10. Other environmental issues

10.1 Non-Aboriginal heritage

10.1.1 Assessment approach

The non-Aboriginal heritage assessment was undertaken in accordance with the principles and ethos of the Australian International Council on Monuments and Sites (ICOMOS) Burra Charter and current heritage best practice guidelines, including the *NSW Heritage Manual Statements of Heritage Impact* (Heritage Branch and Department of Urban Affairs and Planning 1996).

The assessment of non-Aboriginal heritage built on the work undertaken for the *Hume Highway Upgrade Woomargama bypass: Preliminary Environmental Assessment* (RTA 2008a) and included:

- Preparing a revised regional historical overview of the locality.
- Searching all relevant statutory and non-statutory heritage registers.
- Consulting with relevant heritage authorities (including the Heritage Branch, RTA Document Management Centre, and Greater Hume Shire Council), numerous local historical societies (including the National Trust of Australia).
- Targeted survey of the assessment area. As a result of property access restrictions a complete survey of the assessment area was not able to be undertaken. Results from earlier field surveys undertaken as part of the preparation of the preliminary environmental investigation was used to supplement the targeted survey. The RTA has committed to undertake a supplementary archaeological survey of the assessment area prior to the commencement of construction works. If any further heritage items or additional impacts are identified appropriate mitigation and management measures would be devised in consultation with Heritage Branch, Department of Planning.
- Preparing a non-Aboriginal archaeological assessment and statement of heritage impact (SoHI) for each item identified in the assessment area. This would be updated if required following the supplementary archaeological survey.

10.1.2 Existing environment

Settlement of the area around Woomargama village began in the mid to late 1830s. Early development of the area centred upon the establishment of pastoral runs of numerous squatters. From the 1860s, the large pastoral runs were subdivided into smaller blocks and taken up by selectors. By 1881, the village of Woomargama had a resident population of 44. At this stage, the village supported two stores, a postmistress and a blacksmith, two hotels and a school.

Since the 1830s, the village has been known by a number of different names, including Dickson's Swamp, Mountain Creek, Seven Mile Creek and now Woomargama.

Pastoral expansion in the 1830s created an arterial route from Sydney as far the Yass River, known as the Great Southern Road. From this point, the route continued as little more than a track, which passed through Woomargama to Albury. By 1836, the main overland route from Sydney to Melbourne began its existence as the Port Phillip Road. In 1928, the road was renamed the Hume Highway.

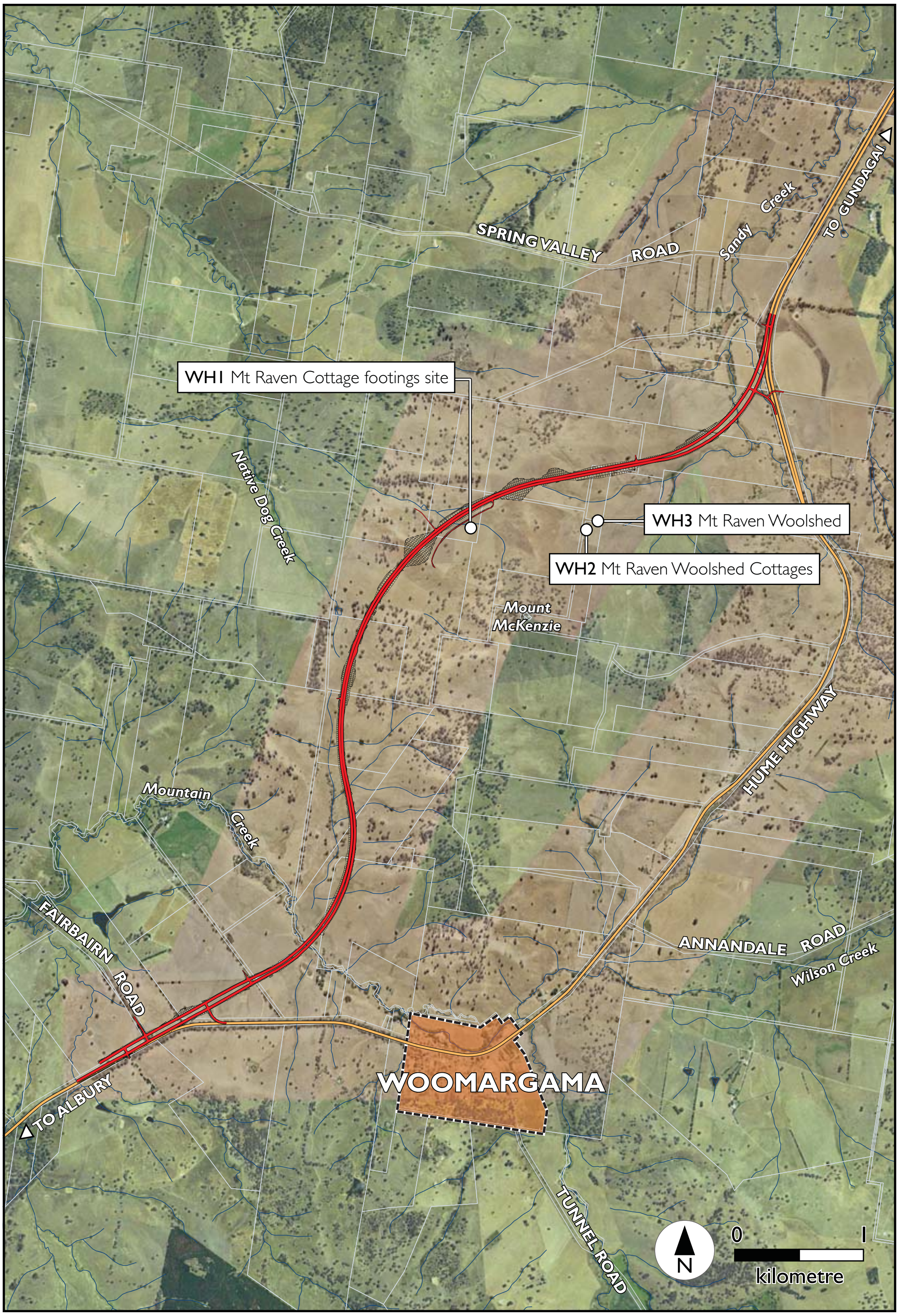
This historical research formed the basis for identification in the assessment area through heritage inventory searches, historical research and site inspections.

Three items of heritage significance have been identified in the assessment area through heritage inventory searches and site inspections. Table 10-1 lists and describes these items, identifies their heritage listing status and identifies their assessed level of significance. Figure 10-1 shows the location of these three heritage items.

Table 10-1 Identified non-Aboriginal heritage sites/items in the assessment area

Site ID	Item	Description	Heritage listing	Significance[1]
WH1	Mount Raven Cottage Site	▪ Remains of footings and historic plantings associated with former cottage site (circa 1930). ▪ These have the potential to yield information on the construction, function and period of use of this structure.	Not listed	Local
WH2	Mount Raven Woolshed Complex	▪ Mount Raven Woolshed Complex is a representative example of post World War 2 type woolshed construction. It includes a woolshed, water tank and stockyards. ▪ The configuration of the woolshed and stockyards are a common sight on many farms across the state. The Woolshed Complex is representative of rural working life in Australia.	Not listed	Local
WH3	Mount Raven Woolshed Cottages	▪ The Mount Raven Woolshed Cottages are a representative example of post World War 2 type shearers' quarters. ▪ The construction methods employed and the spatial configuration of the weatherboard cottages are a common sight on many farms across the state. The cottages are representative of rural working life in Australia.	Not listed	Local

Notes: 1. A NSW heritage place, item or site may be assessed as having local, state, national or world significance.



Proposed bypass
Existing highway
Cadastral
Drainage
Woomargama Village

Figure 10-1 **Location of identified non-Aboriginal heritage items in the assessment area**

10.1.3 Non-Aboriginal heritage impacts

Item WH1

The Mount Raven Cottage Site (WH1) is located within the construction site boundary and would be directly affected by the project. The footings and historic plantings of the Mount Raven Cottage Site remains would be removed.

Items WH2 and WH3

Mount Raven Woolshed Complex (WH2) and the Mount Raven Woolshed Cottages (WH3) are located outside of the construction site boundary and would not be directly affected by the project.

The project may have indirect impacts on these non-Aboriginal heritage items in respect of their landscape and visual setting.

10.1.4 Management of impacts

Table 10-2 identifies mitigation and management measures for non-Aboriginal heritage impacts. These measures have been incorporated into the draft statement of commitments in Chapter 11.

Table 10-2 Non-Aboriginal heritage mitigation and management measures

Potential impact	Mitigation and management measure
Pre-construction	
Impact on previously unidentified items (as a result of property access restrictions).	▪ Carry out a supplementary archaeological survey of the assessment area prior to the commencement of construction works. Should any further items or additional impacts be identified develop mitigation and management measures in consultation with Heritage Branch, Department of Planning.
Direct and indirect impacts on non-Aboriginal heritage.	▪ Manage impact to non-Aboriginal heritage through the CEMP for the project. ▪ Complete an archaeological assessment and archival record (if required) of the Mount Raven Cottage Site (WH1) prior to the commencement of construction works. Lodge the archival record with the Heritage Branch (Department of Planning), Greater Hume Shire Council and the RTA archives.
Construction	
Indirect impact on non-Aboriginal heritage.	▪ Consider the heritage values of Mt Raven Woolshed Complex (WH2) and the Mt Raven Woolshed Cottages (WH3) in consultation with relevant landowner(s) and a suitably qualified heritage specialist as part of the landscaping and urban design.
Construction works uncovering previously unidentified non-Aboriginal heritage	▪ If any unknown non-Aboriginal heritage items are encountered, immediately stop all works that would potentially impact the find. Do not recommence works until appropriate clearance is received.

10.2 Soils and water quality

10.2.1 Assessment approach

The assessment of soils and water quality included the following:

- A desk-based soils assessment to gain an understanding of the soil conditions, the erosion and sedimentation potential of the soil and to identify appropriate erosion and sedimentation controls.
- Surface water quality sampling for turbidity, suspended solids, major dissolved cations and anions, dissolved and total metals, nutrients, benzene, toluene, ethylbenzene and xylene (BTEX) and total petroleum hydrocarbons (TPH). The results of water quality sampling were compared to the *ANZECC Guidelines for Marine and Freshwater Quality* (ANZECC 2000) (ANZECC guidelines) for the three key water uses in the area (aquatic ecosystems, irrigation and livestock water supply).
- Groundwater borehole sampling for temperature, electrical conductivity (EC; salinity), pH, dissolved oxygen, total dissolved solids and redox potential. The results of water quality sampling were compared to the ANZECC Guidelines and the *Australian Drinking Water Guidelines* (ADWG) (NHMRC 2004).

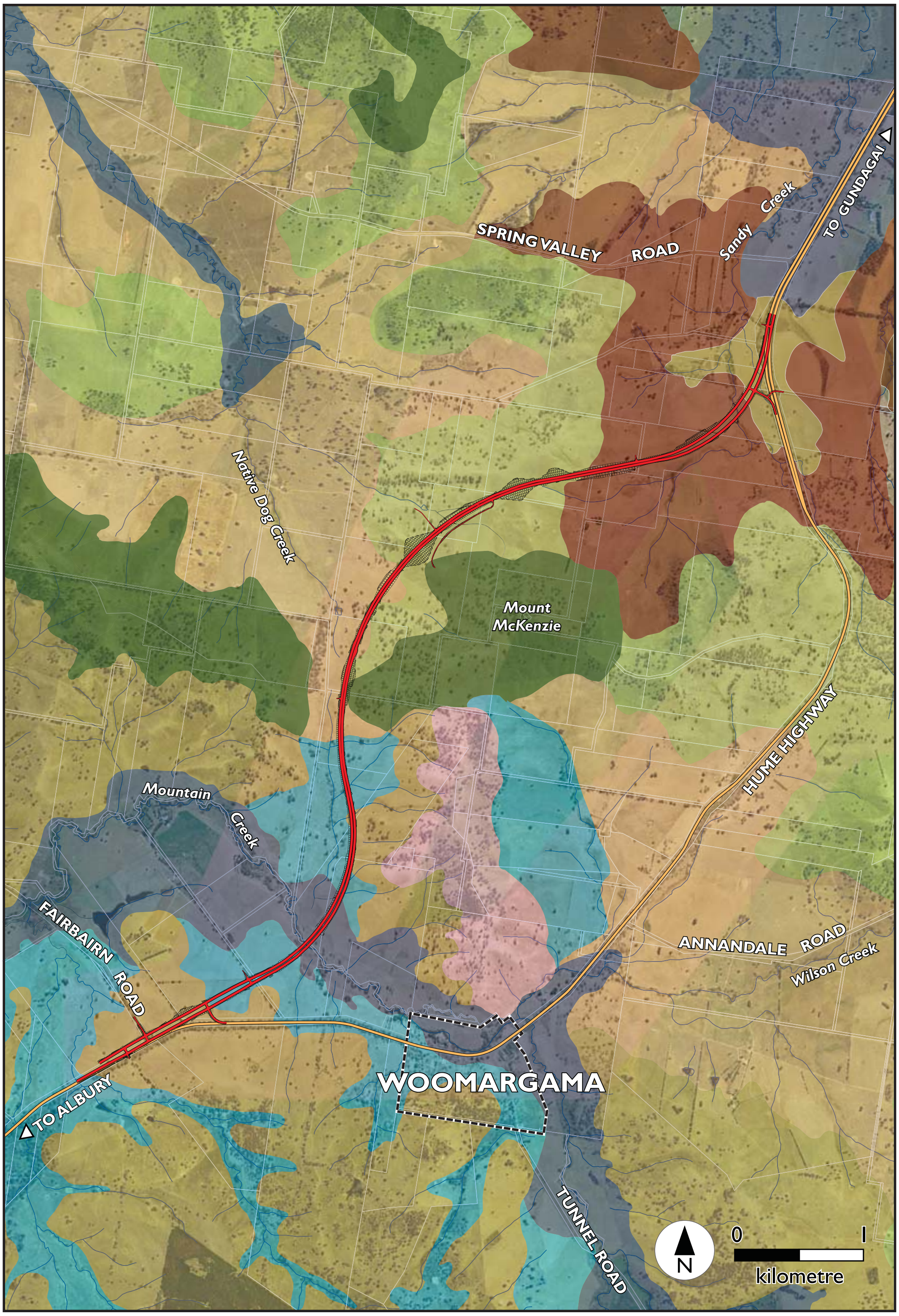
10.2.2 Existing environment

Soils

Seven soil landscape units have been identified in the locality (shown in Figure 10-2), including:

- Yarra Yarra landscape unit.
- Buckaringah landscape unit.
- Wagra landscape unit.
- Dora Dora landscape unit.
- Four Mile Creek landscape unit.
- Mountain Creek landscape unit.
- Lloyd landscape unit.

Table 10-3 provides a summary of the geology, soil type and soil characteristics of these landscape units.



Proposed bypass
Existing highway
Woomargama Village
Cadastral
Drainage

Soil Landscape Units

Buckaringah
Dora Dora
Four Mile Creek
Lloyd
Mountain Creek
Sweetwater
Wagra
Yarra Yarra

Source: Soil Landscape of Holbrook - Tallagamatta 1:100000 sheet, D. Doughty 2003 (Department of Natural Resources)

Figure 10-2 **Soil landscape units in the locality**

Table 10-3 Summary of landscape units in the locality

Geology	Soil types[1]	Soil characteristics likely to impact on project[2]
Yarra Yarra soil landscape unit		
Footslopes/fans adjacent to Silurian granite hills and ranges	▪ Upper/midslopes: Red, Brown and Yellow Chromosols (Red and Yellow Podzolics). ▪ Lower slopes: Brown and Grey Kurosols and Sodosols (Soloths and Solodized Solonetz). ▪ Fans: Orthic Tenosols (Earthy Sands).	▪ All soil layers exhibit sodicity/dispersion and low wet bearing strength characteristics. ▪ Soils are highly erodible (K-factor 0.04). ▪ Subsoils exhibit: ‣ Severe gully erosion (1.5 to three metres deep) in valley depressions (in sodic soils). ‣ Localised sodicity. ‣ Localised waterlogging and poor drainage.
Buckaringah soil landscape unit		
Silurian granite	▪ Crests: Red Chromosols and Kurosols (Red Podzolics). ▪ Upper slopes: Rudosols and Orthic Tenosols (Lithosols). ▪ Slopes: Red, Brown and Yellow Dermosols (Red, Brown and Yellow Earths). ▪ Depressions: Yellow and Grey Dermosols and Kandosols (Yellow Earths).	▪ Soils are highly erodible (K-factor 0.04). ▪ Subsoils exhibit: ‣ Low permeability leading to surface waterlogging. ‣ Moderate gully erosion risk due to potential for each soil horizon to slake (soil crumb collapse in presence of water).
Wagra soil landscape unit		
Silurian granite	▪ Crests and slopes – Clastic Rudosols and orthic Tenosols (Lithosols). ▪ Upper/mid slopes – Red Chromosols and Kurosols (Red Podzolics). ▪ Lower slopes – Brown/Yellow Chromosols and Kurosols (Yellow Podzolics).	▪ Soils are highly erodible (K-factor 0.042). ▪ Subsoils exhibit localised very high exchangeable sodium percentages suggesting sodic/dispersible.
Dora Dora soil landscape unit		
Silurian granite	▪ Crests and upper slopes: Brown and Red Kandosols and Dermosols (Red Earths). ▪ Other slopes: Bleached leptic Tenosols and Rudosols (Lithosols).	▪ Exhibits steep slopes leading to high rates of runoff. ▪ Subsoils exhibit sodic/dispersive characteristics in the B horizon.

Geology	Soil types[1]	Soil characteristics likely to impact on project[2]
Four Mile Creek soil landscape unit		
Colluvium derived from Ordovician and Silurian meta- sediments	▪ Upper slopes: Red Chromosols and Kurosols (Red Podzolics). ▪ Mid slopes: Yellow and Brown Chromosols (Yellow and Brown Podzolics). ▪ Lower slopes: Yellow and Grey Sodosols (Soloths).	▪ Soils are highly erodible (K-factor 0.05). ▪ Subsoils exhibit: ‣ Low wet bearing strength. ‣ Localised sodicity contributes to high erosion risk associated with subsoils particularly in drainage depressions.
Mountain Creek soil landscape unit		
Unconsolidated alluvial plains	▪ Higher, older terraces: Very deep (>1.5 metres) Brown, Yellow and Grey Sodosols (Soloths). ▪ Younger, lower terraces: Yellow and Brown Dermosols (Yellow and Brown Earths). ▪ Recent alluvial channels: Stratic Rudosols (alluvial soils).	▪ Soils are highly erodible (K-factor 0.065). ▪ Subsoils exhibit a combination of sodicity, low permeability and low wet bearing strength.
Lloyd soil landscape unit		
Undivided Ordovician meta-sediments	▪ Crests, ridges and upper slopes: Leptic Rudosols (Lithosols) and Red Kurosols (Red Podzolics). ▪ Mid to lower slopes: Red Chromosols and Kurosols (Red Podzolics). ▪ Drainage lines: Brown Kurosols (Yellow Podzolics).	▪ Soils are highly erodible (K-factor 0.065). ▪ Subsoils have a pH range of 4.5 to 5.8 and exhibit: ‣ Non-cohesive soils, low permeability, and low wet bearing strength indicates that these layers could result in elevated sediment yields to local streams if appropriate sediment controls are not installed.

Source: *Soil Landscapes of the Holbrook-Tallagangatta 1:100,000 Sheet* – D.Doughty, 2003 (Department of Natural Resources).

Notes: 1: Australian Soil Classification System (Great Soil Groups).

2: *K*-factor is a measure of the susceptibility of soil particles to detachment and transport by rainfall and run-off. *K*-factor ranges from 0.005 to 0.075, where anything above 0.04 can be considered highly erodible. The *K* values identified in the table relate to the top of the B horizon (assuming that topsoil is stripped and stockpiled), as this will be the soil profile most exposed to rainfall.

3: Refer to *Soils and Construction: Managing Urban Stormwater* (Landcom 2004) and *Managing Urban Stormwater: Soils and Construction, Volume 2D, Main Road Construction* (DECC 2008).

Water quality

Surface water

Water quality sampling of Mountain Creek was undertaken as part of the Threatened Species Monitoring Program as part of the Hume Highway duplication project. Water was sampled at two locations — in the village and approximately five kilometres downstream. The results indicated that the water quality of Mountain Creek was generally within ANZECC (2000) water quality guidelines for fresh water except for the saturated dissolved oxygen level, which was recorded as 28 per cent (well below the ANZECC guideline of 85 per cent).

A further one off sampling event was undertaken in May 2009 to provide further information on existing water quality. Further details are provided in Section 4.2.2 of Technical Paper 3 (Volume 2). The results indicate that surface water within the Mountain Creek, Native Dog Creek and Sandy Creek catchments have elevated nutrient and zinc levels. This is typical of catchments where grazing and cropping land uses are dominant as at Woomargama. Elevated electrical conductivity values were noted in Sandy and Mountain creeks and associated dams, indicating a potential salinity issue in this area.

Groundwater

Groundwater bores were sampled for water quality field parameters to establish baseline values of water quality. The results of the groundwater water quality sampling are detailed in Table 7-1 of Technical Paper 4 (Volume 2). The results indicated elevated salinity levels (electrical conductivity) in some locations above the ANZECC (2000) assessment criteria. The results also indicated that the groundwater in the alluvial aquifer is generally fresher than the granite aquifer.

Oxygen saturation levels were outside the ANZECC (2000) and ADWG (2004) guidelines range at the majority of bores.

The water type indicated a dominance of chloride in the chemical composition. This indicates that there is possible recharge from freshwater sources, including rainfall recharge and possibly surface water. A bicarbonate component was also present, indicating that the chemistry of the water is being affected by the surrounding geology. Dissolved manganese concentrations exceeded ADWG (2004) aesthetic guidelines at one bore location and ADWG (2004) health guidelines at another bore location. Dissolved iron concentrations were above the ADWG (2004) aesthetic guidelines at a number of bore locations. See Section 7.2 of Technical Paper 4 (Volume 2) for further detail.

10.2.3 Construction impacts

Soils and surface water

The primary potential impact to surface water quality during construction would result from sedimentation as a result of land disturbance. Exposed soils would be readily transported with surface flows to nearby dams and waterways. Soils in the area are predominately silts and clays and generally have a moderate or high erosion potential (refer Table 10-3). These finer particle type soils tend to remain in suspension for longer periods of time, and hence there is a greater risk of sediment loads spreading further downstream from the construction area than if the sediments were larger. Increased sedimentation of waterways can smother benthic habitats and organisms, and can increase levels of nutrients, metals and other potential toxicants that attach to the sediment particles.

Construction works would be undertaken within Mountain and Sandy creeks. This work would have potential short term impacts on surface water quality.

Other potential pollutants that could impact surface water quality during construction include:

- Hydrocarbons and chemicals as a result of spills and leaks from construction vehicles or fuels/chemical stores on construction sites.
- Oils and greases from construction equipment.
- Nutrients attached to sediment particles and from fertilisers used in landscaping works.
- Waste water generated from construction sites.
- Gross pollutants/general litter from construction sites.

Groundwater

Accidental spills from construction vehicles and equipment have the potential to contaminate groundwater aquifers if appropriate controls are not put in place. The alluvial aquifer is likely to be more vulnerable to groundwater contamination than the fractured granite. Groundwater could potentially become contaminated with sediment and/or road construction materials, such as fuels, lubricants and hydraulic oils.

10.2.4 Operational impacts

The project would result in a number of cut batters and fill embankments as the project passes through the saddles of Mount McKenzie (refer Section 5.3.6). Given the high erosion potential of soils affected by the project, these slopes would require effective stabilisation.

The increase in paved surfaces resulting from the project may increase the amount of polluted stormwater runoff. The primary stormwater pollutants associated with the operation of freeways and rural roads comprise:

- Gross pollutants and litter.
- Sediment (eg pavement wear, vehicles, maintenance activities).
- Nutrients (eg fertiliser applied to landscaping).
- Heavy metals from vehicle wear and tear.
- Petroleum hydrocarbons from vehicle spills and leaks.

The pollutants identified above would have the greatest impact during small rainfall events following prolonged dry periods. Such situations allow pollutants to accumulate on the road surface during dry weather with the small rainfall event washing a concentrated 'first flush' of pollutants to receiving waterways while stream flow is low.

Crashes involving vehicles transporting chemicals and/or other dangerous goods may result in spills, which may impact the quality of the surrounding waterways.

There is potential for sedimentation impacts to occur during operation of the project at the bridge structures. Piers on these bridges would provide local sedimentation and scour locations. Similarly, the entrance and exit of culvert structures are areas where sedimentation and scour are likely to occur. As with the construction impacts, the fine-particle silts and clays present in the soils affected by the project have the potential to spread further downstream as suspended sediments are transported with flow.

Surface water run-off and accidental spills or leakage of hazardous materials during operation would have the potential to contaminate groundwater sources, particularly the unconfined alluvial aquifer and shallow local groundwater systems in the granite.