8 Assessment of non-key issues

This chapter provides an assessment of the non-key environmental issues that may be associated with the construction and operation of the project. These issues are not nominated as key issues by the Director-General's environmental assessment requirements (DGRs) but impacts may still occur as a result of the project. In this chapter, the potential impacts for each issue are assessed and mitigation and management measures are identified. The proposed management and mitigation measures have influenced the development of the draft statement of commitments in **Chapter 10**.

8.1 Geology and soils

Geotechnical investigations have been undertaken to identify potential geotechnical, soil and fill issues for the project to assist in identifying mitigation and management measures for the construction and operation phases of the project.

The investigations and previous studies for this environmental assessment were undertaken between 2007 and 2011. These investigations into the surface, geological and soil characteristics of the project area were part of the route options development and the final concept design for the project, following the announcement of the preferred route. Geotechnical investigations included (but were not limited to) core drilling, piezometers, electric cone (piezocone), test pits and laboratory testing of soil and rock samples.

A preliminary contamination assessment undertaken during the route selection process (Maunsell Australia Pty Ltd, 2007) focused on large scale contamination issues. It included a limited site history and desktop study to identify potential areas of contamination, a site drive over and a review of the abovementioned geotechnical investigations.

Additional information sources have also been used to inform the assessment, including:

- NSW Office of Environment and Heritage (OEH) online database for notices under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*.
- Soil landscape unit mapping completed for the former Department of Conservation and Land Management (DCLM).
- Erosion and Sedimentation Management Procedure (RTA, 2008).
- Acid sulfate soil risk maps prepared by the former Department of Land and Water Conservation (DLWC) (1997).

8.1.1 Existing environment

Topography

The project area consists of two main topographic groups being:

- The undulating hills and foothills extending north-west from the South Coast Railway line.
- The Shoalhaven lowland plain, extending south-east of the foothills towards the Shoalhaven Bight.

The elevated north-western portion of the project area is influenced by the Cambewarra Mountain Range (north-west of Berry) which is a narrow low range that runs roughly parallel with the coastline. The lower slopes of this range extend into the project area as the ridge lines approach Berry. Harley Hill and Toolijooa Ridge are situated towards the eastern part of the project area and are disjointed from the Cambewarra Range.

A ridge of moderate elevation, from Foxground to Toolijooa Ridge, and a flatter ridge to the south-west of Toolijooa Ridge, separates the Broughton Creek floodplain from the Crooked River floodplain.

Geology

The geology of the project area corresponds to the Permian Shoalhaven Group, which may be divided into the Volcanic Sandstones sub-group (also referred to as the Budgong Sandstone), the Volcanics Facies subgroup and Berry Siltstone formation.

The younger Volcanic Sandstones and the Volcanics Facies are interbedded volcanic sandstones and latites that are found following ridgelines through Toolijooa Ridge and high points to Harley Hill. These sub-groups are comprised of Jamberoo Sandstone, Kiama Sandstone and Bumbo Latite. The Berry Siltstone is comprised of siltstone and fine grained sandstones with interbedded shale. It occurs south-east of the Crooked River.

Soils

The former DCLM's *Soil Landscapes of the Kiama 1:100,000 Sheet* (Hazelton, 1992) identifies the presence of the following soil landscape units within the project area (refer to **Figure 8-1**):

- Kiama landscape unit, occurring in areas close to Toolijooa Road.
- Wattamalla Road landscape unit, occurring in steeper areas around Toolijooa Ridge.
- Shoalhaven landscape unit, which corresponds to creeks and floodplain areas at Broughton Creek and Berry.
- Coolongatta landscape unit, which largely corresponds to the undulating hills between Austral Park Road and north of Berry.

The Kiama landscape unit is characterised by sandy clay loams and stiff to hard clays. The erosion hazard is rated as moderate to extreme. Other limitations of the landscape unit include low wet bearing strength and potential for localised mass movement.

The Wattamalla Road landscape unit is characterised by shallow soils consisting of sandy and silt loams, very stiff to hard clays and extremely weathered rock developed in units associated with the underlying rock materials. The erosion hazard is rated as high to extreme. Other limitations of the landscape unit include low wet bearing strength, and the potential for localised mass movement.

The Shoalhaven landscape unit consists of alluvial soils, comprised of gravel, sand, silt and clay derived mainly from sandstone and shale that overlay buried estuarine sediments. The erosion hazard is rated as slight to low. The landscape unit is also subject to seasonal waterlogging and has potential for acid sulfate soils (ASS).

The Coolongatta landscape unit consists of sands, and stiff to hard clays. The erosion hazard for this landscape unit is extreme, and the topsoils are highly to moderately erodible. Other limitations of the unit include low wet bearing strength, and the potential for localised surface and mass movement.

Acid sulfate soils

ASS are a naturally occurring soil and sediment that contains iron sulphides. ASS can be classified into two types, being actual ASS and potential ASS (PASS). The latter PASS are waterlogged soils rich in iron sulphides that have not been oxidised. PASS are harmless to the environment if kept in this state or under water. Any exposure of PASS to air or the lowering of the watertable would lead to the development of actual ASS and sulphuric acid would be formed.

The project generally passes over geological conditions mapped by the then DLWC in 1997 as having no known occurrence of ASS. An area close to a section of the highway alignment south of Berry (refer to **Figure 8-2**) has been identified as being of low ASS risk and located at depths greater than four metres.

Following further consideration of the known geological information for the project area, an additional area where there is a low risk of PASS being encountered has been identified. This corresponds with areas with alluvial floodplain soils at the Broughton Creek floodplain, and at the bypass of Berry. These areas are shown on **Figure 8-3**.

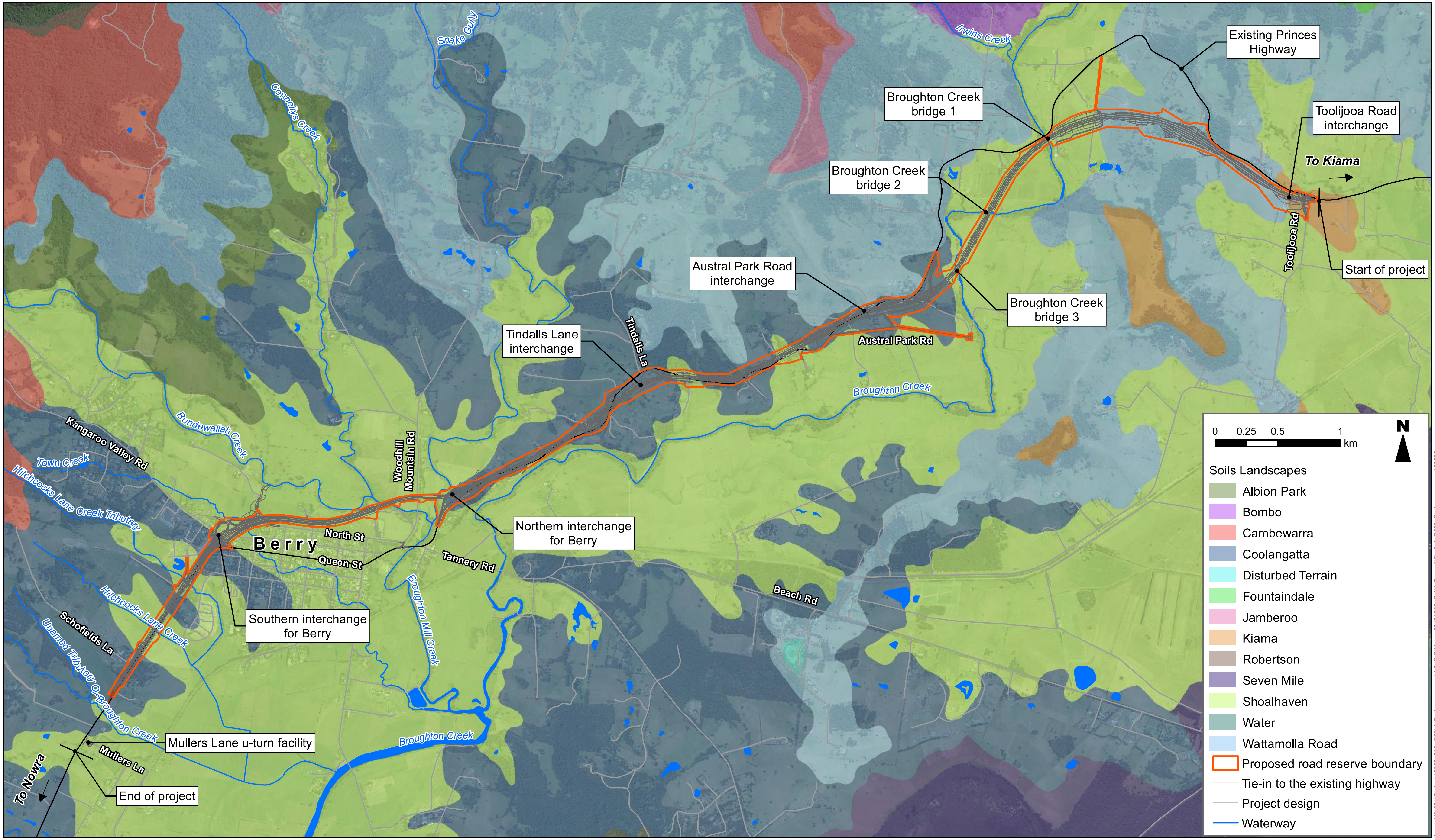

Figure 8-1 Soil landscape units according to *Soil Landscapes of Kiama 1:100,000 Sheet* (Hazelton, 1992)

Source: OEH (2011)

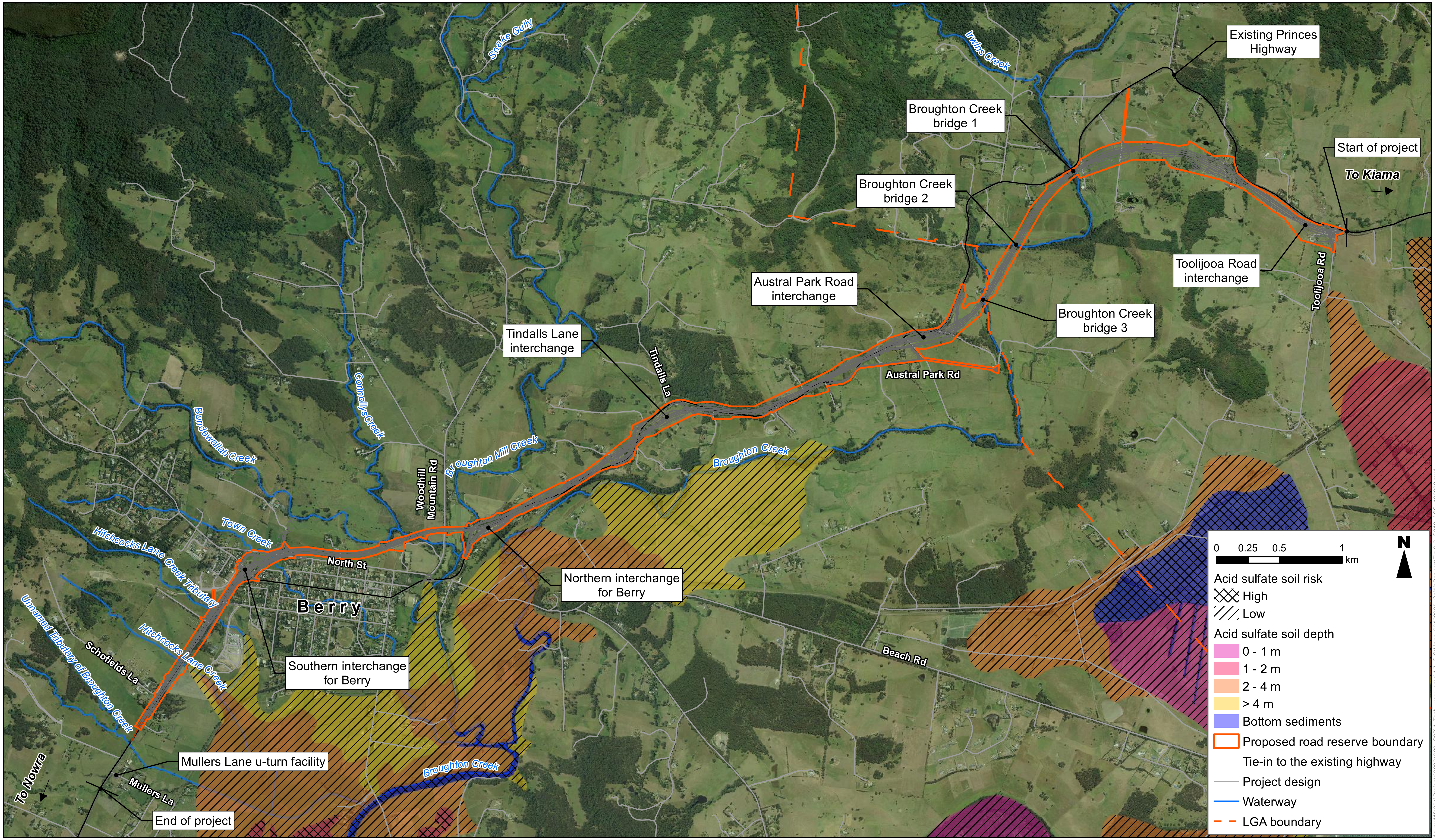

Figure 8-2 Acid sulfate soils in the project area

Source: DECCW (2002)

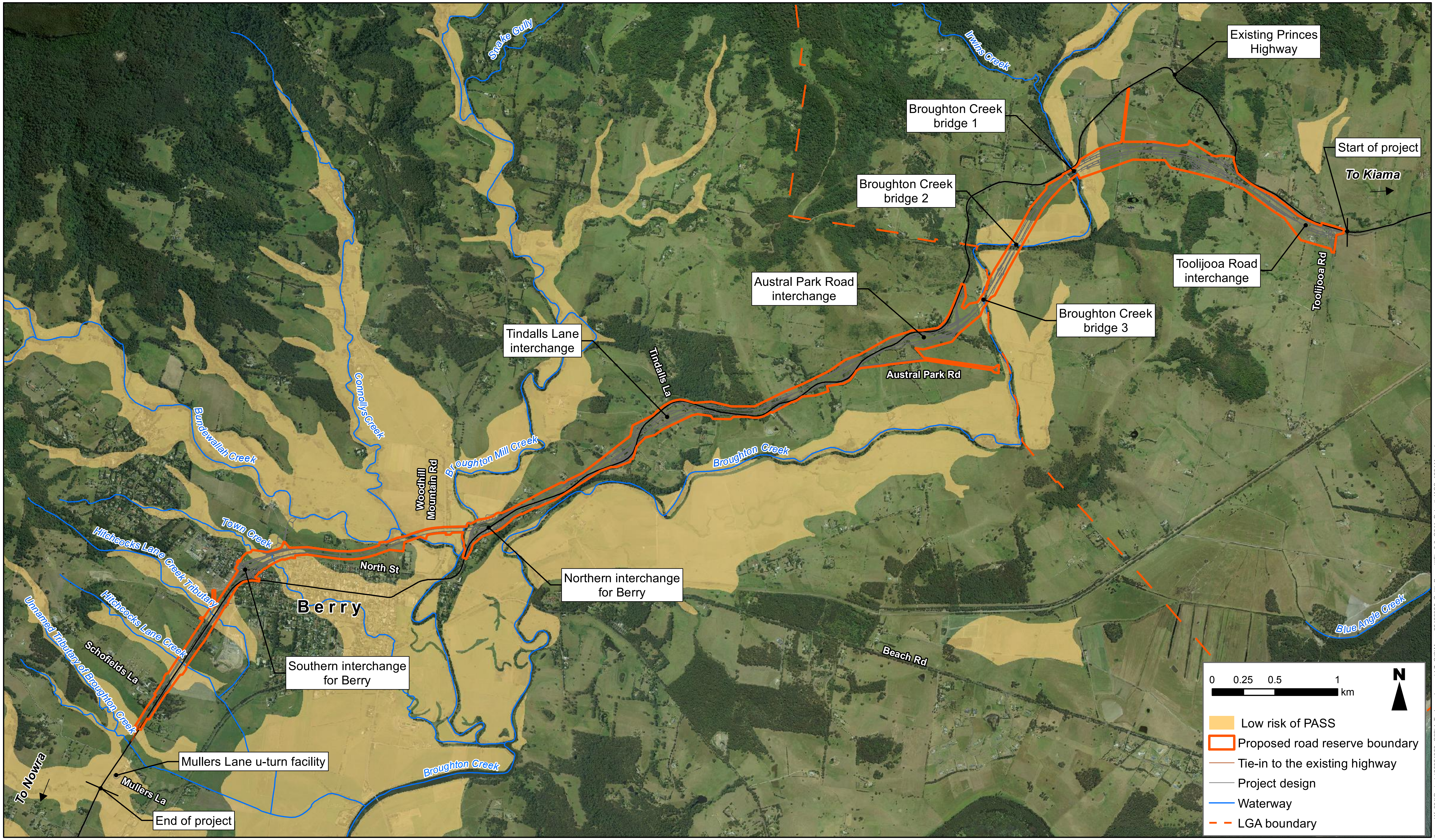

Figure 8-3 Additional areas of potential acid sulfate soil risk

Source: AECOM (2012)

Soft soils

Soft soils generally occur in low lying areas or floodplains, and correspond to areas where deep alluvial soils are present. Soft soils have limited resistance to loads, and as such, roads constructed on soft soils, without ground improvement works, risk ongoing maintenance as a result of ground settlement. This would result in poor road conditions and pavement damage.

The presence and depth of alluvial soils varies across the length of the project. The greatest depth of alluvial soils occurs at the Broughton Creek floodplain at around five metres below ground level. Alluvial soils occur to a lesser extent at stream channels between Austral Park Road and Tindalls Lane, and along the floodplain near Berry. Depths at these locations are estimated at around two to four metres below ground level.

Contamination

Rural land uses, such as dairying, livestock grazing and agriculture, are the predominant land uses in the project area. Turf farming is also undertaken in areas north of Berry near Broughton Mill Creek. These agricultural activities have the potential to give rise to soil contamination as a result of current or historic land use activities including:

- Application of pesticides, herbicides and fungicides.
- Cattle dip sites.
- Leaks from septic tanks, plant equipment, and fuel and chemical storages located within individual properties.
- Localised dumping of farm and household wastes, or use of fill of unknown origin.
- Presence of hazardous building material in structures, such as asbestos, lead and zinc.

Within Berry, the predominant land use is residential. However, the project does pass through recreational lands north of Berry at the sportsground and Camp Quality memorial park. Contamination may have occurred at these locations due to the filling of ground to create playing fields and the application of herbicides (in the case of the sportsground).

A preliminary contamination assessment undertaken during the route selection process (Maunsell Australia Pty Ltd, 2007) focused on large scale contamination issues. It included a limited site history and desktop study to identify potential areas of contamination, a site drive over and a review of geotechnical investigations undertaken concurrently to the assessment to gain an appreciation of the underlying soils and geology. Aerial photographs, interviews, land zoning maps, internet searches and the OEH/Environment Protection Authority (EPA) on-line database informed the site history and desktop study.

The information reviewed as part of the preliminary contamination assessment did not identify the presence of ‘major’ potential contamination sites. ‘Major’ potential contamination sites include large waste dumps, landfills, chemical manufacturing plants and fuel depots which are normally associated with larger scale contamination issues. In addition, interviews conducted with Council representatives, RMS representatives and a long term local resident as part of the preliminary assessment, did not identify the presence of any contamination from the following activities:

- Tanneries (other than a potential site avoided by the project near the David Berry Hospital).
- Cattle tick dip sites.
- Properties where use of pesticides/chemicals may have been intensive.
- Night soil depots.
- Timber treatment.
- Gasworks.
- Mining or extractive industries (other than the quarry avoided by the project).
- Power stations.

There was also little obvious evidence of significant land filling or fill stockpiling in areas of rural land use.

A search of the NSW OEH website did not identify any notices within the project area under the *Contaminated Land Management Act 1997* or the *Environmentally Hazardous Chemicals Act 1985*. A search was conducted again in August 2011 and confirmed that no notices have been issued in the project area.

8.1.2 Assessment of potential impacts

Erosion and sedimentation

The project would require the disturbance of the soil surface and subsurface across the length of the project. A greater level of disturbance to soils and the underlying geology would be required where cuttings and embankments are to be constructed. These include:

- A combination of substantial embankments and cuttings where the project passes through the Toolijooa ridgeline and crosses the Broughton Creek floodplain. The largest cutting would be around 900 metres long and up to 26 metres deep.
- A series of cuttings and embankments through the undulating landscape between Austral Park Road and the northern interchange for Berry. The largest cutting would be around 11 metres deep.
- A transition from an embankment of around two metres to a cutting along the North Street corridor. The majority of this section would be in a cutting, leading to the southern interchange from Berry.
- Embankments of up to around four metres south of Berry.
- The cutting of up to around 7.5 metres at the southern interchange for Berry.

Based on the underlying geology of the landscape, the following conditions would be encountered at these locations:

- Variably weathered and fresh Bumbo Latite, as well as Kiama Sandstone at Toolijooa Ridge.
- Alluvial soils within floodplain areas.
- Variably weathered Jamberoo Sandstone and Berry Siltstone (ranging from fresh to highly weathered) at the cuttings at Toolijooa, as well as between Austral Park Road and Schofields Lane.
- Residual soils across the project at varying depths, some of which are dispersive.

The presence of extremely and highly weathered rock at cutting locations could present stability and ongoing erosion issues in the long term. This is particularly relevant where steep cuts in soils and highly weathered rock are proposed, such as at the Tindalls Lane interchange.

Siltstone beds within the Berry Siltstone rock are also particularly prone to erosion and deterioration when exposed to water, which can be observed along the existing alignment (Coffey Geotechnics Pty Ltd, 2010). This presents a potential erosion impact in the short to long term.

Earthworks for cuttings and embankments would also facilitate the erosion of exposed soils and weathered rock that would potentially lead to embankment and cut slope instability and fretting. Soils within the project area are prone to erosion at varying levels, but all are assumed to be potentially dispersive and would require the implementation of erosion control measures.

Following the Erosion and Sedimentation Management Procedure (RTA, 2008), a number of locations have been identified as posing a high risk for erosion and sedimentation during construction (refer to **Figure 8-4**). These are locations where permanent basins are not proposed and where temporary construction sedimentation basins are not feasible due to space constraints or small catchment areas. However, erosion and sedimentation impacts can be effectively managed as discussed in **Section 8.1.3**.

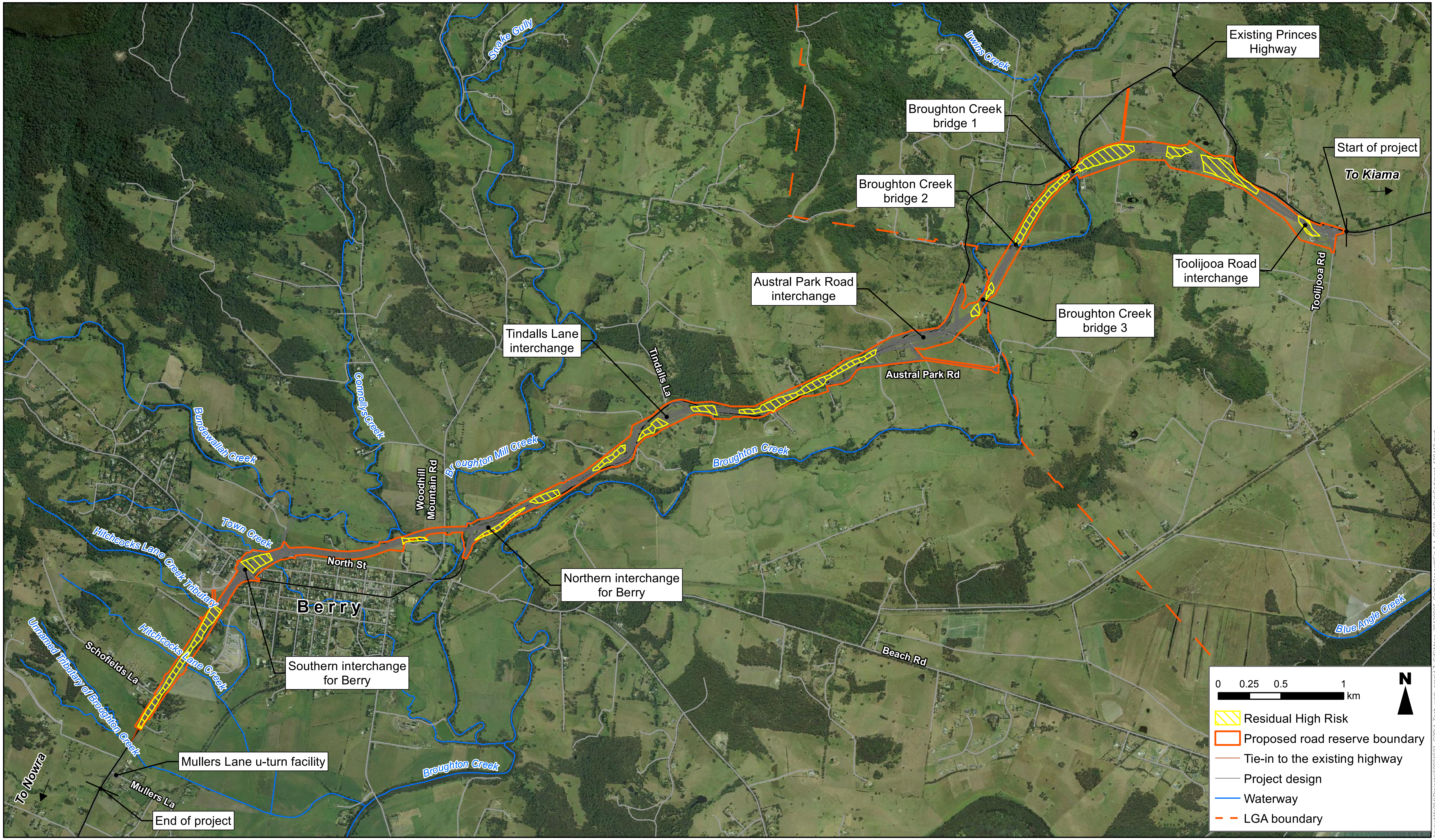

Figure 8-4 Residual high risk erosion and sedimentation area

Source: AECOM (2012)

The stockpiling of spoil and topsoil would also pose a risk for erosion and sedimentation during construction. Soil loss could occur due to the effects of wind or water in the absence of suitable stabilisation and management measures.

Soil loss during construction and/or operation could have a negative impact on agricultural productivity owing to the mobilisation and loss of soil by wind and water. Increased turbidity and suspended sediment loads in surrounding water bodies and drainage areas could reduce water quality which would impact aquatic ecology. Sediment-laden water also has the ability to block stormwater drainage structures and result in localised flooding, if drainage structures are not adequately maintained. Further discussion on this impact is provided in **Section 7.4**.

Acid sulfate soils

The risk of exposing of PASS or ASS as a result of the project is considered to be low and limited to floodplain areas at Broughton Creek and near Berry. The areas of low risk correspond to areas of construction of embankments, bridges, culverts, stormwater detention basins and other land forming works. Piling at proposed bridges and at interchange location areas could also require excavation through PASS to reach the required minimum rock socket depth.

Any exposure of PASS to air or the lowering of the watertable due to excavation would lead to the development of actual ASS. The resultant sulfuric acid and iron rich leachate would potentially have major environmental, agricultural and structural impacts in affected areas if not adequately managed. Potential impacts would include the following:

- Negative impacts to aquatic ecosystems by drainage from oxidised ASS into neighbouring waterways, such as Broughton Creek. This would result in habitat degradation, fish kills, reduced aquatic food resources, reduced migration potential of fish, reduced fish recruitment, increased susceptibility of fish to fungal infections, altered macrophyte communities, weed invasion by acid-tolerant plants and secondary water quality changes.
- Impacts on vegetation growth and agricultural productivity due to low soil pH levels causing stunted vegetation growth, the mobilisation of heavy metals (such as aluminium, iron and manganese), nutrient deficiencies, and decreased soil microbes.
- Structural damage and corrosion of steel and concrete structures due to acidity, resulting in significant ongoing maintenance costs.

The potential for these impacts to arise are considered low and would be adequately managed through the implementation of standard mitigation and management measures included in an acid sulphate soil management plan (ASSMP) identified in **Section 8.1.3.**

Soft soils

Embankments and bridge works would be constructed in areas with alluvial soils. The settlement of soils as a result of the loads being placed on these areas poses a risk to the project in the short term (in terms of time and cost) and long term (if not sufficiently mitigated). This is particularly relevant where major works on the Broughton Creek floodplain are proposed, including embankments of up to 16 metres in height, and to a lesser extent, embankment and bridge works near Berry. There is also potential for differential settlement between the current highway formation and the new highway, where widening works would be undertaken in areas known to contain alluvial soils.

Alluvial soils are of low strength and are highly compressible. The bearing capacity (or strength) of alluvial soils improves as settlement occurs. Based on the extent, depth and type of alluvial soils (or soft soils) along the project corridor, the extent of settlement is unlikely to be excessive. Ground improvements would be undertaken to ensure areas of soft ground are sufficiently stable for the construction of the project and the long-term durability of the completed project. This would be factored into the construction staging program for the project.

In selecting ground improvement methods, additional consideration would be given to corresponding areas of PASS, which may occur at the Broughton Creek floodplain and in areas close to Berry. However, as discussed above, the risk of encountering PASS is low and the potential impacts could be managed and/or mitigated through the completion of soil testing during detailed design and the implementation of an ASSMP.

Contamination

Based on the results of the preliminary contamination assessment described above, there is a low to moderate likelihood of land being affected by contamination as a result of current and historic agricultural practices along the alignment. While no issues relating to contamination along the project alignment arose during recent discussions with affected landowners, there still remains a possibility that contamination would be encountered on agricultural, residential or recreational lands as a result of:

- Asbestos, zinc and lead from hazardous building materials, the disposal of wastes within the property or the miscellaneous storage of plant and equipment.
- Herbicides, fungicides and pesticides (including organochlorins and organophosphates) due to application, disposal, leaks and spills with the property.
- Petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH), volatile organic compounds (BTEX), polychlorinated biphenyls (PCB) and heavy metals where property fuel stores have leaked, where spills have occurred or where fill of unknown origin is present.
- Elevated nutrients and pathogens where septic tanks have leaked.

In the event that contamination is encountered, the contamination is likely to be localised and manageable. Further, the types of contaminants that would be encountered would be unlikely to preclude the redevelopment of the land for the project, which represents a change to a less sensitive land use.

Construction activities also have the potential to cause the contamination of soil due to accidental spills of fuel, oils and other hazardous materials such as bitumen. Spillages of fuel, oils, chemicals and/or other hazardous substances may result in negative impacts on soil and the surrounding environment (as discussed in **Section 8.3**).

Appropriate management measures would be implemented during construction to reduce the risk associated with soil contamination. These are discussed below.

8.1.3 Environmental management measures

Mitigation and management measures would be implemented to avoid, minimise or manage geology and soil impacts. These mitigation and management measures have been identified in **Table 8-1** and incorporated in the draft statement of commitments in **Chapter 10**.

Table 8-1 Mitigation and management measures

Potential impacts	Mitigation and management measures
Construction	
Short and long term stability of embankments and cuttings	Create cut and fill batters at a maximum of 2:1 slope unless otherwise agreed during detailed design. In areas of particular risk due to fretting and spalling, investigate measures which may include: • Retaining structures or soil nailing at very steep or vertical cuts in soils and highly weathered rock, such as the Berry Siltstone. • Retaining structures at bridge abutments. • Wire mesh, spot bolting, shotcrete and benching at steeper slopes. • Erosion protection measures, such as drainage structures, hydro seeding, hydro mulching and geoweb. Mitigation strategies designed to minimise the visual impact of these measures are discussed in **Section 7.6** and **Appendix H**.
Disturbance of acid sulfate soils	Undertake testing for PASS during detailed design and seek opportunities to avoid them and to avoid any lowering of the water table in the vicinity. If this is not possible, limit areas of disturbance as much as possible and implement management measures documented in an ASSMP including actions such as: • Temporarily store bund and treat excavated material and use treated material appropriately. • Undertake specific leachate control procedures. • Implement protocols should any unexpected ASS related incidents occur. • Implement monitoring programs, such as water quality monitoring of areas downstream of PASS risk areas. Develop the ASSMP in accordance with the 'Guidelines for the Management of Acid Sulfate materials: Acid Sulfate Soils, Acid Sulfate Rock and Monosulphidic Black Ooze' (RTA 2005).

Potential impacts	Mitigation and management measures
Contamination	Undertake targeted soil contamination investigations during detailed design, as required. Investigate potentially contaminated areas of land in accordance with the ‘Contaminated Land Management Guideline’ (RTA, 2005) during detailed design, as required. In the event that contamination investigations indicate that the concentrations of contaminants on or adjacent to the project are above the intended land use criteria, develop an appropriate risk-based management plan approach in accordance with the ‘Contaminated Land Management Guideline’ (RTA, 2005). Develop a remedial action plan if contamination is found to pose unacceptable risks to the environment or human health. Remediation works would be undertaken in consultation with the EPA. Refuel construction vehicles and machinery offsite at a fuel station, within the site compound area or any other agreed location. Use drip trays when refuelling vehicles and/or machinery to capture any spills. Store fuel, chemicals and/or other hazardous substances within an appropriately bunded area (refer to **Section 8.3)**. Provide emergency spill kits. Regularly monitor and maintain equipment and vehicles.