8. Environmental risk analysis

This chapter outlines how environmental issues for the project were identified through an environmental risk analysis process, and documents the findings of that process.

DGRs	Where addressed
The environmental assessment must include an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures.	Section 8.2
Where additional key environmental impacts are identified through this environmental risk analysis, an appropriately detailed impact assessment of this additional key environmental impact must be included in the environmental assessment.	Section 8.3

8.1 Overview

An analysis was undertaken, which:

- Identified environmental issues, including key issues in the DGRs and any other issues.
- Examined potential impacts and proposed mitigation measures in relation to the identified issues.
- Examined impacts likely to remain after application of mitigation measures.

Based on this analysis, an environmental risk category was assigned to each impact. This enabled the identification of any matters that might be considered as additional key issues and established the basis for an appropriately detailed assessment of those additional issues to be included in this environmental assessment.

8.2 Risk analysis

The environmental risk categories assigned to each impact are described in Table 8-1. The environmental risk analysis is summarised in Table 8-2. The findings of the analysis are provided in Section 8.3.

Table 8-1 Risk category descriptions

Risk category	Description
A	May have high or moderate level of impacts. Detailed assessment necessary to determine the level of potential impact and to develop appropriate measures to mitigate and manage the impacts.
B	May have high or moderate level of impacts. These can be mitigated by the application of standard environmental management measures.
C	Has low level of impacts manageable using standard environmental management measures.

Impacts that have been assigned a risk category of 'A' are considered in all cases to indicate key issues. The environmental risk analysis has automatically allocated a risk category of 'A' to all key issues identified in the DGRs.

Traffic and transport was identified as a key issue in the *Hume Highway Upgrade Holbrook Bypass: Preliminary Environmental Assessment* (RTA 2008a) and the DGRs. However, further detailed assessment of this issue has determined that standard mitigation measures could be implemented to manage impacts during construction and operation. Were it not for inclusion as a key issue, the risk level for traffic and transport would be reassessed as 'B'.

8.3 Findings

The environmental risk analysis did not identify any key issue additional to those included in the DGRs.

Table 8-2 Environmental risk analysis — summary

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
Flora and fauna	Yes	Clearing of native vegetation, including endangered ecological communities and loss of habitat for threatened species: ▪ Approximately 24 hectares of native vegetation would be cleared, comprising: ▸ 22 hectares of the threatened ecological community Box-Gum Woodland (including 20 hectares of Box-Gum Woodland listed as a critically endangered community under the *Environment Protection and Biodiversity Conservation Act 1999*). ▸ Two hectares of River Red Gum very tall open forest. ▪ This vegetation also provides habitat for a range of threatened species dependent on woodland habitats (eg Brown Treecreeper, Barking Owl, Grey-crowned Babbler, Diamond Firetail).	▪ Flora and fauna impacts would be managed following the 'avoid, minimise, mitigate, offset' hierarchy. Management measures for vegetation loss include limiting the extent of clearing, controlling weeds and revegetation. Measures to manage the loss of fauna habitat include providing alternate habitat and developing fauna crossing treatments. A biodiversity offset package would be developed to manage the residual impacts on ecological values. ▪ Assessments indicated that impacts to an endangered ecological community (Box Gum Woodland) would be significant.	A	Section 9.1 Technical Paper 1
		Impacts on threatened aquatic communities: ▪ Ten Mile Creek forms part of the threatened Aquatic Ecological Community in the Natural Drainage System of the Lower Murray River Catchment. ▸ New bridge and culvert structures over Ten Mile Creek (including temporary crossings during construction) may alter creek bed characteristics and affect sediment loading in the watercourses. Fish assemblages may be affected by the watercourse crossings, including impacts on threatened species (Southern Pygmy Perch).	▪ Watercourse crossings (permanent and temporary) would be designed and constructed in accordance with the Department of Industry and Investment *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge 2003). ▪ Works within the main watercourse of Ten Mile Creek would be avoided during the breeding season of the Southern Pygmy Perch (September to January) unless mitigation measures are developed in consultation with the Department of Industry and Investment.		
		Potential longer-term impacts associated with increased habitat fragmentation: ▪ Approximately five hectares of remnant vegetation (including some threatened ecological communities) may be introduced to new edge effects due to the project.	▪ Revegetation works would be located to increase fauna habitat linkages. ▪ To facilitate the safe movement of fauna across the highway, natural and artificial crossing treatments would be investigated in consultation with DECCW.		

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
		▪ Clearance of linear vegetation along roadside and watercourses would fragment fauna corridors. ▪ Fragmentation of Box-Gum Woodland in the former Town Common could create barriers to movement of threatened species through the landscape. ▪ The threatened Squirrel Glider may occur in the assessment area. A widened road corridor may create a barrier to the glider's east-west movements. ▪ The widened road corridor may prohibit small, sedentary fauna (eg ground-dwelling/arboreal mammals, reptiles and amphibians) from crossing the highway east-west.	▪ The twin bridges over Ten Mile Creek would also act as a fauna underpass for small and large fauna east to west across the project.		
		Cumulative biodiversity impacts associated with the construction of the proposed Tarcutta and Woomargama bypass projects and other Hume Highway duplication projects: ▪ Biodiversity impacts of the project are likely to be more significant as a result of biodiversity impacts from other projects. Cumulative impacts would include a greater extent of clearing of native vegetation and habitats, including endangered ecological communities, and further fragmentation of habitats.	▪ A biodiversity offset package would be implemented to address residual and cumulative impacts.		
Aboriginal heritage	Yes	Direct impacts on Aboriginal archaeology and cultural objects, sites and natural and landscape values.	▪ Any Aboriginal heritage items would be managed in accordance with the Aboriginal Cultural Heritage Assessment Report (CHAR), developed in consultation with Aboriginal stakeholders and DECCW. ▪ All excluded archaeological and cultural sites in the construction site boundary would be fenced and identified as 'environmentally sensitive areas' prior to construction. ▪ Archaeological salvage excavation of archaeological sites would be undertaken to mitigate impacts on significant	A	Section 9.2 Technical Paper 2

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
			archaeological sites, where required, prior to commencement of construction in the area to be salvaged. ▪ Salvage through collection of artefacts would be undertaken, where required, prior to construction.		
Noise and vibration	Yes	Noise and vibration impacts on sensitive receivers during construction: ▪ Noise impacts. ▪ Vibration impacts could occur during some construction activities (eg piling, blasting (if undertaken)).	▪ A construction noise and vibration management plan would be developed and implemented through the construction environmental management plan (CEMP). The plan would include: ▸ A specific notification procedure for any blasting activities. ▸ Procedures for dealing with and responding to complaints. ▸ Procedures for noise monitoring and auditing to verify compliance with the predicted noise impacts. ▸ A notification and negotiation procedure where noise impacts from out of hours construction activities are above criteria. This would involve consultation with sensitive receivers to develop appropriate management measures.	A	Section 9.3 Technical Paper 3
		Noise and vibration impacts on sensitive receivers associated with ancillary facilities.	▪ Siting of compounds and concrete batch plants to adhere to criteria described in Section 6.5. ▪ Best practice mitigation and management measures would be used to minimise construction noise and vibration at sensitive receivers.		
		Noise impacts on sensitive receivers during operation: ▪ Noise reduction at some sensitive receivers. ▪ Noise increases at some sensitive receivers. ▪ Changes to direction of received noise.	▪ Operational noise would be managed to meet the noise criteria applicable to the project where reasonable and feasible. This would include a combination of at road and at receiver noise mitigation measures developed during detailed design and in consultation with affected landowners, where required. ▪ Operational noise measurement would be undertaken to confirm operational noise impacts at sensitive receivers.		

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
Social and economic	Yes	Loss of business and tourism from reduction in passing trade: ▪ Economic impacts. ▪ Loss of local services.	▪ Continued consultation with Greater Hume Shire Council through detailed design and construction to assist in developing strategies to encourage the continued viability of Holbrook. ▪ The project would be designed to facilitate easy access into and out of Holbrook. ▪ Appropriate signposting would be provided. ▪ The maintenance of close views of the town may have a positive impact in that it may encourage motorists to continue to use Holbrook as a stopping point.	A	Section 9.4
		▪ Short-term benefits to the local economy during construction.	▪ Construction materials and other products and services would be sourced locally as far as possible.		
		Changes to connectivity: ▪ Reduced connectivity for some residences.	▪ Connectivity would be maintained through the provision of the southern interchange, which will provide access for two properties on the western side of the project.		
		Direct property impacts, including property acquisition, land use viability, infrastructure and severance.	▪ Consultation would be undertaken with all affected landowners throughout detailed design and construction to develop and implement measures to mitigate impacts on land use viability, infrastructure and severance. ▪ All property acquisitions would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* and the RTA's (1999a) *Land Acquisition Policy.*		
Traffic and transport	Yes	Disruption to the existing local traffic network during construction: ▪ Temporary disruptions/delays to local and highway traffic. ▪ Temporary road closures/diversions. ▪ Temporary restrictions to private access roads.	▪ Standard traffic management measures would be employed during construction to minimise traffic disruptions on the highway and local connecting roads. These management measures would be developed in accordance with RTA QA Specifications (RTA 2008c) and the RTA's *Traffic Control at Work Sites Manual* (RTA 2003a).	B	Section 9.5

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
		▪ Increased construction traffic on the existing road network.	▪ Property access would be maintained for the duration of construction. If required temporary or alternative access would be provided in consultation with affected landowner(s).		
		Damage above normal wear and tear of existing local and regional road network, due to construction traffic.	▪ Pre and post-construction road dilapidation reports. Damage would be repaired unless alternative arrangements are made with the local road authority.		
		Permanent adjustment to some private property access roads and local/regional roads.	▪ Permanent changes to local road network/access would be developed in consultation with the relevant road authority and affected landowners.		
		Changed traffic patterns: ▪ Potential negative impacts that may occur are likely to be short-term while road users adjust and become familiar with changed traffic patterns.	▪ Changes to the road network in the project area would be clearly signposted. ▪ The community would continue to be kept informed of any changes to the road network.		
		Changes to the travelling stock route between the Culcairn Road Travelling Stock Reserve and Wagga Wagga Road.	▪ The project would be designed to facilitate the continued use of the travelling stock route. Any changes to the route would be developed in consultation with the Hume Livestock Health and Pest Authority.		
		Traffic and transport benefits would be expected in relation to travel efficiency. Road safety would improve along the project and the existing highway through Holbrook.	▪ The project would likely improve travel efficiency and road safety for traffic using the project and the existing highway.		
		Cumulative benefits for travel efficiency during operation: ▪ Associated benefits with construction and operation of the proposed Tarcutta and Woomargama bypass projects and other Hume Highway duplication projects.	▪ The three proposed bypasses, in conjunction with the duplication projects, would lead to a cumulative reduction in travel time for vehicles on the Hume Highway.		Section 3.2

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
Surface water and groundwater	No	Impacts on water sources and users through water demand for construction: ▪ Approximately 400 megalitres of water would be required over the two year construction period. This may affect availability of water for other users.	▪ Water captured on site would be reused where feasible. Use of other water sources (eg groundwater and farm dams) would be undertaken in consultation with the relevant landowner/licence holder. ▪ Groundwater levels would be monitored during any groundwater extraction. Mitigation measures would be implemented if the monitoring indicates a potential impact.	B	Section 10.1
		Flooding impacts due to altered flood behaviour of Ten Mile Creek: ▪ Minor increase in afflux.	▪ The project has been designed to minimise change in afflux. Detailed design would seek to further manage changes in afflux. ▪ Bridge and drainage structures would be designed to minimise possible rises in flood levels, and preserve hydraulic connectivity of flow paths.		
		Impacts on waterways and water quality due to: ▪ Erosion and sedimentation. ▪ Fuel spills and leaks. ▪ Inappropriate classification, storage and disposal of liquid and non-liquid wastes.	▪ Standard best practice environmental management measures would be implemented during construction in accordance with *Managing Urban Stormwater: Soils and Construction, Volume 1, 4th Ed.* (Landcom 2006) and *Managing Urban Stormwater: Soils and Construction, Volume 2D, Main Road Construction* (DECC 2008b). ▪ Operational water quality treatment measures would incorporate structural and non-structural measures to control road runoff pollutants entering Ten Mile Creek and other water courses.		
		Impact to groundwater flow due to compaction.	▪ Install appropriate subsurface drainage infrastructure, for example, drainage blankets.		
		Direct and indirect impacts on bores/dams: ▪ Several bores/dams may be destroyed or impacted as a result of the project and would need to be replaced.	▪ It may be necessary to relocate certain boreholes/dams. The new location would be developed in consultation with the landowner.		

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
Non-Aboriginal heritage	No	Impacts on non-Aboriginal heritage items and cultural values: ▪ The project would directly impact two heritage items of local heritage significance: a historic artefact scatter and mound, and a section of the non-operational Culcairn to Holbrook rail line. Impacts on previously unidentified heritage items.	▪ Heritage impacts would be managed through the construction environment management plan. ▪ Relevant mitigation (eg archival record, test/salvage excavation) would be implemented for impacted heritage items. ▪ All excluded items in the construction site boundary would be fenced and identified as exclusion zones prior to construction. ▪ If any unknown non-Aboriginal heritage items are encountered, work would immediately stop and would not recommence works until appropriate clearance is received.	B	Section 10.1
Soils and water quality	No	Erosion and sedimentation during construction and operation:	▪ Standard best practice environmental management measures would be implemented during construction in accordance with *Managing Urban Stormwater: Soils and Construction Volume 1, 4th Ed.* (Landcom 2006) and *Managing Urban Stormwater: Soils and Construction, Volume 2D, Main Road Construction* (DECC 2008b). ▪ A soil conservation specialist would be appointed to the project during design and construction to advise on the appropriate treatments to minimise erosion and sedimentation. ▪ (Refer to 'Surface water and groundwater' issue for further discussion of mitigation of impacts on water quality.)	B	Section 10.3
Visual amenity and landscape	No	Positive impacts on urban design and landscape: ▪ The visual amenity of Holbrook may be improved by the reduction of through-traffic.	▪ The objectives identified in the Hume Highway urban design and landscape strategy would be incorporated into the project. A draft urban and landscape design strategy has been developed for the project. This would be finalised during detailed design.	B	Section 10.3

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
		Negative impacts on urban design and landscape: ▪ The clearance of native vegetation, extensive earthworks and construction of a new highway may reduce the visual amenity of the area. ▪ The addition of a new road on embankment over the low lying floodplain of Ten Mile Creek may reduce the visual amenity of the area. ▪ Large structures associated with the proposed bypass, such as overbridges and the interchanges, may reduce the visual amenity of the area.			
Air quality	No	▪ Air quality impacts on road users and sensitive receivers during construction. ▪ Potential for short-term decreases in local air quality during construction associated with dust-generating activities and emissions from heavy construction machinery.	▪ Standard and dust and emission control measures would be implemented to manage construction air quality impacts.	C	Section 10.4
Hazards and risk	No	Hazards to the environment, workers and the public during construction associated with transport, handling and storage of hazardous materials. Risks to the environment, and human health and safety associated with the transport of hazardous goods on the project.	▪ Potential environmental hazards and risks associated with construction activities would be identified prior to construction, with standard management measures and contingency plans implemented throughout the construction period. ▪ Occupational health and safety hazards would be managed by preparation and implementation of a site-specific safety management plan and safe work method statements. ▪ Spill containment measures/facilities for incidents near sensitive environments would be incorporated into the design of the project.	C	Section 10.6

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
Contaminated land	No	Contaminated land within the construction site boundary: ▪ Potential sources of contamination were identified associated with the refuelling and maintenance activities associated with the Council depot, smash repair workshop, stockpiles located on the Hume Livestock Health and Pest Authority owned land, rail activities associated with the non-operational Culcairn to Holbrook rail line, activities associated with the concrete/cement casting property and possible refuelling operations on-site, activities associated with the sewage treatment plant, activities associated with land filling at the Council landfill, petroleum activities associated with the former service station and truck wash located on the northern section of the current Hume Highway, farming equipment and machinery maintenance on the rural properties and animal and vehicle movements at the local saleyards.	▪ Further investigations into potential contamination would be undertaken followed by remediation as required. ▪ All potentially contaminated waste would be classified according to the *Waste Classification Guidelines: Parts 1 and 2* (DECC 2008a) and disposed of to a suitably-licensed disposal facility or reused in the construction works as appropriate. ▪ Standard contingency measures (including for unknown contaminants, asbestos containing materials and site operations during construction) would be implemented to allow for further investigation and treatment/disposal as appropriate.	B	Section 10.7
Sustainable management (greenhouse gases, waste, energy)	No	Consumption of energy and generation of greenhouse gases and waste during construction of the project: ▪ Greenhouse gases would be emitted from construction plant, equipment and vehicles. ▪ Greenhouse gas emissions would be embodied in materials consumed in construction or impacted by the project, such as vegetation removal and soil disturbance. ▪ Energy-consuming activities over the two year construction period would be extensive. Energy used would be in the form of fuel and electricity. ▪ Waste generated during construction.	▪ Energy efficient work practices would be implemented, including consideration of: ▸ Energy efficient design of site buildings. ▸ Design of site compounds and the batch plant to minimise unnecessary vehicle movement. ▸ Regular servicing of site plant and equipment. ▸ Training of construction personnel in energy efficient plant operation. ▸ The use of accredited GreenPower. ▸ Use of locally sourced materials where available and of suitable quality. ▪ Use of recycled materials, such as replacement of cement with fly ash, recycled aggregate, and recycled content in steel, where possible. ▪ Waste management would be undertaken in accordance with the waste hierarchy (avoid, minimise,	C	

Issue	DGRs — key issue?	Potential impacts	Analysis — proposed mitigation measures and residual impacts after their application	Risk category	Environmental assessment reference
			reuse/recycle, dispose) principles of the *Waste Avoidance and Resource Recovery Act 2001*. A waste management system would be prepared and maintained throughout construction.		