6.3 Soils, water quality, hydrology and groundwater

An erosion and sediment management report for the proposal was undertaken by SEEC (2011) and is provided in Appendix F. A soil contamination assessment of the decommissioned fuel depot site was undertaken for the proposal by Vantage Environmental Management (2011) and is provided in Appendix G.

6.3.1 Existing environment

The study area for soils, water quality, hydrology and groundwater is defined as the area within 500 metres of the proposal.

Topography and geology

The study area is located in the Wonga Hills and Ranges Mitchell Landscape, which comprises rolling hills, low rises and ridges. The general elevation is 250 metres to 370 metres above sea level. Local relief is about 50 metres (Mitchell 2003).

The terrain of the study area is undulating. The proposal north of the existing road-over-rail bridge is located in a natural gully with hills on both sides. South of the existing bridge the proposal traverses a hill with a gradient of about 8.5 per cent.

The geology of the study area comprises two units. The Wagga Marginal Basin geology unit is in the northern half of the study area and an unnamed unit is in the southern half of the study area. Both units are part of the Wagga Group geological classification. The geology of the Wagga Marginal Basin unit is metamorphic, comprising an Ordovician lithology of shale, quartzite, slate and siltstone. The geology of the unnamed unit is metamorphic, comprising an Ordovician lithology of psammite, psammopelite and pelite (NSW Department of Mineral Resources 2002).

Soils

Soil types

The study area is located in the Wonga Hills and Ranges Mitchell Landscape, which contains stony, thin red and brown texture-contrast soils merging to yellow harsh texture-contrast soils on valley floors. The subsoils have high salinity (Mitchell 2003). Chen and McKane (1997) identify three soil landscapes within the study area: Lloyd; Becks Lane and Pulletop. These soil landscapes are very similar, lying on similar parent materials and with a similar suite of soils.

Lloyd soils

This soil landscape has a high erosion hazard and comprises:

- Shallow soils (less than 50 centimetres) consisting of paralithic heptic rudosols on crests, ridges and upper slopes.
- Moderately deep soils (50-100 centimetres) consisting of mesotrophic red chromosols on mid to lower slopes.

Becks Lane soils

This soil landscape has a high erosion hazard and comprises:

- Moderately deep soils (80-100 centimetres) consisting of haplic and bleached red and brown chromosols on slopes.

Pulletop soils

This soil landscape has a moderate erosion hazard and comprises:

- Shallow to moderately deep soils (40-100 centimetres) consisting of mesotrophic red chromosols on crests, ridges and upper slopes.
- Moderately deep soils (80-150 centimetres) consisting of bleached and haplic red chromosols on mid to lower slopes.

Soil constraints

The following soil constraints in the study area were identified (SEEC 2011):

- Dispersible soils – existing gully erosion in the study area and farm dams containing water with suspended sediment indicate that the soils in the study area are dispersible. Dispersible soils are often sodic (have a high sodium content). These soils tend to erode easily and are not suitable for use in earthworks. The soils of the area are noted by Chen and McKane (1996) as being commonly sodic. Soils sampled from the study area were classified as Type D (dispersible), as per Landcom (2004). These soils present an erosion hazard.
- Poorly structured topsoils – topsoils are prone to hard setting surface conditions after light rainfall.
- Stony soils – mainly confined to crests and steeper slopes. These soils have low fertility and are less conducive to rehabilitation.
- Acidic soils – Chen and McKane (1996) note that soils in the area are often strongly acid (pH less than 6). Strongly acidic soil conditions can detrimentally affect revegetation success.
- Low fertility – Chen and McKane (1996) note that soils in the area have low fertility. Low fertility can detrimentally affect revegetation success.
- Existing soil erosion – the proposal crosses some areas currently experiencing mild to moderate gully erosion. This gully erosion is currently active, and showed evidence of lateral gully advance (sidewall slumping).

There are no known occurrences of acid sulfate soils in the study area. Based on mapping of acid sulfate soils for NSW (OEH 2012b), it is unlikely that these would occur in the study area. Acid sulfate soils are generally confined to coastal areas, although they can occur at inland locations where there is poor drainage. No such environments are present in the study area.

Soil contamination

A search of the OEH contaminated land register did not find any declared contaminated sites located in or near the study area. Search results are provided in Appendix C.

The site of the decommissioned fuel depot (see Figure 3.9) is known to contain contamination from previous site operations. The western and northern parts of the decommissioned fuel depot are contaminated.

Preliminary soil testing was conducted within the south-eastern corner of the decommissioned fuel depot where the proposal would be constructed (Vantage Environmental Management 2011). Samples were collected from boreholes at 11 locations to a depth of 3.1 metres. A total of 22 soil samples were submitted for

laboratory analysis. The samples were analysed for a range of parameters. These parameters are those typically associated with storing and dispensing hydrocarbon based fuels.

Soil samples were analysed for contaminants as follows:

- All 22 soil samples were analysed to determine total petroleum hydrocarbon, benzene, toluene, ethylbenzene, xylene (BTEX) and polycyclic aromatic hydrocarbon concentrations.
- Five soil samples were analysed to determine phenol concentrations.
- Five samples were analysed to determine the concentrations of a suite of heavy metals including arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc.
- One soil sample was analysed to determine the concentrations of a broad range of potential contaminants including heavy metals, organochlorine pesticides, volatile organics, polychlorinated biphenyls, cyanide, hexavalent chromium and asbestos.

All parameters analysed in soil samples from the south-eastern corner of the decommissioned fuel depot were at concentrations less than the applicable land use standards for parks and open spaces. Based on the results of the analyses completed, soil at the site would be indicatively classified in accordance with OEH guidelines as General Solid Waste.

Water quality and hydrology

No permanent watercourses occur in the study area. The northern half of the proposal drains into a deeply eroded ephemeral drainage line, which begins near the proposed road-over-rail bridge and runs through Silvalite Reserve to the north (see Figure 1.2). Small pools of water were observed during field investigations in this area. This stream drains north to the Murrumbidgee River.

The southern half of the proposal drains into an ephemeral drainage line to the west. This stream drains north to the Murrumbidgee River.

About 10 dams exist in the study area, including five dams on the western side of the proposal and five dams on the eastern side of the proposal.

All runoff from the study area ultimately drains to the Murrumbidgee River, which is located about 3.5 kilometres north of the proposal.

The proposal is located in undulating country above the river floodplain and as a result flooding is unlikely to occur. Occasional flash flooding may occur in the drainage line at the northern end of the proposal, which runs through Silvalite Reserve.

Water salinity (electrical conductivity) in the Murrumbidgee River is generally below 200 microSiemens per centimetre (NSW Government 2012).

The water quality of the Murrumbidgee River at Wagga Wagga is affected by urban and agricultural runoff.

The four main types of urban stormwater pollution (OEH 2012c) are:

- Litter, such as cigarette butts, cans, paper or plastic bags.
- Chemical pollution, such as detergents, oil or fertilisers.
- 'Natural' pollution, such as leaves, garden clippings or animal droppings.
- Sediment pollution, such as soil erosion and runoff from building sites and unsealed roads.

Agricultural runoff may contain farm chemicals and fertilisers that degrade water quality. Agricultural runoff may also contain manure from stock, which can increase:

- Biochemical oxygen demand.
- Levels of nutrients such as nitrogen.
- Levels of bacteria such as faecal coliforms.

Groundwater

Measurements from a monitoring well located at the site of the decommissioned fuel depot indicate that the water table is deeper than 30 metres (information provided to Roads and Maritime by property owner). The level of the water table is likely to fluctuate with seasons and rainfall.

No registered groundwater bores are located in the study area. Three registered bores are located within one kilometre of the proposal. It is not known whether these are used for groundwater extraction or whether they are monitoring bores. Two of the bores are located near a quarry and the suburb of Glenfield, and are unlikely to be used for groundwater extraction. It is possible that groundwater bores in the locality are used to pump stock water. There is no irrigation agriculture in the study area. Groundwater would not therefore be used for irrigation.

6.3.2 Potential impacts

Construction

Topography and soils

The preliminary erosion and sedimentation assessment for the proposal identified that there is inherently high risk in relation to soils and erosion due to the steep gradients of the study area.

The following construction activities have the potential to directly impact on the soil environment.

Vegetation removal

About 32.5 hectares of vegetation would be removed as part of the proposal. Vegetation removal would expose soils to weathering processes, increasing the risk of erosion and sedimentation.

Cut and fill earthworks

The proposal would involve cut and fill earthworks over an area of about 20 hectares, which would potentially affect topography, geology and soils.

The topography would change from having marked changes in elevation with relatively steep gradients, to having gradual changes in elevation with relatively low

gradients.

In areas of cut, particularly the section of deep cut, the topsoil layer and a proportion of the surficial geology would be removed, exposing the underlying geologic layers. In areas of fill the existing topsoil layer would be removed and crushed material excavated from sections of cut would be placed on top.

Current estimates indicate that the proposal would require about 310,000 cubic metres of excavation. The total volume of fill material required for the proposal is 232,000 cubic metres.

The fill requirements of the proposal have the potential to impact on soils and landforms. Loose fill may be eroded during rainfall events by runoff, increasing the potential for mass movements of soils and sedimentation of local drainage lines. This may in turn influence the vegetation and habitat of adjacent areas by smothering groundcover vegetation and changing soil surface characteristics.

Large cut excavations have the potential to destabilise landforms, particularly on cutting faces. An area of large cut is located between chainages 68850 and 69270. Other smaller sections of cut are located at the northern and southern extents of the proposal. Topsoil loss can reduce agricultural and ecological value, and slow rehabilitation and the re-establishment of native ecosystems (DLWC 2000).

In areas of cut the earthworks have the potential to expose and mobilise acidic soils, which are likely to occur in the study area. Exposed acidic soils may be redistributed closer to the soil surface. Soil acids could potentially be leached into drainage lines where runoff occurs.

Construction of new roads

During construction of new roads there would be a risk of soil compaction from the movement and operation of large machinery such as excavators, rollers and trucks. Heavy machinery can disturb the surface of the soil, which increases the potential for erosion.

Construction of the new road-over-rail bridge

Piles would be required for the foundations of the new road-over-rail bridge. Bored piles would be constructed at both abutments and both piers; with one pier on either side of the rail line reserve. Pile construction would include two sets of piers for the new bridge; one set of piers on either side of the rail line. Pile construction and associated excavation are anticipated to result in a moderate impact to soils due to the required disturbance.

Relocation of utilities

The relocation of the water and gas pipelines would involve soil disturbance by trenching and underboring. The disturbance of soil by machinery could increase the potential for soil erosion.

Removal of pavement from the existing Olympic Highway

The removal of pavement from the existing Olympic Highway, as shown in Figure 1.2, would disturb surface soils, creating the potential for erosion of loose material during rainfall events.

Vehicle movements, including machinery and support vehicles

Machinery and support vehicles used for the construction of the proposal and for the realignment of utilities would be driven off road and would have the potential to transport excess material onto sealed roads near the construction site and stockpile areas.

Stockpiling

It is expected that surplus fill would be excavated from the proposal. Excess excavated material would require stockpiling before being used to flatten fill batters, construct noise mounds or in landscaping. Inadequately stabilised stockpile material could erode in periods of high rainfall or windy conditions.

Landscaping.

Landscaping activities would require minor earthworks that could lead to the erosion of disturbed soils where they are not stabilised.

Impacts on soils are likely to be moderate to high, although localised and short-term. Provided stabilisation strategies are effectively implemented, medium to long-term impacts would be low. Stabilisation and revegetation would act to resist soil erosion to the same extent achieved by existing vegetation.

Soil contamination

Soil testing at the site of the decommissioned fuel depot site has indicated that contaminant levels are low in the south-eastern corner of the property (Vantage Environmental Management 2011). Within the boundary of the decommissioned fuel depot, the proposal would involve filling so that the new road would be up to nine metres above the natural ground surface. As a result the risk of disturbing the contaminated soil is low.

There is potential for chemical and fuel spills during construction, which may result in localised contamination of soils. The potential for contamination is considered to be low provided the safeguards and management measures outlined in Section 6.3.3 are implemented.

Water quality

The introduction of pollutants from construction of the proposal into the surrounding environment, if uncontrolled, could potentially have the following impacts on the water quality of drainage lines and dams:

- Increased sediment load and organic matter causing adverse impacts to water quality in dams and drainage lines, such as increased turbidity. Provided safeguards and management measures are implemented, the proposal would be unlikely to contribute significant amounts of sediment and organic matter to the Murrumbidgee River. This is due to the distance of the river from the proposal (3.5 kilometres) and the lack of permanent streams between the proposal and the river.
- Gross pollutants (large waste items) entering drainage lines in the study area and potentially the Murrumbidgee River.

- Reduced water quality in dams and drainage lines due to an influx of man-made substances.

Construction activities could introduce additional materials to the local drainage lines and dams, particularly during high rainfall events. Contaminants could include rubbish and construction materials, and fuel or chemicals from accidental spills. Spills could occur during refuelling or through leaking of hydraulic and lubricating oil from plant and equipment. Mishaps relating to hazardous chemicals stored on-site could also potentially lead to contamination of drainage lines.

Sediment basins have been designed to contain dirty water runoff from the proposal, as well as the volume of any spill of fuel or chemical that could potentially occur during construction, as described in Section 3.4.3.

Due to site constraints at the northern 280 metres of the proposal and southern 220 metres of the proposal, dirty water runoff cannot be captured using sediment basins. This runoff would occur from a likely total area of about 1.2 hectares. Minimal earthworks are required at these locations. Dirty water runoff from these sites would be managed using clean and dirty water separation, progressive revegetation, soil stabilisers and sediment controls.

The potential for construction water quality impacts to the surrounding drainage lines and dams is considered to be low to moderate. The likelihood of water quality impacts to the Murrumbidgee River is considered to be low to negligible due to the distance of the proposal from the river and the lack of permanent streams between the proposal and the river.

Hydrology

The proposal would cause soil compaction through the operation of construction machinery, as described previously. This has the potential to change the distribution of, and increase the quantity of, water in the local catchment.

The proposal may reduce the quantity of water in nearby waterbodies and drainage lines by sourcing water from farm dams or from sediment ponds constructed as part of the proposal. The volume of water required would be influenced by climatic conditions, and the level of moisture in excavated rock, which would be used to construct other sections of the new highway. The volume of water required for construction of the proposal is not expected to exceed 15 megalitres. If sufficient water cannot be obtained from dams and sediment ponds it may be sourced from Riverina Water County Council water supply mains in the area or other alternative water sources.

Groundwater

Cutting excavation would have a depth of up to 18 metres below the existing ground surface. The largest section of cut is located about 200 metres, and upslope from, the decommissioned fuel depot. Sections of cut in other parts of the proposal that are lower in elevation have much shallower excavation. The depth to groundwater near the decommissioned fuel depot has been measured to be at least 30 metres from the ground surface (Vantage Environmental Management 2011). At some other locations west of the proposal groundwater was identified at shallow depths but this was likely due to perched water tables (Vantage Environmental Management 2011). Generally, groundwater interception would be unlikely during the proposed construction works

due to the hilly terrain of the study area and depth to groundwater.

It is anticipated that the proposal would be unlikely to directly affect any groundwater systems during construction.

It is also unlikely that the proposal would impact on groundwater users due to the lack of nearby registered bores.

The proposal has the potential to cause increased recharge of water to the water table. This could occur through the removal of trees that currently intercept water moving through the soil profile and through re-directing runoff from hard surfaces to locations where increased infiltration may occur. This has the potential to contribute to localised salinity. There is good drainage in the study area. The water table has been measured at 30 metres from the ground surface near the decommissioned fuel depot, and the likelihood of the proposal causing salinity in the study area is low.

Operation

Topography and soils

Impacts to landscape, geology, and soils may occur through the operation of the proposal, due to:

- An increase in the amount and velocity of water runoff due to the sealed road surface and road embankments.
- Minor alterations to the topographic environment through road works and landscaping.

These changes could result in additional erosion and scouring in the study area. Maintenance activities during operation that could disturb soils and landforms include cleaning of culverts and table drains. The use of vehicles during maintenance may result in a spill of chemicals or fuels. Potential for impacts during maintenance would be minimised by adherence to relevant Roads and Maritime specifications and the infrequent nature of the activities. Revegetation, the installation of water control structures and water quality dams would reduce the velocity of water and the potential for erosion during operation.

Water quality

Clean water from upstream of the proposal would be diverted around, away from, or through the proposal.

Three sediment basins would be retained permanently for storm water detention and spill containment during operation. These basins have been designed to contain runoff generated from the proposal during operation, and any potential spills by tankers. The volumes of the water quality control basins have been designed to contain the volume of any spill of fuel or chemical that could potentially occur during operation, such as from a B-double tanker.

Stormwater runoff from the road may impact on the water quality of dams and drainage lines. Operation of roads leads to the build-up of contaminants on road surfaces, median areas and roadside corridors. During rain events these contaminants can be transported by run-off into surrounding waterbodies and lands. The permanent water quality basins would capture some of these contaminants.

Due to the presence of the existing Olympic Highway, these potential impacts are unlikely to have any greater risk than that which is already present.

Maintenance during operation of the proposal may result in a spill of chemicals or fuels in the vicinity of a dam or drainage line; however the risk of this occurring is low. Permanent water quality control basins would intercept spills from most of the proposal.

Hydrology and drainage

The proposal would result in the filling of local natural depressions. This has the potential to change the distribution of, and increase, the quantity of water in the local catchment.

During operation, the compacted fill of embankments and increased pavement area of the proposal would reduce the potential for water infiltration and would increase the amount and velocity of runoff. The detailed design would include formalised drainage structures and scour protection as required to minimise the potential impacts from runoff. Water quality basins would be designed to reduce flow velocities and therefore the potential for scouring.

Groundwater

The proposal may increase the recharge of water to the water table through the generation of additional runoff and concentration of flows. The piers of the bridge would be constructed to withstand groundwater effects, including salinity, should the water table occur at the depth of construction.

6.3.3 Safeguards and management measures

Impact	Environmental safeguards	Responsibility	Timing
Soils and water quality - soil erosion, sedimentation and water quality	• A soil and water management plan will be prepared as part of the CEMP for the proposal in accordance with Roads and Maritime specification G38 – Soil and Water Management and the Blue Book - Soils and Construction - Managing Urban Stormwater Volume 1 (Landcom 2004) and Volume 2D (DEC 2008a). • The soil and water management plan will include but not be limited to: - A primary erosion and sedimentation control plan and a maintenance schedule for ongoing maintenance of temporary erosion and sediment controls. - A sediment basin management plan to guide appropriate management of runoff during construction and operation. - An incident emergency spill plan which will include measures to avoid spillages of fuels, chemicals, and fluids onto any surfaces or into any adjacent/nearby waterways. • An accredited soil conservationist will be	Project manager and contractor	Pre-construction

Impact	Environmental safeguards	Responsibility	Timing
	engaged to provide advice during development and implementation of the soil and water management plan. The soil conservationist will regularly review and inspect works throughout the construction phase.		
Soils and water quality - soil erosion and sedimentation	• Sediment and erosion controls (including sediment basins), clean water diversions and culverts will be constructed and be on line before the commencement of earthworks. • Sediment basins will be regularly serviced and maintained to comply with water quality and capacity requirements. • Energy dissipaters will be installed to reduce flow velocity and potential erosion as required. • Clearing of vegetation and stabilisation/revegetation activities will be carried out progressively to limit the time disturbed areas are exposed to erosion processes. • Site stabilisation of disturbed areas will be undertaken progressively as stages are completed. • Topsoil will be stockpiled separately for possible reuse in landscaping and rehabilitation works. • During construction of trenches for utility pipeline relocations, topsoil will be excavated separately to the subsoil and would be placed on top of the backfilled trenches to promote rapid regeneration of groundcover vegetation. • High risk soil and erosion activities such as earthworks will not be undertaken immediately before or during high rainfall or wind events. • Permanent catch drains will be installed behind proposed cut faces to act as diversion drains during the construction phase. • Erosion and sediment control measures will be maintained until the works are complete and areas are stabilised by revegetation.	Project manager and contractor	Construction
Soils and water quality - water contamination	• All fuels, chemicals, and liquids will be stored at least 50 metres away from any drainage lines and would be stored in an impervious bunded area within the compound sites. • The refuelling of plant and planned maintenance of machinery and plant will be undertaken 50 metres away from	Project manager and contractor	Construction

Impact	Environmental safeguards	Responsibility	Timing
	waterways. • Machinery will be checked daily for leaks of oil, fuel or other liquids. • Control of dirty water will be managed onsite to avoid release in to drainage lines and/or waterways. • Potable water will be used for wash down. • Containment material will be used to capture/filter water used in vehicle wash-downs. • Concrete truck washouts will be undertaken within a designated bunded area of an impervious surface or undertaken off-site. • Visual monitoring of local water quality (ie turbidity, hydrocarbon spills/slicks) will be undertaken on a regular basis to identify any potential spills or deficient erosion and sediment controls. A record will be kept of these inspections. • Emergency spill kits will be kept on-site at all times. • All staff will be inducted about incident and emergency procedures and made aware of the locations of emergency spill kits. • Should a spill occur during construction, the emergency response plan will be implemented, and the Roads and Maritime senior regional environmental officer contacted. OEH will also be notified as per Part 5.7 of the POEO Act.		
Soils and water quality - soil contamination	• If soil contamination is discovered during construction, works will cease immediately, the site will be temporarily fenced and access would be restricted. Soil sampling and analysis would be conducted to assess the extent and nature of the contamination. Remediation would be conducted in line with the guidelines in *Managing Land Contamination: Planning Guidelines SEPP 55–Remediation of Land* (NSW Government 1998).	Project manager and contractor	Construction