Victorian Murray Floodplain Restoration Project

Desktop Groundwater Assessment - Burra Creek

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Lower Murray Urban and Rural Water Corporation

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Document history and status

Revision	Date	Description	Author	Reviewed	Approved
A	21/04/2020	Draft for VMFRP review	A Rastorgueva, A Tyson	G Hoxley	R Titchmarsh
0	19/05/2020	Final	A Rastorgueva, A Tyson	G Hoxley	R Titchmarsh

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Executive Summary

The Burra Creek project area is underlain by shallow groundwater, of varying quality, that is in direct connection to the Murray River. There is connection to deeper aquifers at this site where the separating clay layer is not present. Due to the location of the project and surrounding land use, there are no groundwater users in the vicinity that may be affected. The beneficial uses to be protected are, thus, focussed on groundwater support of the environment and cultural values.

Construction of the project works may require groundwater dewatering and subsequent disposal of pumped groundwater. If this is the case, then minor impacts on adjacent vegetation and ecosystems are possible. This can be mitigated by planning construction to minimise dewatering and to provide watering for any ecosystems that may experience lowered groundwater levels.

Operation of the proposed works will result in elevated groundwater levels, wetting of soils and potentially mobilised salt from the unsaturated soil store. This could result in the displacement of salt to the Murray River and increased evapotranspiration of water from the floodplain, potentially concentrating salts in the soil. However, given the low salt store in the project area and the generally fresh to moderately saline groundwater, these issues are regarded as being low risk. Monitoring of flooding patterns and adaptive management of flooding to minimise waterlogging is expected to satisfactorily control this potential risk.

Beneficial uses of groundwater are not expected to be adversely affected by operation.

There are no registered groundwater users within the extent of expected impacts.

Important note about your report

The purpose of R8's engagement under the Victorian Murray Floodplain Restoration Project (VMFRP) is to design infrastructure for the VMFRP including regulators, containment banks, roads, access tracks and culverts. The designs are required to be suitable for construction pricing to inform business case prioritisation. The purpose of this infrastructure is to allow floodplains to be watered at the hydraulic design levels nominated by VMFRP. R8 are also engaged to provide Regulatory Approvals and Cultural Heritage Services. The purpose of these services is for VMFRP to lodge the necessary approvals documents for the project with the relevant approval authorities.

The sole purpose of this report and the associated services performed by R8 is to complete a Dekstop Groundwater Assessment Report for VMFRP in accordance with the scope of services set out in the contract between R8 and VMFRP. That scope of services, as described in this report, was developed with VMFRP.

R8 has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. However, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

In preparing this report, R8 has relied on the information provided by VMFRP in the data handover pack at the commencement of the project. In particular R8 is reliant on VMFRP's prior flood modelling work to define inundation levels and extents. R8 is not responsible for achievement of the project's desired operational ecological outcomes.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by R8 for use of any part of this report in any other context. This report has been prepared on behalf of, and for the exclusive use of VMFRP, and is subject to, and issued in accordance with, the provisions of the contract between R8 and VMFRP. R8 accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this report by any third party.

1. Introduction

1.1 Program overview

The Burra Creek Floodplain Restoration Project (the project) is one of nine discrete environmental works projects being undertaken as part of the Victorian Murray Floodplain Restoration Project (VMFRP), which is being implemented as part of Victoria's obligations under the Murray Darling Basin Plan. The VMFRP aims to restore a more natural inundation regime across more than 14,000 ha of high ecological value Murray River floodplain in Victoria through the construction of new infrastructure and modification of existing infrastructure.

The VMFRP is being implemented in partnership between Lower Murray Urban and Rural Water Corporation (LMW), Goulburn Murray Rural Water Corporation (GMW), Mallee Catchment Management Authority (Mallee CMA), North Central Catchment Management Authority (North Central CMA), Parks Victoria and the Department of Environment, Land, Water and Planning (DELWP), and is funded by the Commonwealth Department of Agriculture, Water and Environment (DAWE). LMW has been nominated by the partnership as the project proponent for the purpose of submitting referrals and approval applications.

1.2 Project description

The project aims to restore a more natural inundation regime and improve ecological condition across approximately 330 ha of high ecological value Murray River floodplain at Burra North and a further 73 ha of creek habitats at Burra South, through the construction of new infrastructure, the modification of existing infrastructure and removal of some existing barriers to flow within Burra Creek. The project is designed to enable managed inundation up to a design water level of 58.7 mAHD at Burra North and up to the top of bank of Burra Creek at Burra South using water from both natural flood events and pumping from the Murray River.

Specifically, the project involves the following main components:

- Regulator B1 – A large regulator will be installed in Burra Creek at the northern / downstream end of the Burra North managed inundation area, and is designed to enable inflows (backflow) from the Murray River into the creek, the retention of water in the managed inundation area and the return of managed floodwaters to the Murray River on completion of a managed event.
- Regulator B2 – A small regulator will be installed in Burra Creek at the southern / upstream end of the Burra North managed inundation area, and is designed to enable the retention of water in Burra North and to prevent flows into private land at Burra South during a managed event.
- Regulator B4 – A small regulator will be installed within an existing containment bank in Burra Creek at the southern / upstream end of the creek near its junction with the Murray River near Tooleybuc, and is designed to allow flow into Burra Creek for supply of water during a natural event and to enable pumping through the regulator when required.
- Drop structure – A drop structure will be installed at the northern / downstream confluence of Burra Creek and the Murray River, to control erosion during managed releases from Burra Creek to the river, including some modification of the western bank of the Murray River and placement of 0.3 m thick reno mattress down the river bank to approximately 50 mAHD.
- Containment banks – Approximately 2.48 km of containment bank (four sections, Section A, B, C and D) will be constructed by raising existing access tracks at Burra North to a constant level of 59.12 mAHD to facilitate a managed water level of 58.7 mAHD with 300 mm freeboard and 120 mm wearing course. Proposed containment banks will supplement the existing river levee to retain water at the design water level.
- Spillways – Four spillways (approx. 400 m total combined length) at an upstream level of 58.8 mAHD will be incorporated into the containment banks to enable controlled release of larger flows prior to overtopping of the containment banks.

- Temporary pump hardstands – A 6 m x 6 m hardstand area will be constructed at Regulator B4 to support temporary pump infrastructure, and an existing private pump station site at Spillway 4 will be modified to make it suitable for temporary pumping by installing a 6 m x 6 m hardstand and rock-lining in the existing pump discharge pool for erosion control. Temporary pump infrastructure will include a trailer-mounted rig with a suction pipe extending into the Murray River, which would be brought onto site as required.
- Blockage removal – Four existing blockages (Banks 1, 2, 3 and 4) within Burra Creek at Burra North will be removed and one existing block bank (Bank 5) within Burra Creek at Burra North will be modified. Removal of blockages is proposed where there is considered to be no adverse impact on existing water licence holders, while modification rather than removal of Bank 5 is proposed to enable an existing water licence holder to continue to pump suction water from pooled water in the creek.

Access tracks will be reinstated on top of the proposed containment banks and surfaced with gravel, with passing bays at necessary locations. Access track dimensions on the containment banks will be consistent with Parks Victoria access track design and maintenance guidelines, with the concept design assuming a total carriageway width of 5 m, including shoulders (from Parks Victoria Class 5D Access Track/Road Design Standard).

Access during construction and operation of the project will use existing access tracks, which will require some maintenance to allow for construction and operational vehicles. Maintenance works will involve grading and applying additional road base to the track surface.

Temporary construction work sites will include laydown areas at Regulator B1 (approx. 50 m north east of the regulator work site), Regulator B2 (two alternative locations: approx. 15 m north west of the regulator work site on public land and 40 m south east of the regulator work site on private land) and Bank 5 (approx. 50 m west of the work site).

This report has been prepared based on the Issue for Review (IFR) Design dated March 2020.

1.3 Project area

This assessment covers the hydrogeology of the floodplain of the Murray River, north of the Piangil, Victoria. This area encompasses Burra Creek, Macreadie Island and surrounds.

The area that has been considered for this desktop assessment is the construction footprint of the project (development footprint, laydown areas and access tracks, plus a buffer) as well as the inundation area of the proposed operational floodplain restoration project (for the purposes of this report henceforth known as the 'project area'). The hydrogeological layering and other information in the area has been reviewed and considered considering the proposed floodplain works. The focus of this assessment is the hydrogeology on the Victorian side of the Murray River, whilst recognising that the aquifers in question have some limited hydraulic connection to the NSW side.

1.4 Purpose of this report

This report documents a desktop assessment of groundwater considerations associated with the Burra Creek Floodplain Restoration Project and will feed into the referral documentation being prepared under the *Environment Effects Act 1978* (EE Act) and *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act).

1.5 Limitations

The following limitations apply to the assessment contained in this report:

- No site visit has been undertaken;
- Reports and records available on the public record have been used;
- Knowhow and experience of Jacobs staff have informed the assessment; and

- Detailed groundwater investigation and monitoring at the precise sites for the proposed works and area of inundation are not available and so general understanding of the hydrogeology and sites has been used. It is possible that future detailed studies may revise the findings presented here, once in possession of site-specific information.

2. Key legislation

The following are the key legislation for this groundwater assessment. Other legislation may also apply:

- *Water Act 1989* – sets requirements for groundwater bore approval and licencing and regulates groundwater take and use from aquifers in Victoria. Groundwater users are regulated by this Act and impacts on users and the environment are also controlled. This Act will control groundwater monitoring works undertaken by the project.
- *Catchment and Land Protection Act 1994* – deals with diffuse source effects in catchment, such as recharge and water quality changes.
- *Water Act 2007* (Cwth) – deals with the management of salinity in the Murray River and sets the requirements for the Basin Plan, which includes groundwater management and sustainable diversion limits for aquifers (SDL).

In addition to the relevant Acts, regulations under these acts are also important. Specifically, for groundwater, the protocols and agreements made under the Basin Salinity Management Plan 2030 (BSM2030) are important as they define the conditions and controls relating to salt discharge to the Murray River and anabranches.

3. Existing conditions

3.1 Regional hydrogeology

The Burra Creek project area is in the Murray Geological Basin. This basin was infilled with sediments during the Tertiary and Quaternary period. The regional hydrogeology is laid out in the Swan Hill and Balranald 1:250,000 scale hydrogeological maps (O'Rorke *et al.*, 1992; Kellett, 1994). Figure 1 shows a generalised hydrogeological cross section for this area, identifying the main units and their relationships. For this assessment, it is only the upper units that are of interest.

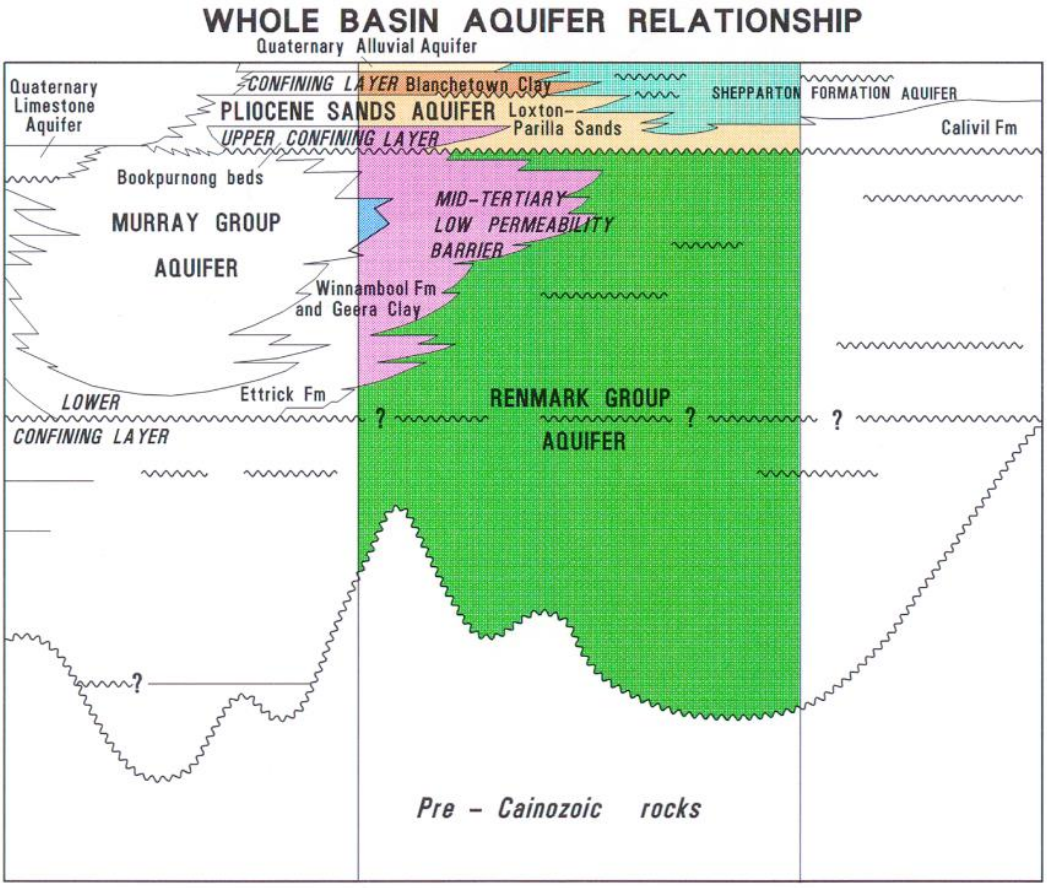

Figure 1: Regional hydrogeological units and their relationship within the Burra Creek area (Source: Balranald 1:250,000 Hydrogeological Map)

The project area is located within the Murray Geological Basin and sediments of the basin underly the project area. The geology and hydrogeology of shallow sediments in the area have been best described by Thorne *et al.* (1990). Other studies of the Murray River corridor in the Mallee have occurred but have not materially changed the understanding in the Burra Creek project area.

For this assessment, the focus is on the groundwater environment and current conditions off the shallow aquifer systems. A series of aquifer layers are present at the site, to a depth of approximately 300m below ground. Of these layers, only the upper layers are relevant. The full geological sequence is published by the Government of Victoria through the Victorian Aquifer Framework and the 3D groundwater atlas of Victoria (see GHD & AWE, 2012).

3.2 Project area hydrogeology

The shallow groundwater hydrogeological conditions at the site are described in Thorne et al. (1990) and a cross section of hydrogeological conditions from this report is presented in Figure 2 with a longer and more regional section presented as Figure 3. The key features of these sections are as follows:

- Across the relatively narrow floodplain is a sequence of alluvial sediments comprising an aquitard at the surface and aquifer unit below;
- The alluvial sediments are hydraulically connected to the Murray River;
- Underlying the shallow alluvial sediments near the river is the regional aquifer;
- Underlying the alluvial sediments across the floodplain is the regional aquitard, which is relatively thin in this location and pinches out close to the river;
- Underlying the aquitard is the regional aquifer which has partial connection to the alluvial sediments in this area;
- The groundwater levels are very similar in elevation to the river level in the alluvial sediments across the floodplain.

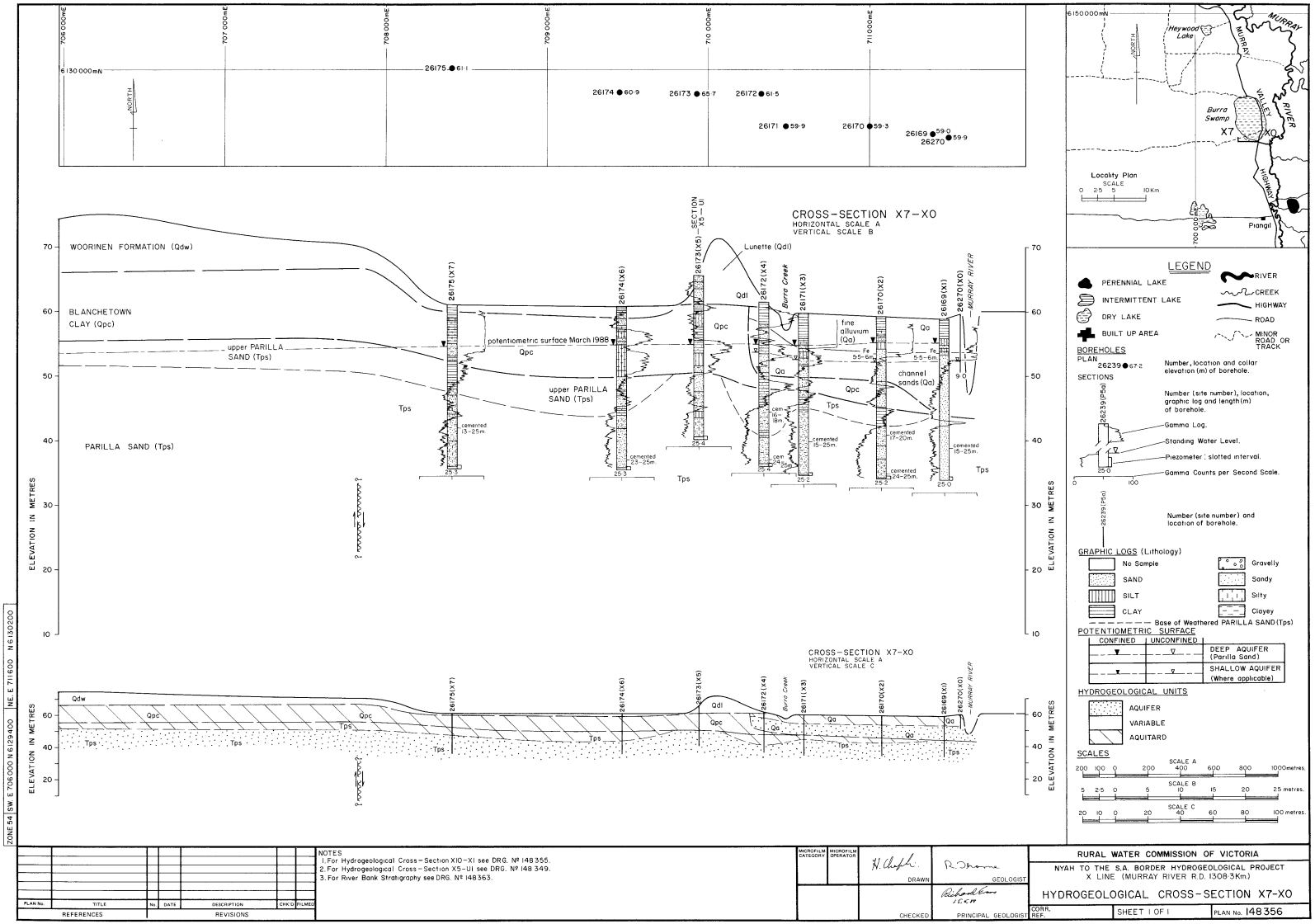

Figure 2: Cross section showing key shallow hydrogeological layers just to the north of Burra Creek (Thorne et al. 1990)

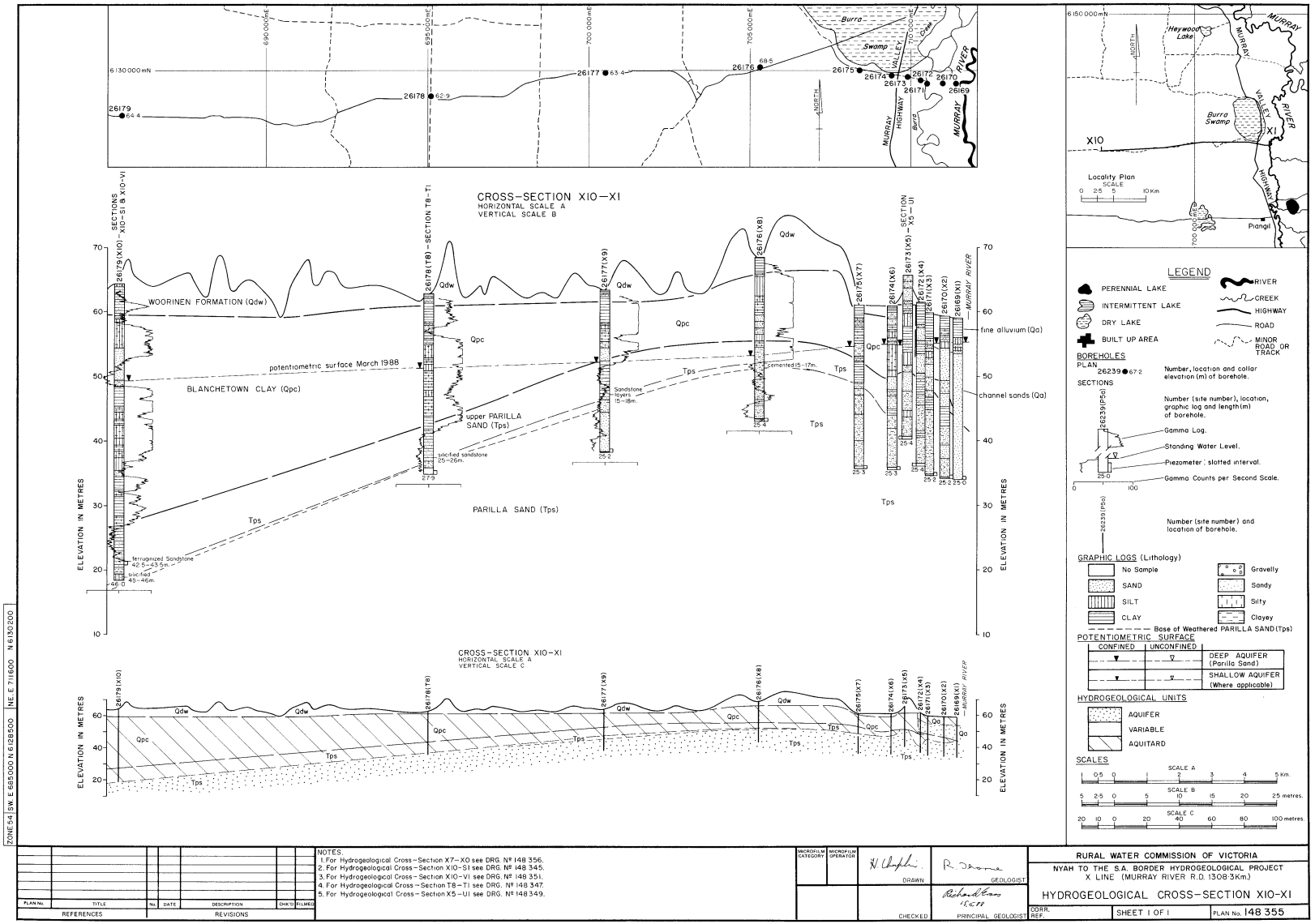

Figure 3: Cross section of the upper units of the regional hydrogeology near and inland from the floodplain to the north of Burra Creek (Thorne et al. 1990)

The aquifer sequence at the project area is summarised by the following hydrogeomorphic units (from the surface downward):

- The alluvial aquitard (Coonambidgal Formation: 100): Floodplain fine grained silts and clays that are part of the contemporary floodplain and the recent geological past, relatively thin across the project area;
- Channel Sands aquifer (100): An Upper Tertiary, fine to coarse grained sand aquifer in direct connection with the Murray River;
- Blanchetown Clay aquitard (103): A clay sequence of varying thickness that acts to reduce vertical interaction between the Channel Sands and the deeper regional aquifer. The aquitard pinches out close to the river;
- Loxton Parilla Sand aquifer (104): A thick sequence of Tertiary age Marine sediments that underly the river and floodplain sediments. This is the regional aquifer and is typically saline or brackish in water quality.

Regional groundwater flow is generally to the north-west. In some cases, there will be localised flow toward the Murray River. Local flow cells are possible that may change the local flow direction from the regional flow pattern.

3.3 Salinity

Salt inflow to the Murray River in the Mallee tract (that is, downstream of Swan Hill) is a major source of salt load in the river. Accordingly, there is considerable concern about the soil and shallow groundwater salinity in the vicinity of the VMFRP sites and salinity risk is an area that should be considered.

Groundwater salinity in the watertable aquifer across the project area is interpreted to range widely, from less than around 500 mg/L close to the river to up to 35,000 mg/L inland. Fresher water is adjacent to the river with salinity increasing moving inland. The interpreted distribution of salinity is shown in Figure 4.

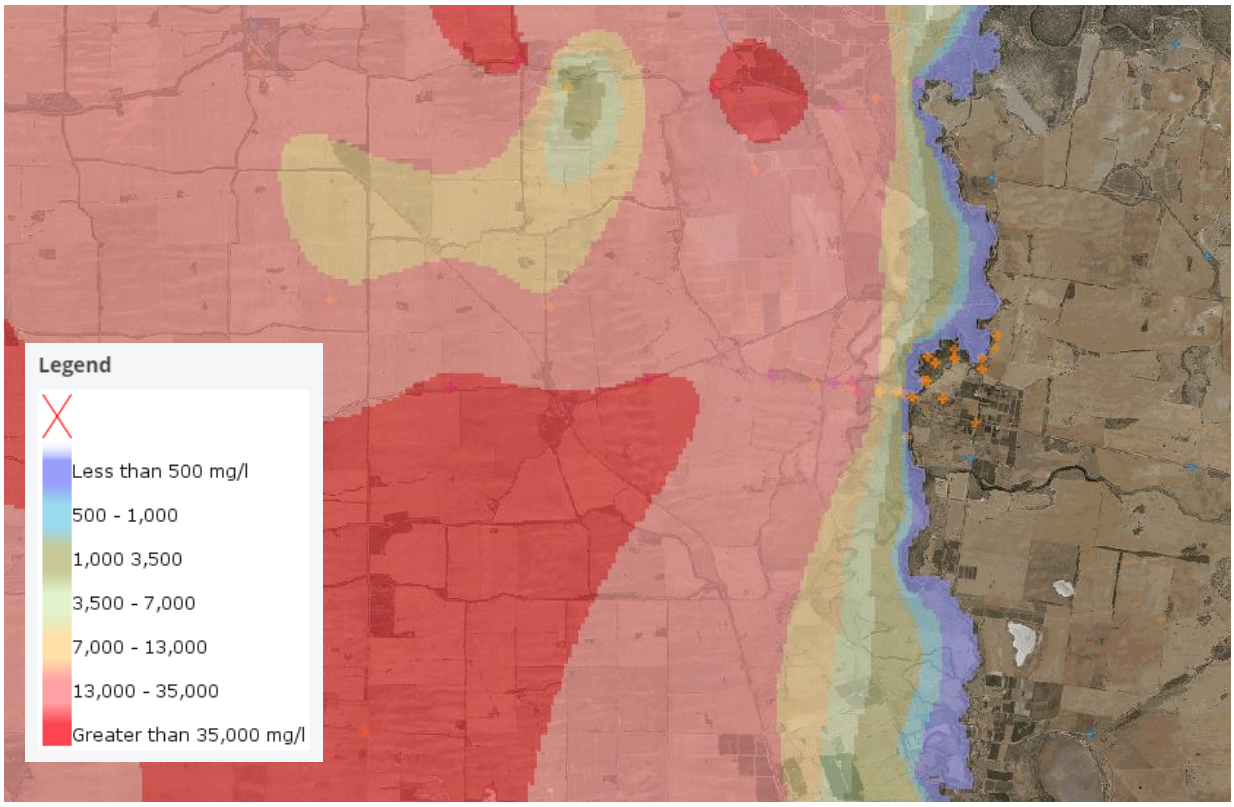

Figure 4: Interpreted groundwater salinity for the Burra Creek project area (FedUni 2015)

Soil salinity has been mapped over the site and for the riverine corridor in the area by airborne electromagnetic surveys (AEM). The project area falls in the Robinvale to Boundary Bend AEM survey area (Cullen et al. 2008).

Figure 5 shows the interpreted salt loads in the area from the AEM survey. It can be seen from this figure that soil salinity in the project area has been mapped as low to moderate (below 200 t/ha/m).

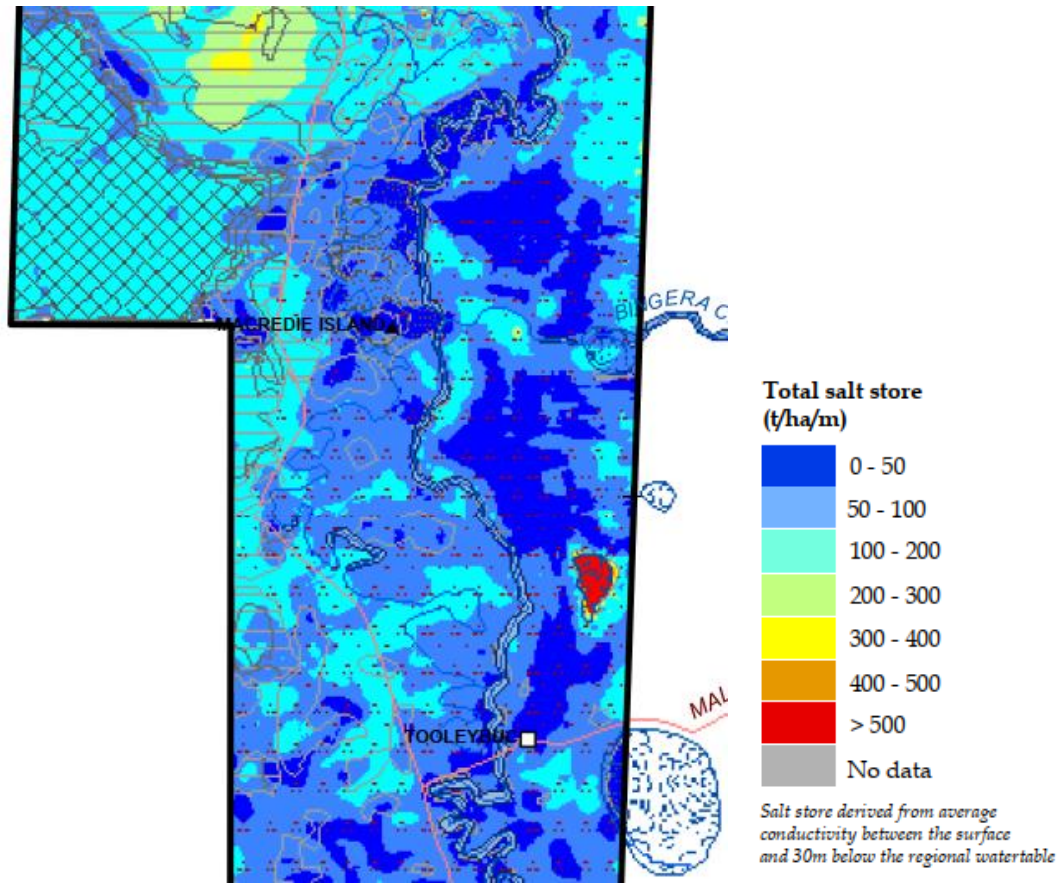

Figure 5: Interpreted salt store in the unsaturated zone for the project area (Cullen et al. 2008)

3.4 Beneficial uses of groundwater

In accordance with the State Environment Proteciton Policy (SEPP) (Waters), the interpreted groundwater salinity at the project area indicates that following groundwater beneficial uses are protected in the project area:

- Water dependent ecosystems and species;
- Potable water supply (desirable);
- Potable water supply (acceptable);
- Potable mineral water supply;
- Agriculture and irrigation (irrigation);
- Agriculture and irrigation (stock watering);
- Industrial and commercial;
- Water-based recreation (primary contact recreation);
- Traditional Owner cultural values;
- Cultural and spiritual values;
- Buildings and structures;

- Geothermal properties.

Water quality standards are described for most of these beneficial uses and are provided in the SEPP (Waters).

3.4.1 Groundwater bore use

Because of the generally saline nature of the regional aquifer, the proximity to fresh water from the Murray River and limited access to floodplain aquifers by private landowners, there are no licenced groundwater users in vicinity of the project area. There are also no registered stock and domestic bores in the vicinity. The groundwater bores in the area are groundwater observation bores.

3.4.2 Groundwater dependent ecosystems

Groundwater plays an important role in sustaining aquatic and terrestrial ecosystems including wetlands and rivers. For example, groundwater can contribute to river baseflow during low rainfall periods. Groundwater Dependent Ecosystems (GDEs) can vary in nature, ranging from partially or infrequently reliant on groundwater to continually and wholly dependent (BoM, 2020). The National GDE Atlas (the Atlas) maps the potential for groundwater dependence across Australia based on national and regional studies. The Atlas classes potential GDEs into two groups: aquatic, which rely on the surface discharge of groundwater; and terrestrial, which rely on the subsurface presence of groundwater.

Figure 6 presents the potential aquatic and terrestrial GDEs mapped in the project area from the Atlas. Within and surrounding the inundation area, terrestrial vegetation with a high potential for groundwater interaction are identified. This includes lignum swampy woodland, riverine chenopod woodland and grassy/shrubby riverine forest. A wetland in the southern portion of the reserve near Obree Road is identified as a potential aquatic GDE on the Atlas. The wetland is also identified in the Victorian Wetland Inventory as having moderate potential for groundwater dependence (DELWP, 2020). The Murray River is mapped as a low potential aquatic GDE (BoM, 2020).

It is anticipated that the project will have a beneficial impact on potential GDEs within the project area. A separate assessment of the impacts to vegetation and ecological systems from the project has been undertaken for the Burra Creek Floodplain Restoration Project; *Flora and Fauna Assessment Report – Burra Creek* (R8, 2020).

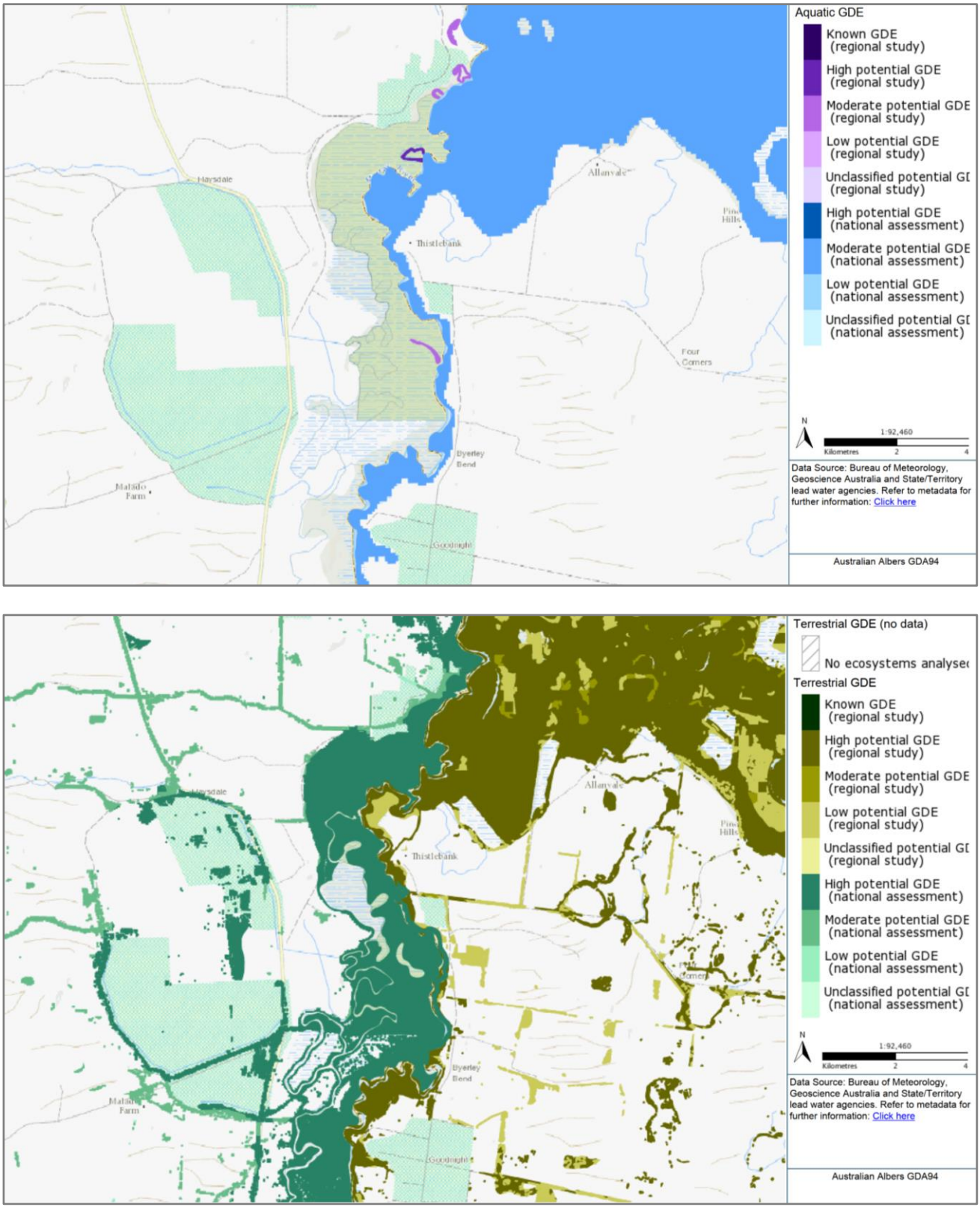

Figure 6 Potential Groundwater Dependent Ecosystems mapped in the project area for terrestrial GDEs and aquatic GDEs (BoM 2020).

4. Potential effects

The potential groundwater effects of the proposed construction and operation of the works are given below.

- Temporary and limited drawdown of groundwater levels during construction, specifically this may be required for the regulators and inflow structure, as these may need to be dug into the subsurface. Typically banks and surface earthworks will not intersect groundwater and thus are not expected to have a groundwater effect during construction. Temporary removal of groundwater may be required for safe access to excavations associated with the larger structures.
- Increased groundwater level, as a result of flood recharge, across the inundated area.
- Reduced groundwater salinity immediately following flood events, as a result of flood recharge (of river water) that is generally lower salinity than groundwater. This phenomenon is also observed during natural floods, so is not an unusual occurrence in the floodplain. What is different with respect to the application is that the recharge is augmented beyond the existing level for a given event. It is essentially impossible to control or mitigate this effect for a given level and duration of flooding.
- Modified groundwater quality of the watertable during and after flood events. This is an analogous response to the salinity change noted above. Trace amounts of contaminants (such as nutrients) that are present in the flood water may enter groundwater during inundation. This process naturally occurs but will be augmented by the operation of the works. There is little published information on the impact of this in groundwater and it has generally been considered that the impact is minor. Given the absence of clay aquitard close to the river there is potential for the recharge change to propagate into the regional aquifer close to the river. Local reduction in salinity may occur in the Parilla Sand aquifer close to the river.
- Mobilisation of salt from either the soil surface or from shallow groundwater to return to the Murray River. Salt on the soil surface may be dissolved and entrained by flood water and then held in solution until the release of the flood water, which then discharges salts to the Murray River. This process has been extensively considered by SKM (2014) and the assessment of the possible salinity impacts is considered low for this site.
- Shallow groundwater in the vicinity of vegetation may occur for extended periods of time during and immediately after flooding. Vegetation that has shallow groundwater level for extended periods can become waterlogged and be harmed. Whilst vegetation health is not strictly a groundwater issue, the management of root zone aeration will be important to avoid waterlogging of vegetation.

The following table describes the potential effects on the beneficial use of groundwater as a result of the construction and operation of the project.

Table 1: Expected effect on groundwater beneficial uses

Beneficial Use	Potential Effect
Water dependent ecosystems and species	Beneficial effect expected Water dependent ecosystems use soil water and shallow groundwater as a water source during dry periods. The intent of the project is to provide additional reserves of shallow soil water to enhance vegetation health and to thus support the ecology dependent on soil water and shallow groundwater.
Potable water supply (desirable)	Negligible effect expected River water is of similar character to the shallow groundwater, regular flooding of this area already occurs and an increase in frequency of flooding is expected to have negligible impact on water quality at this site.
Potable water (acceptable)	Negligible effect expected Refer to comments regarding potable water, above.

Beneficial Use	Potential Effect
Potable mineral water supply	Not applicable The water does not classify as mineral water
Agriculture and irrigation (irrigation)	No effect expected The water quality and availability for this beneficial use will not alter.
Agriculture and irrigation (stock watering)	No effect expected The water quality and availability for this beneficial use will not alter.
Industrial and commercial	No effect expected The water quality and availability for this beneficial use will not alter.
Water-based recreation (primary contact recreation)	No effect expected The water quality and availability for this beneficial use will not alter. See the comments under Potable water, above.
Traditional Owner cultural values	Limited information – no significant effect expected No specific cultural requirements have been identified for this assessment but given that the water quality is expected not to significantly change and that the effect on reliant ecosystems is expected to be beneficial, it is presumed that there is minimal risk to cultural values.
Cultural and spiritual values	Limited information – no significant effect expected No specific cultural requirements have been identified for this assessment but given that the water quality is expected not to significantly change and that the effect on reliant ecosystems is expected to be beneficial, it is presumed that there is minimal risk to cultural and spiritual values.
Buildings and structures	No effect expected The water quality and availability for this beneficial use will not alter.
Geothermal properties	No effect expected The water temperature at the surface is below the threshold for geothermal water and no effects are expected at depth.

5. Recommended mitigation measures

A set of draft mitigation measures have been developed as part of the draft Environmental Management Framework. A review of the draft mitigation measures has been undertaken with comments provided in the table below.

Groundwater review of draft mitigation measures	
1) Identify if any updates to draft mitigation measures are required to align with current legislation /guidelines / best practice	▪ Seek to minimise the total volume and rate of groundwater extracted for construction purposes. ▪ Provide Salinity Credits for saline wash off and salt load to the river, manage flood periods to control real time river salinity. ▪ Plan construction to minimise dewatering, provide make-up of offset water for affected vegetation during construction. ▪ Do not dispose of groundwater from construction activities to land. ▪ Planning and monitoring of flooding events to avoid prolonged periods of inundation that could lead to waterlogging (to avoid vegetation impacts). Avoid extended periods of shallow watertable < 3m below surface to avoid waterlogging of vegetation.
2) Are any other mitigation measures that need to be included to reduce the residual risks of the project?	▪ None identified.

5.1 Further work

Specific groundwater level and quality information is required for the site to form a baseline for the potential construction and operation impacts, as well as to monitor the effects of inundation outside of the inundated area. It is understood that a program of groundwater monitoring bores is proposed for the site and that these should be installed and in place by mid-2020. This will assist in setting the pre-scheme baseline.

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