Chapter 15
Soils and contamination

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15 Soils and contamination

This chapter summarises the soils and contamination assessment carried out for the upgrade of the Great Western Highway between Blackheath and Little Hartley (the project). The full contamination assessment is provided in Appendix K (Technical report – Contamination).

15.1 Assessment approach

The following steps were followed to inform the soils and contamination assessment:

- review of available desktop information to provide context for the existing environment including:
  - previous and relevant site contamination reports
  - topographical and geological context, soil landscapes, salinity and acid sulfate soil potential for the region
  - soil and groundwater data collected from geotechnical investigations for the project
  - relevant Lotsearch reports, historical aerial photographs, historical titles and/or section 10.7 certificates (formerly section 149 certificates)
- a site inspection in December 2021 to investigate the existing environment
- development of a preliminary conceptual site model to provide the framework for identifying how receivers may potentially be exposed to contamination from contamination sources
- qualitative risk rating of contamination related construction and operational impacts of the project using the following categories:
  - low risk: a complete pollutant linkage would be unlikely
  - medium risk: a complete pollutant linkage may potentially be present, however the likelihood and consequence would be medium
  - high risk: a complete pollutant linkage would be likely.
- identification of suitable mitigation measures to manage the potential soils and contamination impacts of the project.

Further details of the methodology undertaken for the contamination assessment are provided in Section 2 of Appendix K (Technical report – Contamination).

15.2 Existing environment

15.2.1 Sensitivity of the receiving environment

The project would be located adjacent to the Blue Mountains National Park and the Greater Blue Mountains World Heritage Area. This sensitive and unique environment comprises important views, rugged tablelands, sheer cliffs, deep, inaccessible valleys and swamps supporting a diverse ecosystem. There are a number of sensitive ecological receivers and water bodies near the project, including threatened species and groundwater dependent ecosystems as well as water bodies supporting Sydney's drinking water catchment. The area is largely undeveloped and remains largely in its natural form.

15.2.2 Soils

Topography

The project would be located along a ridgeline. The land to the east is generally similar or at higher elevation and land to the west follows a moderately steep slope down towards the Megalong Valley. There are numerous mountain peaks in the area, including Mount Boyce to the west and Mount Victoria to the north. The land closest to the eastern and western ends of the project are the lowest and flattest and the land with greatest elevation is located near Mount Victoria at around 1,000 to 1,100 metres Australian Height Datum.

Soil landscapes

Nine soil landscapes are located across the area of the project. Soil landscapes within one kilometre of the project are mapped in Figure 15-1. A summary of the erosion hazard of each soil landscape is outlined in Table 15-1.

Table 15-1 Erosion hazards of soil landscapes near the project

Soil landscape	Erosion hazard
Lithgow (li)	Slight erosion hazard in wind and non-concentrated (slower, low power) stream flows. Moderate-high erosion hazard in concentrated (faster, higher power) stream flows.
Cullen Bullen (cb)	Moderate-high erosion hazard in concentrated and non-concentrated flows. Slight wind erosion hazard.
Medlow Bath (mb)	Moderate erosion hazard in non-concentrated flows. Moderate to high erosion hazard in concentrated flows. Slight-moderate wind erosion hazard.
Hassans Walls (hw)	Very high-extreme erosion hazard in concentrated and non-concentrated flows. Slight wind erosion hazard.
Warragamba (wb)	Very high-extreme erosion hazard in concentrated and non-concentrated flows. Slight wind erosion hazard.
Wollangambe (wo)	High-extreme erosion hazard in concentrated and non-concentrated flows. Slight wind erosion hazard.
Deanes Creek (dc) and Deanes Creek variant a (dca)	Slight-moderate erosion hazard in non-concentrated flows. Very high-extreme erosion hazard in concentrated flows. Slight wind erosion hazard.
Mount Sinai (ms)	High-extreme erosion hazard in concentrated and non-concentrated flows. Slight-moderate wind erosion hazard.
Disturbed terrain (xx)	Erosion hazard is variable according to site characteristics. Disturbed terrain was identified near the project at Berghofer's Pass (see Figure 15-1).

Soil salinity

Salinity refers to the salt content of soil or water and is caused by the build-up of salt in surface soil or water. The risk of salinity impacts can be increased by clearing vegetation, irrigation or other activities that can lead to a temporary rise in the groundwater table, which then leaves salt behind as it recedes. Based on searches of the National Assessment Dryland Salinity data, there are no areas of soil salinity recorded near the project. The overall salinity hazard along the project

alignment is identified as ‘very low’ by the Hydrogeological Landscapes of New South Wales and the Australian Capital Territory (Department of Planning and Environment, 2016b).

Acid sulfate soils and rock

Acid sulfate soils are naturally occurring soils containing iron sulfides, which on exposure to air, oxidise and create sulfuric acid. Disturbance of acid sulfate soils and/or potential acid sulfate soils can result in adverse impacts on surface and groundwater quality, flora and fauna, and degradation of habitats.

Acid sulfate soil risk maps from the Australian Soil Resource Information System (ASRIS) database[1] have been reviewed for areas surrounding the project to determine the risk of acid sulfate soils being present. The acid sulfate soil probability near the project is shown in Figure 15-2. The project would be located within land mapped as low (six to 70 per cent chance of occurrence) and extremely low (one to five per cent chance of occurrence with occurrences in small, localised areas) probability for acid sulfate soil risk.

Acid sulfate rock (ASR) is unweathered rock (i.e. rock that has not been exposed to water, wind, ice, plants, or changes in temperatures) which contains metal sulfide minerals. When exposed to either oxygen or water, oxidation of the sulfide within the ASR leads to the formation of iron oxides, sulfuric acid, sulfates, and salts. Potential ASR deposits have been identified around the western sections of the project alignment, as shown in Figure 13-1 in Chapter 13 (Groundwater and geology).

[1] Acid sulfate soils have been verified using ASRIS data as class data derived from local environmental plan mapping is not available for this area.

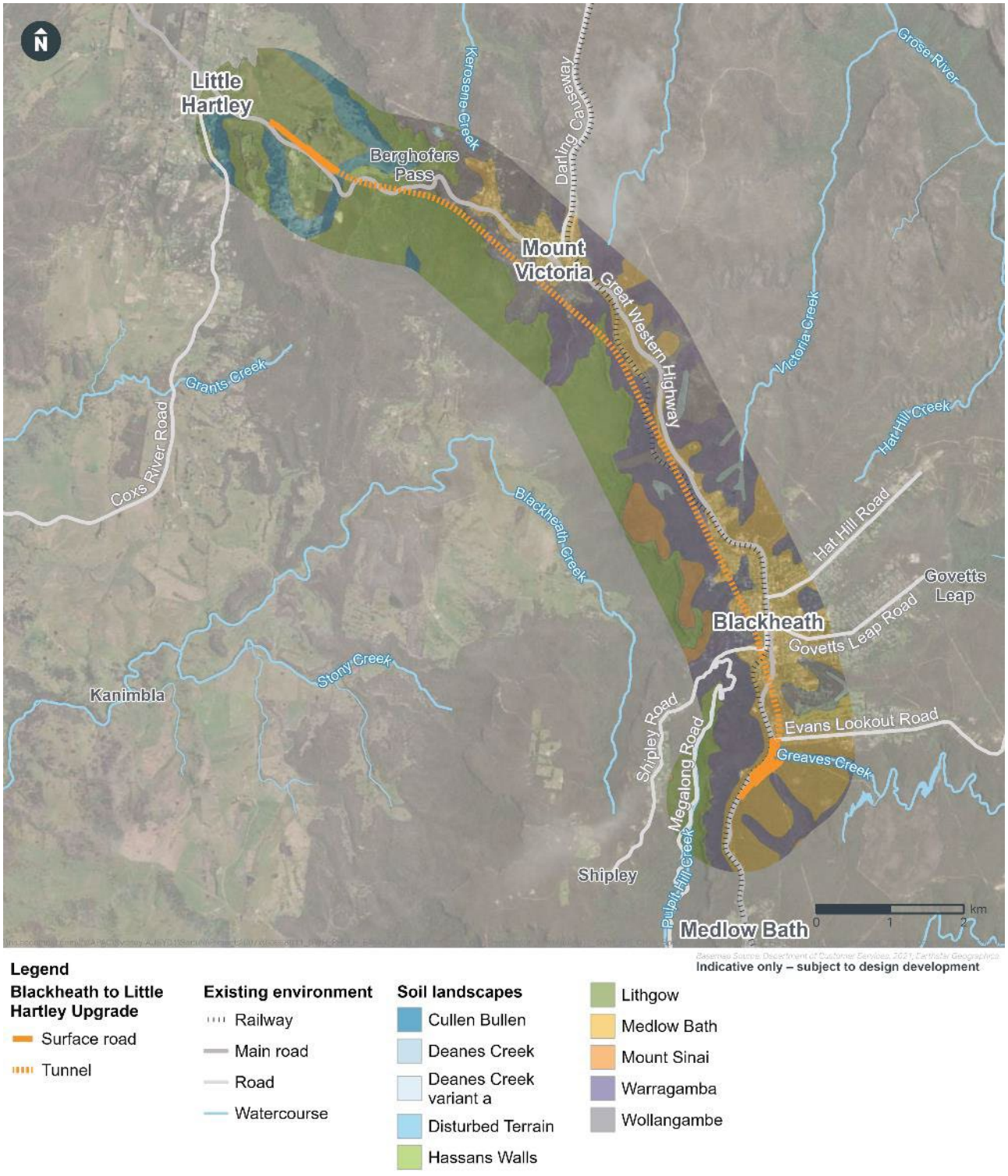

Figure 15-1 Soil landscapes within one kilometre of the project

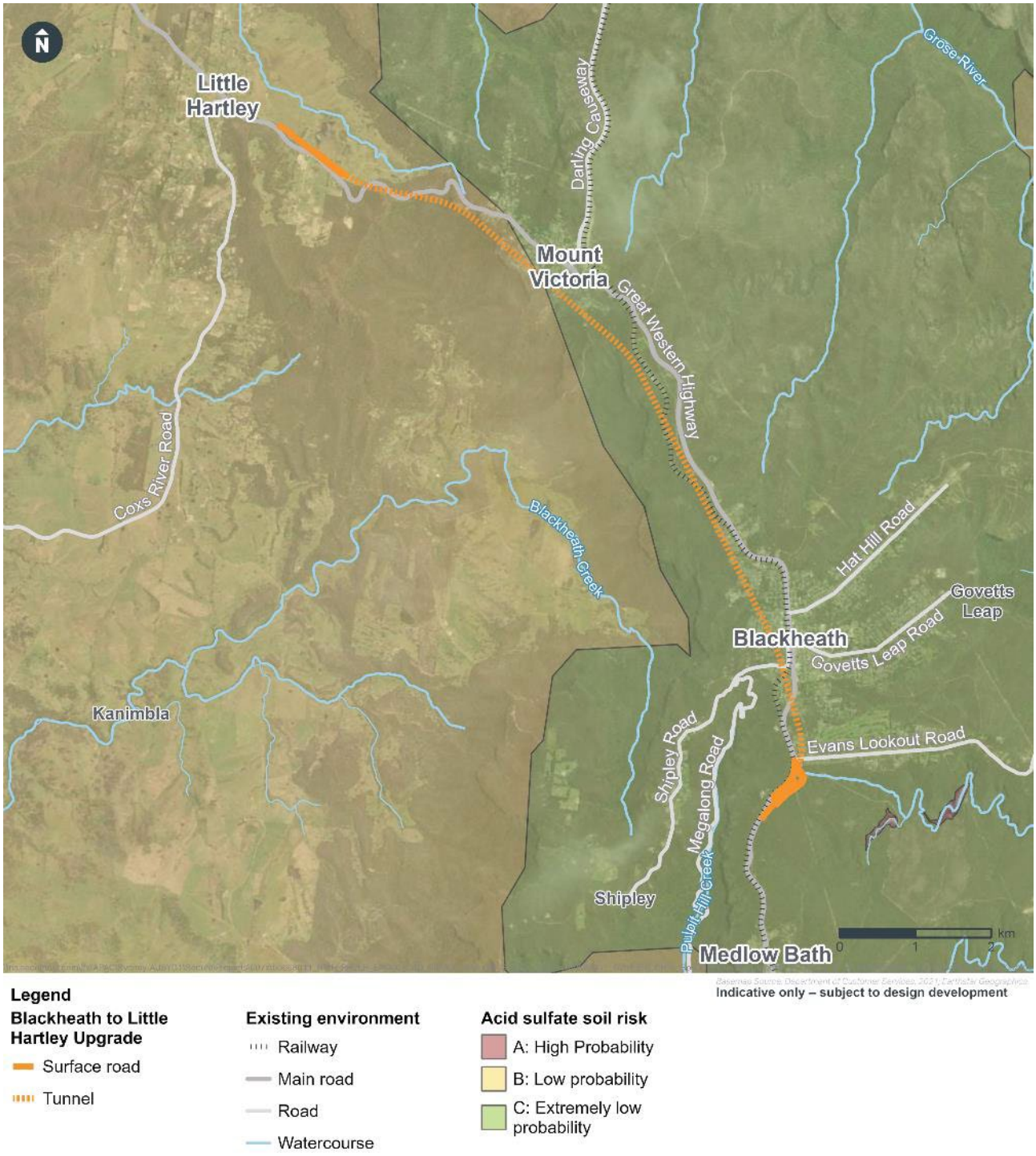

Figure 15-2 Acid sulfate soil risk near the project

15.2.3 Contamination

The areas of environmental interest (AEIs) and contaminants of potential concern identified near the project are summarised in Table 15-2 and the AEIs are shown in Figure 15-3 to Figure 15-5. Some AEIs, including vehicle crashes and spills, coal seam gas and potential acid forming rock, could be encountered at various locations and are therefore not always indicated on figures (referred to as general areas of environmental interest in Figure 15-3 to Figure 15-5).

Table 15-2 Areas of environmental interest and potential contaminants of concern near the project

ID	Areas of environmental interest	Contaminants of potential concern
AEI-1	Mount Victoria rail maintenance yard	Heavy metals, polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPHs), total recoverable hydrocarbons (TRHs), asbestos and volatile organic compounds (VOCs) including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-2[1]	Railway lines and rail compounds	Heavy metals, PAHs, TPHs, TRHs, asbestos and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-3	Current and former service stations, garages and service centres in Blackheath, Little Hartley and Mount Victoria	Heavy metals, PAHs, TPHs, TRHs, asbestos, per- and poly-fluoroalkyl substances (PFAS) and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-4	Two fire stations in Blackheath and two fire stations in Mount Victoria	Heavy metals, PAHs, TPHs, TRHs, asbestos, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-5	Electricity substations at Blackheath and Mount Victoria	Heavy metals, PAHs, TPHs, TRHs, asbestos, PFAS, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (SVOCs) and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-6	Blackheath Laundrette	Heavy metals, PAHs, TPHs, TRHs, SVOCs and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-7	Mount Victoria Sewerage Treatment Plant and effluent outflow area	Heavy metals, PAHs, TPHs, TRHs, SVOCs including phenols and organochlorine pesticides (OCPs), nutrients, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-8	Covered stockpiles adjacent to Valley View Road Blackheath	Heavy metals, PAHs, TPHs, TRHs, SVOCs including phenols and OCPs, nutrients, asbestos (bonded/friable), PCBs, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.

ID	Areas of environmental interest	Contaminants of potential concern
AEI-9	Areas of possible historical landfilling in Blackheath Tip (yet to be remediated), Blackheath Oval/Jubilee Park, Eltham Park, Mountain Christian College	Heavy metals, PAHs, TPHs, TRHs, SVOCs including phenols and OCPs, nutrients, asbestos (bonded/friable), PCBs, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-10	Weber's Nursery, Mount Boyce and Wood You Believe Firewood	OCPs, organophosphorus pesticides (OPPs), herbicides, termiticides (arsenic) and nutrients (ammonia, nitrate, nitrite, phosphorous).
AEI-11[1]	Areas of possible historical landfilling adjacent to Soldiers Pinch, Browntown Oval and Great Western Highway roadworks/cut and fill areas	Heavy metals, PAHs, TPHs, TRHs, SVOCs, phenols, OCPs, nutrients, asbestos (bonded/friable), PCBs, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-12[1]	Illegal dumping	Heavy metals, PAHs, TPHs, TRHs, PFAS, asbestos and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-13	Lolly Bug Little Hartley former service station	Heavy metals, PAHs, TPHs, TRHs, PFAS, asbestos and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-14[1]	Vehicle crashes and spills	Heavy metals, PAHs, TPHs, TRHs, VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene, PFAS, asbestos.
AEI-15[1]	Previously demolished historical buildings	Lead and asbestos.
AEI-16	Former Little Hartley airfield	Heavy metals, PAHs, TPHs, TRHs, PFAS and VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene.
AEI-17[1]	Historical use of pesticides and herbicides	OCPs, OPPs, herbicides, termiticides (arsenic) and nutrients.
AEI-18[1]	Coal seam gas	Dissolved methane.
AEI-19[1]	Potential acid forming rock, towards the western section of the project alignment	Low pH.
AEI-20	CSR building products clay/shale, structural clay mine	Heavy metals, PAHs, TPHs, TRHs, VOCs including benzene, toluene, ethylbenzene, xylenes and naphthalene, PFAS and asbestos.

Table notes:

1. General AEIs

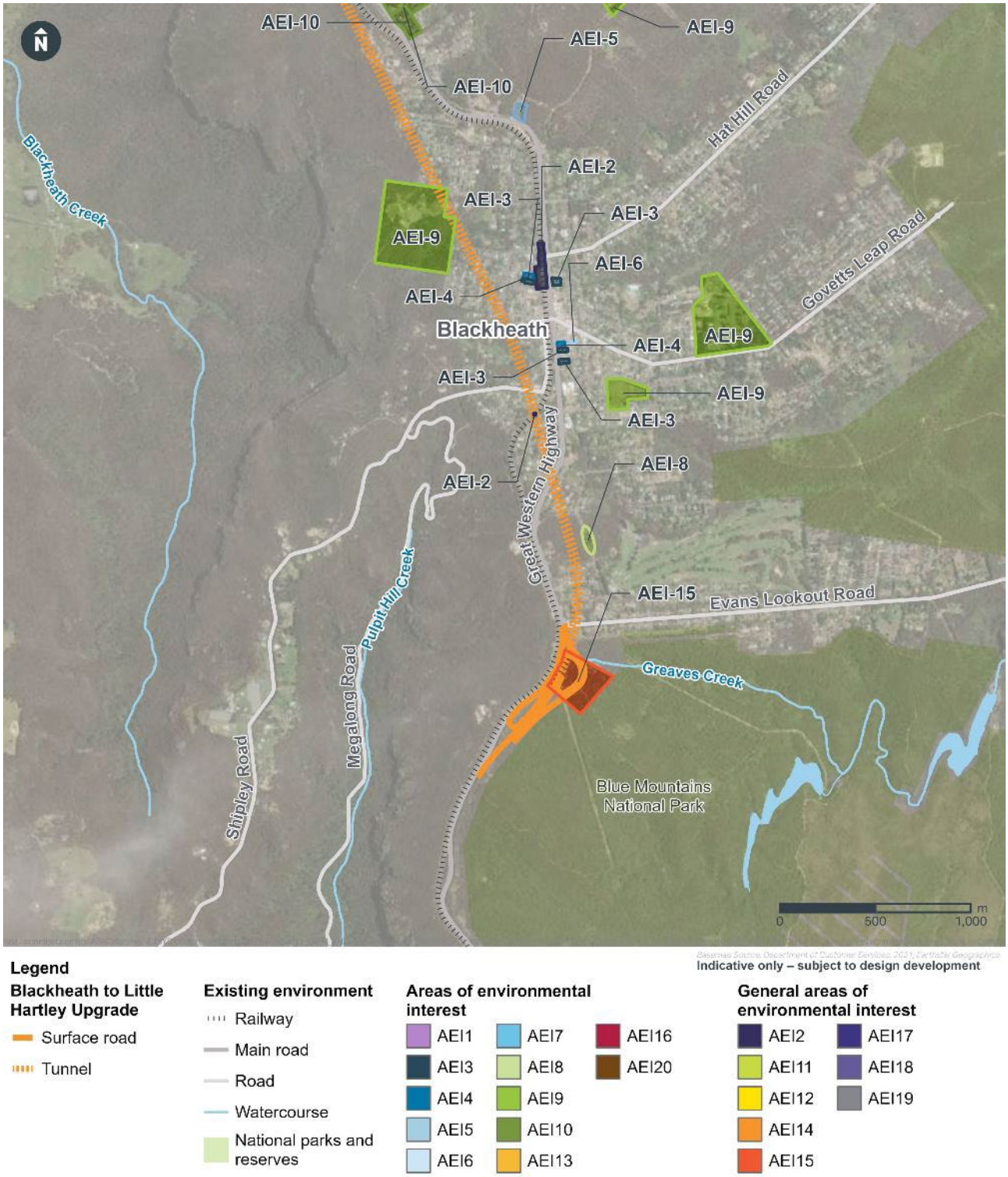

Figure 15-3 Areas of environmental interest near the project at Blackheath

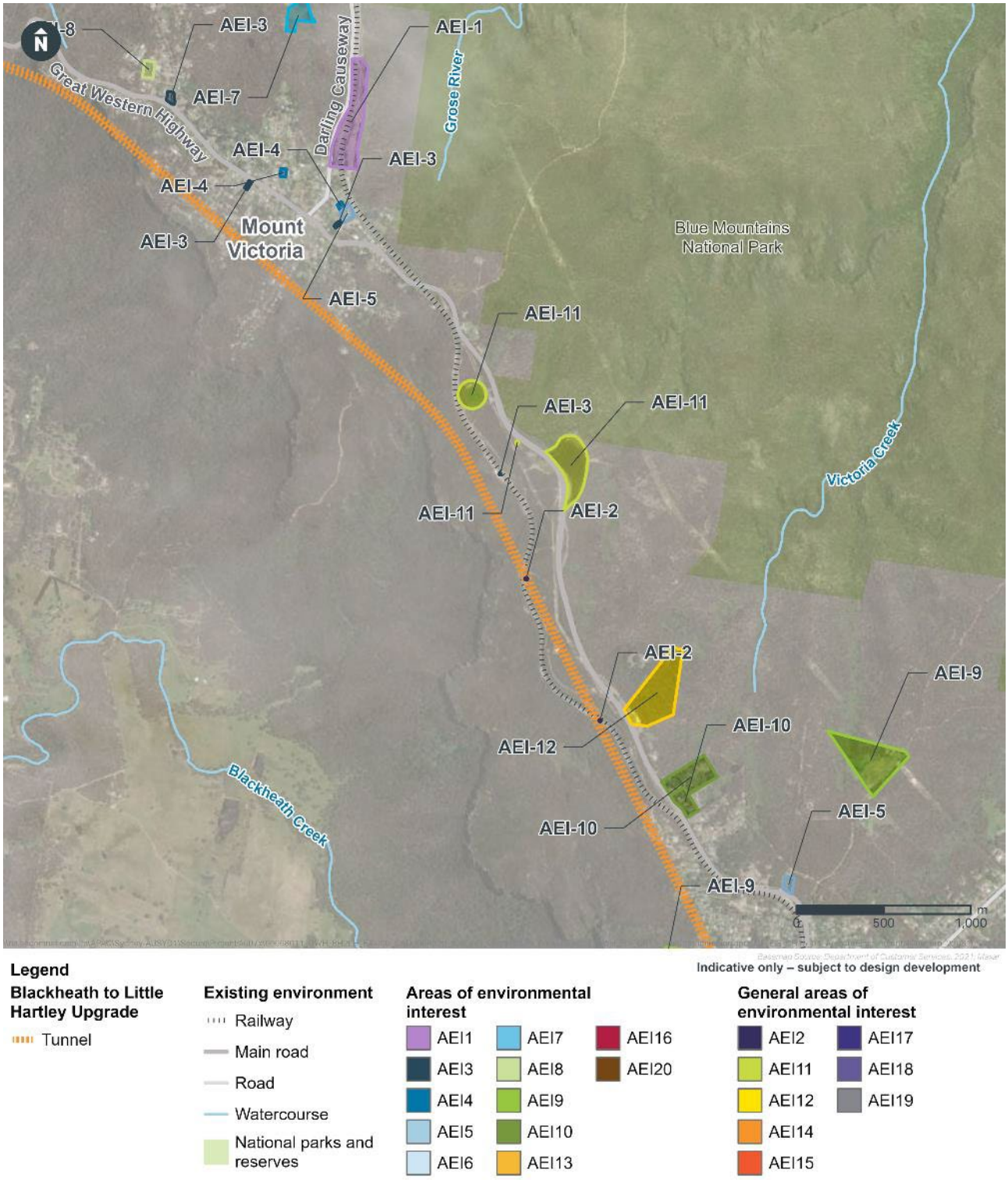

Figure 15-4 Areas of environmental interest near the project at Mount Victoria

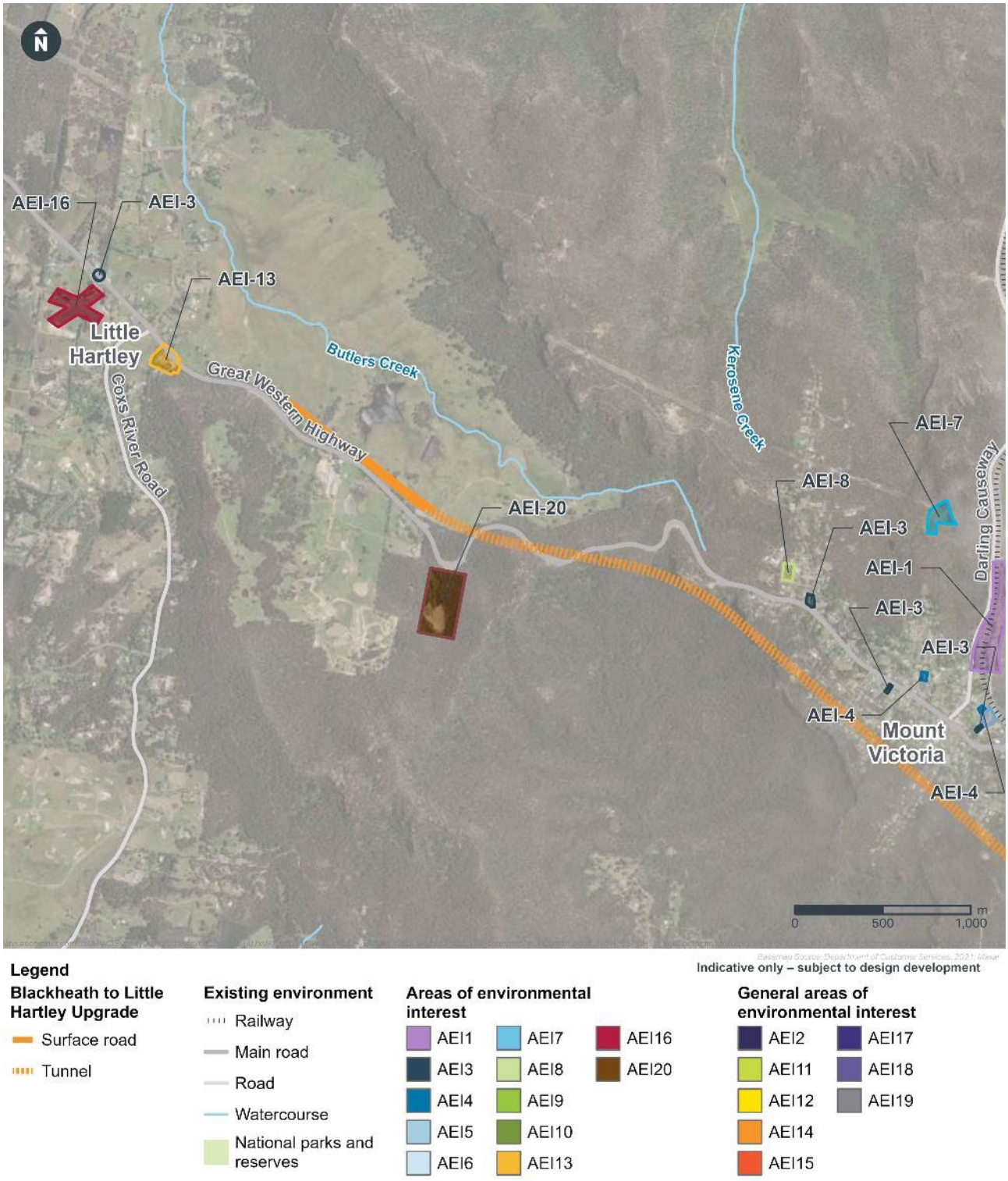

Figure 15-5 Areas of environmental interest near the project at Little Hartley

15.3 Potential impacts – construction

15.3.1 Soils

Construction of the project would temporarily expose the natural ground surface and subsurface through the removal of vegetation and excavation and compaction of topsoil. The temporary exposure and stockpiling of soil to water runoff and wind could increase soil erosion potential. There is the potential that exposed soils and other unconsolidated materials (such as spoil, sand and other aggregates) could be transported from the construction footprint into surrounding waterways via stormwater runoff.

Erosion controls would be implemented and managed in accordance with relevant guidelines to manage this risk.

It is unlikely that saline or acid sulfate soils would be encountered during construction. Unexpected saline or acid sulfate soils encountered during construction would be managed under the unexpected finds procedure that would be developed and implemented as part of the project.

Impacts from potential ASR are limited to potential water quality impacts from oxidation of inadequately treated ASR around Little Hartley. Further information on surface water impacts can be found in Chapter 14 (Surface water and flooding).

15.3.2 Contamination

Surface work

Construction work could result in potential soil, surface water or groundwater contamination from the following activities if unmitigated:

- spills of oils, fuels or chemicals from plant and equipment in the construction footprint
- accumulation of potentially contaminated sediments in sediment ponds and water treatment plant
- importing or backfilling of excavations with potentially contaminated spoil
- stockpiling of potentially contaminated spoil.

In addition, there is a risk of disturbing existing contaminated soil or groundwater sources during construction activities, which could result in:

- exposure of project workers and surrounding human receptors to contamination
- generation of contaminated surface water runoff from contaminated soils which could discharge to waterways or surrounding land
- generation of solid or liquid waste requiring disposal to landfill or a liquid waste facility.

Based on historical land use and currently available information, there is a pre-mitigation risk rating of medium for the construction sites at Blackheath, Soldiers Pinch and Little Hartley as shown in Figure 15-6. Construction activities in these locations would include excavation and temporary stockpiling. Potential contamination pathways could be through:

- direct contact, ingestion and inhalation by construction workers
- off-site transport via dust, vehicle/plant movements
- surface water runoff and discharge to receiving environment
- groundwater extraction and discharge to receiving environment.

Areas identified as having a medium risk of potential contamination during construction are presented in Table 15-3 and would be subject to targeted site investigations during ongoing design development. No high risk areas were identified, and areas identified as low risk would be managed through standard mitigation (refer to Section 7 of Appendix K (Technical report – Contamination)). Risk ratings would be reduced through the implementation of appropriate

mitigation measures as detailed in Section 15.5. This includes detailed site investigations for areas of environmental interest within the construction footprint identified as posing a medium or greater risk and preparation of a Remedial Action Plan if required.

Table 15-3 Potential contamination issues during construction

Construction site	Potential contamination issue	Risk rating
Blackheath	• AEI-10 areas of possible historical landfilling • AEI-11 illegal dumping • AEI-13 vehicle crashes and spills • AEI-14 previously demolished historical buildings • AEI-16 historical use of pesticides and herbicides	Medium
Soldiers Pinch	• AEI-10 areas of possible historical landfilling • AEI-11 illegal dumping • AEI-13 vehicle crashes and spills	Medium
Little Hartley	• AEI-10 areas of possible historical landfilling • AEI-11 illegal dumping • AEI-12 Lolly Bug Little Hartley former service station • AEI-13 vehicle crashes and spills • AEI-14 previously demolished historical buildings • AEI-15 former Little Hartley airfield • AEI-16 historical use of pesticides and herbicides • AEI-20 CSR building products clay/shale, structural clay mine	Medium

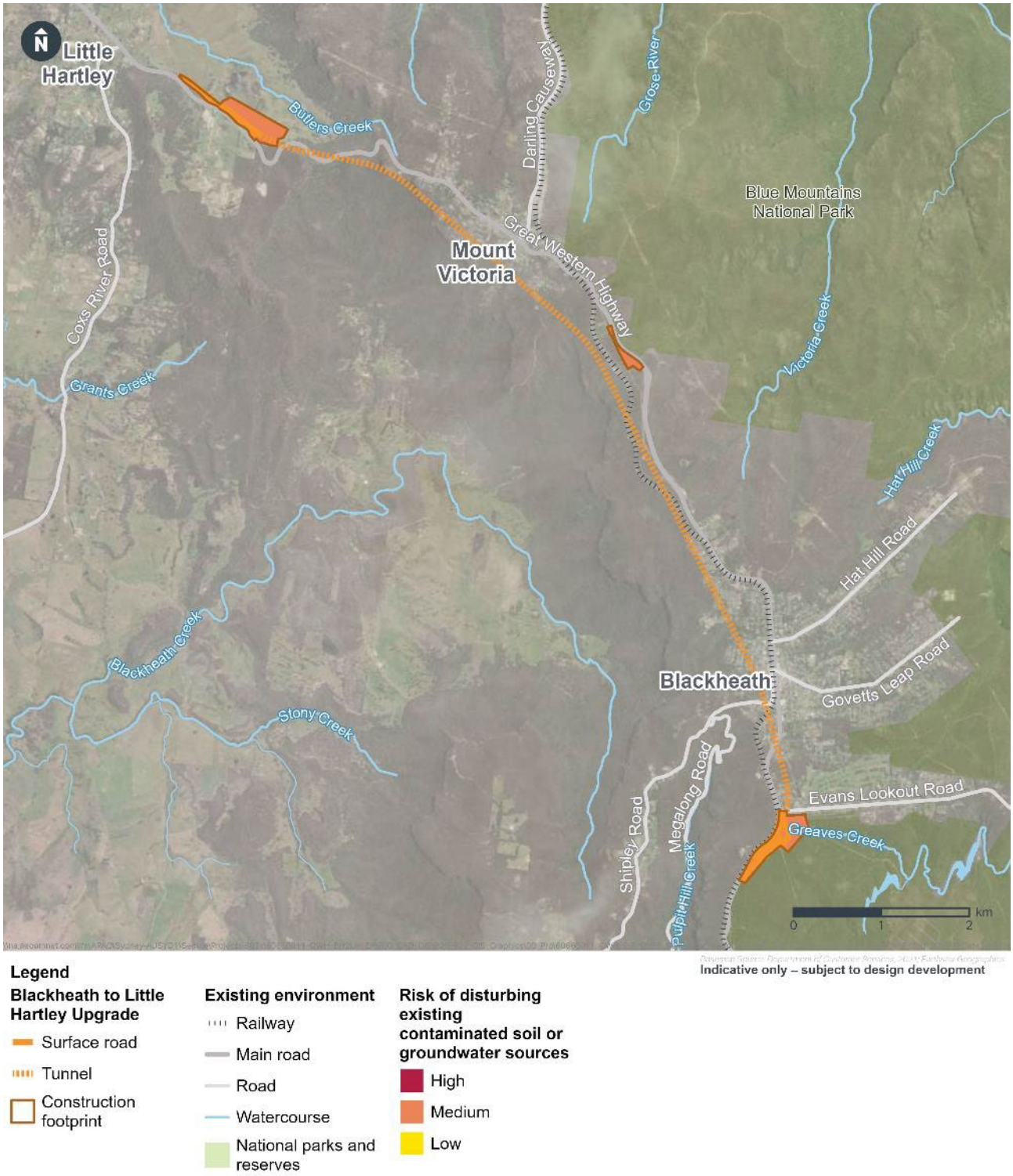

Figure 15-6 Pre-mitigation contamination risks relevant to the project

Tunnelling

Coal seams of varying thicknesses may be encountered during tunnel construction between Mount Victoria and Little Hartley, and therefore coal seam or methane gas may also be present in the surrounding geology. The risks to construction worker safety would be mitigated through measures such as advance investigation and monitoring, and possibly gas drainage (depressurising the coal seams of gas and water).

Groundwater from coal seams is likely to be saline and may contain concentrations of dissolved methane and hydrogen sulfide, as well as some heavy metals that would require treatment prior to discharge. Given the majority of the tunnels are likely to be constructed within bedrock and the

majority of the tunnel would be tanked to minimise groundwater ingress, the potential risk for contaminated groundwater to be intercepted would be low. Intercepted groundwater would be directed to the construction water treatment plants where it would be treated and then reused and/or discharged.

15.4 Potential impacts – operation

15.4.1 Soils

Once construction is complete, potential impacts from saline or acid sulfate soils or erosion and sedimentation impacts would be negligible as:

- soils would generally not be disturbed during operation of the project
- the project would be located within land mapped as low to extremely low acid sulfate soil probability
- the overall salinity hazard along the project alignment would be very low
- exposed soil would be rehabilitated with vegetation cover to minimise erosion and sedimentation.

Further information on acid sulfate soils is provided in Chapter 14 (Surface water and flooding).

15.4.2 Contamination

Potential contamination sources during operation of the project would include:

- chemical and oil leaks or spills associated with vehicle accidents
- chemical and oil storage and use at operational ancillary facilities
- potentially contaminated stormwater flowing into tunnel portals, water treatment plant, or sediment ponds
- water discharged for fire suppression in the tunnel
- potential chemical leaks or inadequately treated discharge from water quality treatment plant used to treat stormwater ingress or water discharged for fire suppression in the tunnel.

These impacts could potentially cause localised soil and sediment contamination, and groundwater and surface water pollution if not managed appropriately. The receivers that could be potentially impacted include:

- riparian and aquatic flora and fauna near and within waterbodies and tributaries near the project
- nearby flora and fauna
- onsite maintenance workers carrying out intrusive works.

Potential contamination impacts associated with operation of the project were assigned a pre-mitigation risk rating (refer to Section 2.3.4 of Appendix K (Technical report – Contamination). No areas with high contamination risk were identified. Potential operational contamination impacts from key operational infrastructure and their pre-mitigation risk ratings are presented in Table 15-4. Risk ratings would be reduced through the implementation of appropriate mitigation measures as detailed in Section 15.5.

Table 15-4 Potential contamination issues during operation

Infrastructure	Potential contamination impact	Risk rating
Tunnel operations facility at Blackheath	• contamination impacts from leaks and spills from oils, fuels, solvents and other chemicals stored and used at the facility if not stored and handled in accordance with applicable regulations.	Medium
Water treatment plant at Little Hartley	• minimal soil or groundwater contamination impacts would be expected from the operation of the water treatment plant • sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations and from leaks and spills of untreated wastewater.	Medium
Sediment and water quality basins at Blackheath and Little Hartley	• minimal soil or groundwater contamination impacts would be expected from the operation of the sediment and water quality basins • sources of contamination could be from spills of untreated surface water and inappropriate management of contaminated sediments.	Medium
Ventilation facilities and associated infrastructure – Blackheath and Little Hartley	• under the ventilation outlet option, minimal soil or groundwater contamination impacts would be expected from the operation of the substation and ventilation facilities • under the portal emissions option, negligible soil or groundwater impacts would be expected from the operation of portal emissions infrastructure • sources of contamination could be from small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations.	Low
Tunnels	• during operation, groundwater seepage, stormwater drainage at tunnel portals, tunnel wash-down water, fire suppressant deluge or fire main rupture and spillage of flammable and other hazardous materials would be captured by tunnel drainage and treated, reused or discharged to the receiving water bodies. If the discharged water is not treated to the required standard there could be adverse impacts on water quality of the receiving environments • groundwater quality may be impacted along parts of the tunnel alignment due to overlying contamination sources impacting groundwater. The mainline tunnels have been designed to minimise intersecting highly permeable material that could result in high groundwater inflows into the tunnels and would be tanked to minimise groundwater ingress.	Low

Infrastructure	Potential contamination impact	Risk rating
Other features including utility connections and substations for power supply	• sources of contamination could be leaks and spills of small volumes of oils, fuels, solvents and other chemicals used for operation and maintenance if not stored and handled in accordance with regulations • inappropriate soil management practices during installation of utilities, spills and leaks from substations and not assessing imported materials.	Medium

15.5 Environmental mitigation measures

15.5.1 Performance outcomes

Performance outcomes for the project in relation to soils and contamination are listed in Table 15-5 and identify measurable performance-based standards for environmental management.

Table 15-5 Soils and contamination performance outcomes

SEARs desired performance outcome	Project performance outcome	Timing
The environmental values of land, including soils, subsoils and landforms, are protected.	Design and construct the project to minimise the disturbance of soils and changes in landform. Rehabilitate disturbed land that is not required for operational infrastructure to a state comparable with its pre-disturbance condition or as otherwise agreed with the landowner.	Design and construction
Risks arising from the disturbance and excavation of land and disposal of soil are minimised, including disturbance to acid sulfate soils and site contamination.	Characterise and evaluate the risks associated with land and soils affected by the project prior to disturbance, including with respect to potential contamination and acid sulfate soils. Develop and implement management measures specific to the characteristics and risks of land and soils to be disturbed, including the preparation of a Remedial Action Plan for contaminated land where relevant.	Construction

15.5.2 Mitigation measures

Mitigation measures to avoid, minimise or manage potential soil and contamination impacts of the project are listed in Table 15-6. A full list of environmental mitigation measures for the project is provided in Appendix R (Compilation of environmental mitigation measures).

Table 15-6 Environmental mitigation measures – soils and contamination

ID	Mitigation measure	Timing
SC1	A Detailed Site Investigation (DSI) will be carried out for areas of environmental interest within the construction footprint identified as posing a medium or greater risk, in accordance with the *National Environment Protection (Assessment of Site Contamination) Measure 1999* (as amended 2013) and other relevant guidelines. If the DSI identifies that remediation of contaminated land is required, a Remedial Action Plan will be developed and implemented in accordance with relevant guidelines and codes of practice. If required, remediation will be performed as an integrated component of construction and to a standard commensurate with the proposed end use of the land.	Design
SC2	An unexpected contamination finds procedure will be developed and implemented during construction of the project. The unexpected contamination finds procedure that includes a process for addressing unexpected contamination and will generally include provision for: • cessation of works within the affected area until inspection of the suspected contamination by a qualified contaminated lands specialist (verification by a certified contaminated land practitioner) • collection of soil samples for analysis based on observations • assessment of results against applicable land use or waste classification criteria in accordance with applicable statutory guidelines • management of the contamination in accordance with applicable statutory guidelines.	Construction
SC3	An Acid Sulfate Rock Management Plan (ASRMP) will be prepared as part of the Construction Environmental Management Plan (CEMP), taking into account the management guidelines in the *Acid Sulfate Soil Manual* (ASSMAC, 1998) and the *National Acid Sulfate Soils Guidance: National Sulfate Soils Identification and Laboratory Methods Manual* (Water Quality Australia, 2018). The ASRMP will include the process for identification, management and handling and re-use or disposal of acid sulfate rock.	Construction