwater movement (DLWC 1999). To manage areas identified as having a moderate-high vulnerability to groundwater pollution. Sediment detention basins should be suitably located so as to prevent contamination of local groundwater i.e. no located within the southern section.

During construction, earthworks that involve cutting below existing surface levels would have the potential to interact with any shallow groundwater flows, which may inturn affect construction programs. Construction activities in these areas increase the risk of pollution to the watertable, and may require additional earthworks to provide suitable drainage to transport this groundwater away from construction sites and prevent contamination of groundwater. Detailed consideration of these issues would be undertaken prior to and during construction, following completion of a hydrogeological assessment.

Operation

Salinity and waterlogging

Bore data collected within the Kyeamba Valley within the alluvium suggests that the capacity of the alluvium to handle additional water entering from fractured rocks has nearly been reached (Woolley 2006). In areas where there is no alluvium and the pressure head of groundwater is above ground level, water has the potential to travel to the surface and is likely to result in waterlogging and potential salinisation (Woolley 2006). Seasonal waterlogging of the surface soils occurs over much of the footslopes areas, particularly at Kyeamba, resulting in a soaking of agricultural land through rising water-tables. The impacts of waterlogging also include depriving roots of oxygen, inhibiting plant growth and establishment.

In general terms, dryland salinity is a problem associated with increased water supply in salty landscapes (Spies and Woodgate 2005). The Proposal would result in additional water being available to the landscape, via increased impervious areas, and the concurrent removal of vegetation. The climate, land cover, soil characteristics, salt stores and the hydrogeology and geomorphology of the landscape determine whether this increase in water is enough to cause dryland salinity (Coram, et al. 2001).

In addition, the highway duplication may exacerbate the salinity problem by creating an impermeable barrier to the movement of shallow groundwaters. Groundwaters may be impounded upslope of the road and eventually rise to the surface. Salts are then concentrated to the surface by evaporative transfer. The increase of waterlogging and the

removal of mature vegetation along the highway corridor thus exacerbates the waterlogging and salinisation issues.

Areas vulnerable to impacts relating to waterlogging and salinity would be identified as part of the detailed hydrogeological assessment and management measures would be implemented in these areas to prevent potential impacts. The outcomes of this assessment would allow a consideration of appropriate management responses to any long term impacts, including the modification of the movement of groundwater, stemming from the operation of the Proposal. Different management responses are required for the two groundwater systems within the local area, and specifically the Kyeamba catchment:

- Within the local alluvial system recharge reduction should be targeted through the establishment of trees or high water-use vegetation (deep-rooted perennial pastures) at each local flow cell rather than as a general coverage (Cresswell et al. 2003; Woolley 2006).
- Direct pumping of groundwater may also be an option in the deeper aquifer. However, Ridley and Pannell (2005) recommend that this approach is only used where plant-based measures are not considered cost-effective or act quickly enough to protect assets due to the uncertainly surrounding potential downstream impacts.

Salinity and groundwater are often closely linked and therefore implementation of management measures such as the establishment of trees is also likely to assist with potential salinity and waterlogging issues.

Groundwater contamination

The constant pollution associated with vehicle exhaust, pavement, brake and tyre wear associated with rural highways (Legret and Pagaotto 1999) would have the potential to interact with the aquifers, those classified as moderate or moderately high groundwater vulnerability to pollution within the study area (DLWC 1999) are particularly at risk. The incorporation of operational detention basins may serve to minimise this pollution potential through the interception of contaminants before they are released into the wider environment. However these would need to lined with an impervious material to prevent seepage of contaminants into groundwater.

Hazards to infrastructure

Potential impacts on the operational life of the new carriageway can result from groundwater seepage adjacent to the pavement. Increase in the water content of the sub-pavement can decrease soil stiffness and cause greater pavement deflections (Kelley 1999). Where localised shallow groundwater flows are identified adjacent to the highway, the implementation of lateral drainage structures such as blind ditches parallel to the highway alignment, can be incorporated to channel localised flows to a lower gradient, thus preventing any highway seepage and keeping subgrade pavement dry (Yuan et al 2006). The implementation of this measure would need to be determined with consideration of secondary impacts associated with minor diversions of groundwater flows and adjacent landowners.

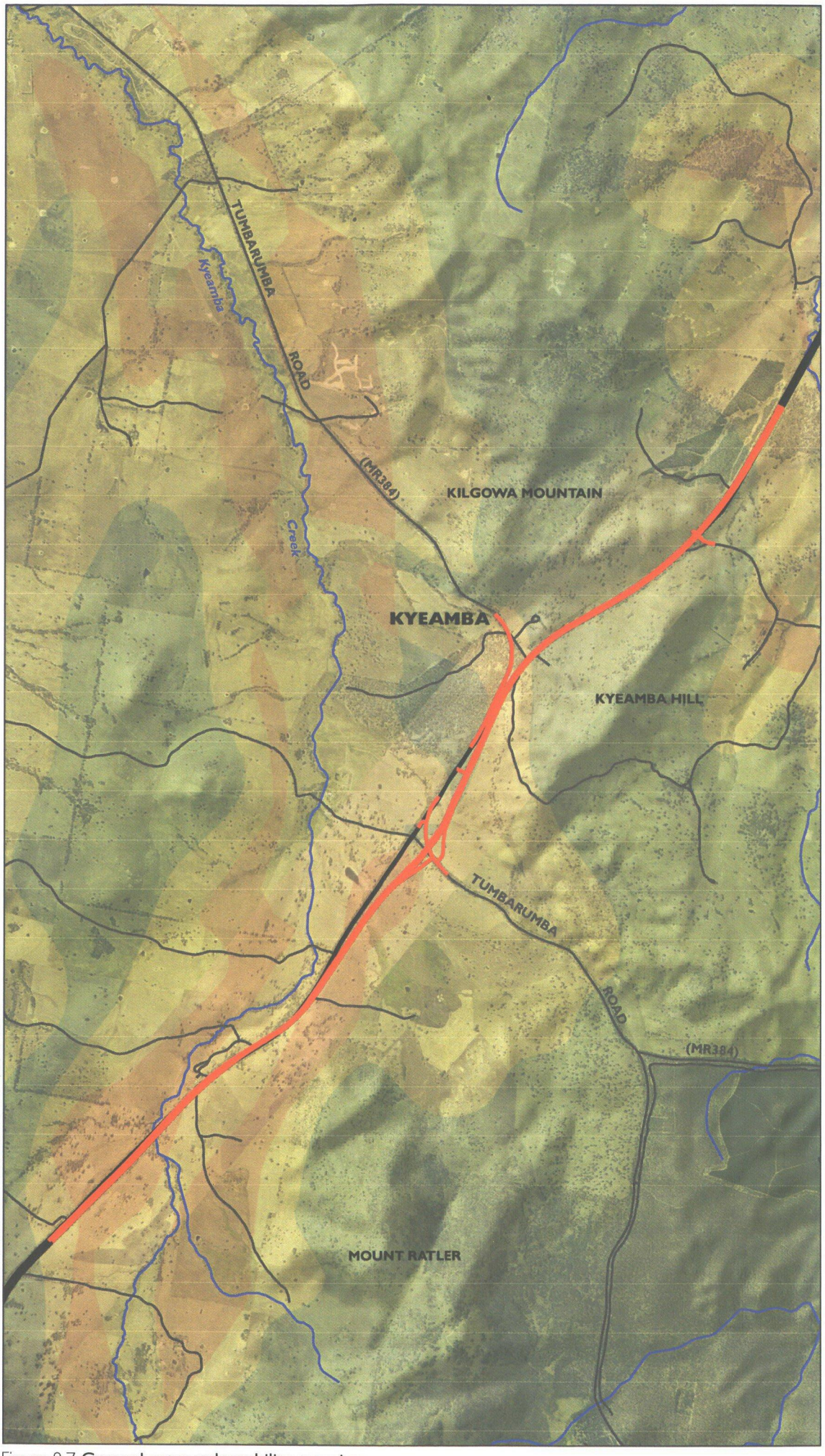

Figure 8.7 **Groundwater vulnerability mapping**

8.7.3 Mitigation measures and management response

Table 8-7 Summary of groundwater mitigation measures and management responses.

Potential impacts	Mitigation measures and management responses
Prior to construction	
Impacts on the local groundwater system, including impacts on adjoining properties	▪ Undertake a detailed hydrogeological survey of the study area, to determine the local characteristics of the groundwater system and identify opportunities and constraints for the Proposal at both construction and operation stage. Particular attention would be given to the ability of the groundwater system to provide for the water requirements of the Proposal. ▪ Identify areas which would be suitable for groundwater extraction, considering as a minimum the following: ▪ Impacts on adjoining land uses and properties. ▪ Requirements for transportation or conveyance of water from the source to the construction site. ▪ Facilities to store water within the construction site, including options to increase water use efficiency, and minimisation of any water loss, for example through evaporation.
During construction	
Interacting with shallow groundwater flows, increased pollution potential and requirements for additional drainage infrastructure to manage additional water flows.	▪ Develop drainage infrastructure and as necessary land management initiatives, for example re-vegetation of local flow cells to manage any groundwater seepage, into the construction site. ▪ Ensure erosion and sediment controls employed to manage surface water quality impacts are suitable to protect pollution of the water table.
During operation	
Impacts on the local groundwater system, including impacts on adjoining properties.	▪ Consider the findings of the detailed hydrogeological survey of the study area, to determine the local characteristics of the groundwater system and identify opportunities and constraints for the Proposal at both construction and operation stage.
Potential for induced localised dry land salinity	▪ Develop strategies to manage groundwater issues associated with surrounding land uses, including management of recharge areas in consultation with local stakeholders, as necessary.
Pollution of the watertable from highway runoff and accidental spills	▪ Capture highway drainage and direct into permanent water quality control ponds, derived from converted sediment basins, used during construction.
Groundwater Impact on required bore depth of other users within catchment	▪ Research into current bores, depths and uses by landholders. Avoidance of areas aquifers are currently heavily drawn upon by bores by landholders.
Waterlogging and associated impacts to vegetation and land capability	▪ Recharge reduction through the establishment of trees or specific cropping patterns in local flow cells as necessary, and in consultation with local stakeholders.
Decreased pavement life	▪ Install appropriate subsurface drainage infrastructure, for example blind ditches, in areas identified as having shallow groundwater levels, to divert groundwater away from pavement sub-grade.

8.8 Resource management

The Proposal would involve major cutting and fill activities along the alignment. This is particularly prevalent at the intersection with Tumbarumba Road at chainage 71600, where it is proposed to construct the highway alignment to allow the Tumbarumba Road to traverse the highway via an overpass. For the most part the Proposal is designed to achieve an earthworks cut and fill balance. However, currently fill requirements identify a shortfall in the order of 100,000 m^3 (approximately 170,000 tonnes). This fill deficit would need to be imported from suitable sites close to the road corridor.

Comprehensive geotechnical investigations are to be undertaken during the detailed designed stage in order to refine earthworks volumes, and identify the quality of materials to be used in construction. As part of these investigations there would be a detailed identification of additional fill requirements, including the types of material required, specific volumes required, and specific sources of this material.

Fill, including select material could be derived from three potential sources. In order of priority, these are:

- Other duplication proposals being undertaken as part of the Hume Highway Duplication.
- Licensed quarries in the adjacent area.
- A borrow pit within or adjacent to the Proposal corridor.

There is the potential to source some of the required fill from the other sections of the Hume Highway undergoing duplication concurrently with the Kyeamba Hill duplication. However, it is expected that the majority of fill would need to be obtained from a material extraction facility located within the surrounding area, and not within the Proposal corridor. A potential source of this fill material would be an existing quarry site located within the vicinity of Tumbarumba Road (east), approximately three kilometres east from the Proposal site. This quarry site is located off Humula Eight Mile Road 'Sykes Pit' near Forest Creek, and currently supplies schist material for the regional road maintenance requirements.

In addition to the Sykes Pit quarry, a review of the Department of Primary Industries (DPI) *Wagga Wagga Industrial Minerals Map and Register* has identified up to four other quarries within a 10 kilometre radius of the proposal which could supply construction materials.
These other quarries include;

- Bulgalgee.
- Holbrook Area.
- Rosalie.
- Burkinshaws Lane.

The establishment of a new quarry or expansion of an existing quarry, if necessary, would be subject to a separate environmental assessment. Although a quarry Proposal is not the subject of this environmental assessment it is important to consider the implications of the Proposal in regard to processing, transport and rehabilitation of any such areas.

The key activities that would require further assessment include:

- The operation and establishment (if required) of such an extraction facility.
- The impact of transporting material from the quarry site to the Proposal area via local roads, and the need or otherwise to construct any additional haulage roads for this purpose.
- The impact of approximately 6000 – 9000 additional truck movements during the construction period.

Quarry operations are expected to include site clearance and management, material extraction and processing, progressive rehabilitation, environmental controls for aspects such as soil, noise and water.

Information regarding the potential impacts of a quarry extraction in relation to traffic and road network, air quality and noise are found in Chapter 9. Management measures for the potential impacts would be developed and implemented by the RTA in consultation with Department of Planning and Department of Primary Industries, once a suitable source is located.

8.9 Cumulative impacts

Cumulative impacts would arise from the synergistic interaction of the construction and operation of the proposed duplication of the Kyeamba section of the Hume Highway Duplication with the other four sections to be constructed simultaneously and with other major activities to be undertaken in the region over the same period. For the purposes of this assessment cumulative impacts are defined as the residual effects (following the implementation of mitigation measures) which may result from the whole of the Hume Highway Duplication program.

The Proposal, which is the subject of the Environmental Assessment, is one of five to be implemented simultaneously over the period from 2007 to 2009. Other projects and proposals which require consideration in relation to cumulative effects are:

- Albury Wodonga Hume Freeway to be completed in 2007.
- Kyeamba Hill duplication.
- Little Billabong duplication.
- Yarra Yarra to Holbrook duplication.
- Woomargama to Mullenganda duplication.
- Tarcutta Bypass to be completed in 2012.
- Holbrook Bypass to be completed in 2012.
- Woomargama Bypass to be completed in 2012.
- Upgrading works on the Main South Railway Line between Junee and Albury.

Other infrastructure works within the region include the Coolac Bypass due to start in late 2006, interchange and bridge works on the Hume Highway at Gundagai, and the truck and trailer interchange facility at Tarcutta due to open late 2006. The majority of these works are expected to be completed prior to a start on the Hume Highway Duplication works and would therefore result in few cumulative impacts.

8.9.1 Assessment of cumulative impacts

Cumulative impacts during the simultaneous construction of five projects along the same major road corridor relate predominantly to the addition of their direct impacts on biodiversity, possible loss of sites of significance to the Aboriginal community and impacts on non-Aboriginal heritage items. Also, requirements for construction resources may result in unsustainable demands, producing short-term procurement issues with attendant increases in project costs.

Cumulative impacts during operation focus predominantly on the achievement of the transport and economic benefits of the combined projects resulting in improvements to road standards. This would have subsequent reductions in the regional road crash numbers, cost reductions for road users due to improved travel efficiencies and improvements in regional access. The undesirable impacts of traffic, such as noise would be mitigated within the context of the individual projects and could not be considered to be cumulative.

Changes to regional and local road network

Improvements in road standards and the removal of inadequate sections of the Hume Highway would result in improved accessibility and associated reduction in crashes, and indirectly result in benefits to the regional economy and public health. Subsequent adjustments to travel behaviour would result in increasing usage of the high standard highway as travellers divert from more direct however lower standard routes. Potential benefits to the road transport industry through improved travel times and efficiency improvements may produce reductions in rail freight and passenger patronage. However, the Commonwealth Government's Auslink Program has identified the Main South Line as one that will receive investment to improve travel efficiency, regardless of the Hume Highway Duplication.

Traffic impacts during construction

Duplication of the Highway at five locations along the Highway corridor would create unavoidable delays to travel during construction. Various measures would be implemented at each worksite aimed at minimising these impacts. In particular these would require developing designs and construction procedures that minimise the need to occupy areas on the existing alignment and that coordination of all the works is achieved in such a manner that excessive delays are not experienced as a result of simultaneous works.

Biodiversity

Approximately 57 hectares of Box-Gum Grassy Woodland would be removed by the Hume Highway Duplication. This area may be reduced, if practicable, during detail design by the use of a narrow medians, steepened batters and adjustment to the alignment. Strategically placed revegetation works within the Hume Highway corridor or adjacent lands would be implemented to offset the loss of this vegetation to the region.

Changes to property access

All five sections of the Hume Highway Duplication would require temporary and/or permanent modification to existing property access. These would be managed in accordance with existing RTA procedures for each Proposal section and would not constitute a cumulative impact.

Aboriginal heritage

Awaiting input from the RTA.

Non-Aboriginal heritage

The design is based on preliminary assessment of historic, built and landscape heritage values along the Hume Highway corridor. As far as possible, items with high heritage conservation values have been avoided. Potential impacts and relevant mitigation measures are recorded in Chapter 8 for the proposal. Cumulative impacts of the Hume Highway Duplication comprise the combined impacts of this Proposal and the other four proposals on existing heritage values.

Resource demand including construction water

The simultaneous construction of five sections of the Hume Highway Duplication totalling 67 kilometres would place considerable demands on resources in the region, particularly those that require substantial volumes of fill material. In most sections, a balance of cut and fill requirements would be achieved, however, in circumstances where fill deficits occur this would need to be imported. In order of preference such fill would be sourced from other sections of the Hume Highway Duplication, a licensed quarry in close proximity to the

proposal and or a new borrow-pit. Cumulative demand would comprise total demand for all construction resources required for the Hume Highway Duplication.

Construction activities would require considerable volumes of water. Efficient construction techniques would minimise this requirement, however over al the Hume Highway Duplication length considerable amounts would need to be sourced. Preliminary investigations indicate that available groundwater resources would be adequate and reliable. In addition, other sources such as town water supplies or large waterways may be a source of supply for those sections where procurement is economically feasible.

8.9.2 Mitigation and Management Measures

All impacts would be managed by generic mitigation measures in addition to those specific to each individual section. The assessment of cumulative impacts is based on those residual effects remaining following the implementation of those measures.

9 Consideration and Management of Other Issues

Chapter 9 of the Environmental Assessment provides a broad assessment of those issues relating to the construction and operation of the proposal. The assessment covers other issues that are not considered to be key issues requiring more detailed study and investigation at this stage of the planning process. The issues addressed in this section are normally associated with road proposals and are routinely managed via the detailed design of the Proposal or by the implementation of measures aimed at ensuring that all necessary environmental criteria and guidelines are achieved.

All necessary mitigation measures and management procedures would be included in the Environmental Management Plans for construction and operation of the Proposal in compliance with RTA *Quality Assurance Specification G36 Environmental Protection.*

Tailored monitoring programs during construction and operation of the Proposal would determine whether these measures are effective or whether they need to be reinforced or changed to achieve the necessary environmental objectives.

Those environmental effects within the category of other issues relate to:

- Traffic.
- Property access.
- Air quality and greenhouse gases.
- Noise and vibration.
- Visual.
- Waste.
- Geology, soils and contaminated land.
- Landuse and property.
- Social.
- Hazards and risk.

With the implementation of mitigation measures in the design and the application of appropriate management measures during construction and operation, residual impacts for these environmental effects are expected to be minor.

9.1 Traffic

The Hume Highway is the principle road transport corridor connecting Sydney and Melbourne and provides for interstate traffic. It also serves important regional and local transport functions and thus is an important part of the NSW State and regional road network (RTA 2006). The reliable and efficient operation of the Hume Highway is vital to the economy of the NSW State and Victorian State. The Hume Highway Duplication would greatly improve its operation, however, construction works to achieve it would undoubtedly create delays. Great care would be taken to make certain that any delays to road users during the upgrading process are kept to a minimum and that relevant and timely information about these delays is available.

Approximate traffic volumes for the study area for 2003 were 8,300 vehicles per day (AADT). In terms of traffic composition heavy vehicle transport comprises approximately 39 percent of the highway traffic. The peak period for heavy vehicles is between 8pm to 1am. The higher volume of heavy vehicles and lower volume of general traffic on the highway at night means that a high proportion of total night time traffic is heavy vehicles.

In addition to the highway, the study area is serviced by Main Road 384 – Tumbarumba Road. Tumbarumba Road is an important east-west link in the region and this road accommodates traffic figures of approximately 400 vehicles per day (AADT).

The proposed design includes a major upgrade to the Tumbarumba Road intersection to create a new, grade separated interchange with the highway, as described in Chapter 4. In addition, new bus turnarounds bays and improvements for local access will improve the local road and highway network.

Construction

The Proposal is likely to cause traffic disruptions on the Hume Highway and local connecting roads during construction. It is anticipated that impacts on motorists would be limited mainly to short time delays and an increase in travelling times during periods of the construction works.

During the construction period six main strategies would be implemented to reduce the impact on traffic in the study area and would include:

1) Proactive and coordinated planning throughout the construction process.
2) Safe provision for traffic to be made at all work sites.
3) Delays to traffic at each work site would be minimised.
4) Duplication works would be coordinated to minimise cumulative delays.
5) Informing the road user about:
   - work locations;
   - timing of works;
   - hours of work;
   - speed zoning;
   - changed traffic conditions;
   - the delays they are likely to encounter; and
   - other routes which might be suitable.
6) Local community's awareness of the works.

The existing carriageway of the Hume Highway would remain under traffic while the new carriageway is constructed. Minor short-term impacts would occur while the new carriageway is joined to the existing duplicated sections of the carriageway at either end. In the absence of alternative routes, delays and traffic stoppages would be minimised by the provision of local deviations and minor detours. Similarly, where crossovers are required it is anticipated that minor short-term impacts would occur when traffic is diverted to the new carriageway.

Impacts on freight movements are expected to minor as the majority of heavy vehicles using the Hume Highway in the Proposal area travel at night (8pm to 1am) and is anticipated that the majority of works would be undertaken outside this period.

Many homesteads and farms within the Proposal site have direct access to the highway. During construction there is the potential that while heavy machinery is operating in the vicinity of these access points that access would be temporarily curtailed or suspended. Construction traffic management plans would be developed to address these issues and include provisions to maintain access to all adjacent properties and side roads. Where possible, construction traffic would be separated from highway users by the early clearance of the alignment and the development of construction lanes where this is necessary.

During the earthwork phase of the construction period, there would be a requirement for large quantities of fill material to be imported from offsite locations. At current estimates this fill importation is in the order of 100,000m^3 which would have to be brought in on truck

from the surrounding regions. A potential source of this fill material would be an existing quarry site located within the vicinity of Tumbarumba Road (east), approximately three kilometres east from the Proposal site.

In terms of truck movements, a worst case scenario loading of around 100,000 m^3 of fill has been estimated at around 80 trucks per day, based on a 5.5 day week for a six month duration. This equates to around eight trucks per hour, in a cyclic manner of around one truckload every six minutes. In addition, other construction traffic would be generated during the construction phase.

Tumbarumba Road in this section is a two lane rural arterial road that has sealed bitumen pavement, with a 60km/h speed limit applying. Kyeamba Gap quarry is located one kilometre off Tumbarumba Road (east), along an unsealed access road. This single lane unsealed road provides rural access to Humula to the east. Although it may be used infrequently for residential access to Humula, it is expected that traffic use of this road would be very low.

Use of these roads for haulage of fill material is not expected to generate any significant traffic issues with adequate capacity and suitable road conditions to serve the purpose of the proposal.

However, it is anticipated that an analysis of the haulage routes would be undertaken during the detailed design phase when the requirements for fill are more precisely identified. This analysis would include impact to the local road network and the needs of local users, preferable times for haulage operations, the interaction with other construction activities being undertaken, anticipated performance of intersections and the requirements for access from the material extraction areas including sight distances and safety along the route and a condition analysis of the road pavement. The analysis would also include a description of suitable traffic management and control measures for the duration of the proposal.

The construction contractor would establish and implement traffic management measures to ensure safe and efficient movement of local traffic and to reduce inconvenience to local residents. The local community would be kept informed of these measures through regular contact with the construction contractor.

Operation

Currently, the highway has a higher accident rate than targets set by the RTA, due to the substandard geometry and single carriageway. The separation of the two carriageways would also improve safety by reducing accident rate per VKT and by reducing the severity of accidents (serious injuries and fatalities). Overall the Proposal would result in an improved level of service, road safety conditions and freight efficiency for the Hume Highway between the Sturt Highway and Tabletop.

Adverse traffic impacts as a result of the Proposal during both construction and operation are not considered to be significant. The substantial improvements to safety and transport efficiencies are expected to provide significant benefits for highway users. Adverse impacts would be manageable through the implementation of specific mitigation measures provided in **Table 9-1**.

Table 9-1 Traffic mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Delays to motorists	▪ Develop management measures for the Proposal in accordance with *RTA QA Specification G10 – Traffic Control at Work Sites.* These measures would outline construction vehicle movement arrangements, developed with specific regard to other road works in the region, local traffic movement requirements (stock or machinery) and peak traffic volumes, including long weekends and holiday periods. ▪ Plan construction methods and staging for the project to minimise road closures, subject to other project constraints, and allow staged construction so that disruption to the existing traffic is within acceptable levels.
Local road network	▪ Conduct a pre-construction audit of the surrounding roads adjacent to the Proposal to determine whether additional truck movements would result in the deterioration of the pavement. ▪ Undertake an analysis of the local road network to identify the impact to the local road network in relation to fill haulage operations.

9.2 Air quality and greenhouse gases

The Hume Highway at Kyeamba passes through sparsely populated rural areas with no industrial sources of air borne pollutants. The principal source of emissions is traffic on the Highway although the relatively low average number of vehicles using the route (less than 10,000 per day) could not be considered as having more than a minor effect on local air quality. Existing air quality can therefore be expected to be good, consistent with rural environments generally and well within relevant air quality goals.

Construction

Dust would be generated during construction of the Proposal especially during earthworks. Depositing dust, if present at sufficiently high levels, can reduce the amenity of an area and affect the health of local residents. The total mass of dust generated during the construction of the Proposal would depend on the silt and moisture content of the soil and the type of operation being conducted. Major sources of dust would be bulldozers, scrapers, excavators and wind erosion from exposed surfaces including temporary construction site areas. Any quarrying operations would also contribute to dust emissions, although this is likely to be remote for the site of the road works.

Maximum total dust deposited from any source should be no more than 4 grams per square metre per month over a 12-month period (DEC 2001). Typical dust deposition rates in a rural environment such as that adjacent to this section of the Hume Highway would be in the range of 1 to 2 grams per square metre per month. The Proposal should therefore contribute no more than 2 grams per square metre per month. Monitoring would be undertaken to ensure that dust deposition resulting during construction does not exceed this criterion.

Vehicle emissions from diesel powered construction equipment would also occur. This source is likely to generate negligible emissions at nearby residential receivers as equipment would be operated intermittently during construction and would be dispersed across a number of construction sites.

Operation

Computer modelling of similar projects in rural areas (e.g. *Upgrading the Pacific Highway - Bulahdelah* RTA 2004) has shown that all air quality parameters would remain well within air quality goals within the proximity of highway traffic (0 to 50 metres) even with traffic volumes modelled twice as high as those expected on this section of the Hume Highway. Air quality impacts cannot therefore be considered to be a key issue during operation of the Proposal.

Increases in carbon dioxide concentrations in the atmosphere are expected to cause increases in temperature. Individual road projects are unlikely to have a noticeable effect of greenhouse gas emissions. Approximately 14 percent of total carbon dioxide emissions in NSW are estimated to come from the transport sector. Emissions of carbon dioxide from motor vehicles are directly proportional to fuel consumption. Improved level of service, particularly for heavy vehicles, would increase transport efficiency and reduce fuel consumption to an extent.

Air quality impacts as a result of the Proposal during both construction and operation are not considered to significant and would be manageable through the implementation of standard mitigation measures provided in **Table 9-2**.

Table 9-2 Air quality mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Reduction in air quality	▪ Implement dust emission control measures which may include: watering dry surfaces; covering loads on trucks transporting material to and from site; spray planting cover crop of sterile grasses on long term stockpiles; and removing mud and dirt tracked on to road surfaces; ▪ Monitor and record the effectiveness of measures implemented to control dust emissions; ▪ Monitor emissions from plant and equipment to determine compliance with Australian Design Rules and manufacturers specifications; ▪ Comply with Greenhouse gas emission targets established for the Proposal (50% renewable energy used in site compounds during construction); and ▪ Increase the frequency of dust emission controls such as watering when winds reach a velocity greater than 2.5m per second and modify work practices during high wind events.

9.3 Noise and Vibration

Section 9.3 is based on a desktop noise assessment and model calculation. This model is yet to be verified by field monitoring results. Pending the outcome of this noise monitoring, certain text may be subject to change.

Existing Noise Levels

Ambient noise levels have been measured at key locations along the route to provide information on the current noise environment. Although these measurements provide data on the level of the existing traffic noise, the purpose of the survey is to gather data that is used to validate the predictive accuracy of the road traffic noise model and to provide input to the construction noise impact assessment.

The noise criteria for the Proposal are set independently of the measured noise levels, however, the need for noise mitigation has been assessed, based on a combination of the noise criteria and the existing noise conditions along the Proposal route.

Noise monitoring was performed during October 2006, over a nominal one week period. The location details of the noise monitoring equipment are as follows:

1) Location 1 – X
2) Location 2 – X

The $L_{A10,(18\ hour)}$ and $L_{Aeq,(15\ hour)}$ and $L_{Aeq,9\ (hour)}$ road traffic noise indices and the L_{Amax} descriptors were calculated on a daily basis for these monitoring locations and are summarised as the median of the combined daily results. The daily noise measurement profile is shown graphically in **Appendix F** and summarised in **Table 9-3**.

Table 9-3 Summary of traffic noise descriptors ambient noise monitoring results-dB(A)

Monitoring Location	$L_{A10\ 18\ hour}$	$L_{Aeq\ 15\ hour}$	$L_{Aeq9\ hour}$	L_{Amax} Day	L_{Amax} Night
Location 1 – X					
Location 2 – X					

Table 9-4 presents the summary data for day evening and night time monitored noise levels. The L_{A90} 10th percentile monitoring data provides the basis for setting noise goals for the construction activity based on the DEC's noise criteria. While the L_{A10} 50th percentile is not used in the setting of noise criteria, the assessment of construction noise levels should recognise influences from the existing environment. Refer to **Section 9.4.2** for construction noise criteria and assessment.

Table 9-4 Unattended noise monitoring – location 1

Date	Day		Evening		Night	
	L_{A90}#	L_{A10}*	L_{A90}#	L_{A10}*	L_{A90}#	L_{A10}*
Median						

#

*

At Kyeamba Hill the nearest receivers are residential dwellings located on the eastern side of the highway at chainage 74,000 approximately 30 metres from the road reserve. However, residential receivers are located intermittently on both sides of the highway from 30-200 metres distance. No sensitive land uses exist within the study area.

Construction Noise

Noise from construction activity is measured as the single value noise level that is exceeded for 10 percent of the time (L_{A10}). The DEC recommends limiting the free-field L_{A10} (15 minute) noise levels from a construction site (or works) to meet the goals detailed in the DEC ENCM 1994 *Construction Site Noise*. These goals are consistent with the recommendations in the RTA's *Environmental Noise Management Manual* (ENMM) (2001). These noise goals are dependent on the existing background noise levels and the expected duration of the works. The noise goals for any given duration of construction activity are detailed in **Table 9-5**.

Table 9-5 DEC Construction Criteria Guidelines

Criterion No.	Duration of works	DEC L_{A10} Guidelines
1	Construction period of 4 weeks and under	The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).
2	Construction period greater than 4 weeks and not exceeding 26 weeks	The L_{A10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).
3	Construction period greater than 26 weeks	The DEC does not provide noise control guidelines for construction periods greater than 26 weeks duration, however, it is generally accepted that provided L_{A10} noise levels from the construction area do not exceed a level of 5 dB(A) above background, then adverse (intrusive) noise impacts are not likely to be experienced at nearest sensitive receptor locations.

Source: *Environmental Noise Control Manual* (DEC 1994)

Restrictions are also placed on the hours of construction to ensure that the acoustic amenity of the closest residences is protected. Hours of operation for construction works should follow standard construction times listed below. An allowance for negotiated variations to these times with the DEC may be necessary where construction works need to occur at times outside these hours for operational, safety and access reasons.

- Monday to Friday: 7am to 6pm;
- Saturday: 8am to 1pm; and
- No audible construction work to take place on Sundays or public holidays.

Major construction activity is anticipated occur over 18 months, during which time construction noise would vary depending on the particular activity and its location to sensitive receivers along the duplicated section of highway.

For the construction phase of the proposal, noise sources would be continually moving and are not expected to be located in any one area for more than 26 weeks. Noisiest construction activities are earthworks, drainage and bridging which involve the movement of heavy machinery such as bulldozers and scrapers. Earthworks and construction of major structures such as bridges and major intersections usually have the longest duration at each location.

Insert here detail regarding the actual quantification of noise levels and the amount by which background noise levels are likely to be exceeded at residential dwellings during construction following monitoring results.

Construction vibration

Some blasting would be required for the excavation of cuttings at the northern half of the works, between chainage 67,000 and chainage 72,000. The distance from the area of blasting to the nearest dwelling is at least 100 metres. Vibration levels and overpressure resulting from blasting would largely depend on the charge used and details such as stemming, depth and type of detonating cord.

Criteria are designed to ensure that annoyance from blasting is minimised at the surrounding receivers, by defining maximum levels of blast overpressure and ground vibration. The Australian New Zealand Environment Council (ANZEC) recommends that blast

overpressures does not exceed 115 dB(A) at receivers and that ground borne vibration is limited to a maximum levels of 5mm/s at the nearest dwellings. Careful design can normally maintain blast overpressure levels within the criteria and vibration is rarely a problem beyond 50 metres of the site.

To ensure that blast overpressure levels are within acceptable limits and comply with the ANZEC criteria, the construction contractor would be required to monitor initial trail blasts to obtain rock characteristics, in order to develop a suitable blast program. It is expected that provided a precautionary approach to initial blasts are used and the program adjusted accordingly, compliance with the ANZECC would be achieved.

Noise mitigation measures would be included in a Noise and Vibration Management Plan based on guidelines in Section 9 of the RTA ENMM.

Operational noise

Impacts of operational noise generated by the Proposal have been assessed using the *Environmental Criteria for Road Traffic Noise* (ECRTN) (DEC 1999) from the DEC and additional information contained in the RTA ENMM.

Road traffic noise goals are taken from the DEC ECRTN guidelines. The appropriate noise goal identified for the duplication of the Hume Highway from this guideline is for a *road redevelopment*. The base criteria for this type of road development are recommended as a daytime level of $L_{Aeq\ (15hour)}$ 60 dB (A) and night time level of $L_{Aeq\ (9hour)}$ 55 dB (A). Assessment methodologies and application of these noise criteria to a road Proposal are covered in the RTA ENMM.

Depending on the extent of impact of the current traffic noise environment at a receiver location, the base criteria may be modified for a redeveloped road. These modifying values are known as the allowance criteria. At a location where there is an existing road traffic noise impact the allowance criteria is used in assessing the appropriate forms of noise mitigation. The ECRTN and the ENMM specify that the allowance for a road redevelopment should be within +2 dB(A) of future noise levels calculated for the existing road use at the equivalent time of Proposal opening.

The analysis considers the future traffic scenario for the existing road alignment with projected traffic flows for the year 2009. These values provide the basis for assessing the allowance criterion when compared to the duplicated road design. The design alignment uses the estimated traffic volumes for the year 2019, nominally 10 years after Proposal opening. These results are compared to the ECRTN base criterion and where they exceed these base values, the allowance values are calculated to determine appropriate mitigation requirements for the individual receivers.

The individual receivers for each section were identified using high-resolution aerial photography and the location of these receivers is shown in **Figure 9-1**. These receivers were then individually assessed against the ECRTN criterion for a road redevelopment - night time noise emission - as this is the limiting criterion for the proposal. The results for each receiver are discussed below. The graphical representations of the predicted impacts are shown in the form of noise contours and are presented in **Appendix F**

It is important to note that the results in all cases represent the unmitigated noise impacts for a residential dwelling. The RTA would aim to reduce the actual noise impacts of the alignment to ensure that noise levels at all dwellings comply with the ECRTN criterion through the use of appropriate noise mitigation measures.

Figure 9.1 **Location of noise receivers**

The predicted noise levels for each potentially affected receiver along the Kyeamba Hill highway duplication are shown in **Table 9-6**.

Table 9-6 Predicted noise impacts at Kyeamba receiver locations

Designation	Predicted LAeq Noise Levels 2019		Predicted LAeq Noise Levels 2009		Noise goals	
	Day (15 hour)	Night (9hour)	Day (15 hour)	Night (9hour)	Day (15 hour)	Night (9hour)
KY_1	63	62	63	62	60	59*
KY_2	59	59	57	56	60	58*
KY_3	60	59	58	58	60	59*
KY_4	61	61	59	59	60	59*
KY_5	54	54	52	52	60	55

(*) +2 dB(A) allowance added to the 2009 level to form the assessment goal. The allowance level must be less than the acute noise criterion 60dB(A).

With the exception of KY_5, all receivers at Kyeamba Hill are predicted to be above the ECRTN base criteria levels for a road redevelopment. The receiver at KY_5 indicates an increase of 2 dB(A) above the 2009 levels but is still predicted to be within the ECRTN nighttime noise level goal of 55dB(A). Receivers KY_1 to KY_4 generally exceed allowance criteria for a road redevelopment and the predictions indicate that at least two of the receivers would exceed the acute noise level criterion of LAeq (9hour) 60 dB(A) while the other two would be marginally less than this criterion. *Due to the level of accuracy of modelling predictions, it is recommended that receivers KY_1 to KY_4 inclusive be considered for additional noise mitigation measures.*

Noise and vibration impacts as a result of the Proposal during both construction and operation are unlikely to be major and would be manageable through the implementation of standard mitigation measures provided in **Table 9-7**.

Table 9-7 Noise and vibration mitigation measures and management response

Potential impacts	Mitigation measures and management responses
Pre Construction	
Damage to buildings during construction	▪ Undertake condition surveys on buildings and structures within the potential radius of effect prior to commencement of rockbreaking and pile-driving activities, if required.
During Construction	
Rock blasting annoyance	▪ A specialist blasting contractor would determine the appropriate blast program for the construction. Controlled blasting techniques would be employed where feasible. ▪ Test blasts would be implemented at locations furthest from residential receivers and noise and vibration levels measured at the nearest structures would be undertaken. ▪ The ANZEC criteria for noise from blasting would be employed as meeting this guideline would provide adequate protection from vibration exceedance.
Deterioration of noise environment at affected locations	▪ Adopt best management practices consistent with *RTA Environmental Noise Management Manual, 2001*. ▪ Restrict construction activities to normal construction hours wherever necessary — that is, 7.00 am to 6.00 pm, Monday to Friday; 8.00 am to 1.00 pm, Saturdays (7.00 am if inaudible at residences); and no work on Sunday or public holidays. Work outside these hours would require consultation with the Department of Environment and Conservation and the local community. ▪ Undertake community consultation before commencing

Potential impacts	Mitigation measures and management responses
	construction activities outside normal hours, and advise Department of Environment and Conservation, in accordance with RTA *Environmental Noise Management Manual Practice Note vii — Roadworks Undertaken Outside of Normal Working Hours.* ▪ Implement controls on construction equipment and activities in accordance with Australian Standards and RTA specifications. Regularly inspect, test and maintain all stationary and mobile plant equipment to ensure that emission levels do not deteriorate over the life of the project. ▪ Notify residents prior to noisy or vibration generating activities. ▪ Undertake a noise monitoring program to manage noise and vibration. ▪ Provide residents with a contact name and number to allow complaints or questions to be raised. Establish a procedure for maintaining contact and responding to all complaints within 24 hours.
During Operation	
	▪ To be completed following monitoring results.

9.4 Visual

The visual environment at the Proposal site typically comprises the existing highway infrastructure, farm buildings and residential homesteads, cleared hill slopes, meandering creek lines and pockets of remnant and planted woodlands. The dominant visual features are the hills to the north and the east of the Proposal site, which offer vistas to much of the surrounding regions. In addition, the stands of vegetation on adjoining lands and within the road reserve corridor are a very noticeable aspect of the environment when travelling through the study area.

The nearest residential properties to the Proposal site are located either side of the highway at discrete locations on the alignment. The view to the Proposal site from these properties is obscured by vegetation at most locations. Locations where the current highway would be most visible due to the cleared vegetation exist at chainage 69,500 and 74,700. The dwellings located west of the highway are situated in such a way that local topography and vegetation would obscure or remove any direct line of sight for much of the Proposal.

Construction

During construction, the works would be visible from both the highway and a number of properties within the study area. The elevated location of the homestead situated east of the highway along the Proposal length would provide a direct line of sight west to the proposal. For road users a mixture of deep and shallow cuts, a series of fill embankments and generally cleared exposed corridors would be visible along the length of the construction area. The affects would be exacerbated during the clearing of vegetation, particularly at the southern ends of the Proposal corridor, where views across the highway would be opened up.

There would be some short-term loss of amenity during the construction activity. This would be minimised as much as possible through the progressive rehabilitation of cuttings, embankments and median areas throughout the construction period.

Operation

The Proposal has been designed to minimise the contrast between the local topography and the road by aligning the formation as much as possible with landscape contours. Key landscape design objectives include, but are not limited to:

- Providing a flowing highway alignment that is responsive to, and best fits with, the landscape.
- Providing an enjoyable and memorable motoring experience which engages with the landscape of southwest NSW, and makes best use of views and vistas.
- Providing a well-vegetated road corridor that is cognisant of the natural systems and ecology of the corridor.

The proposed highway infrastructure does not contrast to any great extent with the existing visual environment at the Proposal site and in surrounding areas. The road alignment would be generally within the existing alignment of the road corridor and thus the overall visual impacts are not likely to be high. Much of the road alignment is elevated at near to similar levels that currently exist, and would not be constructed upon high embankments or made through deep cuttings. The works are intended to 'tie-in' with the already duplicated sections of the highway at either end, and in this respect the Proposal would introduce an element of continuity of the visual environment and realise the urban and landscape design vision for the transport corridor.

However, for some properties located close to the current highway alignment boundary the changes would be more noticeable as the works would be situated in the immediate foreground.

This is likely to be more pronounced at the Tumbarumba Road intersection, where substantial cut and fill works are required. The interchange in the middle section of the alignment would result in a more substantial visual change to the surrounding landscape. This would include a major cut into an existing hill slope and the construction of bridges and on and off load access ramps.

The proposed intersection infrastructure is not in close proximity to residential properties although some premises further south at chainage 73,000 are likely to be able to view the changes to the visual environment. These residents may be aware of the construction activities and operational aspects of the proposal. The visual impact of this infrastructure would be moderate to high on these properties, however this would be reduced through the implementation of mitigation measures. The landscape treatment would be sympathetic to the existing environment and this would assist in reducing the visual bulk of the interchange and embankments.

Other areas where the visual qualities of the existing environmental would undergo substantial change are those where extensive vegetation clearing would occur and large cut formations would be made out of the adjoining lands. The visual effects of vegetation clearing would be most prevalent between chainages 73,000 and 75,000.

The landscape treatment of the Proposal would include revegetation of the road corridor using the same vegetation types that occur within the existing environment. Landscaping would be undertaken in suitable areas along the length of the Proposal and include as a minimum the use of locally occurring native plant species. Existing mature vegetation would be retained wherever possible.

It should be noted that no interruption to views to surrounding areas to the north or the west would occur as a result of the proposal. The landscape treatments would be mindful of the existing views to the surrounding low lying areas and would not interrupt these by new plantings. The use of pasture grasses and low shrubs in the low lying areas would reflect the surrounding floodplain landscapes and maintain these views of the landscape.

Table 9-8 Visual mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Reduction in visual quality of the roadside environment	▪ Minimise the width of disturbance required on fill embankments where construction requires the removal of native vegetation. ▪ Stabilise all disturbed areas with native local species reflecting natural vegetation patterns. ▪ Include native tree species in the plant mix in areas where guard rails are present. ▪ Include planting on both sides of new perimeter fences. ▪ Use dark coloured transparent fence material. ▪ Where planting is proposed on steep embankments, stabilise the area with erosion-control matting and mulch topping to improve final appearance.

9.5 Waste

The disposal of waste is an activity regulated by the *Waste Avoidance and Resource Recovery Act 2001*. The Act establishes a waste hierarchy (avoid, recover and dispose) that encourages efficient use of resources and reduction in waste generation. The Department of Environment and Conservation (DEC) is the lead agency in NSW on waste management and has established an implementation framework in the '*Waste Avoidance and Resource Recovery Strategy 2006*'. The Waste Strategy 2006 provides guidance to industries, communities and groups on waste management priorities for action and supersedes the '*Waste Avoidance and Resource Recovery Strategy 2003*'.

Construction

During construction, the following activities would generate waste:

- Earthworks;
- Drainage works;
- Clearing and grubbing;
- Restoration works on existing pavement;
- Equipment maintenance; and
- Site office activities.

The key wastes that would be generated by the above activities include:

- Concrete
- Scrap metal
- Green waste
- Sewage from compound site
- Excavated soil
- Reclaimed asphalt
- General construction waste
- Fuels, oils, liquids and chemicals
- Contaminated/unsuitable soils
- Paper and cardboard

Where possible, material from extractive works would be reused for construction of fill embankments or for select or sub-base components of the formation. Green waste would be mulched and incorporated in landscaping works. All other waste streams including construction waste would be removed and disposed of in accordance with the following DEC guideline: *Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-liquid Wastes*.

Operation

Initially there would no waste streams derived from the operation of the proposal. Pavements have been designed for a 40 years design life and it would be unlikely that during this time anything more than routine maintenance would necessary.

The management of waste is not considered a key issue given that standard measures are available to address the waste generation, disposal and reuse in order to minimise potential impacts.

Table 9-9 Waste mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Production of waste	▪ Identify strategies to 'reduce, reuse and recycle'; Give priority to reuse of materials on-site. Where recycling is more feasible, carry out recycling in accordance with the NSW Government's Waste Avoidance and Resource Recovery Strategy 2006. ▪ Transport excavated material not suitable for on-site reuse or recycling, to a site authorised to accept that material for reuse or disposal. ▪ Source materials to avoid in the creation of excess waste. ▪ Chip leaf material and small branches of native vegetation to use as mulch in revegetation works.
Failure to comply with the relevant waste legislation	▪ Develop strategies to transport and dispose of contaminated material if encountered. Contaminated soil identified on site would be classified in accordance with DEC *Waste Classification Guidelines* and would be transported and disposed of in accordance with the *Protection of the Environment Operations (Waste) Regulation* 2005. ▪ Classify waste materials in accordance with the following DEC guideline: *Environmental Guidelines: Assessment, Classification and Management of Liquid and Non-Liquid Wastes.*

9.6 Geology, soils and contaminated land

Soils within the study area vary from clay residual soils on upper slopes, colluvial clay soils on lower gradient foot slopes to alluvial soils (predominantly clay and silt) on the main floodplains.

Anecdotal site history information for the area indicates that there was previously a service station and truck depot located near Tumbarumba Road at chainage 70,000. The historical use of underground storage tank(s) at this site is expected to have resulted in some soil (and possibly groundwater) contamination. This area is located within the proposed road corridor and would therefore be subject to excavation during construction.

Construction

Impacts on geology and soils would be predominantly restricted to the construction phase of the proposal.

The proposed route area intersects a range of slates, phyllites, siltstones, sandstone and granite. This bedrock environment is robust and would not be expected to be impacted as a result of the proposal. Localised instability is possible in rock cutting batters, particularly in the two major cuttings located near Kilgowla Mountain at the northern end of the Proposal and opposite Tumbarumba Road. These cuts would be managed through supporting measures including rock bolting or mesh where considered appropriate.

The soils at lower elevations within the study area are the result of both colluvial and alluvial processes with residual soils similar to colluvial soils located on upper slopes and saddles. The main impact of construction activities on these soils will be related to soil erosion. Clearing of protective vegetation during the construction phase will result in increased susceptibility of underlying unconsolidated soils to both wind and water erosion. The alluvial silts and fine sand soils on the floodplain areas will be particularly erodible. Mitigation measures including the installation of erosion and sedimentation controls, dampening exposed surfaces and progressive and early revegetation strategies would be implemented.

Management measures would be developed in accordance with *Landcom Managing Urban Stormwater: Soils and Construction (4th edition) 2004* and in consultation with the DEC for the construction phase of the proposal, and would include but not be limited to the measures outlined in **Table 9.10**.

The site would be subject to a contamination investigation prior to construction and would be remediated as part of the works. The risk and potential negative impacts associated with the disturbance of contaminated soils (and possibly groundwater) would be minimised through preparation of Remediation Action Plans, appropriate onsite management of contaminated soils, remediation or removal of contaminated soils and validation of excavated areas. This remediation of this historical site would be a positive impact as appropriate remediation of the site during construction would prevent contaminant migration and potential problems in the future.

Operation

An additional effect of road construction on the soils in the Kyeamba Hill area is expected to be localised waterlogging. This will occur where road embankments, which are laid on stripped and compacted soil sub-grades, act as subsurface dams blocking downslope movement of shallow groundwater (that is, through flow moving along the A/B soil profile interface). Further detail regarding the impacts from this and appropriate mitigation measures are provided in Section 8.3.

Management measures to deal with potential impacts with geology, soils and contaminated lands would be implemented as outlined in **Table 9-10**.

Table 9-10 Soil mitigation measures and management response

Potential impacts	Mitigation measures and management responses
Pre Construction	
Soil contamination risk	▪ Manage contaminated land identified during construction in accordance with the requirements of the *Contaminated Land Management Act* 1997 and undertake necessary remediation in accordance with *State Environmental Planning Policy 55 – Remediation of Land* (SEPP 55). ▪ Perform a contamination investigation in accordance with NSW DEC requirements, *Guidelines for Assessing Service Station Sites* (1994) and *Sampling Design Guidelines* (1995). ▪ Preparation and implementation of Remediation Action Plan. ▪ Remediation and/or removal of contaminated soils (and possibly groundwater). ▪ Validation of excavated areas prior to backfilling with clean fill. ▪ Establishment of strict runoff controls around any temporary contaminated soil stockpiles. ▪
During Construction	
Pollution of waterways	▪ Construct temporary stormwater control devices and erosion

Potential impacts	Mitigation measures and management responses
/reduction in air quality/degradation of land	and sedimentation controls where necessary to prevent sediment-laden runoff entering the local drainage system. ▪ Maintain and check the erosion and sedimentation controls on a regular basis with records kept and available on request. ▪ Clear sediment from behind sediment barriers on a regular basis and manage all controls to work effectively at all times. ▪ Include hardstand material or rumble grids at entry and exit points to minimise the tracking of soil and particulates onto pavement surfaces. ▪ Establish stockpiles on slopes less than 2:1 (horizontal to vertical). ▪ Design, establish, operate and decommission all stockpiles in accordance with RTA Stockpile Management Procedures 2001. Locate stockpiles not less than 100m from the high bank of any rivers or drainage lines. ▪ Undertake site rehabilitation of disturbed areas progressively as stages are completed. ▪ Grade out cuttings and embankments , wherever practicable, to reflect and reflect the characteristics of the local natural landform, returning the land to its former use wherever possible.

9.7 Landuse and property

The existing highway alignment passes adjacent to approximately 11 parcels of lands, some of which have permanent residential accommodation in the form of rural homesteads.

Construction

Where practicable, site compounds, access tracks and storage facilities would be located in areas wholly within the road reserve, away from residences to minimise land use impacts during construction. Providing these measures are implemented the potential land use and property impacts during construction are considered to be minimal.

Operation

The upgrade has been designed to minimise the requirement for land take and to minimise the impacts on private properties. The alignment of the duplicated carriageway, where possible, has been confined to land immediately adjacent to the existing highway, avoiding residences, although a greater road corridor width up to 120 metres would be required in some areas to accommodate two new carriageways.

However, it is proposed to move the Tumbarumba Road intersection approximately 200 metres further east to create a new interchange. Also widening of the highway outside of the road reserve would affect land either side. Actual amounts of land affected by acquisition would be finalised in the detailed design. Details of lands affected by the Proposal are provided in **Table 4-3** in Chapter 4.

Table 9-11 Landuse and property mitigation measures and management response

Potential impacts	Mitigation measures and management responses
Pre Construction	
Property acquisitions	Negotiate all property acquisitions in accordance with RTA Land Acquisition Policy, and undertake compensation in accordance with the *Land Acquisition (Just Terms Compensation) Act* 1991. Resolve property acquisitions and/or leasing arrangements between the RTA and property owners prior to commencement of works.

9.8 Social

The duplication of the Kyeamba Hill section of the Hume Highway has the potential to affect the local community, in addition to individual residents surrounding the Proposal.

Community consultation has been progressively undertaken since the announcement of federal funding for the Proposal. This includes community updates and meetings with potentially impacted landowners. Consultation is expected to continue throughout planning and construction stages.

The Environmental Assessment and consultation undertaken to date has identified the following to be the key issues of concern to the community:

- Impact on land use and on private properties.
- Access and potential disruption to connectivity during construction and operation.
- Safety issues.
- Impacts on amenity.

Community profile

Data from the Australian Bureau of Statistics Census (ABS 2001) and the Wagga Wagga City Council Social Plan (WWCC 2004) was synthesised to create a broad picture of community profile. While no specific social or economic indicators exist for Kyeamba, these studies show that the Wagga Wagga area, encompassing the urban area of Wagga Wagga, farming areas and the surrounding villages of Galore, Collingullie, Currawarna, Uranquinty, Mangoplah, Kyeamba, Humula, Tarcutta, Ladysmith and Oura, had a population of 57,249 in 2001. This represents a relatively low growth rate (0.2%), in the five years since the 1996 Census.

In general, the Wagga Wagga regional centre is characterised by a concentration of young families with children dependent on access to community and recreational facilities (WWCC 2004).

In terms of Kyeamba village growth potential, as indicated in Chapter 3 of this report, the village was a once more thriving centre than it is today. This situation is unlikely to currently change unless considerable development pressures came from the regional centres. Owing to the distance of Kyeamba from these centres (i.e one hour drive to Wagga Wagga city) this inaccessibility is likely to keep growth and development pressures low. As for many of the other adjacent rural villages, general population trends indicate populations in rural areas will decline rather than increase.

Further analysis indicates that there is a relatively high proportion of the regional area's population in the agricultural and manufacturing workforce when compared to the Wagga Wagga LGA. The preferred mode of transport is the motor vehicle, and over 73 percent of households have one or two vehicles - slightly higher than the NSW State figure of 70 percent (WWCC 2004). Therefore, there is a high reliance on the motor vehicle and the need for a safe and efficient road network in the regional area.

Access

Many of the rural landholders own and farm adjoining lands on both sides of the existing carriageway. These landholders require access across the highway for machinery and stock to maintain their current farming practices. The Proposal has the potential to reduce this access.

Up to nine residential dwellings have direct access to the existing highway within the limits of the proposal. Access points for properties along the highway would be retained although adjustment may be required. Providing access is maintained and connectivity considerations are addressed during detailed design the potential impact on local residents is considered to be minor.

The Hume Highway is a route of strategic national significance serving intrastate and interstate users and is the main road transport corridor linking Sydney and Melbourne. Approximately 20 million tonnes of freight each year is transported within the corridor (RTA, 2006).

The highway is also a main access route in the region and is used by commuters from some of the southern districts such as Holbrook, to access regional centres of Gundagai and Wagga Wagga. In addition, Tumbarumba Road is also used to access Wagga Wagga from the villages surrounding this section of the highway. The efficiency of the road network is therefore of major social and economic significance to the local community and wider region.

Safety

Road safety is a significant community concern and the proposed duplication can be justified on the grounds of road safety.

Construction

During construction the Proposal has the potential to have short-term adverse impacts on regional and interstate commercial operators and local residents using the highway. Impacts would include traffic delays along the alignment and restrictions to access where works would be conducted to provide crossovers and connections to the existing formation. Traffic management plans would need to be implemented during the construction phase to minimise traffic impacts.

There is the potential for safety issues to occur during construction. This would be minimised through the implementation of speed limitations, diversions and measures to separate construction traffic, maintaining safety for road users and construction personnel. Safety concerns would need to be addressed during construction within a Construction Traffic Management Plan.

During the construction of the proposal, there would be short-term impacts on the general amenity of the study area due to an increase in noise, nuisance dust and general deterioration of the visual quality of the environment. These amenity impacts would be minimised through management of noise and dust emissions and maintaining tidy and well managed site compound areas. Landscaping of the roadside areas would mitigate visual amenity impacts of the construction phase.

Operation

During operation, the Proposal would provide positive social and economic benefits for access and connectivity both locally and within a regional context. Road users would benefit from increased travel time savings attributable to improvements in both vertical and horizontal alignment.

The Proposal would result in an improvement in road safety in the long-term by providing consistent road conditions, increased passing opportunities and intersection improvements along the Hume Highway. One property at chainage 74,000 presently in close proximity to the road reserve, may be marginally closer to the highway than currently. As such there is the potential for impacts on amenity during operation through increased traffic noise and

vibration exposure (refer to Section 9.3). Where potential impacts to social amenity are envisaged, mitigation measures have been included in other sections of this Chapter 9.

Table 9-12 Social mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Disruption to property access	▪ Avoid blocking existing access to properties wherever possible. Where not possible, provide suitable temporary access. ▪ Establish contact point for affected property owners to obtain information about the Project and advise the RTA/construction contractor of matters relevant to their property. ▪ Provide advance notification to property owners on project schedules, construction works and access arrangements. ▪ Incorporate property access arrangements in Construction Traffic Management Plans. ▪ Regrade existing access ways. Where not practicable, provide suitable alternative access routes in consultation with landowners.

9.9 Hazards and risks

The Proposal would give rise to a number of hazards and risks during both construction and operation.

Construction

During construction, in the absence of appropriate environmental management measures, there is the potential for receiving water bodies, land and dependent ecosystems to be adversely affected by the proposal. The receiving environment may be affected by:

- Dangerous and hazardous goods (explosives, fuels, lubricants, oils, cement, paints, solvents and other additives).
- Construction and building waste.
- Traffic hazards during construction.
- Increased sedimentation and turbidity of waterways.
- Spread of noxious weeds.

The implementation of appropriate mitigation measures for erosion, sedimentation and pollution control would minimise the risk to the receiving environment.

The use of dangerous goods may have occupational health and safety implications for workers and members of the public. However, none of the materials or goods used during the construction process, with the exception of explosives, would have the potential to affect members of the public directly. The implementation of Australian Standards for the storage and handling of dangerous goods would reduce the potential for adverse affects on the workforce or members of the public.

Traffic accidents or incidents involving members of the public moving through and adjacent to work sites would have the potential to occur during construction. Standard measures including the implementation of traffic management strategies to divert traffic away from work areas, separate construction vehicles and plant from the road network, and to slow traffic through and adjacent to the work site would reduce the risks to members of the public.

Operation

During operation there is the potential for contaminants arising from normal operation of the highway (tyre and brake wear, engine oil leaks, litter) or chemicals from accidental

spillages to adversely affect the quality of the local environment. The main route for these contaminants to the environment is via water flows from pavement surfaces. The installation of sedimentation basins with oil and water separation baffles and sufficient storage capacity for spillages would reduce the risk to the environment.

Risks to members of the public during operation would relate to incidents involving the release of dangerous goods. However, traffic accidents involving vehicles transporting chemicals and other dangerous goods would generally affect only a small area with hazards relating to toxic effects, fire and explosions. The Proposal is located within a sparsely populated area and any incidents would have limited potential to affect those not directly involved in a traffic accident or incident. In the event of an incident involving dangerous goods it is known that emergency services equipped to deal with chemical spillages are located at Holbrook and it would be anticipated that response times would be low.

The Proposal has been designed to meet Australian Standards for highways and would contribute to an overall improvement in driving conditions. The Proposal would reduce the likelihood of serious head-on collisions through separation of carriageways.

The Proposal would have the potential to create a number of hazards and risks during both construction and operation. However, the identified hazards and risks would be normal for a highway and manageable through the implementation of standard mitigation measures as detailed in **Table 9-13**.

Table 9-13 Hazards and risk mitigation measures and management response

Potential impacts	Mitigation measures and management responses
During Construction	
Risk to human life and degradation of the natural environment	▪ Develop and implement procedures to achieve compliance with all legislative and industry standard requirements for the safe handling and storage of hazardous substances and dangerous goods. ▪ Bund storage areas for oils and other hazardous liquids in accordance with Australian Standards and collect any spillages for off-site disposal at a licensed facility ▪ Conduct activities with the potential for spillage such as refuelling, maintenance of equipment, mixing of cutting oil and bitumen in bunded areas away from watercourses. ▪ Undertake potentially hazardous and contaminating activities (such as washing construction plant, refuelling plant and handling hazardous chemicals) only at appropriate locations that have adequate environmental protection measures..

10 Draft Statement of Commitments

10.1 Overview

The Environmental Assessment in Chapters 8 and 9 has identified measures to manage any potential impacts associated with the Proposal. This chapter presents the measures as draft commitments that the RTA will undertake as part of the construction and operation of the Hume Highway Duplication at Kyeamba. The draft commitments may be amended in response to stakeholder and community input during the display of the Environmental Assessment, in addition to any requirements the Minister for Planning may incorporate as Conditions of Approval. Following project approval, the RTA and its contractors will be required to deliver and operate the project in accordance with these commitments.

10.2 Draft commitments

The draft Statement of Commitments, including commitments relating to key issues assessed in Chapter 8 and other issues assessed in Chapter 9 is provided in **Table 10-1**. The statement of commitments includes, for each draft commitment:

- An objective.
- Details of the commitment.
- Reference to when the commitment applies.
- Reference to any relevant standard, benchmarks or guiding principles influencing the objective and implementation of the commitment.

Table 10-1 Draft Statement of Commitments

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Biodiversity				
Where possible improve fauna passage and habitat connectivity	B1	Opportunities to utilise existing/future drainage infrastructure or stock underpasses as a fauna underpass will be considered to link currently isolated sections of potential Striped Legless Lizard and Pink-tailed Worm Lizard on either side of the highway.	Prior to and during construction	
	B2	Revegetation works will be located to reduce the effects of the Proposal on fauna habitat linkages by re-establishing or augmenting existing linkages.	Prior to and during construction	
Maintain fish passage	B3	All culvert modification/extension and bridges will be designed in accordance with the requirements outlined in *Fish Passage Requirements for Waterway Crossings* (Fairfull and Witheridge, 2003).	Prior to and during construction	Fairfull and Witheridge (2003) & *Fisheries Management Act 1994*
Offset losses of Box-gum woodland	B4	An offset approach will be implemented to manage impacts through strategically placed revegetation works in the highway corridor. This will be developed in consultation with the DEC and Commonwealth DEH.	Prior to construction	Consultation with DEH and DEC
Maintain habitat connectivity for squirrel gliders	B5	The median width will be reduced to the minimum necessary for safe operation of the road in those areas where existing glider movement across the highway is likely to occur. Adjacent roadside vegetation will also be retained as necessary to facilitate squirrel glider crossings.	Prior to and during construction	
Obtain native seeds for revegetation	B6	Native seed will be collected by a qualified bush regenerator prior to clearing, for use in the revegetation of disturbed areas.	Prior to and during construction	DEC *Restoration and Rehabilitation Guidelines*
Minimise clearance of vegetation with particular attention given to minimising clearance of Box-gum Woodland clearance	B7	Vegetation clearance will be kept to the minimum necessary to construct the road. Impacts will be avoided where possible and existing roadside vegetation will be maintained within the new median where safety and design are not compromised.	During construction	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Landscape planting to use endemic species thereby increasing the habitat value and visual amenity of the area	B8	Where possible the landscaping of areas within the Proposal corridor will be undertaken with endemic species. Landscaping of the area would include: • Planting of a range of locally occurring native shrubs, trees and groundcover plants. Discussion will be held with DEC and DEH regarding the choice of species, with preference shown to those species characteristic of Box-gum Woodland. • Logs, dead trees and other suitable habitat features will be included in the landscaping works • Existing natural vegetation will be incorporated where possible, linking bushland remnants • Planting and maintaining a suitable ground and shrub layer of vegetation	During construction	RTA QA Specification *R178 Vegetation*
Progressive revegetation/ rehabilitation of construction areas	B14	Disturbed areas will be progressively revegetated.	During construction	As above
Rehabilitate Box-gum woodland within abandoned sections of the existing road corridor	B15	Abandoned sections of the existing road corridor will be rehabilitated through physical removal of weeds and replanting of Box-Gum woodland species using local native provenance.	Post construction	As above
Minimise impact on species utilising hollow bearing trees and to minimise impacts on habitat features	B16	Where clearing of vegetation and fauna habitats will take place, a two stage clearing process will be followed, whereby non-hollow bearing trees will be felled first.	During construction	
	B17	Clearing protocols will be put in place that involve checking hollow-bearing trees for the presence of bird nests and arboreal animals such as possums, gliders and bats prior to felling or pushing. Animals found to be occupying trees will be safely removed before clearing of the trees. A qualified and licensed ecologist will relocate removed animals	During construction	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
		locally into nearby woodlands.		
	B18	All hollow-bearing trees to be felled will be clearly marked and their species and approximate dimensions catalogued so that hollows or nest boxes can be affixed to similar standing trees. The location of each relocated hollow or nest box will be recorded using GIS equipment during installation.	During construction	
	B21	Salvaged sections of hollows or nest boxes will be attached to trees in a way that allows for tree expansion and does not poison the tree. Hollows or nest boxes will be attached to trees with consideration of aspect, height and location appropriate for the target fauna species.	During construction	
Minimise impacts on Pink-tailed Worm-lizard and Striped Legless-Lizard	B22	Areas of potential habitat for the Pink-tailed Worm-lizard and the Striped Legless-Lizard will be inspected by a qualified ecologist prior to construction works impacting upon it. If any Pink-tailed Worm-lizards or Striped Legless-Lizards are identified, they will be removed from the construction area to suitable adjacent habitat.	Prior to direct impacts from construction	
Provide for vegetation to be reused where possible	B23	In conjunction with the Department of Primary Industries (NSW Fisheries) a strategy will be developed to allow suitable trees removed as part of construction to be utilised in the *Re-snagging and riparian restoration – Hume Dam to Yarrawonga* Program, or to be used to provide habitat for ground dwelling animals within the road reserve	During construction	
Minimise spread of noxious weeds and exotic species	B25	Soil that may contain seeds of exotic species will be stockpiled away from watercourses and vegetated areas and covered to eliminate the spread of the soil and seed during rainfall and wind events.	During construction	
Minimise vegetation clearance and habitat disturbance	B26	The limits of clearing will be clearly marked and temporary fencing will be installed around the construction footprint area to avoid unnecessary vegetation and habitat removal.	Prior to construction	
	B27	Equipment and stockpiling of resources will be restricted to designated areas in existing cleared or degraded land to minimise the	During	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
		overall impacts of the construction and avoid unnecessary vegetation and habitat removal.	construction	
Minimise noise and vibration impacts on fauna	B28	Blasting of rock or other activities associated with short, sharp noises will be avoided during known breeding seasons for mammals and birds within the study area as necessary.	During construction	RTA *Environmental Noise Management Manual.*
Minimise potential increases in local water turbidity	B29	In addition to other erosion and sedimentation controls, sediment detention basins and other stormwater treatment measures will be installed to trap runoff from construction areas in accordance with *Managing Urban Stormwater: Soils and Construction* (Landcom 2005).	During construction	*Managing Urban Stormwater: Soils and Construction (Landcom 2005).*
Minimise vegetation clearance and habitat disturbance	B30	Sediment detention basins will be located in existing cleared areas where possible to minimise the loss of habitat.	During construction	
Prevent water pollution	B32	The RTA's *Code of Practice for Water Management* will be implemented to achieve ANZECC Water Quality Guidelines (2000) for all water discharge into the streams.	During construction	ANZECC Water Quality Guidelines (2000), RTA *Code of Practice for Water Management*
Maintain fish passage as far as possible	B33	Fish passage will be maintained at all times during the culvert extension and modification works and bridge construction.	During construction	*Fisheries Management Act 1994*
Reduce the spread of noxious weeds	B34	Ongoing management and monitoring of weed invasion will be undertaken for a period of not less than two years following completion of the Proposal.	During operation	Council noxious weed guidelines and *Noxious Weeds Act 1993*
Protect riparian areas from degradation and minimise waterlogging and salinisation.	B31	Riparian zones will be revegetated with seeds of local provenance to increase the stability of highly erodible stream banks, act as an additional filter for runoff from the road surface and minimise waterlogging and salinisation.	During operation	
Maximise success of revegetation works	B36	Plantings will establish trees as well as a ground layer and will be maintained for not less than two years and until revegetation has been successful (i.e. 85% of plants have become established).	During operation	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Prevent degradation of aquatic habitats from water pollution	B40	Maintain water quality in all natural watercourses to meet the relevant ANZECC Water Quality Guidelines (2000).		ANZECC Water Quality Guidelines (2000)
Maintain aquatic habitat features	B41	Woody debris will be placed downstream of culverts where necessary so as not to obstruct potential fish passage.		*Fisheries Management Act 1994*
Surface Water				
Minimise adverse impacts on local water quality	S1	As much grass/shrub cover on the soil surface as possible will be retained to minimise erosion and sedimentation impacts when clearing drainage lines.	During construction	*ANZECC Guidelines for Fresh and Marine Water Quality 2000* *Protection of the Environment Operations Act 1997* RTA *Code of Practice for Water Management*
	S2	Clean runoff will be diverted around the site by installing diversion drains at the upstream limits of construction areas.	During construction	DEC license requirements
Minimise adverse impacts on local water quality, and provide for appropriate opportunities to reuse water during construction	S3	Sediment basins will be installed in the early stages of construction and as much dirty runoff will be diverted to these basins as possible. Turbid runoff will be treated on-site with flocculants or other suitable measures to an acceptable quality for subsequent reuse during construction.	During construction	RTA *Code of Practice for Water Management*
Minimise adverse impacts on local water quality	S4	Scour protection will be installed in creek/river banks areas at risk of erosion as necessary.	During construction	
	S5	Culverts will be installed as early as possible in the construction program to ensure that transverse drainage is in place during early stages of construction. Permanent stream protection measures and other waterway structure requirements will also be established as early as possible.	During construction	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Minimise the risk of soil or water contamination	S6	Any construction materials and fuels stored or used on site will be managed to minimise the risk of soil or water contamination. Dewatering activities will be managed and erosion and sedimentation controls will be installed and maintained. Chemical and fuel storage areas are to be within construction compounds and are to be bunded to prevent pollution of the environment in the event of a spill.	During construction	*Managing Urban Stormwater: Soils and Construction (Landcom 2005).*
Minimise the potential for pollution of local watercourses	S7	Sediment basins (used during construction) will be converted to permanent water quality control ponds as required for the operation of the Proposal.	Prior to operation	
	S8	Separators will be installed in permanent water quality control ponds that are also intended for use as spillage control ponds, to prevent discharge of oil and grease products.	Prior to operation	
Groundwater				
Establish baseline groundwater conditions to allow management of impacts	G1	A detailed hydrogeological survey of the study area will be undertaken prior to construction and as part of the detailed design to determine the local characteristics of the groundwater system and identify opportunities and constraints for the Proposal at both the construction and operation stages. Particular attention will be given to the ability of the groundwater system to provide for the water requirements of the Proposal. Areas suitable for groundwater extraction will be identified, considering as a minimum the following: • Impacts on adjoining land uses and properties. • Requirements for transportation or conveyance of water from the source to the construction site. • Facilities to store water within the construction site, including options to increase water use efficiency, and minimisation of any water loss, for example through evaporation.	Prior to construction	

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Minimise the impact on groundwater resources	G2	Drainage infrastructure and as necessary land management initiatives will be developed, for example re-vegetation of local flow cells, to manage any groundwater seepage, into the construction site. Suitable erosion and sediment controls will be employed to manage impacts to surface water quality and minimise potential pollution of the aquifer. This will include lining of any water retention basins in identified areas of groundwater recharge.	During construction	Findings of the detailed hydrogeological survey identified in G1
	G6	Current bores, depths and uses by landholders will be determined. Areas where aquifers are currently heavily drawn upon by bores by landholders will be avoided. Consultation with the DNR will occur to assist in identifying appropriate groundwater resources.	During operation	As above
Minimise the impact on groundwater resources and land capability and manage land degradation relating to waterlogging and salinisation	G3	Strategies will be developed to manage groundwater issues associated with surrounding land uses, including management of recharge areas in consultation with local stakeholders, as necessary.	During operation	As above
	G5	Runoff from the road surface will be captured and directed into permanent water quality control ponds. Where possible, these ponds will be converted sediment basins used during construction.	During operation	As above
	G7	Recharge will be reduced as necessary, through the establishment of trees or specific cropping patterns in local flow cells as necessary. The need for these measures will be determined in consultation with local stakeholders and the DNR.	During operation	As above and *Tools for improved management of dryland salinity in the Murray-Darling Basin* (MDBC, 2004)
Minimise impact of high watertable on road infrastructure	G8	Appropriate subsurface drainage infrastructure (for example blind ditches) will be installed in areas identified as having shallow groundwater levels, to divert groundwater away from pavement sub-grade.	During operation	As above

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Non-Aboriginal Heritage				
Minimise impacts on identified heritage items	H1	Where the Proposal will affect heritage items of high value the following will be undertaken: • Minor horizontal alignment adjustments will considered to minimise impact on heritage items of high significance. • If it is not possible to avoid damaging or destroying significant heritage items, detailed heritage investigations and/or research will be performed prior to construction. Information collected will be documented in appropriate archival records.	Prior to construction	
	H2	A strategy will be developed to minimise the impacts on heritage items as part of the Proposal. This will include: • Establishment of measures to prevent construction activities from occurring that would impact on heritage items wherever possible. • Minimising the disturbance or damage to heritage sites which are impacted by the Proposal. • Establishing measures to minimise access to heritage sites by construction teams not directly impacted by the Proposal.	Prior to construction	
	H3	Where heritage items are not directly impacted care will be taken not to disturb them during the works. This will include briefing of construction works team to protect such assets during the construction phase, and clear delineation of items including fencing and signage where necessary.	Prior to and during construction	RTA Heritage Guidelines
Report on identified heritage items	H5	Heritage items of significance will be listed on the RTA Section 170 Register where they meet the criteria for listing, and managed in accordance with the intent of the *Heritage Act, 1977*.	Prior to operation	As above

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Aboriginal Heritage				
Not currently available	AH1	Not currently available	N/A	N/A
Traffic				
Manage construction traffic and construction program so that disruption to existing traffic is minimised	T1	Management measures for the Proposal will outline construction vehicle movement arrangements, developed with specific regard to other road works in the region, local traffic movement requirements (stock or machinery) and peak traffic volumes, including long weekends and holiday periods.	During construction	*RTA QA Specification G10 – Control of Traffic*
	T2	Construction methods and staging for the project will be planned to minimise road closures and allow staged construction so that disruption to the existing traffic is within acceptable levels (subject to other project constraints).	During construction	As above
Air Quality				
Minimise generation of dust	A1	The effectiveness of measures implemented to control dust emissions will be monitored and recorded. Dust emission control measures will be implemented which will include as necessary: • watering of dry exposed surfaces; • covering loads on trucks transporting material to and from site at all times; • spray planting cover crop of sterile grasses on long term stockpiles and exposed areas; and • preventing, and where necessary removing mud and dirt tracked on to road surfaces.	During construction	DEC dust deposition goals (2001) • maximum total dust deposited of 4g/m^2/month over a twelve month period • maximum increase in deposited dust level of 2 g/m^2/month
	A2	The frequency of dust emission controls such as watering will be increased when winds reach a velocity greater than 2.5m per second. Work practices will be modified during high wind events.	During construction	As above

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Minimise unnecessary greenhouse gas emissions into the atmosphere	A3	Emissions from plant and equipment will be monitored to determine compliance with Australian Design Rules and manufacturers specifications.	During construction	Australian Design Rules and relevant manufacturers specifications
	A4	Greenhouse gas emission targets established for the Proposal will be achieved (50% renewable electrical energy used in site compounds during construction).	During construction	
Noise and Vibration				
Establish baseline conditions prior to start of construction.	N1	As necessary, condition surveys will be undertaken on buildings and structures within the potential area of vibration impact prior to commencement of rock-breaking and blasting activities.	Prior to construction	*Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration* (ANZECC, 1990)
Minimise the impact of construction noise and vibration on surrounding residents and where necessary, comply with all relevant standards to reduce noise and vibration to an acceptable level	N2	Construction activities will be restricted to normal construction hours wherever necessary — that is, 7.00 am to 6.00 pm, Monday to Friday; 8.00 am to 1.00 pm, Saturdays (7.00 am if inaudible at residences); and no work on Sunday or public holidays. Work outside these hours will not be performed without prior consultation with the Department of Environment and Conservation and the local community.	During Construction	DEC *Environmental Noise Control Manual Construction Site Noise* (DEC 1994) DEC licence conditions.
	N3	Community consultation will be carried out before commencing construction activities outside normal hours, and Department of Environment and Conservation will be advised.	Prior to carrying out work outside of normal construction hours	*RTA Environmental Noise Management Manual Practice Note vii - Roadworks Undertaken Outside of Normal Working Hours*
	N4	Controls on construction equipment and activities will be implemented in accordance with Australian Standards and RTA specifications. All stationary and mobile plant and equipment will be	During construction	*AS 2436-1981 Guide Noise Control an Construction, Maintenance and Demolition*

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
		regularly inspected, tested and maintained to ensure that emission levels do not deteriorate over the life of the project		*Sites*
	N6	As necessary, nearby residents will be notified prior to noisy or vibration generating activities.	During construction	
	N7	Residents will be provided with a contact name and number to allow complaints or questions to be raised. A procedure will be established for maintaining contact and responding to all complaints within 24 hours.	Prior to and during construction	
Comply with NSW DEC noise criteria and therefore minimise the operational noise impact on nearby residences to an acceptable level	N8	A process for ascertaining the most reasonable and technically feasible approach to managing the mitigation of operational noise impacts related to Proposal will be developed. This process will be developed during further detailed development of the Proposal and in consultation with relevant stakeholders.	Prior to operation	RTA *Environmental Noise Management Manual. Environmental Criteria for Road Traffic Noise* (DEC, 1999) DEC licence conditions
Visual amenity				
Minimise the effect of the Proposal on visual amenity and appearance of the area.	V1	The width of disturbance required on fill embankments where construction requires the removal of native vegetation will be minimised.	During construction	
	V2	All disturbed areas will be stabilised with native local species reflecting natural vegetation patterns as closely as practicable.	Progressively during construction	RTA QA Specification *R178 Vegetation*
	V3	Where guard rails require visual screening, the plant mix to be used will comprise only locally occurring native species	During construction	As above
	V4	There will be planting on both sides of new perimeter fences.	During construction	As above
	V5	Dark coloured transparent fencing materials will be used.	During construction	RTA *Urban and Regional Design Practice Notes*

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
	V6	Where planting is proposed on steep embankments, the area will be stabilised with erosion-control matting and mulch topping to improve final appearance. Landscaping and revegetation of these areas will consider views from surrounding properties and include screen planting where necessary to minimise views of the road corridor from houses.	During construction	RTA QA Specification *R178 Vegetation*
Waste Minimisation and Management				
Reduce creation of waste, maximise re-use and recycling, and ensure any waste generated is managed appropriately in accordance with relevant guidelines to prevent any adverse impacts on the environment.	W1	Strategies will be identified to 'reduce, reuse and recycle'; Reuse of materials on-site will have priority over recycling. Where recycling is more feasible, it will be carried out in accordance with the NSW Government's *Waste Avoidance and Resource Recovery Strategy 2006*.	During construction	Minimal quantity of waste sent to landfill.
	W2	Excavated material not suitable for on-site reuse or recycling will be transported to a site authorised to accept that material for reuse or disposal	During construction	
	W3	Materials will be sourced to avoid in the creation of excess waste. Excavated material will be used in the construction where it is appropriate and necessary. The project will aim to utilise excess material from other sections of the duplication project (where available) to maximise the use of available construction resources.	During construction	
	W4	Chip leaf material and small branches of native vegetation to use as mulch in revegetation works.	During construction	RTA QA Specification *R178 Vegetation*
	W5	Testing for contamination will occur prior to construction at target sites (eg. former service station sites). Strategies to transport and dispose of contaminated material will be developed if encountered. All necessary Department of Environment and Conservation licences and approvals will be obtained prior to the disposal of any contaminated waste and in accordance with the NSW waste tracking requirements.	During construction	*Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-liquid Wastes.*

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
	W6	Waste materials will be classified in accordance with DEC Environmental Guidelines.	During construction	As above.
Landform, Geology and Soils				
Establish site conditions to enable appropriate remediation measures to be identified and implemented as necessary.	LC1	A contamination investigation in accordance with NSW DEC requirements will be performed and subsequently a Remediation Action Plan will be prepared as necessary.	Prior to construction	*Guidelines for Assessing Service Station Sites* (EPA,1994) *Sampling Design Guidelines* (EPA, 1995)
Remediate contaminated areas in accordance with relevant guidelines and legislation and minimise adverse impacts on surrounding areas.	LC2	Former service station site near Tumbarumba Road will be remediated appropriately during the construction phase according to the following: • Preparation and Implementation of Remediation Action Plan. • Remediation and/or removal of contaminated soils (and possibly groundwater) during construction • Validation of excavated areas prior to backfilling with clean fill • Establishment of strict runoff controls around any temporary contaminated soil stockpiles	Prior to and during construction	As above and *State Environmental Planning Policy 55 – Remediation of Land* (SEPP 55) *Contaminated Land Management Act 1997* DEC (2006), *Guidelines for NSW Site Auditor Scheme*
As above	LC3	Contaminated soil identified on site would be classified in accordance with DEC Waste Classification Guidelines and would be transported and disposed of in accordance with the Protection of the Environment Operations (Waste) Regulation 2005. The excavation surfaces would be subject to validation testing to ensure that contamination has been removed to an acceptable level.	During construction	*Environmental Guidelines: Assessment, Classification & Management of Liquid & Non-liquid Wastes.*
Minimise disturbance to landform, geology and soils and prevent erosion and soil contamination	L1	Temporary stormwater control devices or erosion and sedimentation controls will be constructed where necessary to prevent sediment-laden runoff entering the local drainage system.	During construction	*Managing Urban Stormwater: Soils and Construction (Landcom 2005).*

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
	L2	Erosion and sedimentation controls will be maintained and checked on a regular basis with records kept and available on request.	During construction	
	L3	Sediment will be cleared from behind barriers on a regular basis and controls will be monitored and maintained to ensure they work effectively at all times.	During construction	
	L4	Hardstand material or rumble grids will be installed at entry and exit points to minimise the tracking of soil and particulates onto pavement surfaces.	During construction	
	L5	Stockpiles will be established on slopes less than 2:1 (horizontal to vertical).	During construction	
	L6	All stockpiles will be designed, established, operated and decommissioned in accordance with *RTA Stockpile Management Procedures 2001*. Stockpiles will be located not less than 100m from the high bank of any rivers or drainage lines.	During construction	
	L7	Rehabilitation of disturbed areas will be undertaken progressively as stages are completed.	During construction	
	L8	Cuttings and embankments will be graded, wherever practicable, to reflect and reflect the characteristics of the local natural landform, returning the land to its former use wherever possible.	During construction	
Social and Economic Considerations (including land use)				
Ensure land acquisition is managed so that outcomes are acceptable to the local community	E1	All property acquisitions will be negotiated in accordance with RTA Land Acquisition Policy, and compensation provided in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991*. Property acquisitions and/or leasing arrangements between the RTA and existing property owners will be resolved prior to commencement of works.	Prior to construction	*Land Acquisition (Just Terms Compensation) Act 1991* RTA Land Acquisition Policy

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
Establish conditions of existing road to allow identification of appropriate measures to minimise or ameliorate impacts.	E2	A pre-construction audit of the existing single carriageway Hume Highway and surrounding roads adjacent to the Proposal will be conducted to determine whether additional truck movements would result in the deterioration of the pavement. The RTA will be responsible for maintenance and repair of any identified pavement deterioration.	Prior to construction	
Minimise the social and economic impact of the Proposal construction works on the local community	E4	Blocking existing access to properties will be avoided wherever possible. Where not possible, suitable temporary access will be provided as necessary in consultation with owners and occupants.	During construction	Property access is to be maintained for the duration of construction.
	E5	A contact point will be established for affected property owners to obtain information about the Proposal and advise the RTA/construction contractor of matters relevant to their property.	Prior to and during construction	
	E6	Advance notification will be given to property owners on project schedules, construction works and access arrangements.	Prior to and during construction	
	E7	Property access arrangements will be incorporated in plans developed to manage construction traffic.	During construction	
Minimise the economic and social impact of the Proposal on the local landowners	E8	Regrade existing access ways where necessary. Where not practicable, provide suitable alternative access, the location of which will be determined in consultation with the landowner.	During construction and prior to operation	
Hazard and Risk				
Reduce the hazard risk to minimise impacts on the surrounding environment and protect safety of the community	R1	Procedures will be developed and implemented to achieve compliance with all legislative and industry standard requirements for the safe handling and storage of hazardous substances and dangerous goods	At all times	AS 1216 *Class Labels for Dangerous Goods*
	R2	Bund storage areas will be established for oils and other hazardous liquids in accordance with Australian Standards and collect any	During	AS 1940 *The Storage and Handling of Flammable and*

Objective	Ref #	Mitigation Measure	Timing	Standard/ benchmark/guiding principle
		spillages for off-site disposal at a licensed facility.	construction	*Combustible Liquids*
	R3	Activities with the potential for spillage such as refuelling, maintenance of equipment, mixing of cutting oil and bitumen will be conducted in bunded areas away from watercourses.	During construction	As above
	R4	Potentially hazardous and contaminating activities (such as washing construction plant, refuelling plant and handling hazardous chemicals) will be conducted only at appropriate locations that have adequate environmental protection measures.	During construction	As above

11 Justification and Conclusion

Chapter 11 provides the justification for the proposed duplication of the Hume Highway at Kyeamba. This is based on the ability of the Proposal to meet the project objectives developed to address the identified needs as outlined in Chapter 2. These objectives are based on the recommendations of relevant strategic policies and plans.

11.1 Justification

Travel Efficiency, Safety and Access

The Hume Highway is a route of strategic national significance serving intrastate and interstate users and is the main road transport corridor linking Sydney and Melbourne. The limitations of the existing facility in providing an efficient, integrated and safe transport link has lead the Commonwealth government to include the Hume Highway Duplication as part of the AusLink program.

A substantial proportion of traffic comprises heavy vehicles and a considerable proportion of heavy vehicle movements occur during the night. This gives rise to unusual characteristics in relation to Highway capacity. The level of service on the single carriageway sections of the Highway gradually deteriorates later in the day and during the evening, reaching level D for the five hour period from 8.00 pm to 1.00 am. At this level, traffic flow approaches instability with drivers severely restricted in their freedom to manoeuvre within the traffic stream. This situation occurs every night of the week and has rapidly deteriorated since 2001 when the affected period occurred for only one hour. The level of service is predicted to deteriorate further, reaching level E during the period 9.00 pm to 1.00 am by 2016 and during the period from 7.00 pm to 2.00 am by 2021 if no improvements are made to the route. The average level of service across the whole day is expected to have similarly deteriorated.

Fatal crash rates on the undivided sections of the Hume Highway were approximately 85 percent higher than those on the divided sections over the period between 1997 and 2002. Injury and total crash rates were approximately 40 percent and 15 percent higher respectively. Total crash rates on the divided road sections are similar to current crash rates for the Hume Highway as a whole within NSW. Total crash rates on the undivided sections are higher.

A relationship between increasing crash rates and deteriorating level of service is evident. Total crash rates on the undivided sections of the Highway have steadily increased over the past five years and this trend could be expected to continue. In particular, the number of head-on crashes is expected to increase as traffic volumes continue to grow and the level of service of the road deteriorates to an unacceptable level beyond 2011 during the afternoon and night time periods on weekdays and during holiday periods.

The proposed duplication of the Highway would improve the efficiency of travel, safety and accessibility of the road. Crashes could be expected to be reduced to the level experienced on the dual carriageway sections of the Highway cutting the current total crash rate by approximately 57 percent. A safer road environment would also be provided by the introduction of grade separation at the intersection with Tumbarumba Road.

The proposed duplication of the Hume Highway would see an improvement on opening from an unsatisfactory level of service with substantial delays to a good level of service with

minimum delays and spare capacity to accommodate predicted future growth. Ten years after opening, the performance of the duplicated sections of the Highway is predicted to remain adequate.

Economic Considerations

The completion of the Hume Highway Duplication would result in net economic benefits with a ratio of benefits to cost of between 1.3 and 1.5:1 depending on the traffic growth scenario and the adopted Proposal cost contingency on account of reduced road user, accident and travel time saving benefits. This represents a good investment of public money for the benefit of current and future generations.

In addition to the economically quantifiable benefits, there would also be substantial long-term National and statewide economic benefits relating to the proposed duplication. These would include time and vehicle operating efficiencies and associated savings in freight costs. This is important, as the Hume Highway is the busiest inter-capital corridor in Australia for both freight and passenger transport, in addition to considering the expected future increase to travel demand.

Key Social and Community Considerations

The existing Hume Highway is the dominant feature in the existing rural landscape. The proposed duplication would create an incremental increase in some localised impacts, which would have generally a minor impact on the social environment. The design of the Proposal has specifically aimed at reducing potential impacts and incorporates a number of management and mitigation measures to address residual impacts. Benefits in terms of improved road safety on the Highway and Tumbarumba Road are as important for the local community as for long distance travellers.

No major issues have been identified with respect to land use, property acquisition, noise, visual and air quality. Issues relating to indigenous and non-indigenous heritage have also been addressed so that residual impacts would be minimal.

Water supply for construction is likely to be an issue requiring active management and control. Multiple sources of construction water would be investigated to minimise the potential for any long term impacts on the availability and quality of water to other users in the groundwater and surface water catchments.

Key Biophysical Considerations

Impacts on the biophysical environment were a fundamental input to the design process. Vegetation impacts have been avoided as far as possible and minimised through design development and other measures. There would be residual impacts but these would be offset by the provision of new habitat on residual land and the management of existing native vegetation areas within the corridor.

Impacts on corridor vegetation would be reduced by the use of narrow median and steepened cuts where feasible. In some locations groups of mature trees would be retained within a widened median where possible. The alignment would deviate from the existing corridor at the Tumbarumba Road/Highway intersection to the east through cleared land to allow the retention of substantial areas of roadside native vegetation and the use of the existing pavement as part of the intersection. Where the duplication would remain within the corridor, it is generally located to retain as much existing vegetation as possible.

No major residual issues associated with other biophysical aspects including water quality, soil and erosion control would be anticipated.

Ecological Sustainable Development

Ecologically sustainable development (ESD) is the use, conservation and enhancement of community resources so that ecological processes, and hence the quality of life, are sustained and improved for present and future generations. It is based on four principles:

- the precautionary principle;
- social equity and intergenerational equity;
- conservation of biological diversity and ecological integrity; and
- improved valuation and pricing of environmental resources.

These principles have been taken into account throughout the process of generating the Proposal and assessing its benefits and effects. In addition, the preparation of the EA itself contributes to operating in accordance with these principles as it makes detailed information about the Proposal available to inform public discussion in coming to a decision on whether it should proceed.

The precautionary principle has been applied by reliance on available scientific data throughout the planning and assessment of the Proposal leading to the identification of mitigation measures and environmental safeguards. Wherever a potential impact has been identified, impacts have been minimised as far as practicable in the design and mitigation measures are proposed to reduce the impact as far as is practicable.

Social equity within the current generation requires that the economic and social benefits of the proposed development are distributed appropriately among all members of the community. It is also necessary that environmental safeguards against degradation of flora and fauna, groundwater, surface water, cultural heritage, visual, acoustic and air amenity are implemented to ensure that no part of the community would be unacceptably disadvantaged. The potentially adverse impacts on environmental resources likely to affect social equity have been assessed and mitigation measures included in the Proposal. These measures relate to erosion and sediment control, surface and groundwater management, air quality controls, noise controls, traffic and waste management. Implementation of the mitigation measures would result in a reduction in effects on social and intergenerational equity.

The principle of conservation of biological diversity and ecological integrity has been considered throughout the assessment process. While the Proposal has been designed to minimise impacts on local native vegetation, its implementation would result in the removal of some 12 hectares of Box-Gum Grassy Woodland, an ecological community listed as critically endangered. A rehabilitation strategy to offset this loss would be prepared and implemented including seed collection, identification of areas for revegetation, protection of existing habitat, ground preparation, planting of seedlings and regular maintenance. Impacts on this community would be further assessed under environmental assessment processes under the EPBC Act.

The principle of valuation involves consideration of all environmental resources, which may be affected by the Proposal, including air, water, land and living things. The value placed on environmental resources in and around the Proposal corridor is evident in the extent of environmental investigations, planning and design of impact mitigation measures to prevent irreversible damage to those resources. Environmental monitoring would be undertaken during construction and operation in accordance with the requirements of the relevant management plans. The cost of this monitoring, ongoing investigations, planning, design and implementation of the mitigation measures has been factored into the economic analysis of the Proposal.

11.2 Conclusion

The proposed duplication of the Hume Highway would substantially meet the objectives adopted for the project. It would improve the efficiency and safety of travel on the Highway and benefit both the national and State economies.

Reducing the likelihood of potential environmental impacts has been a major consideration during the option assessment, design development and environmental assessment stages of the Proposal. The approach to these activities has aimed specifically at the avoidance (where possible and in the first instance) or mitigation of environmental impacts.

The Proposal would be constructed to meet current environmental standards established under legislation and government policy and the performance of the Proposal would be monitored to ensure that this is achieved.

Accordingly the Proposal is justified on the basis of social, biophysical and economic considerations and in accordance with the principles of ESD

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