11. Groundwater

The Groundwater Assessment examined the potential effects of the Project on groundwater and its beneficial uses under the State Environment Protection Policy (SEPP) (Groundwaters of Victoria) as well as the potential for groundwater to impact on road construction and the structural integrity of the road.

Regional bore water information and mapping indicates that the salinity of the groundwater in the study area is relatively high with levels ranging from 1,500 milligrams per litre (mg/L) to 3,000mg/L of Total Dissolved Solids (TDS) near Stawell, to over 7,000mg/L TDS elsewhere. High salinity levels mean that groundwater in the area has limited extracted value, generally only suitable for stock watering and industrial use. Groundwater with lower salinity levels is suitable for irrigation, although water above 1,500 to 2,000mg/L TDS may cause plant stress. The SEPP (Groundwaters of Victoria) defines beneficial uses of groundwater, based on the existing groundwater quality (salinity).

Regional mapping by the Department of Primary Industries (DPI) has identified a number of Groundwater Dependent Ecosystems (GDEs) in the study area that potentially use groundwater to some extent, although they may not necessarily be dependent on it. Very little data is currently available to assess whether or not these GDEs are actually dependent on groundwater. However, the higher salinity groundwater in much of the study area would not be conducive to plant growth.

The key risk considered in the impact assessment was the intersection of groundwater during construction. Although it is considered that the likelihood of this occurring is low, it cannot be discounted that groundwater may be unexpectedly encountered at localised areas along the alignment. If groundwater was intersected during construction it is expected that the impact would range from insignificant to moderate depending on the location in which groundwater was intersected.

As the proposed alignment would be predominantly above grade, with limited cuts below the existing grade, there would be limited or no opportunity for the road to directly interact with the groundwater environment.

The alignment passes through the former Great Western Landfill and existing quarries. The deepest cuts of the Project would occur within these locations to a similar depth that has been excavated for the quarry. The quarry operator has indicated that groundwater intrusion is not an issue for operations.

Testing of the former landfill (Golder 2011) suggested that wastes were deposited above the groundwater table. The landfill is in the base of an old quarry and may not have been constructed with an engineered lining system. It is therefore possible that leachate from this landfill has impacted upon the groundwater quality in this location.

The likelihood of intercepting contaminated groundwater was considered to be low because investigations (Golder 2011) suggest that groundwater occurrence is deep and that a cut located in this area is unlikely to intersect groundwater. The waste exhumed by Golder (2011) was dry and showed minimal signs of decomposition, suggesting that the soil cover could be providing a reasonable barrier to limiting rainfall infiltration and thereby reducing leachate generation. Also, landfilling activities ceased in 2000, and given the inferred permeable nature of the underlying geology, any leachate plumes may have migrated away from the site.

The waste material from the area of landfill intersected by the proposed alignment would be relocated. This could result in an overall improvement in the containment and management of the waste material through upgraded storage conditions that meet current EPA regulations.

In assessing the impact to groundwater in the environmental risk assessment, the majority of risks associated with the Project have been assigned a negligible rating, as most of the Project would be constructed either above the existing grade or in shallow cut and therefore there would be limited opportunity for direct interaction with the groundwater environment.

Uncertainties regarding groundwater would be reduced prior to construction with the implementation of geotechnical and groundwater investigations to established baseline conditions. The program would be required to characterise the groundwater occurrence and quality to inform the engineering design of the area of large cutting, particularly north-east of Great Western.

Overall, it was considered that the risk to groundwater as a result of construction and operation of the Project would be negligible to low.

11.1 EES Objectives

The EES objective relevant to Groundwater is:

- *"To protect catchment values, surface water and groundwater quality, stream flows and floodway capacity, as well as to avoid impacts on protected beneficial uses".*

This chapter discusses the groundwater environment within the project area, including the location and quality of groundwater. The potential impacts from the Project on groundwater have been assessed, and proposed management measures have been identified to minimise these impacts. More specifically, this chapter addresses the EES scoping requirements by:

- Characterising the groundwater in the project area in terms of location, behaviour and quality, including its protected beneficial uses under the State Environment Protection Policy (Groundwaters of Victoria).
- Identifying potential effects of road construction and operation activities on groundwater and any potential effects of groundwater on road construction and integrity (e.g salinity).
- Identifying measures to avoid, mitigate and manage any potential effects including any relevant design features of the road or techniques for construction.
- Describing the likely residual effects of road construction and operation activities on groundwater in the project area.

This chapter is based on a groundwater assessment completed by GHD Pty Ltd (2012d). The assessment report is included in Technical Appendix F.

11.2 Study Area

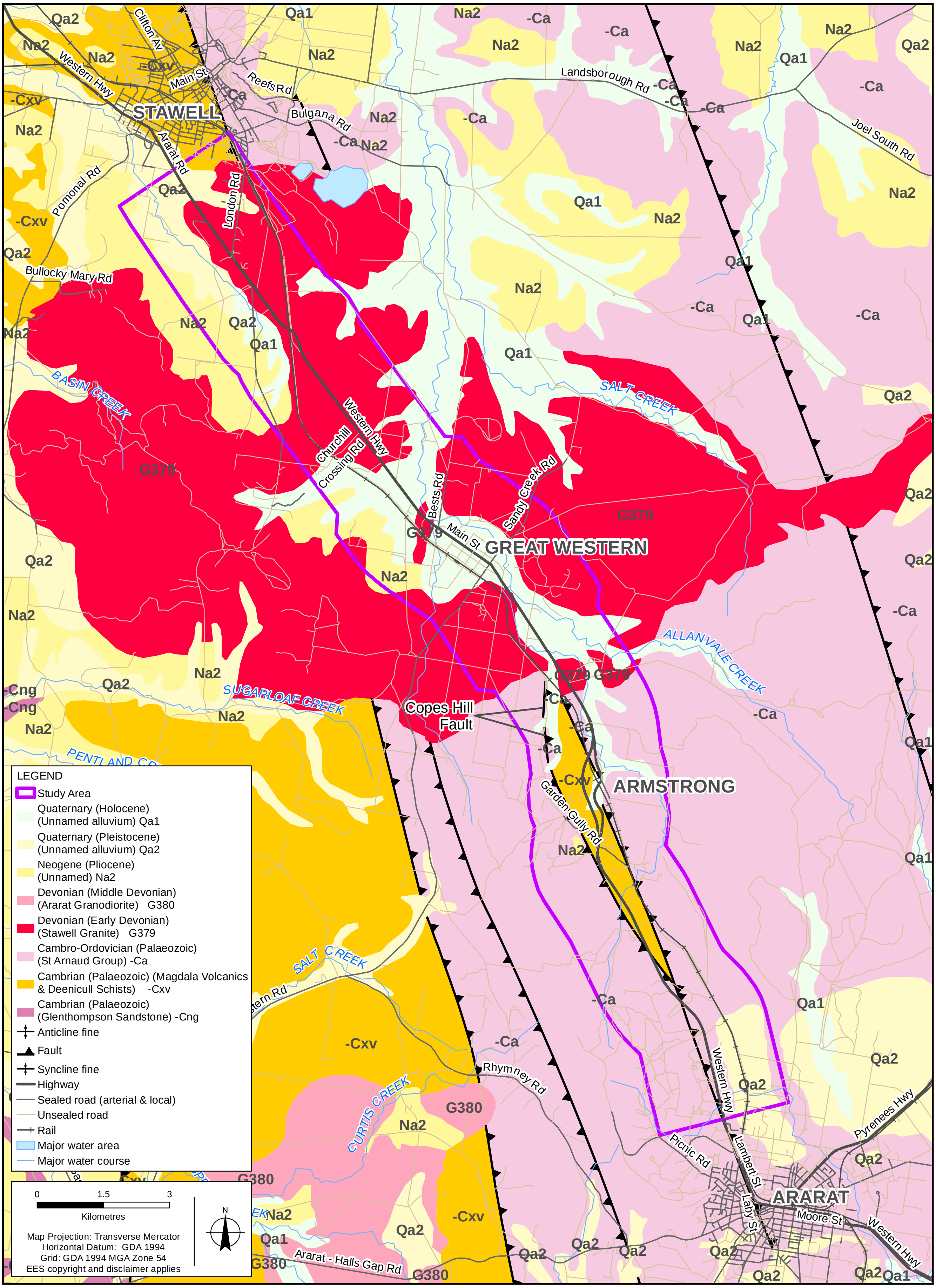
The groundwater study area encompasses an area extending approximately 1500 metres (m) either side (east and west) of the edge of the existing highway, except around Great Western where it extends up to 1800m (encompassing the extent of new alignment possibilities). The study area is shown in Figure 11-1.

As groundwater needs to be considered both on a local and regional scale, wider influences outside of the study area have been incorporated.

11.3 Methodology

To assess the groundwater environment within the study area, the following tasks were completed:

- Review of existing hydrogeological reports in the study area;
- Identification of beneficial uses of groundwater within the study area, in terms of State Environment Protection Policy (Groundwaters of Victoria) (SEPP (Groundwater));
- Analysis of the geology of the study area and examining the relationships between aquifers at the local and regional scale;
- Interpretation of recharge and discharge processes, and interactions between surface and groundwater;
- Interpretation of groundwater quality in relation to the interpreted geology and flow systems;
- Identification of the location of users/receptors of the groundwater systems such as bore owners, streams and wetlands; and
- Provision of a concise summary of the conceptual hydrogeological model for the Western Highway study area.



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Data source: DSE, VicMap, 2012; VicRoads, 2012; GHD, Design, 2012; DPI, 2012

Figure 11-1 Groundwater Study Area

11.4 Legislation and Policy

The legislation and government policies related to groundwater are outlined in Table 11-1.

Table 11-1 Relevant Groundwater Legislation and Policies

Legislation / Policy	Description
State	
Water Act 1989	Approval for the extraction, use or disposal of groundwater for the Project would be required under the Water Act. It is not yet known if this would be required for the Project. This would be confirmed during the detailed design phase.
Environment Protection Act 1970	The EP Act regulates the discharge of emissions to the groundwater environment by a system of licences and works approvals. Any discharge into groundwater during the construction of the Project must be in accordance with the requirements of the EP Act. The requirement for any discharge would be confirmed by the construction contractor(s).
State Environment Protection Policy (Groundwaters of Victoria)	The SEPP (Groundwater) has been prepared under the provisions of the EP Act and sets out segments of the groundwater environment, based on salinity. Each segment has beneficial uses that must be protected. The EPA can determine that the beneficial uses of a segment are not applicable to groundwater where: ▪ There is insufficient yield. ▪ The background level of a water quality indicator other than total dissolved solids (TDS) precludes a beneficial use. ▪ The soil characteristics preclude a beneficial use. ▪ A groundwater quality restricted use zone has been declared.

11.5 Existing Conditions

The regional geology is relatively simple with only a limited number of formations occurring within the study area. A description of the geological formations or layers found in the region, and the aquifer type, is shown in Figure 11-1. The identified aquifers are all potentially unconfined. More detail on geology is provided in Technical Appendix E (Soils and Geology Impact Assessment).

Within the study area, groundwater occurs throughout the various geological formations to varying degrees. These aquifers are likely to be of low value, given that little resource development has occurred, and that no Groundwater Management Units (GMUs) have been declared within 5 kilometres (km) of the study area.

There are nine drilling records recorded within the study area. One of these is a bore for stock and domestic water use, two are observation bores and the classification of the remaining drilling records is not known.

Regional bore water information and mapping indicates that the salinity of the groundwater in the study area is relatively high with levels ranging from 1,500mg/L to 3,000mg/L of Total Dissolved Solids (TDS) near Stawell, to over 7,000mg/L TDS elsewhere. High salinity levels mean that groundwater in the area has limited extracted value, generally only suitable for stock watering and industrial use. Groundwater with lower salinity levels is suitable for irrigation, although water above 1,500 to 2,000mg/L TDS may cause plant stress. The SEPP (Groundwaters of Victoria) defines beneficial uses of groundwater, based on the existing groundwater quality. Table 11-2 provides a summary of the groundwater segments and corresponding beneficial uses.

Groundwater Dependent Ecosystems (GDEs) are ecosystems that rely on groundwater to meet all or some of their water requirements. Department of Primary Industry (DPI) mapping shows that there is potential for GDEs to be present in the study area. These are mostly vegetation systems relying on access to groundwater by tree roots, where the water table is likely to be within 10m of the ground surface. The potential GDEs in the study area are largely associated with the granitic geology near the Black Range (State Reserve) west of Great Western, and the Ararat Hills (Regional Park). Figure 11-1 shows the DPI mapping of GDEs within the study area.

Table 11-2 Groundwater Beneficial Uses

Beneficial Use	Segment				
	A1	A2	B	C	D
	Salinity (mg/L TDS)				
	0-500	501-1,000	1,001-3,500	3,501-13,000	>13,000
Maintenance of ecosystems	✓	✓	✓	✓	✓
Potable water:					
▪ Desirable	✓				
▪ Acceptable		✓			
Potable mineral water supply	✓	✓	✓		
Agriculture, parks and gardens	✓	✓	✓		
Stock watering	✓	✓	✓	✓	
Industrial water use	✓	✓	✓	✓	✓
Primary contact recreation (e.g. swimming/bathing)	✓	✓	✓	✓	
Buildings and structures	✓	✓	✓	✓	✓

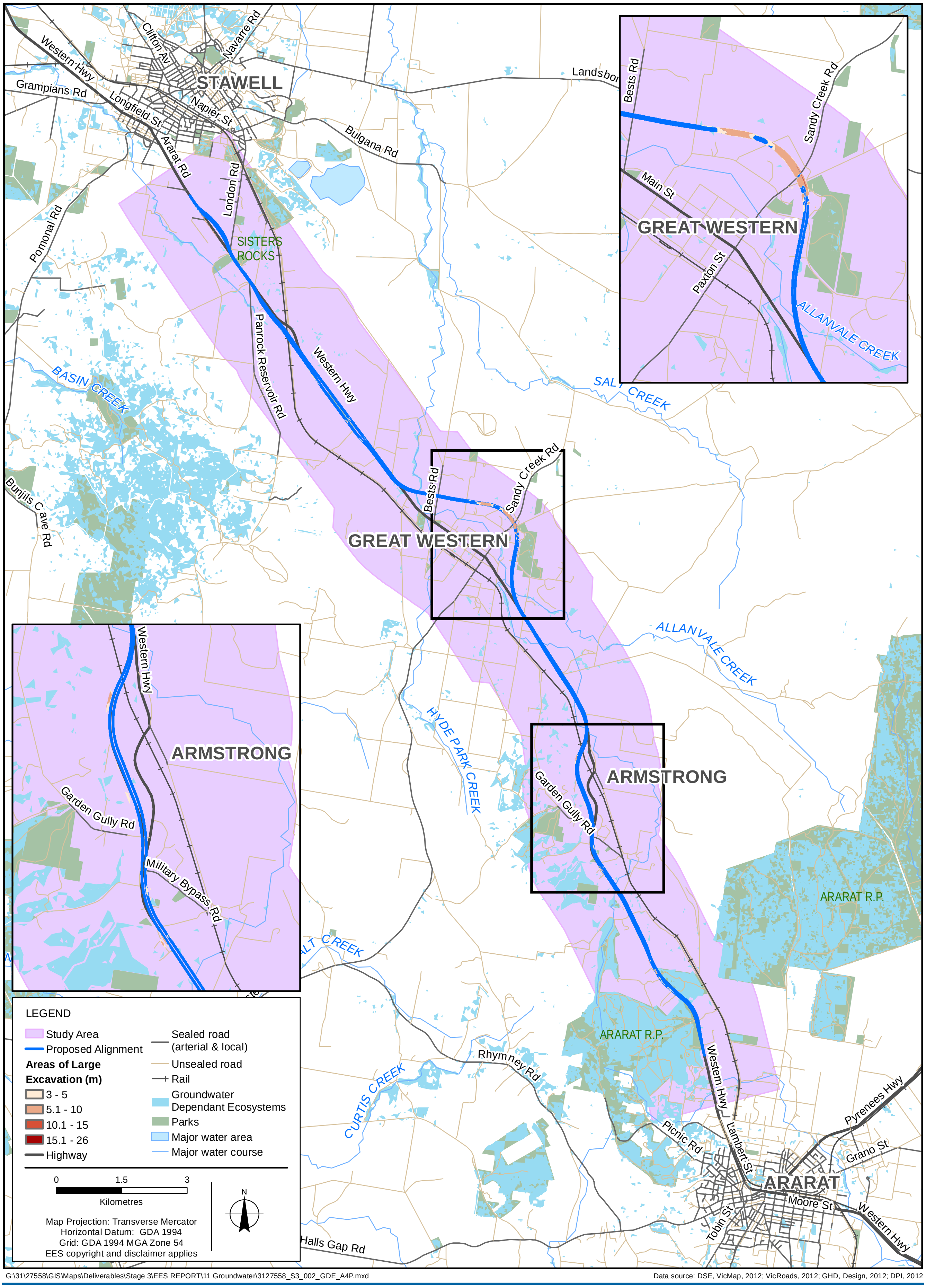

Figure 11-2 DPI identified GDEs and areas of largest cut

11.6 Impact Assessment

The impact and risk assessment presented in the following sections was conducted on the proposed alignment.

There is little development of groundwater resources in the region therefore the understanding of groundwater conditions is based on limited available data from existing bores. However, based on the information available and considering that the project has few areas of deep cut proposed, the information was suitable to inform the impact assessment. Further investigation of groundwater depth, flows and quality would therefore be required prior to construction.

11.6.1 Key Issues

The impact assessment identified the following key potential issues:

- Changes to groundwater availability from:
  - Dewatering created by cuttings
  - Groundwater use during construction
  - Changes to aquifer character
  - Severance to access to groundwater supplies
- Changes to groundwater quality from:
  - Groundwater contamination
  - Activation of Acid Sulphate Soil conditions
  - Changes in groundwater flow (e.g. from cuttings).

However, as the proposed alignment would be predominantly above grade, with limited cuts below the existing grade, there would be limited or no opportunity for the road to directly interact with the groundwater environment.

11.6.2 Impact Pathways

Potential impacts to the groundwater environment could occur during either the construction of the Project or during its operation. Impacts can be simplified into two categories: impacts relating to groundwater availability for 'beneficial uses' and groundwater quality. In some cases there could be an overlap between these categories, for instance if construction dewatering triggered the oxidation of acid sulphate soils, affecting water quality.

11.6.2.1 Construction Dewatering

Cuts below the water table along the proposed alignment could potentially cause groundwater inflows into areas of excavation. This could potentially impact subsurface construction and potentially cause the following issues:

- A reduction in the availability of water to nearby bores through the lowering of the water table;
- Depressurisation of perched groundwater aquifers;
- Loss of water supply to Groundwater Dependent Ecosystems;
- Ground settlement;
- Activation of acid sulphate soils; or
- Mobilisation of contaminated groundwater plumes.

The precise details of the water table elevation along the proposed alignment would not be known until detailed geotechnical investigations are conducted. However, based upon the information that is currently available, it is expected that there is an elevated risk of intersecting groundwater along the alignment where the depth of cut is greater than 3m. It is therefore estimated that only 1.5km of the proposed 24km alignment has an elevated risk of intersecting groundwater (see Table 11-3). In addition, most of the proposed deep cuts are near the crest of hills and in steeper topographies (for example, near Great Western), where the likelihood of encountering groundwater is further reduced due to its greater depth. The areas of deepest cut are shown in Figure 11-2.

Overall there would be a low likelihood of encountering groundwater, however it cannot be discounted that groundwater may be unexpectedly encountered at localised areas along the proposed alignment. Geotechnical investigations would be undertaken to confirm the depth of the water table during the detailed engineering design phase.

Table 11-3 Areas of elevated risk of encountering groundwater

Chainage (m)	Approximate Length (m)	Maximum Depth of Cut (m)	Comment
4850-5000	<100	3	
5400-5550	<100	4.36	
13100-14000	850	9.63	Approximately 300m over 8m depth
14150-14550	350	6.91	Approximately 250m over 5m depth

11.6.2.2 Groundwater Resources

As outlined in Section 11.6.2.1, the water levels and operation of groundwater users in the study area may potentially be influenced by excavations, or as a result of groundwater bores installed for the construction phase of the Project (e.g. for dust suppression or road making).

There are a few bores that have been identified close to the proposed alignment. If any bore is required for the Project, a licence would be required from Southern Rural Water. This licence application would include an assessment of potential impacts on existing users and a licence would not be granted unless the risks to groundwater users and the environment were acceptable.

There is no documented evidence of spring fed dams in Section 3 of the Project; however this would be confirmed following geotechnical investigations of groundwater levels during the detailed engineering design phase.

For these reasons, it is expected that the impacts to the groundwater resource of the study area would be negligible.

11.6.2.3 Compaction or Subsidence

Land subsidence is a gradual settling of the ground surface, and is potentially a result of aquifer dewatering. It may have implications for the integrity of structures where the dewatering occurs, such as buildings, roads and underground services.

The geological terrains most likely to have compressible materials are the Tertiary and Quaternary aged sediments, which are generally restricted to present day waterways. These areas would be crossed by bridge structures and therefore groundwater would not be impacted in these localities. Most areas requiring deeper cuts are located on the Cambro-Ordovician basement rock which is not considered compressible.

Drawdown in areas of fine grained materials could cause subsidence, however this would generally extend less than 100 m from an alignment

Overall, the impact is considered to be negligible due to the geology of the proposed alignment and limited area of proposed cut below the groundwater level.

11.6.2.4 Groundwater Quality

The background groundwater quality of the water table is variable, but generally most areas of the proposed alignment fall within Segment C (refer to Table 11-2). This water quality is relatively poor with salinity in excess of that acceptable for potable use. The beneficial uses to be protected in accordance with the SEPP (Groundwaters of Victoria) are identified in Table 11-2.

It is possible that construction and operational activities could result in the contamination of groundwater quality through:

- Spillage, improper handling, storage and application of hazardous materials during construction;
- Disposal of fluids or wastes to groundwater;
- Aquifer re-injection to mitigate drawdown and related impacts (e.g. settlement);
- Exposure of Acid Sulfate Soil;
- Incompatibilities with construction materials e.g. leaching from imported backfill;
- Establishing hydraulic connection between two aquifers of differing water quality which were previously hydraulically isolated; or
- Spillage and road run-off during operation of the project.

The likelihood of these events occurring is low, as the VicRoads standard environmental management procedures address these risks. In addition, runoff generated during operation of the road would be captured in the road drainage system, largely preventing the runoff from entering the groundwater environment. For further information on acid sulfate soils and potential contamination due to landfill, see Chapter 10 (Soils and Geology).

The alignment passes through the former Great Western Landfill and quarries to the north east of Great Western. The alignment extends through the existing quarry where it is excavated to a depth of around 6m, which similar to that of the proposed alignment in this area. The quarry operator has indicated that groundwater intrusion is not an issue for operations. The quarry is also currently seeking approval to expand operations to the north in the area of the proposed alignment.

Testing of the former landfill (Golder, 2011) suggested that wastes were deposited above the groundwater table. The landfill is in the base of an old quarry and may not have been constructed with an engineered lining system. It is therefore possible that leachate from this landfill has impacted upon the groundwater quality in this location.

The likelihood of intercepting contaminated groundwater was considered to be low because:

- Testing pitting investigations (Golder, 2011) suggest that groundwater occurrence is deep and that a cut located in this area is unlikely to intersect groundwater;
- The waste exhumed by Golder (2011) was dry and showed minimal signs of decomposition, suggesting that the soil cover could be providing a reasonable barrier to limiting rainfall infiltration and thereby reducing leachate generation; and
- Landfilling activities ceased in 2000, and given the inferred permeable nature of the underlying geology, any leachate plumes may have migrated away from the site.

As the deepest cuts of the Project would occur in this location, further geotechnical investigations would be undertaken where necessary to inform the engineering design of the cutting and to characterise the groundwater occurrence and quality.

The waste material from the area of landfill intersected by the proposed alignment would be relocated. This could result in an overall improvement in the containment and management of the waste material through upgraded storage conditions that meet current EPA regulations. The current landfill is not lined and was established before the current regulations were put in place.

11.7 Risk Assessment

An environmental risk assessment was undertaken on the proposed alignment to identify key environmental issues associated with the construction and operation of the Project. The methodology for this risk assessment has been described in Technical Appendix Q.

Table 11-4 shows a summary for groundwater of:

- The impact pathways identified; and
- A description of the consequences.

In assessing the impact to groundwater, the majority of risks associated with the Project have been assigned a negligible likelihood of occurring, as most of the Project would be constructed either above the existing grade or with shallow excavation and therefore there would be limited opportunity for direct interaction with the groundwater environment. Management measures have been identified to protect and maintain groundwater availability and quality. Overall, it is concluded that the risk to groundwater as a result of construction and operation of the Project would be negligible to low.

Table 11-4 Groundwater Risks

Risk No.	Impact Pathway	Consequence Description
GW1	Cuts below water table along alignment, requiring dewatering	Construction dewatering results in unacceptable impact to other groundwater users, e.g. existing irrigators, stock and domestic users (construction and/or operation).
GW2	Cuts below water table along alignment, requiring dewatering	Management of the recovered groundwater – erosion or water quality degrades receiving surface waterways (construction and/or operation).
GW3	Cuts below water table along alignment, requiring dewatering	Dewatering / depressurisation consolidates compressible materials causing settlement and land instability (construction and/or operation). Few built structures are in those areas that are below the grade.
GW4	Cuts below water table along alignment, requiring dewatering	Temporary construction dewatering adversely affects groundwater flow to GDEs. Cuts below grade that permanently result in change in groundwater flow regime. (construction and/or operation).
GW5	Cuts below water table along alignment, requiring dewatering	Dewatering alters hydraulic gradients resulting in existing groundwater contamination plumes potentially being dislocated / moved. Interruption of existing groundwater remediation efforts.
GW6	Cuts below water table along alignment, requiring dewatering	Potential generation of acid plumes / mobilisation of heavy metals / aggressive groundwater, leading to attack on submerged steel / concrete structures (piles, services).
GW7	Contamination of groundwater from construction activities, e.g. spillage, use of 'contaminated' fill material, construction waste management, hazardous materials handling.	Impact to groundwater quality/ breach of SEPP (GoV). Potential to breach SEPP (Waters of Victoria). Impact to worker safety during construction.
GW8	Contamination of groundwater from operational activities (road runoff, traffic accidents, stormwater, spillage)	Impact to groundwater quality/ breach of SEPP (GoV).
GW9	Ponding and retention of water associated with highway drainage (operation)	New or increased groundwater accessions, altered groundwater flow patterns, new or exacerbated waterlogging and salinity impacts
GW10	Construction earthworks removing impervious layers (across site, floodplains, river crossings and embankments).	Site recharge enhanced increasing groundwater levels (water logging, groundwater displacement) and or introducing contaminants.
GW11	Construction works create impervious ground surface layers.	Reduced recharge to groundwater system.
GW12	Project pipelines or service conduits constructed in saturated materials alter groundwater flow.	Buried services within the alignment located below the water table may create preferential groundwater seepage paths, and alter seepage migration routes. In shallow groundwater environments the resulting impact can be significant. Furthermore groundwaters (e.g. saline groundwater) may be aggressive to buried services.

Risk No.	Impact Pathway	Consequence Description
GW13	Alignment of road passes through existing groundwater bore location (or farm dam) or severs access for stock or irrigation infrastructure.	Requirement to compensate groundwater user, install replacement bore (observation, stock, irrigation etc.) or replacement dam. Temporary loss of production.
GW14	Use of groundwater for construction water supply.	Adverse impact to existing groundwater users, environment.
GW15	Shallow groundwater or rising water tables	Rising water and/or precipitation of salts can damage road pavements.

11.8 Environmental Management Measures

VicRoads has a standard set of environmental management measures which are typically incorporated into its construction contracts for road works and bridge works. These measures have been used as a starting point and are described in detail in Chapter 21 (Environmental Management Framework). In some instances, additional Project specific environmental management measures have been proposed to reduce risks.

Management measures specific to each identified groundwater risk, and the residual risk rating after environmental management measures have been applied are outlined in Table 11-5.

Table 11-5 Groundwater Environmental Management Measures and Residual Risk

Risk No.	Environmental management measure(s)	Residual Risk
GW1	A groundwater management plan and monitoring program would be developed and implemented to address potential impacts to groundwater if encountered. The groundwater management plan would include controls to prevent erosion and sedimentation and include water disposal options. Construction groundwater supplies would have to be from licensed bores and subject to the Grampians Wimmera Mallee Water approvals process and/or groundwater trading rules / local management rules. A key mitigation measure is preconstruction investigations of groundwater (occurrence and quality), particularly in proposed areas of cut, and establishment of baseline conditions. An audit of landholders would be conducted to identify water supplies that may be impacted, e.g. dams or bores. Measures to mitigate groundwater draw down impacts would include: ▪ Minimise dewatering required by micro-review of gradelines. ▪ Detailed design of cuts and ground support. Alteration of the construction technique to reduce the need for dewatering. A variety of engineering options are available, e.g. use of sheet piles / contiguous piles. ▪ Careful design of the dewatering methodology, e.g. multiple closely spaced bores may create a localized cone of depression. ▪ Increased construction effort, e.g. reducing the duration over which dewatering may be required; ▪ Careful timing of the works to periods where water levels may be at their lowest. ▪ Re-injection of the pumped groundwater between the excavation site and impacted part to impart hydraulic control (aquifer recharge). ▪ Non-continuous pumping that may allow water level recovery during pumping quiescence. ▪ Supplying any affected parties with an alternate water supply, e.g. carting water, deepening the pump intake setting depth. ▪ Replacement of existing bores that are adversely impacted by construction. ▪ Implementing a groundwater monitoring program. Sufficient contingency must be incorporated into water treatment plans, monitoring programs (environmental, safety) to cope with the ingress, management, treatment and disposal of contaminated groundwater water that may be unexpectedly encountered.	Negligible
GW2	Comply with section 1200.08 Erosion and Sediment Control of the VicRoads contract specification. As per GW1.	Negligible
GW3	As per GW1. A site specific investigation would be conducted during detailed design to identify likelihood of subsidence.	Low
GW4	As per GW1. If required, an alternate water supply would be established to maintain environmental water requirements, e.g. treated stormwater / road drainage could be redirected as a replenishing or alternate water supply.	Negligible

Risk No.	Environmental management measure(s)	Residual Risk
GW5	As per GW1. Contaminated materials would be managed as follows: ▪ The discovery of contaminated material on the site during works would be managed in accordance with VicRoads and EPA Guidelines. ▪ Where putrescible waste material is encountered the Superintendent and EPA would be notified. The Contractor would undertake a visual assessment of the Site for contaminated soils and materials.	Negligible
GW6	As per GW1. Development of an Environmental Management Plan (EMP) to establish a consistent and sustainable approach to managing PASS e.g. DSE Victorian Best Practice Guidelines for Assessing and Managing Coastal Acid Sulphate Soils. Minimise the dewatering influence near PASS materials (as per GW1). Soil sampling and laboratory analysis would be conducted as part of the detailed design phase to confirm the presence of ASS. Groundwater levels and quality would be monitored in all aquifers adjoining PASS materials. Performance standards and action triggers would be established for: ▪ implementing remedial actions. Impacted or at risk areas/assets remediation can be undertaken through pH adjustment, e.g. lime dosing. ▪ considering the need for artificial recharge.	Low
GW7	Contaminated materials would be managed as follows: ▪ The discovery of contaminated material on the site during works would be managed in accordance with VicRoads and EPA Guidelines. ▪ Where putrescible waste material is encountered the Superintendent and EPA would be notified. ▪ The Contractor would undertake a visual assessment of the Site for contaminated soils and materials. The EMP would include specific procedures to minimise leakage or spillage of any fuels or chemicals. Fuel and chemical storages and equipment fill areas would be monitored at internals or not more than seven days.	Negligible
GW8	Standard procedures for State Emergency Response, Country Fire Authority and Environment Protection Authority would be implemented.	Negligible
GW9	Water Sensitive Road Design measures would be evaluated in the detailed design phase, as described in VicRoads Integrated Water Management Guidelines (August 2011).	Low
GW10	A groundwater management plan and monitoring program would be developed and implemented to address potential impacts to groundwater, if encountered. River crossings would be duplicated consistent with CMA requirements. Earthwork surface finish specifications would be specified to mitigate enhanced accessions. Site would be rehabilitated with vegetation / grasses. Grading would be conducted for erosion control. Allowance would be made for subsidence with backfilled excavations. Temporary access tracks would be removed and ground conditions rehabilitated.	Negligible
GW11	As per GW1 and GW10	Low
GW12	As per GW1. Apply pipeline construction measures (trench cut offs- or breakers) that mitigate risk process, if groundwater is encountered.	Negligible
GW13	Negotiation with asset owners would be undertaken. Confirm of bore locations (and operational status) within construction corridor and conduct landholder consultation. Construction groundwater supplies would be from licensed bores and subject to the Grampians Wimmera Mallee Water approvals process and/or groundwater trading rules / local management rules. Audit of landholders would be conducted of identified water supplies that may be impacted, e.g. dams or bores.	Negligible
GW14	Construction groundwater supplies would be from licensed bores and subject to the Grampians Wimmera Mallee approvals process and/or groundwater trading rules / local management rules.	Negligible
GW15	Adequate road (under) drainage. Understanding of conditions of existing road i.e. correlations from existing behaviour.	Negligible

11.8.1 Residual Risks

Following implementation of the proposed mitigation measures there are not expected to be any significant impacts. The overall risk to groundwater is negligible to low.

11.9 Conclusion

The assessment found that groundwater quality in the study area is relatively poor with uses generally limited to stock and non-potable domestic purposes.

Regional mapping by the Department of Primary Industries (DPI) has identified a number of Groundwater Dependent Ecosystems (GDEs) in the study area that potentially use groundwater to some extent, although they may not necessarily be dependent on it. Limited data is currently available to assess whether or not these GDEs are actually dependent on groundwater. However, the higher salinity groundwater in much of the study area would not be conducive to plant growth.

The key risk identified in the impact assessment is the intersection of groundwater during construction. Although it is considered that the likelihood of this occurring is low, it cannot be discounted that groundwater may be unexpectedly encountered at localised areas along the alignment. If groundwater was intersected during construction it is expected that the impact of this event would range from insignificant to moderate depending on the location in which groundwater was intersected, as well as the length of time that the groundwater was affected.

As the proposed alignment would be predominantly above grade, with limited cuts below the existing grade, there would be limited or no opportunity for the road to directly interact with the groundwater environment.

The alignment passes through the former Great Western Landfill and existing quarries. The deepest cuts of the Project would occur within these locations to a similar depth that has been excavated for the quarry. The quarry operator has indicated that groundwater intrusion is not an issue for operations.

Testing of the former landfill (Golder, 2011) suggested that wastes were deposited above the groundwater table. The landfill is in the base of an old quarry and may not have been constructed with an engineered lining system. It is therefore possible that leachate from this landfill has impacted upon the groundwater quality in this location.

The likelihood of intercepting contaminated groundwater was considered to be low because investigations (Golder, 2011) suggest that groundwater occurrence is deep and that a cut located in this area is unlikely to intersect groundwater. The waste exhumed by Golder (2011) was dry and showed minimal signs of decomposition, suggesting that the landfill cap could be limiting rainfall infiltration and thereby reducing leachate generation. Also landfilling activities ceased in 2000, and given the inferred permeable nature of the underlying geology, any leachate plumes may have migrated away from the site.

The waste material from the area of landfill intersected by the proposed alignment would be relocated. This could result in an overall improvement in the containment and management of the waste material through upgraded storage conditions that meet current EPA regulations.

In assessing the impact to groundwater in the environmental risk assessment, the majority of risks associated with the Project have been assigned a negligible rating, as most of the Project would be constructed either above the existing grade or in shallow cut and therefore there would be limited opportunity for direct interaction with the groundwater environment.

Uncertainties regarding groundwater would also be reduced prior to construction with the implementation of geotechnical and groundwater investigations to established baseline conditions. The program would be required to characterise the groundwater occurrence and quality to inform the engineering design of the area of large cutting, particularly north-east of Great Western.

Overall, it is concluded that the risk to groundwater as a result of construction and operation of the Project would be negligible to low.