CHAPTER 5.4 WATER

5.4 Water

5.4.1 Overview

A surface water assessment and groundwater assessment has been prepared by EMM and are provided in Appendix M (Surface Water Assessment) and Appendix N (Groundwater Assessment), respectively. In addition, an assessment of dredging and subaqueous placement of excavated material has also been prepared by Royal HaskoningDHV (Appendix L). The following aspects are considered in the assessments:

- potential impacts to surface water resources, including Yarrangobilly River, Wallaces Creek and Talbingo Reservoir;
- potential impacts associated with placement of excavated rock within Talbingo Reservoir;
- water management during construction, including a site water balance;
- flood risk management associated with works on flood prone land; and
- potential impacts on groundwater aquifers and GDEs.

A comprehensive surface and groundwater monitoring network (shown in Figure 5.7) has been designed and used to establish a baseline dataset for Exploratory Works. Baseline water level and water quality field data collected from the various groundwater systems and watercourses has been used to determine the overall water chemistry, flow paths, recharge and discharge characteristics, and groundwater–surface water connectivity. Similarly, investigations have been carried out to inform the method and location of subaqueous rock placement. A full description of the assessment methods and applicable guidelines is provided in Appendix L, Appendix M and Appendix N.

5.4.2 Existing environment

The Yarrangobilly River and Talbingo Reservoir are the defining features of Lobs Hole. The river initially flows in a southerly direction before turning to the west, towards Talbingo Reservoir. The Yarrangobilly River and its tributaries (including Wallaces and Stable creeks) are shown in Figure 5.8. Watercourses in the project area are all 'gaining' streams with groundwater providing stream baseflows. Recharge to the groundwater system is via rainfall infiltration.

i Yarrangobilly River and tributaries

The Yarrangobilly River is a major regional watercourse that flows into Talbingo Reservoir, downstream of Lobs Hole. There are no dams or flow diversions in the Yarrangobilly River catchment upstream of the Talbingo Reservoir. At Lobs Hole the river has been impacted by historical mine workings and spoil piles. These remnant mining areas are located on the floodplain and surrounding areas (see Figure 5.8). Stream flows in the Yarrangobilly River are continuous all year round during normal rainfall conditions. The majority of annual stream flows occur in late winter and early spring, which is a typical regime for rivers in the Australian Alps.

The water quality during base flow conditions can be characterised as neutral to slightly alkaline, high carbonate levels, low salinity, low suspended solids and low levels of nutrients and metals. Water quality during non base flow conditions is expected to have lower carbonate levels and potentially higher suspended solids and nutrient levels. High concentrations of heavy metals have been noted in the river resulting from the former Lobs Hole Mine.

Wallaces Creek is a major tributary to the Yarrangobilly River and forms the southernmost portion of the catchment. Wallaces Creek has a similar flow regime and water quality characteristics to the Yarrangobilly River. Stable Creek is a watercourse that joins Wallaces Creek approximately 600 m upstream of the confluence of Wallaces Creek and the Yarrangobilly River. Other local named and unnamed watercourses in the area are all intermittent or ephemeral streams.

ii Talbingo Reservoir

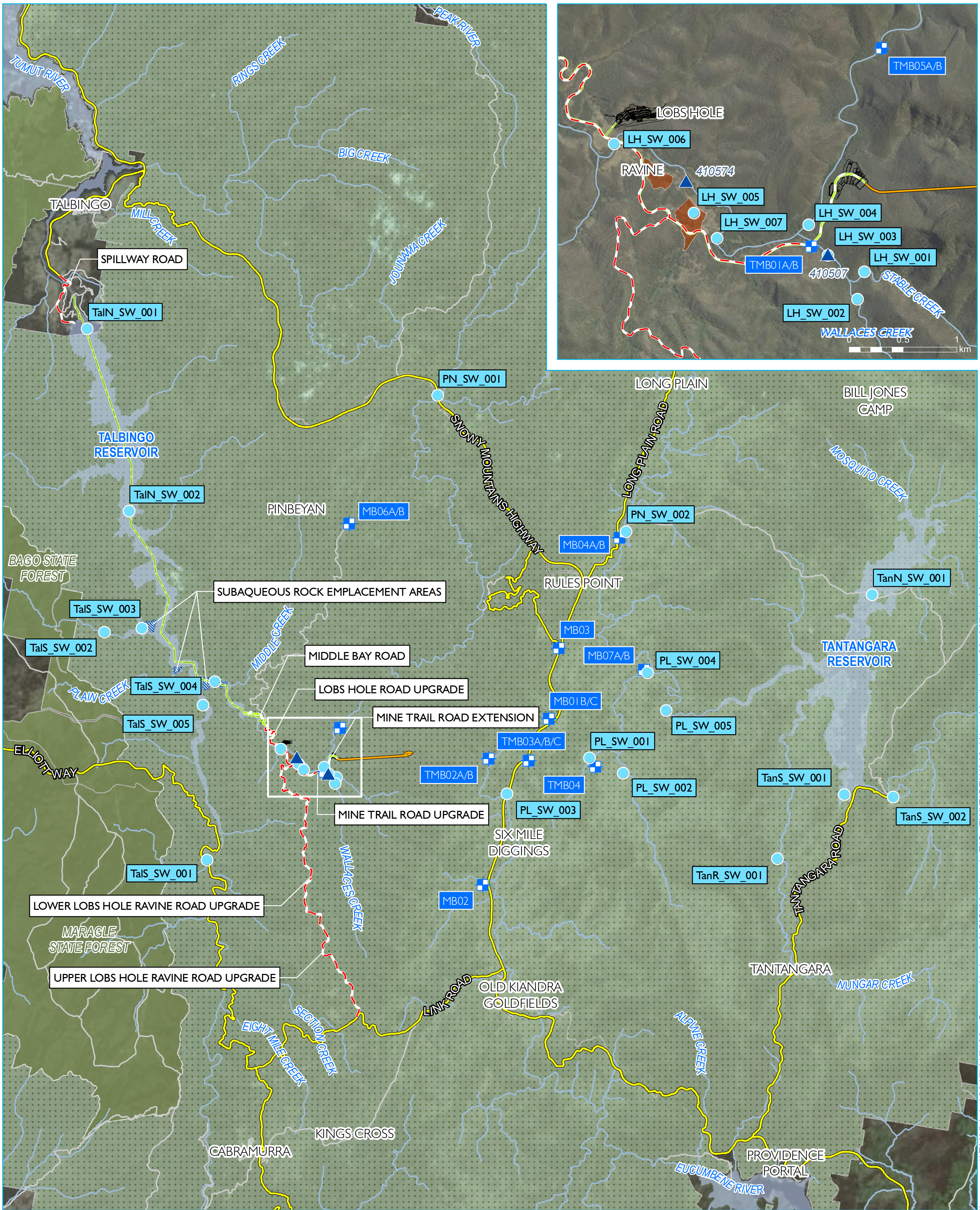
Talbingo Reservoir forms part of the Snowy Scheme. The reservoir is approximately 25 km long and has a surface area of approximately 19.4 km^2 (at FSL). The reservoir receives inflows from the Tumut River (primary from discharges from Tumut 2 power station), Yarrangobilly River, pumping from Jounama Pondage, and minor tributaries. Inflows are estimated at 1,615 gigalitres per year (GL/year) on average.

Talbingo Reservoir is operated as head water pondage for generation of hydro-power from the Tumut 3 power station. Water is released from the reservoir through the Tumut 3 power station into Jounama Pondage, which releases water into Blowering Reservoir. Blowering Reservoir releases water into the Tumut River to supply a variety of users but primarily large irrigation schemes. Outflows from the reservoir are estimated at 1,615 GL/year on average. However, the net discharge from Talbingo Reservoir is about 1,221 GL/year as some of the outflow is pumped via Tumut 3 back into the reservoir.

Water quality is characterised as having a neutral pH, low carbonate, low salinity, low levels of suspended solids and low nutrient levels. Elevated concentrations of copper and zinc were identified in most samples from the southern (upstream) portion of the reservoir. Elevated copper and zinc concentrations were not identified in either the Yarrangobilly River or Tumut River inflow locations.

Metals and organic contaminants in sediments may be naturally present in a variety of forms. Some contaminants (primarily nickel and copper) were detected above relevant sediment quality guidelines in the sediments of Talbingo Reservoir, in particular at Middle Bay (site of the barge ramp). These are not considered to be bioavailable (ie absorbed by organisms).

Potential sites for subaqueous placement within Talbingo Reservoir include Plain Creek Bay, Ravine Bay and Cascade Bay. The physical and geochemical properties of the sediments are generally homogenous throughout the reservoir, primarily comprising silts (mainly coarse silts) and clay. Similarly, hydrodynamic conditions reflect low energy conditions as evident by the muddy textured sediments. The sites vary in maximum depth of between 25 m and 35 m below MOL, but vary in suitable placement area. Plain Creek Bay is a semi-enclosed bay and has the smallest placement capacity, and Ravine Bay is a more open bay and has the largest placement capacity.



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Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018); DFSI (2017); LPMA (2011)

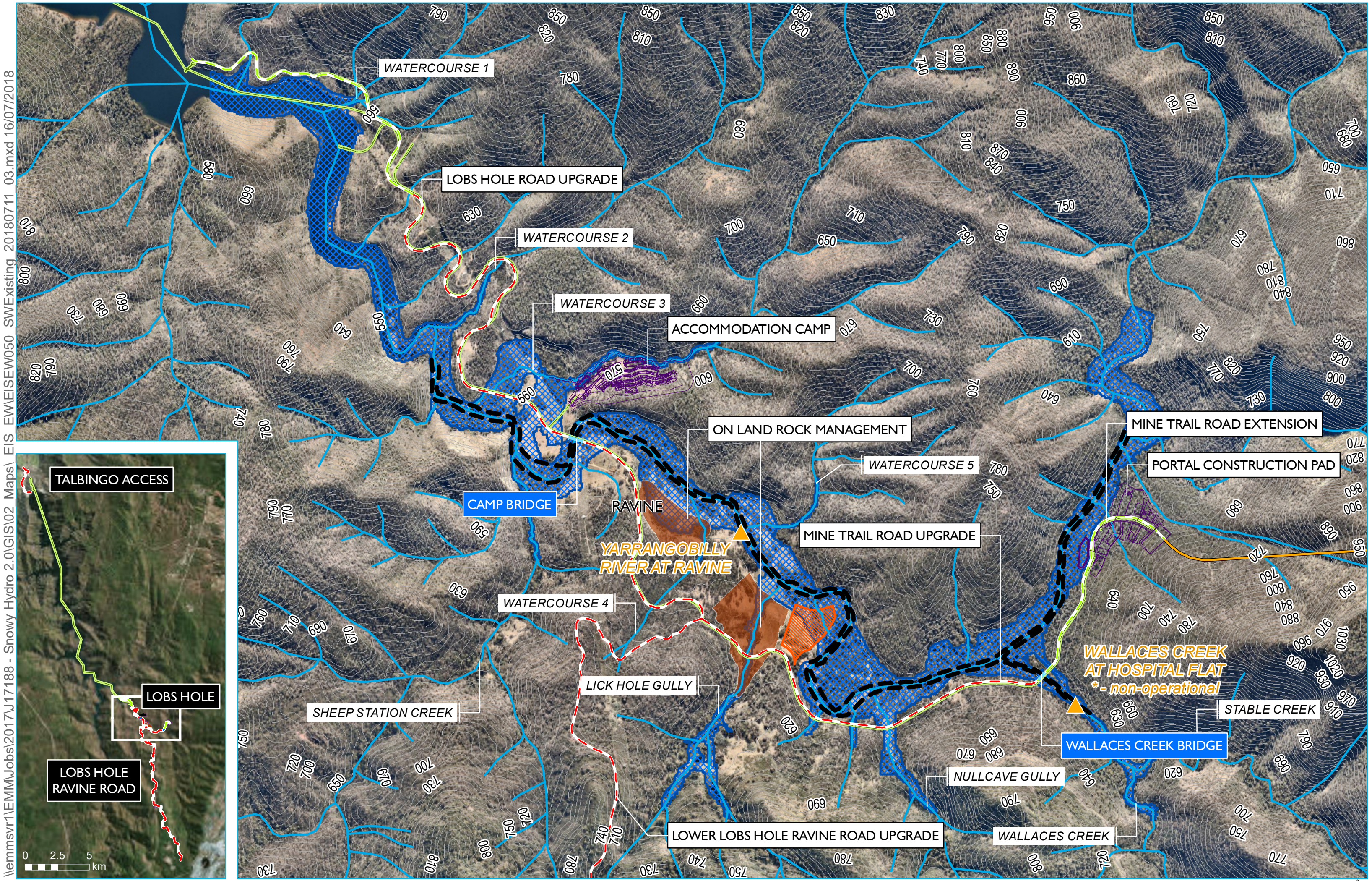
KEY

- Snowy Hydro gauging station
- Surface water sampling location
- Groundwater monitoring bore
- Access road upgrade
- Access road extension
- Communications cable and water services pipeline location
- On land rock emplacement area
- Exploratory tunnel
- Portal construction pad and accommodation camp conceptual layout
- Main road
- Local road
- Perennial watercourse
- On land rock management
- Subaqueous rock emplacement area
- Scheme storage
- Kosciuszko National Park
- State forest

Baseline water monitoring network

Snowy 2.0
Environmental Impact Statement
Exploratory Works
Figure 5.7

snowy 2.0 EMM creating opportunities



Source: EMM (2018); Snowy Hydro (2018); NearMap (2018); SMEC (2018); Robert Bird (2018)

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KEY

- Stream gauge location
- Exploratory tunnel
- Portal construction pad and accommodation camp conceptual layout
- Permanent bridge
- Access road upgrade
- Access road extension
- Communications cable
- Yarrangobilly River top of bank
- Watercourse
- Contour (10 m)
- On land rock management
- Mine workings area
- 500 year flood extent (indicative floodplain extent)

Existing surface water environment

Snowy 2.0
Environmental Impact Assessment
Exploratory Works
Figure 5.8

snowy2.0 EMM creating opportunities

iii Groundwater and groundwater dependent ecosystems

The groundwater units within the project area are defined as:

- localised unconsolidated shallow Quaternary gravels episodically recharged through rainfall/flooding events; and
- deep groundwater associated with deeper fractured rock (ie Ravine Beds).

The Ravine Beds is the main groundwater bearing unit to be intercepted by the exploratory tunnel. Groundwater within the Ravine Beds has a marginally brackish water quality and is low yielding. The groundwater quality is described as slightly alkaline with typically low concentrations of most dissolved metals. This is typical of alpine areas where groundwater is readily recharged via rainfall and snow melt.

Ecosystems that rely on groundwater (or GDEs) are important environmental assets and typically occur where groundwater is at or near the land surface. Within the project area they are associated with:

- creeks (such as Yarrangobilly River) where deep groundwater is discharging and provides baseflow;
- shallow (perched) groundwater systems;
- springs associated with the steep escarpment across the eastern extent of the project area; and
- terrestrial vegetation overlying shallow groundwater (within the vegetation's root zone).

There are no identified high-priority GDEs within the project area. Yarrangobilly Caves is the only High Priority GDE listed within the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater Sources 2011* relevant to Snowy 2.0, and is approximately 8 km north east of the Exploratory Works project area.

Three native vegetation types were identified as having potential to access groundwater sporadically (as previously described in Section 5.1). None of these terrestrial ecosystems are highly dependent or entirely dependent on groundwater.

5.4.3 Assessment of impacts

i Potential surface water impacts

Potential impacts to the surface water environment are due to ground disturbance, construction activities, and water management. Potential impacts include:

- water quality impacts associated with sediment-laden runoff (including fine or dispersive sediments) from construction areas, unsealed access roads, rock emplacement areas, accommodation camp and portal construction pad into Yarrangobilly River, Wallaces Creek and other local waterways;
- water quality impacts associated with dredging and construction of barge access infrastructure, and disturbance of potentially contaminated sediments;
- contamination of stormwater runoff due to construction activities (including accidental spills) resulting in downstream impacts if not appropriately captured and managed;

- changes to flow regime from new infrastructure primarily bridges, the accommodation camp, and rock emplacement areas;
- increased runoff volumes due to failure of road embankments, water management systems and other infrastructure during flood events;
- increased erosion of landforms and waterways associated with uncontrolled runoff and changes to flow regimes;
- uncontrolled discharge of process water into the stormwater system due to inadequate system design or stormwater ingress into the process water system;
- receiving water impacts due to discharge of process water or extraction of water;
- water quality impacts associated with the discharge of process and treated wastewater (sewage) to Talbingo Reservoir; and
- potential for acid rock drainage seeping from rock emplacement areas into the Yarrangobilly River.

ii Potential impacts from subaqueous placement in Talbingo Reservoir

Potential impacts within Talbingo Reservoir are due to the subaqueous placement of excavated material within deep and bay areas of the reservoir. Potential impacts include:

- changes to bathymetry (depth of reservoir bed) and hydrodynamics (water movement) within the reservoir;
- water quality impacts (localised and downstream) from sedimentation and turbidity generated during:
  - transport of excavated material, including from the transport barge to the discharge barge;
  - placement of excavated material from the discharge barge to the reservoir floor;
  - interaction of the excavated material with the water column and reservoir bed sediments; and
- aquatic ecology impacts (which have been assessed in Appendix G).

iii Water management system

A water management system is proposed to manage both runoff from Exploratory Works and water produced by and used by the proposed activities (referred to as process water). An overview of the management approach applied to Exploratory Works is provided in Table 5.9.

Table 5.9 Summary of water management principles

Focus area	Management approach summary
Clean water management	● Where possible clean water will be diverted around or through water management areas.
Water management during construction (initial nine months of construction)	● Erosion and sediment controls will be established to manage sediment laden runoff from construction disturbance areas.
Runoff from unsealed access roads	● Erosion and sediment controls will be established to manage sediment laden runoff from unsealed access roads.
Stormwater management: accommodation camp	● All pervious areas including batters will be vegetated with endemic native vegetation. ● A stormwater management system will manage runoff from impervious areas.
Stormwater management: construction pad	● Activities that have the potential to contaminate stormwater runoff will be isolated from the stormwater system through the use of covering (ie by a building or roof) and bunding. ● A stormwater management system will manage runoff from the construction pad ● and be designed to contain any leak, spill or fire water runoff from the construction pad.
Process water management	● A process water management system will be established to manage water produced by and used by construction activities. ● Any surplus process water will be treated and discharged into the Yarrangobilly River Arm of Talbingo Reservoir. ● Any additional water requirements will be sourced from Talbingo Reservoir.
Wastewater (sewage) management	● All wastewater will be treated in a wastewater (sewage) treatment plant ● Treated wastewater will be discharged into the Yarrangobilly River Arm of Talbingo Reservoir.
Rock and soil emplacement water management	● Rock and soil emplacements will be designed to be physically and chemically stable landforms.

Water balance modelling has been carried out to assess and describe the functionality of the proposed process water system (and is provided in detail at Appendix M). The water balance model results indicate that:

- the majority of tunnel affected water produced over the exploratory tunnelling period can be used as process water. However, discharge of treated process water to Talbingo Reservoir will be required at times (up to 48 kL/day);
- extraction of water from Talbingo Reservoir will be required in most months to meet process water demand (up to 26 ML/month); and
- extraction from the portal construction pad's water management basin will significantly reduce overflow volumes from the basin into the Yarrangobilly River.

iv Flood risks

Exploratory Works elements avoid flood prone land where possible. However, some infrastructure will unavoidably need to be constructed on flood prone land. The flood model was applied to assess changes to the existing flooding regime associated with the infrastructure and are summarised in Table 5.10. This process concluded that the predicted changes to flood regimes will not impact infrastructure or items of heritage significance. The accommodation camp and portal construction pad will both be predominantly established above the Probable Maximum Flood (PMF) extent and will therefore provide flood refuge for site personnel.

Table 5.10 Predicted flooding impacts

Infrastructure on flood prone land	Predicted flooding impacts
Camp Bridge and Wallaces Bridge	These bridges are proposed to be elevated above the 1% annual exceedance probability (AEP) flood level (consistent with AustRoads standards for flood free access). As a result, the road embankment leading to the bridges is predicted to form a blockage of floodplain conveyance upstream. However, there is no infrastructure or items of heritage significance in the affected areas. The extent of change is shown in Annex C of Appendix L.
Western emplacement area	The western emplacement area is on the southern side of the Yarrangobilly River floodplain. Model results predict that it will result in minimal change to existing flood regimes for lower magnitude events. However, it is predicted that the emplacement area will narrow the floodplain during higher magnitude flood events.
Portal construction pad (water management basin)	The water management basin for the portal construction pad is on the eastern side of the Yarrangobilly River floodplain. The basin will be built on top of the floodplain, rather than cutting in to it. Model results predict that the basin embankments will narrow the floodplain during higher magnitude flood events.

v Potential groundwater impacts

Potential impacts to the groundwater environment are due to ground disturbance (in particular excavation and tunnelling), construction activities, and water management. Potential impacts are summarised in Table 5.11.

Table 5.11 Potential groundwater impacts

Component	Potential impact
Earthworks	• spills of hydrocarbons leaching/running into groundwater/ephemeral creeks.
Blasting	• increased nutrient load (ammonium nitrate).
	• increased hydraulic connection between surface and groundwater resources.
Material stockpiling	• leaching or mobilised contaminants.
Excavations	• local depressurisation of groundwater resources.
	• altering the local groundwater flow system.
	• reducing baseflow to possibly connected waterways.

Table 5.11 Potential groundwater impacts

Component	Potential impact
	• decreased baseflow to possible GDEs reliant on surface expression of groundwater.
	• decreased groundwater availability to possible GDEs reliant on the subsurface presence of groundwater.
Surface infrastructure	• decreased groundwater recharge.
Fuels and chemical storage and refuelling	• spills of hydrocarbons that leach downwards or are mobilised.
Transportation/ storage of hydrocarbons, solvents, oils	• waste spills that mobilise in ephemeral creek lines or underground in storage.

vi Avoidance and minimisation of impacts

The water objectives and principles identified in Table 5.9 aim to minimise disturbance to water resources. A summary of how impacts have been avoided and minimised is as follows:

- Exploratory Works will divert runoff from undisturbed areas, collect and reuse water, and minimise releases into waterways. This will be achieved via a series of water dams and stormwater basins;
- the process water system has been designed in a way that will avoid any discharge to or extraction from the Yarrangobilly River;
- the eastern emplacement area has been designed to have low risk of erosion and flooding, and to be a chemically stable landform that does not result in degradation of the receiving environment;
- Exploratory Works has minimised flood risks, by locating infrastructure away from flood-prone land where possible; and
- water management for the project combines site surface water management, management of groundwater inflow, and the correct transportation and storage of chemical compounds.

The initial phase of subaqueous placement in Talbingo Reservoir has been designed to minimise impacts by selecting suitable placement locations, methods, and environmental controls. The strategy for managing and monitoring subaqueous placement will be confirmed in consultation with EPA. Additional investigations are currently underway and will be needed to inform the suitability of further placement, including geochemical analysis and hydrodynamic modelling.

vii Residual impact summary

a. Impacts to surface water resources

During the initial nine months of construction, runoff from the construction areas and unsealed access roads will be laden with sediment. Sediment and erosion controls are expected to effectively remove coarse sediment but may provide limited removal of fine and dispersive sediments. As a result, additional measures will need to be considered to prevent where possible fine and dispersive sediments draining into receiving waters.

It is expected that any runoff laden with fine and dispersive sediments that enters the Yarrangobilly River will be significantly diluted by river flows and rapidly dissipate. Hence, no material change to the Yarrangobilly River water quality is expected.

Some local watercourses will unavoidably be disturbed by the establishment of rock emplacement areas, bridge crossings and the accommodation camp. With the exception of the bridges over the Yarrangobilly River and Wallaces Creek, these other local watercourses are lower value ephemeral streams. The accommodation camp will be subject to detailed design and will need to consider the impacts described in this EIS to further avoid and minimise impacts.

Dredging and construction of barge access infrastructure will unavoidably generate turbidity and disturb sediments. As some contaminants (metals) were detected during field investigation, further testing was carried out to investigate the potential for metals to release from the sediments into surrounding water. The results suggested that following dilution with water, all contaminant concentrations are below detection levels and pose a low risk to the environment. Adverse water quality impacts due to the release of metals into the water column are therefore not expected. Further, sediment to be dredged for barge access will be placed on material with similar physical and chemical properties.

b. Impacts from subaqueous placement

While the placement of material will result in localised changes to bathymetry, the top of surface of placed rock will not encroach within 3 m of the MOL. The hydrodynamic environment of Talbingo Reservoir is typically very low. The placement of a relatively small amount of material into deeper parts of the reservoir (below MOL) would represent some 0.007% of the 'dead water' storage volume of the reservoir. This is a negligible impact on the overall hydrodynamic environment of Talbingo Reservoir, and no significant change is expected at a local level at the placement area.

The transport barge will include watertight bulwarks and excavated material will be kept wet during transport to and on barges for placement. The discharge barge will be fitted with a receiving well and discharge pipe. These barge fittings will minimise mobility of sediments during transport and reduce potential impacts to water quality. A number of environmental controls are embedded into the method for transport and placement, including a silt curtain surrounding the works. Based on this method, adverse impacts to surface water quality are not expected.

Further (and as described in Chapter 2), only suitable (non-reactive) material will be placed in the reservoir. This, combined with the method of placement, reduces the risk of adverse impacts at the reservoir bed which are considered to be low and localised. Elevated turbidity is expected near the reservoir bed during placement as a result of disturbance, but this is expected to be localised and short term due to the very low currents and intermittent nature of placement activities (ie individual barge loads will be separated in time). As impacts are localised, regional impacts to downstream water users of Talbingo Reservoir (Tumut River catchment) are not expected. Continual monitoring will be needed to ensure settlement of both coarse and fine sediments after placement.

c. Water management system impacts

It is expected that clean water interfaces with Exploratory Works can be adequately managed through the appropriate design and construction of clean water diversion systems.

It is expected that the extraction of water from Talbingo Reservoir will not result in any environmental impacts. Potential impacts associated with controlled discharge to Talbingo Reservoir can be managed through the appropriate treatment of process water prior to discharge. Accordingly, no material receiving water impacts are expected.

Treated wastewater (including treated sewage) will be discharged into the Yarrangobilly River arm of Talbingo Reservoir. During drought conditions, this discharge may result in the near-field concentration of phosphorus exceeding the trigger value for physical and chemical stressors that is provided in ANZECC 2000. No measurable near-field impacts are expected during non-drought conditions due to higher river inflows and in the greater reservoir due to the high inflows associated with the existing operation of the Snowy Scheme.

d. Flood risks

Exploratory Works elements avoid flood prone land where possible. However, bridge crossings over the Yarrangobilly River and Wallaces Creek, western emplacement area, and the water management basin for the portal construction pad will unavoidably need to be constructed on flood prone land. Flood modelling concluded that the predicted changes to flood regimes will not impact infrastructure or items of heritage significance.

e. Impacts to groundwater resources

Groundwater modelling predicts localised water table drawdown in the vicinity of the tunnel alignment, primarily around the portal where the exploratory tunnel intercepts shallow geological material that is more permeable than the deeper rock in which the majority of the tunnel will be excavated.

No drawdown impact is predicted at Yarrangobilly Caves, the only high priority GDE in the broader area. Potential GDEs are considered to have opportunistic dependency on groundwater. Where water table drawdown is predicted to occur, the ecosystems are expected to be able to adapt and, therefore, influence would be minimal.

Only minor impacts to baseflow to the Yarrangobilly River and associated tributaries are expected, with the base case and maximum plausible impact scenarios predicting baseflow reductions of 0.14% (4 ML/yr) and 0.18% (14 ML/yr) respectively arising from the excavation of the exploratory tunnel. Losses are predicted to increase post construction until a new equilibrium is reached for which the steady state model predicts losses of 0.67% (19 ML/yr) and 2.29% (178 ML/yr) respectively for the base case and maximum plausible impact scenarios. These short and longer term baseflow reductions to the Yarrangobilly River are considered minimal impacts and are acceptable under the thresholds set by the *NSW Aquifer Interference Policy*.

5.4.4 Mitigation measures

A Water Management Plan (WMP) is to be developed for guidance during construction in regard to management, allowable impacts and mitigation to surface and groundwater in the project area. A Surface and Groundwater Monitoring Program will be incorporated into the WMP. The development of the WMP will be undertaken in consultation with DoI-Water, EPA and WaterNSW.

A summary of the mitigation and management measures that would be implemented for Exploratory Works for surface and groundwater is provided in Table 5.12. These measures will be incorporated into the WMP.

Table 5.12 Summary of mitigation measures

Impacts/risks	Reference#	Measures
Stormwater management and erosion and sediment control from construction areas	WAT01	Erosion and Sediment Control Plans (ESCP) will be prepared for all work sites in accordance with the Blue Book. The plans will consider local soil characteristics, clean water management and the proposed construction methods.
	WAT02	The following controls will be applied to the design of the clean water management system: ● where possible, all clean water will be diverted around or through water management areas. Runoff from clean water areas than cannot be diverted must be accounted for in the design of water management systems; ● all clean water drainage will be designed and constructed to convey the 1% AEP peak flow and will have adequate scour protection; ● where possible, diversions will seek to avoid materially increasing flow rates in adjoining watercourses; and. ● where possible, the diversion of major drainage lines or watercourses using contour drains will be avoided.
	WAT03	Where construction areas are not constrained by terrain, sedimentation dams will be constructed in accordance with the methods recommended in *Managing Urban Stormwater: Soils and Construction: Volume 1* (Landcom, 2004) and *Volume 2D* (DECC 2008). Construction of sedimentation dams in steep terrain will be avoided.
	WAT04	A stormwater management plan for the accommodation camp and portal construction pad will be prepared as part of the detailed design and will consider the design measures identified in the Surface water assessment (Appendix M). Collectively, the stormwater controls will be sized and configured to achieve the following pollution load reductions (as calculated using the MUSIC water quality model): ● 85% reduction in post development mean annual load of total suspended solids; ● 60% reduction in the post development mean annual load of total phosphorus; and ● 45% reduction in the post development mean annual load of total nitrogen.

Table 5.12 Summary of mitigation measures

Impacts/risks	Reference#	Measures
	WAT05	A stormwater management plan for portal construction pad will be prepared as part of the detailed design and will consider the design measures identified in the Surface water assessment (Appendix M). Key controls include: • Activities that have the potential to contaminate stormwater runoff will be isolated from the stormwater system through the use of covering (ie by a building or roof) and bunding. • A stormwater management system will manage runoff from the portal construction pad. The system will include a 2,500 m^3 water management basin. Captured water in the basin will be harvested for use in construction activities. • The stormwater management system will be designed to contain any leak, spill or fire water runoff from the portal construction pad.
Process water management	WAT06	A process water system will be designed and implemented to manage any potentially contaminated water that may be produced by construction activities. The design of the process water system will: • be separated from the stormwater system to avoid uncontrolled overflows associated with stormwater ingress; • incorporate a water treatment plant that will treat water to a suitable quality for its proposed use in construction activities or discharge to Talbingo Reservoir (if required); and • have the ability to extract water from the construction pad's water management basin.
	WAT07	A wastewater (sewage) treatment plant will be designed and implemented to treat all waste water produced by Exploratory Works. The plant will treat wastewater to the water quality specifications provided in Appendix M.
Flood risks	WAT08	Camp and Wallaces Bridges will be designed in accordance with AustRoads bridge design standards which require the: • bridge deck soffit to be located above the 1% AEP flood level; • bridge structure to be designed to withstand a 0.05% AEP event; and • abutments to be protected by appropriately designed scour protection.
	WAT09	The western emplacement will be designed to prevent the risk of emplacement material being entrained in flood waters during a 1 in 500 year flood event.
	WAT10	Flood emergency procedures will be prepared and implemented as part of the Emergency Response Plan.
Spills of hydrocarbons leaching/running into groundwater/ creeks	WAT11	Procedures to address spills, leaks and tunnel washing will be developed and implemented as part of the CEMP.

Table 5.12 Summary of mitigation measures

Impacts/risks	Reference#	Measures
Surface and groundwater	WAT12	A Surface and Groundwater Monitoring Program will be developed and implemented to monitor the effectiveness of water quality controls and compliance with licence conditions. The program will: ● establish monitoring locations to provide suitable baseline and detection monitoring of surface and groundwater parameters; ● monitor groundwater inflows in the tunnel and groundwater levels as well as groundwater quality during construction; and ● set out annual monitoring requirements for Yarrangobilly Caves and PCTs potentially reliant on groundwater.
	WAT13	Areas of groundwater inflow within the tunnel will be shotcreted to prevent further ingress.
Impacts from barge access construction	WAT14	A dredge environmental management plan (DEMP) will be implemented for dredging and construction of barge access infrastructure including: • a water quality monitoring program at the dredge area prior to, during and following completion of dredging and barge access infrastructure construction works; • installation of silt curtains around dredge and work areas. • selecting uncontaminated granular fill with less than 2% fines and selecting granular bedding material; • ensuring skip bins for land disposal of excavated material are watertight; and • all activities would be carried out in a manner that minimises the potential for leaks and spills and in compliance with waste handling and disposal procedures outlined in the DEMP.
Water quality impacts from subaqueous placement in Talbingo Reservoir	WAT15	The subaqueous placement monitoring program for Talbingo Reservoir (described in Appendix D of Appendix L) will be implemented and include: • survey monitoring of pre-placement and post-placement bathymetry at the placement location to assess the accuracy of subaqueous placement, batter slopes of placed material and any underwater spreading of the placed material; • a water quality monitoring program at the subaqueous placement area prior to, during and following completion of works, including development of a total suspended solid (TSS) and turbidity (NTU) relationship and a structured management response to alerts and any exceedances of established triggers; • confirmation of physical and chemical characteristics of the sediment at the subaqueous placement area prior to the placement of dredged material; • installation of silt curtains around the discharge barge at the subaqueous placement area; and • design of the discharge barge and fall pipe arrangement at the subaqueous placement area to minimise surface turbidity.