B5 Department of Primary Industries

This chapter addresses issues raised by the NSW Department of Primary Industries (DPI).

Contents

B5.1 Groundwater

Refer to Chapter 19 (Groundwater) and Appendix T (Technical working paper: Groundwater) of the Environmental Impact Statement (EIS) for details of potential construction impacts on groundwater.

B5.1.1 Groundwater tunnel inflows

With respect to Groundwater SEAR 3b, the Department of Planning and Environment should continue to condition groundwater tunnel inflows so they do not exceed 1 L/sec/km. Currently all modelling of groundwater extraction impacts are based on this assumption and has been used to determine where proposed tunnels will be lined and unlined.

Where tunnelling is designed to occur through shallow sandstone, there is a high risk of fracture and a high degree of connection to the overlying alluvium. The Proponent should further clarify how the long term tunnel inflow rates will be maintained below the recommended rate of 1 L/sec/km specifically for the areas where the juxtaposition of sandstone and alluvium occurs.

Response

Previous tunnelling in Hawkesbury Sandstone in the Sydney region has shown that groundwater inflow is typically highest during construction. It then reduces as the cone of drawdown expands and equilibrium, or a steady state condition, is reached. Long-term groundwater inflow rates are expected to be lower than construction inflow rates for the project. Tunnelling and cut-and-cover sections for the project through the alluvium, such as in the Whites Creek alluvium beneath the Rozelle Rail Yards, would be tanked to prevent tunnel ingress from the palaeochannels as noted in section 19.2.7 of the EIS. Tunnelling will be beneath the alluvium and palaeochannels at Hawthorne Canal and Iron Cove Creek to reduce the risk of groundwater inflows. Groundwater leakage from the alluvium into the drained sandstone tunnels beneath the alluvium will be minimised as required using methods such as pre-grouting, grout injection and the use of waterproofing membranes during construction as is proposed elsewhere along the alignment (refer to section 19.3.2 of the EIS).

Tunnel inflows will be measured during construction by directing collected water through a flow meter, to monitor inflows. If exceedance of inflow criteria is identified, appropriate waterproofing, such as grout injection into the rock to reduce the permeability, will be implemented in accordance with the environmental management measure GW2 (see **Chapter E1** (Environmental management measures)) and conditions of approval. Other waterproofing options to reduce groundwater inflows could include the installation of waterproofing membranes or pressure grouting into the tunnel walls as outlined in section 2.3.2 of Appendix T (Technical working paper: Groundwater) of the EIS.

A detailed groundwater model will be developed by the construction contractor during detailed design. The model will be used to predict groundwater inflow rates and volumes within the tunnels and groundwater levels (including drawdown) in adjacent areas during construction and operation of the project as identified in the environmental management measure GW7 (see **Chapter E1** (Environmental management measures)).

A groundwater monitoring program will be prepared and implemented to monitor groundwater inflows in the tunnels and groundwater levels as well as groundwater quality in the three main aquifers and inflows during construction (see environmental management measure GW9 in **Chapter E1** (Environmental management measures)). The program will identify groundwater monitoring locations, performance criteria in relation to groundwater inflow and levels and potential remedial actions that will be considered to address any non-compliances with performance criteria. As a minimum, the program will include manual groundwater level and quality monitoring monthly and inflow volumes and quality weekly. The monitoring program will be developed in consultation with the NSW Environment Protection Authority (NSW EPA), DPI-Fisheries, DPI-Water, City of Sydney Council and Inner West Council.

The groundwater monitoring program prepared and implemented during construction will be augmented and continued during the operational phase (see environmental management measure OGW10 in **Chapter E1** (Environmental management measures)). Groundwater will be monitored during the operations phase for three years or as otherwise required by the project conditions of approval and will include trigger levels for response or remedial action based on monitoring results and relevant performance criteria.

At least three monitoring wells and vibrating wire piezometers (VWPs) should be constructed as close as possible to the tunnel centrelines to allow for the comparison of pore pressures and standing water levels. The wells could be constructed about five to 10 metres above the top of the tunnel crown to allow for groundwater drawdown monitoring in the Hawkesbury Sandstone.

The program will include procedures for monitoring and reporting of extracted groundwater volumes to DPI-Water annually for the duration of construction and operation, unless otherwise agreed to or directed by the Secretary. The operational groundwater monitoring program will be developed in consultation with the NSW EPA, DPI-Water and the relevant councils and documented in the Operational Environmental Management Plan (OEMP) or Environmental Management System (EMS).

B5.1.2 Salt water intrusion

DPI considers that the largely untanked (unlined) sections of tunnel which require continuous dewatering will exceed the Level 1 water quality criteria under the Aquifer Interference Policy and will trigger Level 2. The proponent should demonstrate where salt water intrusion from tidal areas will occur and then re-analyse these impacts on sensitive uses of the groundwater. The proponent should also confirm if the particle tracking component of the groundwater model was sufficient to analyse these overall impacts of salt water ingress to the tunnel ecosystems along this tidal fringe.

Response

Saltwater intrusion during construction is discussed in section 5.5.6 and during operation in section 6.4.3 of Appendix T (Technical working paper: Groundwater) of the EIS.

A minimal impact assessment was conducted as part of the EIS in accordance with the *NSW Aquifer Interference Policy Step by Step Guide* (NSW Office of Water 2013b) (AIP). In accordance with the AIP, groundwater modelling (particle tracking) was conducted to assess the potential impacts of saline intrusion. A summary of the assessment is provided in Table 9-1 of Appendix T (Technical working paper: Groundwater) of the EIS for the Less Productive Fractured Rock Aquifer which covers much of the project footprint. The EIS also considered the Botany Sands, which although not intersected by the project, are in close proximity to the east of the project, and therefore likely to be impacted by the project. A summary of the assessment for the Botany Sands is presented in Table 9-2 of Appendix T (Technical working paper: Groundwater) of the EIS for Highly Productive Coastal Aquifer.

Groundwater model development

The groundwater model was developed primarily as a flow transport model to predict groundwater drawdown for various scenarios to allow impacts to receptors to be assessed. The model was not designed as a solute transport model to predict groundwater concentration variations over time. Instead the model was adapted to conduct a capture zone analysis to identify zones within which recharge to the land surface will ultimately report to the tunnels, and within which saline tidal water will be drawn towards the tunnels.

Particle tracking has been used to estimate the travel time of particles from a tidal water body travelling towards the tunnels. This process simulates the movement of saline water or saltwater intrusion through the porous alluvium and sandstone. The computed rate of groundwater flow or travel times is dependent on the aquifer properties including the hydraulic conductivity, hydraulic gradients and effective porosity. Backward or reverse particle tracking is where a large number of particles are released at the tunnel inverts represented in the model. Flow directions are reversed and the locations where those particles would have been at different times in the past are computed and displayed as a function of time.

In the three dimensional model, plotting the reverse particle tracks maps the capture zone and thus the impacted area. While this method of tracking saltwater intrusion does not provide salinity concentration changes with time, it does provide the time scale over which the saltwater intrusion is predicted to occur. Particle tracking calculates the movement of the saltwater interface. Since the area of influence is mapped and it has been calculated that the saltwater intrusion leading edge moves very slowly, taking in the order of tens to hundreds of years to travel a few kilometres, this modelling methodology is considered suitable to predict impacts due to saltwater intrusion.

Less Productive Fractured Rock Aquifer (Ashfield Shale and Hawkesbury Sandstone)

The AIP assessment for the Less Productive Fractured Rock Aquifer considered groundwater in both the Ashfield Shale and Hawkesbury Sandstone. Natural groundwater salinity (electrical conductivity) collected during the groundwater monitoring program from June 2016 to November 2017 has been averaged for each monitoring well and converted to milligrams per litre (mg/L) total dissolved solids and is presented on **Figure B5-1** (Ashfield Shale) and **Figure B5-2** (Hawkesbury Sandstone). The figures show that groundwater salinity is highly variable which is attributed to limited hydraulic connectivity within the fractured rock aquifer. There appears to be no trend associated with increased salinity within the bedrock aquifers associated with close proximity to tidal water bodies. There is a reticulated water supply provided by Sydney Water across the project footprint which limits the use of groundwater resources.

Groundwater between the tunnel and tidal water bodies is predicted to become more saline as saltwater intrusion occurs due to tunnel inflows, causing a reduction in the groundwater pressure within the pores of the Hawkesbury Sandstone and inducing groundwater flow away from the shoreline. Saltwater intrusion occurs predominately around the foreshore, becoming less pronounced with increased distance from the edge of the saline water source. Groundwater modelling (particle tracking) has been used to predict the travel time taken for the saline water to migrate into the groundwater, which has shown that the saline intrusion leading edge moves very slowly taking in the order of tens to hundreds of years to travel a few kilometres.

Groundwater quality within the Ashfield Shale is highly variable but is typically brackish or saline, due to the marine salts contained within the shale. Groundwater quality is generally good within the Hawkesbury Sandstone, with low salinity except in the upper part of the aquifer which can be elevated due to leakage from the Ashfield Shale. Groundwater use across most of the project footprint is low as bore yields are typically low and the area has access to reticulated water. In the area between the tidal zones and the tunnels, no registered domestic or recreational water supply bores were identified in the tidal area that could become more saline.

Five domestic or recreational bores were identified in the DPI-Water search; none were located between the project footprint and the tidal zones. Two of the bores were located in the Botany Sands (GW106192 and GW111164), one at Redfern Park (GW71907) which is used for irrigation, one at Abbotsford (GW106159), and one at the University of Sydney (GW110247). There are also no groundwater dependent ecosystems between the project footprint and tidal zones. A map of groundwater dependant ecosystems in relation to the project footprint is provided in Figure 4.8 of Appendix S (Technical working paper: Biodiversity Assessment Report) of the EIS.

In the broader area, it is predicted that it would take in the order of hundreds of years for saline water to travel from the alluvium in Whites Bay to the University of Sydney bore (GW110247), which is the closest to the tidal zone. It also shows that the nearest high priority groundwater dependent ecosystems (Lachlan Swamp and Botany wetlands) at Centennial Park will not be impacted by saltwater intrusion as saltwater would not be travelling towards these wetlands.

Given the limited groundwater use and the lack of groundwater dependent ecosystems or culturally significant sites within the *Water Sharing Plan for the Greater Metropolitan Region Groundwater Sources (Greater Metropolitan Regional Groundwater Sharing Plan)* (NSW Office of Water 2011) which covers the project footprint and surrounds, it would be unlikely that there would be a lowering of the aquifer systems beneficial use category within the project footprint. As a result, an assessment against the Level 1 water quality criteria under the Aquifer Interference Policy was considered appropriate for the Less Productive Fractured Rock Aquifer, as the criteria for this level were not exceeded.

Highly Productive Coastal Aquifer (Botany Sands)

As with the project footprint, groundwater within the Botany Sands area has limited beneficial use potential. Although the Botany Sands aquifer contains a significant groundwater resource under natural conditions, due to contamination, DPI-Water has embargoed domestic groundwater use under the *Greater Metropolitan Regional Groundwater Sharing Plan*. There is also a reticulated water supply provided by Sydney Water to this area, thereby limiting the usage of groundwater resources.

Groundwater modelling predicts there is likely to be saline water ingress from Alexandra Canal to the project footprint, which may increase the salinity of the groundwater resource between the project footprint and the canal. Groundwater flow toward the project footprint from Alexandra Canal would be restricted by the cut-off wall which is to be installed as part of the New M5 project around the southeast perimeter of the Alexandria landfill. In the area between the eastern edge of the former landfill and Alexandra Canal, groundwater gradients will be reversed within the Botany Sands aquifer due to the installation of the cut-off wall, restoring pre quarry hydraulic gradients, causing groundwater to discharge into the canal. The Botany Sands aquifer however will not be impacted by salt water intrusion as the Botany Sands occur predominately east of Alexandra Canal. Any canal water drawn around the cut-off wall, over hundreds of years, would impact the Ashfield Shale and not the Botany Sands.

The closest high priority ecosystems in the Botany Sands listed under Schedule 4 of the *Greater Metropolitan Regional Groundwater Sharing Plan* are the Botany Wetlands including the Lachlan Swamps, Mill Pond, Mill Stream and Engine Pond. These ecosystems are located more than two kilometres from the project footprint. Groundwater modelling conducted as part of this investigation indicates that the water quality at these wetlands is unlikely to decline due to saltwater intrusion or any other influences due to the project (refer to section 5.4.1 of Appendix T (Technical working paper: Groundwater) of the EIS). This is because saltwater ingress due to depressurisation of the aquifer, induced by tunnel inflows, will predominately occur along the foreshore where there is tidal interaction. Consequently, the majority of saltwater intrusion will occur along the foreshore fringes, limiting impacts to groundwater resources further inland. Capture zone analysis undertaken as part of the groundwater modelling predicted that groundwater quality within the Botany Sands aquifer would increase in salinity slowly over time in the order of hundreds of years. At the St Peters interchange, the cut-off wall constructed around the south east perimeter of the former Alexandria landfill would further restrict saline water movement through the Botany Sands from the Alexandra Canal.

No culturally significant sites were identified within the *Greater Metropolitan Regional Groundwater Sharing Plan* that would be impacted by groundwater changes as a result of the project. Groundwater modelling predicted that no registered bores within a two kilometre radius of the tunnels that intersect alluvium are likely to be drawn down by more than two metres. As this is within Zone 2 of the Botany Sands Source Management Zone, domestic use of groundwater is banned, and as a result the drawdown impacts are not considered significant.

As a result, the Level 1 assessment was considered appropriate for the Highly Productive Coastal Aquifer as the criteria for Level 1 have not been exceeded.

Areas potentially impacted by saltwater intrusion

Areas potentially impacted by saltwater intrusion are the areas between a tidal (saline) water body and the tunnel. Initially it will be the groundwater within the alluvial flanking the foreshore that will be impacted as groundwater is slowly drawn towards the tunnels. Natural groundwater salinity (mg/L total dissolved solids (TDS) within the alluvium derived from the groundwater monitoring program is presented in **Figure B5-3**. The range of salinity values indicates groundwater salinity within the alluvium is highly variable ranging from fresh water to in excess of 10,000 mg/L TDS, with no apparent areal trends.

Four key areas have been identified that may be subject to saltwater intrusion as shown on **Figure B5-4** and **Figure B5-5** (refer to Figure 3-2 and Figure 2-3 of Appendix T (Technical working paper: Groundwater) of the EIS). These figures show the direction of flow of saline surface water towards the tunnels and the initial area of influence. These identified areas are:

- Lilyfield and Rozelle on the south eastern edge of Iron Cove
- Rozelle west of White Bay
- Rozelle west of Rozelle Bay
- St Peters north-west of Alexandra Canal.

Following construction, it is recommended that existing monitoring wells between these foreshore areas and the project tunnels are identified and are added to the groundwater monitoring network to monitor for any changes in groundwater quality that could be attributed to saltwater intrusion.

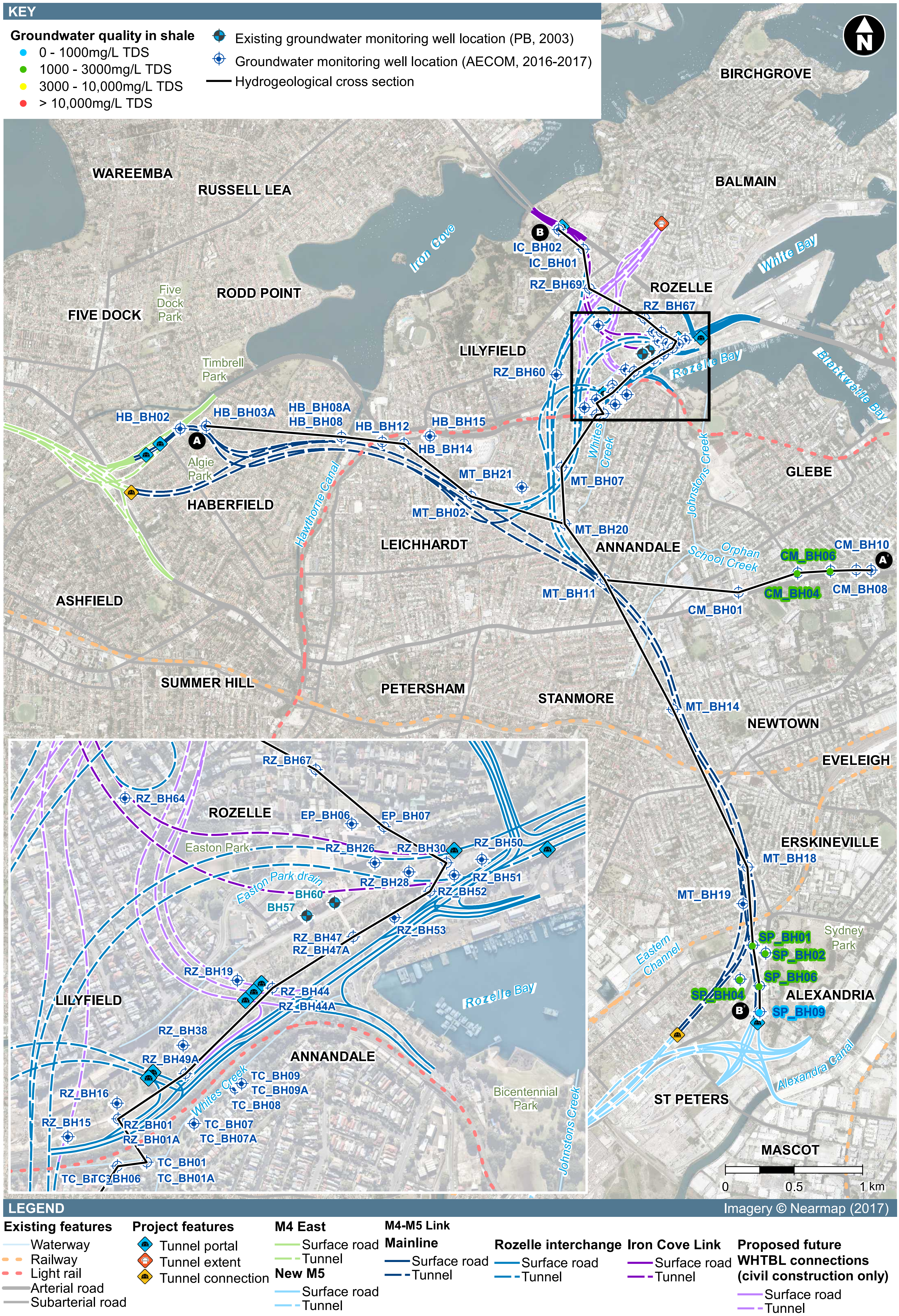

Figure B5-1 Groundwater quality - shale

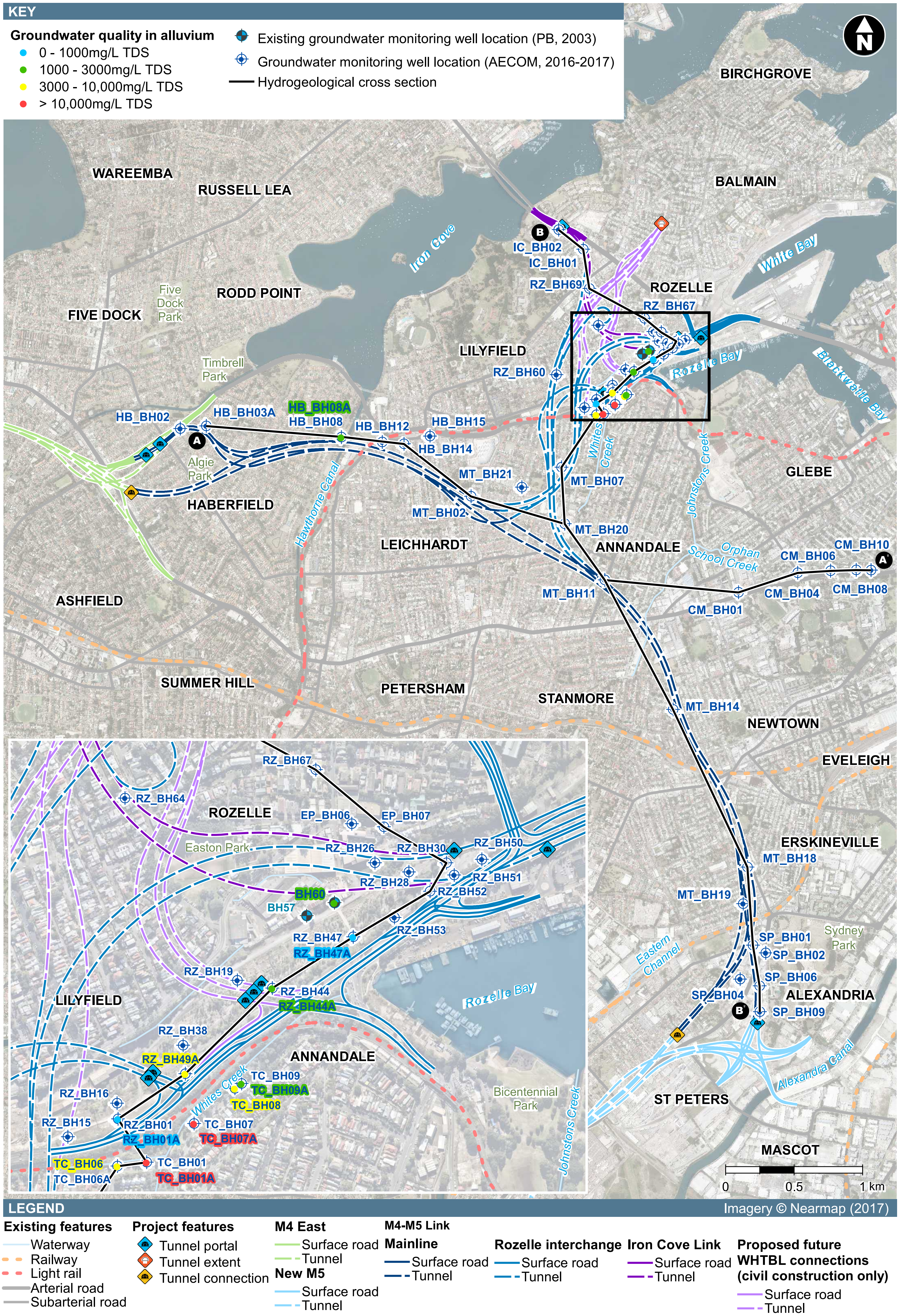

Figure B5-2 Groundwater quality - alluvium

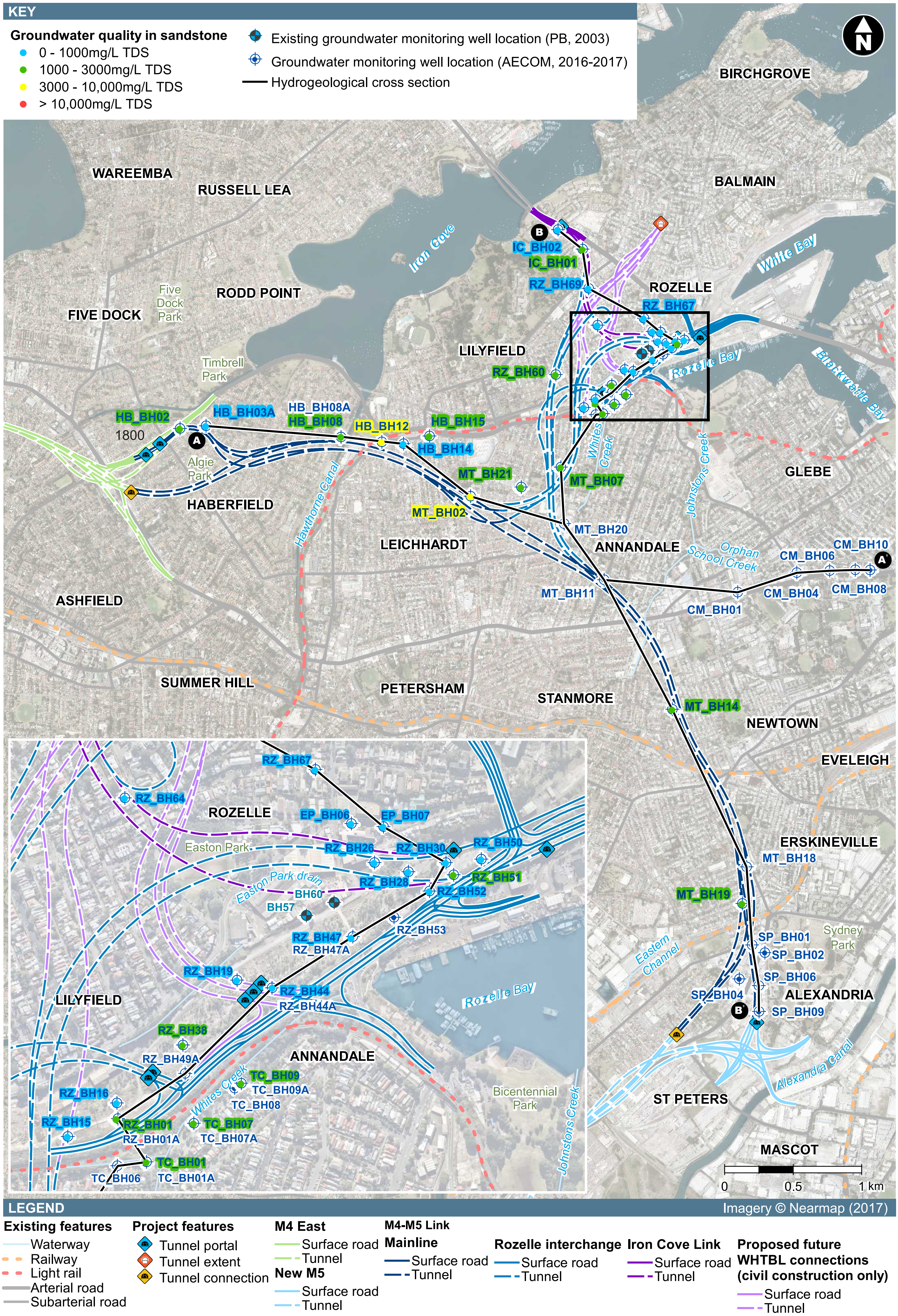

Figure B5-3 Groundwater quality - Hawkesbury Sandstone

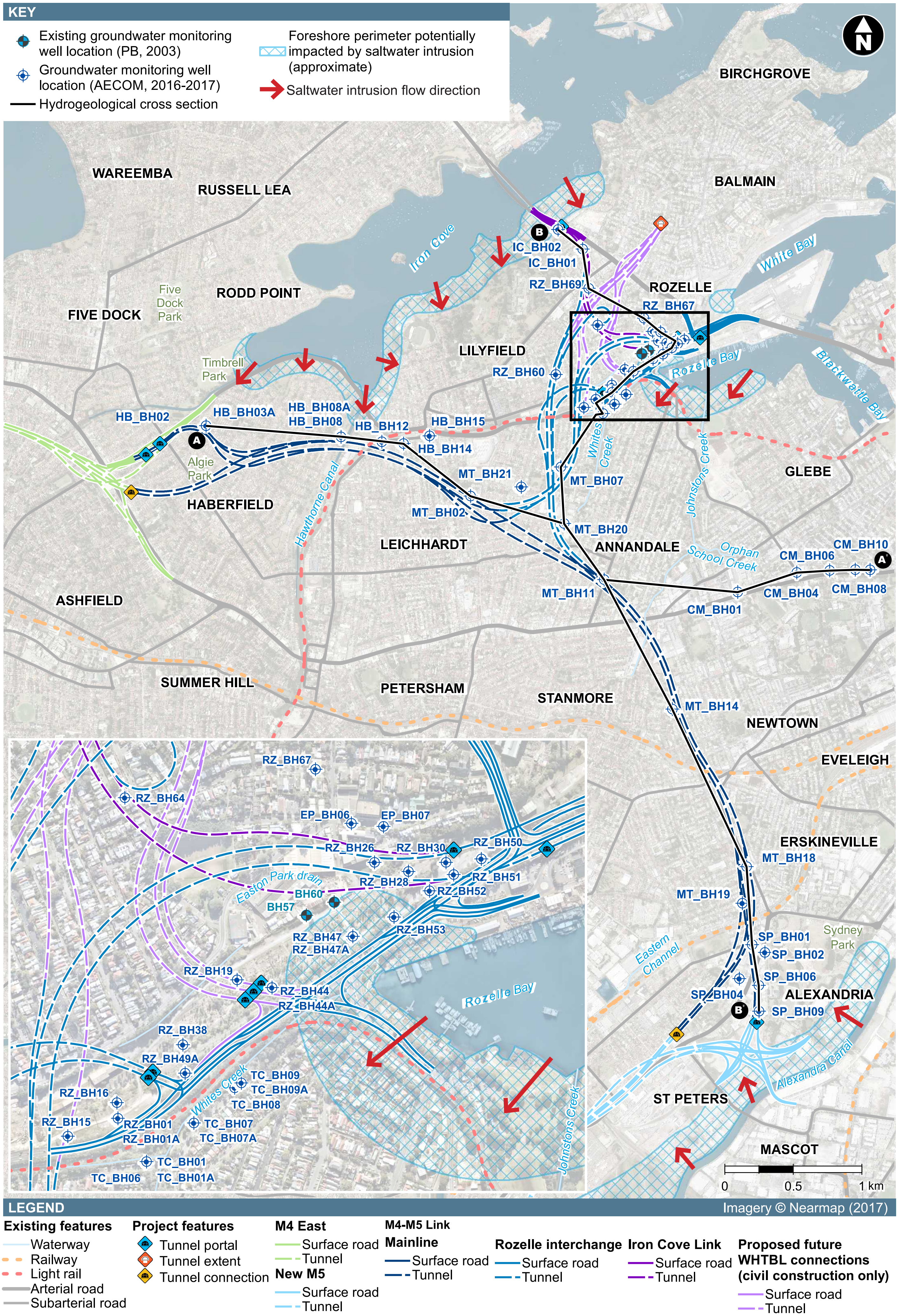

Figure B5-4 Areas potentially in luenced by saltwater intrusion

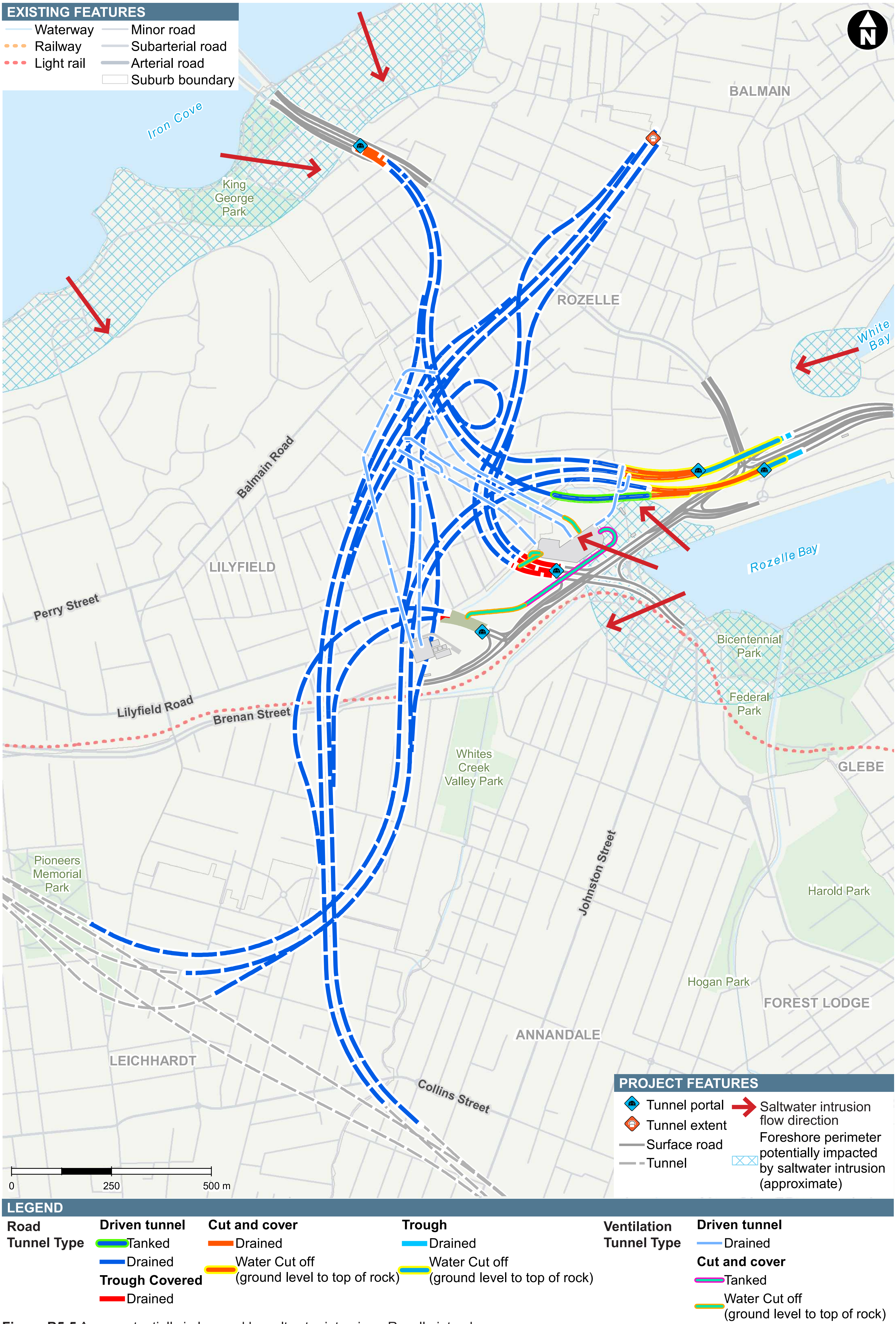

Figure B5-5 Areas potentially in luenced by saltwater intrusion - Rozelle interchange

B5.1.3 Groundwater monitoring measures

The proponent should consult with Crown Lands and Water (water.referrals@dpi.nsw.gov.au) on the design and development of groundwater monitoring measures, which should include:

- Increased monitoring of groundwater salinity at key monitoring bore sites (acknowledging the Level 2 trigger)
- Use of open monitoring bores to monitor groundwater level impacts as well as groundwater quality
- Monitoring during construction and the post-construction operational phase for the life of the development. This will allow gauging of the predicted impacts, allowing mitigation measures to be undertaken in the case of exceedances
- Continuation of baseline groundwater monitoring post EIS until the handover to the construction phase. This background information will assist in assessing groundwater impacts and trigger level guidelines outside seasonal variation.

The proponent should liaise with Crown Lands and Water to discuss licensing requirements for the ongoing take of groundwater.

Response

As discussed in **section B5.1.2**, the Level 1 criteria for water quality of the AIP was considered appropriate for the groundwater assessment.

Groundwater monitoring has been carried out since June 2016 and this has provided a robust baseline monitoring dataset which has informed the modelling presented in Chapter 19 (Groundwater) and Appendix T (Technical working paper: Groundwater) of the EIS. As outlined in environmental management measure OGW10 (see **Chapter E1** (Environmental management measures)), the groundwater monitoring program prepared and implemented during construction will be augmented and continued during the operational phase. See **section B5.1.1** for further details about groundwater monitoring that would be carried out by the project.

The licensing and/or registration requirements associated with groundwater abstraction would be discussed with Crown Lands (NSW Department of Industry – Lands and Water) during the detailed design and construction phases of the project. Consultation with key stakeholders, including Crown Lands and Water, would continue during the development of detailed design for the project in accordance with the Community Communication Strategy (environmental management measure SE2 (see **Chapter E1** (Environmental management measures)) and conditions of approval.

B5.2 Flooding and drainage

Refer to section 17.4 and Appendix Q (Technical working paper: Surface water and Flooding) of the EIS for details of operational impacts on flooding and drainage.

B5.2.1 Monitoring and maintenance of the wetland

The proponent should advise who will be responsible for monitoring and maintaining the constructed wetland at Rozelle for the operational life of the project.

Response

The implementation of management measures identified in the EIS and relevant conditions of approval would be the responsibility of NSW Roads and Maritime Services (Roads and Maritime) as the proponent of the project.

B5.3 Soil and water quality

Refer to Chapter 15 (Soil and water) and Appendix Q (Technical working paper: Surface water and Flooding) for details of impacts to soil and water quality.

B5.3.1 Consultation with Crown Lands and Water and DPI Fisheries

The proponent should develop the following in consultation with Crown Lands and Water:

- Construction Environmental Management Plan
- Operational Environmental Management Plan.

The proponent should prepare the following in consultation with Crown Lands and Water and DPI Fisheries (ahp.central@dpi.nsw.gov.au):

- Construction Soil and Water Management Plan
- Sediment Control Plans for activities occurring around Whites Creek and Rozelle Bay.

Response

Construction environmental management measures, as identified in **Chapter E1** (Environmental management measures) would be captured in a Construction Environmental Management Plan (CEMP) and associated sub-plans, including a Construction Soil and Water Management Plan (CSWMP). The CSWMP will include measures to manage surface and groundwater impacts during construction and will be prepared in consultation with the relevant stakeholders as required by the conditions of approval. In addition, Erosion and Sediment Control Plans will be prepared and implemented on a case by case basis consistent with *Managing Urban Stormwater – Soils and Construction Vols 1 and 2, 4th Edition* (Landcom, 2004) and in accordance with the relevant conditions of approval for the project. The CEMP and associated sub-plans will be prepared in consultation with relevant stakeholders as required by the conditions of approval.

Operational environmental management measures would be captured in an OEMP or EMS and reflect the environmental management measures (see **Chapter E1** (Environmental management measures)) and the relevant conditions of approval for the project. The OEMP will outline the environmental management practices and procedures that are to be followed during operation, and will be prepared in consultation with relevant agencies as required by the conditions of approval.

B5.3.2 Detailed assessment of discharge of nutrients

The proponent should provide more detailed investigation into treatment during detailed design with details of final expected discharge values to be provided to Crown Lands and Water for review when the design is completed this should include more detailed assessment of discharge of nutrients into Hawthorne Canal.

Response

Construction

As outlined in environmental management measure SW10 (see **Chapter E1** (Environmental management measures)), temporary construction water treatment plants will be designed and managed so that treated water will be of suitable quality for discharge to the receiving environment. An Australian and New Zealand Environment and Conservation Council (2000) (ANZECC) species protection level of 90 per cent is considered appropriate for adoption as discharge criteria for toxicants where practical and feasible. The discharge criteria for the treatment facilities will be included in the CSWMP.

The final design of treatments will be supported by Model for Urban Stormwater Improvement Conceptualisation (MUSIC) modelling and water sensitive urban design principles.

Operation

The operational water treatment facilities will be designed and managed such that effluent will be of suitable quality for discharge to the receiving environment. Discharge criteria will be developed in accordance with ANZECC (2000), with consideration of the species protection levels for slightly to moderately disturbed marine waters and relevant NSW WQOs, and will also include the following discharge criteria:

- 0.3 milligrams per litre for iron
- 1.9 milligrams per litre for manganese.

Opportunities to incorporate other forms of nutrient treatment (for example ion exchange or reverse osmosis) within the water treatment plant at the Darley Road motorway operations complex (MOC1) will be investigated during detailed design.

The discharge criteria for the treatment facilities will be nominated during detailed design in consultation with relevant stakeholders and included in the OEMP.

Design of the operational stormwater controls and water treatment facilities will be undertaken in accordance with environmental management measures OSW12, OSW15 and OSW16 (see **Chapter E1** (Environmental management measures)).

B5.3.3 Water Guidelines for Controlled Activities

The proponent should ensure all works on waterfront land are carried out in accordance with the DPI Water *Guidelines for Controlled Activities on Waterfront Land* (2012).

Response

Works, including all associated temporary and permanent infrastructure, located near or adjacent to waterways will be designed and constructed in a manner consistent with the *Controlled Activities on Waterfront Land Guidelines* (DPI 2012).

B5.4 Land use and property

Refer to section 12.3 of the EIS for details of potential impacts on property.

B5.4.1 Compulsory acquisition

The proponent will need to compulsorily acquire any impacted Crown lands under provisions of the Land Acquisition (Just Terms Compensation Act 1991).

Response

As outlined in section 12.3 of the EIS, land acquisition required for the project would be undertaken in accordance with the *Land Acquisition (Just Terms Compensation) Act 1991* (NSW), the *Land Acquisition Information Guide* (NSW Government 2014) and the land acquisition reforms announced by the NSW Government in 2016 (NSW Government 2016), as detailed in the environmental management measures in **Chapter E1** (Environmental management measures).

Section 12.3.2 of the EIS discusses the proposed acquisition of two areas of Crown land for the project. These being:

- Land required for the construction of the bioretention facility and upgrades to the existing car park at King George Park at Rozelle, adjacent to Manning Street. This land is currently being used as an informal car park for users of King George Park
- Land within King George Park adjacent to Victoria Road and Byrnes Street at Rozelle for the widening of Victoria Road. This land consists of turf and a landscaped embankment. A small section of the Bay Run in King George Park would also be permanently realigned slightly to accommodate the widened Victoria Road carriageway and the bioretention facility.

Since the EIS was finalised, ongoing design development has identified that the proposed location of the bioretention facility on Manning Street at Rozelle as outlined in Chapter 5 (Project description) and Chapter 12 (Land use and property) of the EIS is on land currently subject to an undetermined Aboriginal land claim lodged by Metropolitan Local Aboriginal Land Council (Lot 662, DP 729277). Given the uncertainty regarding the future outcome and timing of resolution of this claim, an alternative location for the bioretention facility has been considered and assessed.

The revised location for the bioretention facility is described in **Part D** (Preferred infrastructure report) and shown in **Figure D3-1**. The bioretention facility would be within and adjacent to land at King George Park that is adjacent to Victoria Road and Byrnes Street at Rozelle. The land on which the bioretention facility would be located is Crown land, under the control and care of Inner West Council and Roads and Maritime.